

**EXPLANATORY STATEMENT**

**PROPOSAL P265**

**PRIMARY PRODUCTION & PROCESSING  
STANDARD FOR SEAFOOD**

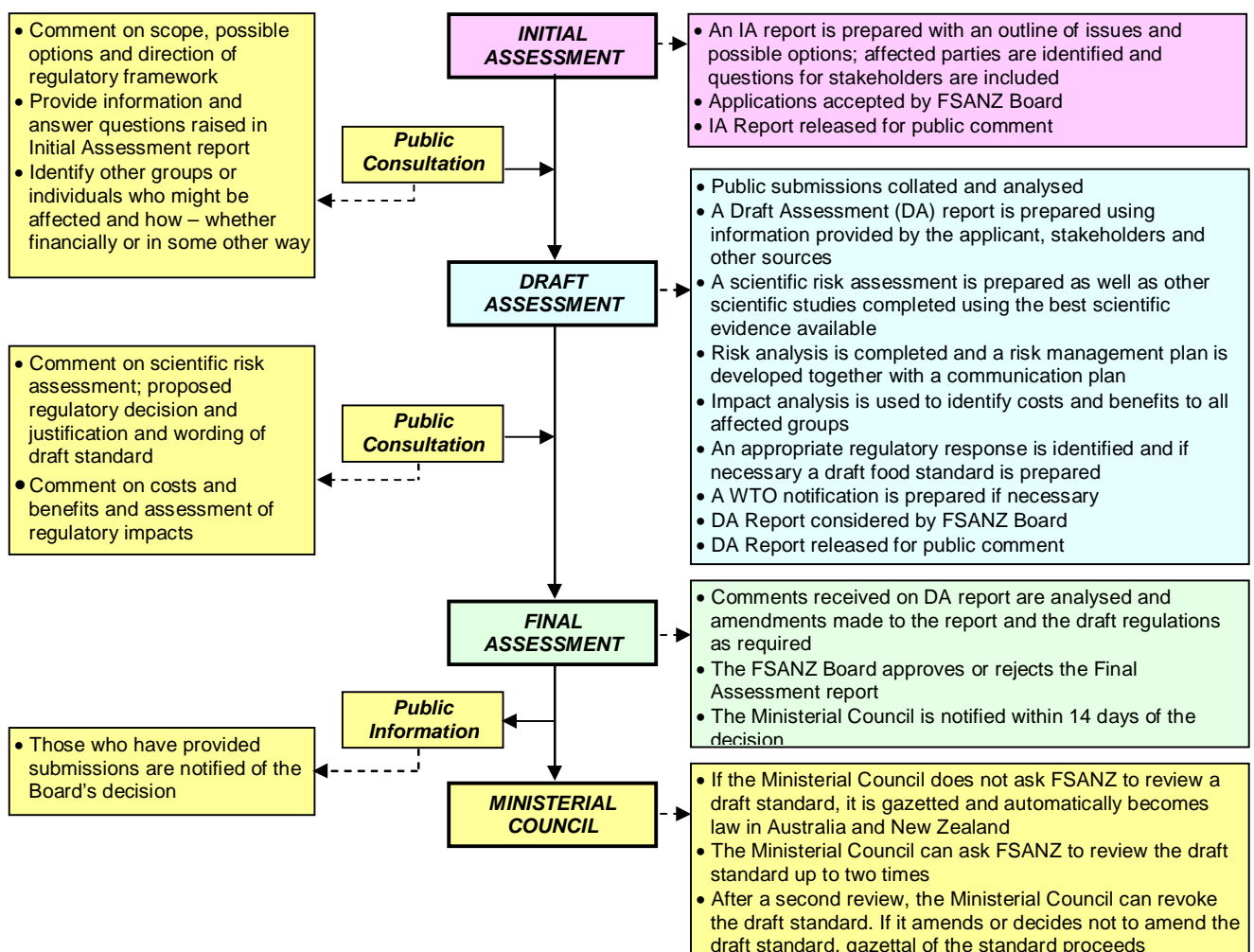
## FOOD STANDARDS AUSTRALIA NEW ZEALAND (FSANZ)

FSANZ's role is to protect the health and safety of people in Australia and New Zealand through the maintenance of a safe food supply. FSANZ is a partnership between ten Governments: the Commonwealth; Australian States and Territories; and New Zealand. It is a statutory authority under Commonwealth law and is an independent, expert body.

FSANZ is responsible for developing, varying and reviewing standards and for developing codes of conduct with industry for food available in Australia and New Zealand covering labelling, composition and contaminants. In Australia, FSANZ also develops food standards for food safety, maximum residue limits, primary production and processing and a range of other functions including the coordination of national food surveillance and recall systems, conducting research and assessing policies about imported food.

The FSANZ Board approves new standards or variations to food standards in accordance with policy guidelines set by the Australia and New Zealand Food Regulation Ministerial Council (Ministerial Council) made up of Commonwealth, State and Territory and New Zealand Health Ministers as lead Ministers, with representation from other portfolios. Approved standards are then notified to the Ministerial Council. The Ministerial Council may then request that FSANZ review a proposed or existing standard. If the Ministerial Council does not request that FSANZ review the draft standard, or amends a draft standard, the standard is adopted by reference under the food laws of the Commonwealth, States, Territories and New Zealand. The Ministerial Council can, independently of a notification from FSANZ, request that FSANZ review a standard.

The process for amending the *Australia New Zealand Food Standards Code* (the Code) is prescribed in the *Food Standards Australia New Zealand Act 1991* (FSANZ Act). The diagram below represents the different stages in the process including when periods of public consultation occur. This process varies for matters that are urgent or minor in significance or complexity.



## **Final Assessment Stage**

FSANZ has now completed two stages of the assessment process and held two rounds of public consultation as part of its assessment of this Proposal. This Final Assessment Report and its recommendations have been approved by the FSANZ Board and notified to the Ministerial Council.

If the Ministerial Council does not request FSANZ to review the draft amendments to the Code, an amendment to the Code is published in the *Commonwealth Gazette* and the *New Zealand Gazette* and adopted by reference and without amendment under Australian State and Territory food law.

Note, however, that this particular Standard, will not apply in New Zealand.

## **Further Information**

Further Information on this Proposal and the assessment process should be addressed to the FSANZ Standards Management Officer at one of the following addresses.

**Food Standards Australia New Zealand**  
**PO Box 7186**  
**Canberra BC ACT 2610**  
**AUSTRALIA**  
**Tel (02) 6271 2222**  
**[www.foodstandards.gov.au](http://www.foodstandards.gov.au)**

**Food Standards Australia New Zealand**  
**PO Box 10559**  
**The Terrace WELLINGTON 6036**  
**NEW ZEALAND**  
**Tel (04) 473 9942**  
**[www.foodstandards.govt.nz](http://www.foodstandards.govt.nz)**

Assessment reports are available for viewing and downloading from the FSANZ website [www.foodstandards.gov.au](http://www.foodstandards.gov.au) or alternatively paper copies of the reports can be requested from FSANZ's Information Officer at [info@foodstandards.gov.au](mailto:info@foodstandards.gov.au) including other general enquiries and requests for information.

# TABLE OF CONTENTS

<b>EXECUTIVE SUMMARY</b> .....	<b>7</b>
<b>1. INTRODUCTION</b> .....	<b>11</b>
1.1    FOOD SAFETY IS A PUBLIC HEALTH ISSUE .....	11
1.2    AUSTRALIAN FOOD STANDARDS.....	11
<b>2. BACKGROUND</b> .....	<b>13</b>
2.1    THE SEAFOOD SECTOR .....	13
2.2    DEVELOPMENT OF A PRIMARY PRODUCTION AND PROCESSING STANDARD FOR SEAFOOD	13
2.3    LABELLING OF FISH NAMES.....	14
<b>3. CURRENT MANAGEMENT STRATEGIES TO ADDRESS SEAFOOD SAFETY .....</b>	<b>15</b>
3.1    DOMESTIC PRODUCTION - REGULATORY REQUIREMENTS FOR FOOD SAFETY .....	16
3.1.1 <i>Australia New Zealand Food Standards Code - adopted nationally under State/Territory legislation</i> .....	16
3.1.2 <i>State and Territory regulations for the primary production of seafood</i> .....	16
3.1.3 <i>Australian Shellfish Quality Assurance Program (ASQAP)</i> .....	18
3.2    VOLUNTARY INDUSTRY STANDARDS AND GUIDELINES FOR DOMESTIC PRODUCTION .....	19
3.3    IMPORTED SEAFOOD - REGULATORY REQUIREMENTS FOR FOOD SAFETY.....	19
3.3.1 <i>Recognised quality assurance arrangements</i> .....	20
3.3.2 <i>Certification provided by overseas governments</i> .....	20
3.3.3 <i>Monitoring for food safety by States and Territories</i> .....	21
3.3.4 <i>Enforcement of process standards for imported food</i> .....	21
3.3.5 <i>Importation of seafood from New Zealand</i> .....	22
3.4    FOOD SAFETY AND EXPORTED SEAFOOD.....	22
3.5    SUMMARY OF REGULATION OF THE AUSTRALIAN SEAFOOD SECTOR.....	22
<b>4. REGULATORY PROBLEM</b> .....	<b>23</b>
4.1    GROWING GLOBAL BURDEN OF FOOD-BORNE ILLNESS .....	23
4.2    IMPACTS OF FOOD-BORNE ILLNESS IN AUSTRALIA.....	24
4.3    A NEW APPROACH TO FOOD SAFETY .....	24
4.4    IDENTIFICATION OF PUBLIC HEALTH AND SAFETY RISKS POSED BY SEAFOOD .....	25
4.4.1 <i>Risk ranking method</i> .....	25
4.4.2 <i>Future reviews of the risk ranking</i> .....	26
4.4.3 <i>Food safety hazards in seafood</i> .....	26
4.4.4 <i>Summary of risk rankings</i> .....	27
4.5    EXAMINATION OF EXISTING MANAGEMENT SYSTEMS AND THEIR CONTROL OF IDENTIFIED RISKS	31
4.5.1 <i>Seafood ranked as high (relative to other seafood)</i> .....	31
4.5.2 <i>Lower risk seafood</i> .....	33
<b>5. OBJECTIVE</b> .....	<b>34</b>
<b>6. REGULATORY OPTIONS</b> .....	<b>35</b>
6.1    SCOPE OF THE STANDARD AND DEFINITION OF SEAFOOD .....	35
6.2    OPTION 1 – THE STATUS QUO .....	35
6.3    OPTION 2 – A PRIMARY PRODUCTION AND PROCESSING STANDARD TARGETING HIGH-RISK SEAFOOD ACTIVITIES ONLY .....	36
6.4    OPTION 3 – A RISK-BASED PRIMARY PRODUCTION AND PROCESSING STANDARD TO IMPROVE THE OVERALL SAFETY IN THE SEAFOOD SUPPLY CHAIN .....	36
6.5    SUMMARY OF OPTIONS.....	38
<b>7. IMPACT ANALYSIS FOR SEAFOOD</b> .....	<b>38</b>

7.1	AFFECTED PARTIES .....	38
7.2	OPTION 1: THE STATUS QUO .....	39
7.2.1	<i>Benefits of Option 1</i> .....	39
7.2.2	<i>Costs of Option 1</i> .....	40
7.3	OPTION 2 – A PRIMARY PRODUCTION AND PROCESSING STANDARD TARGETING HIGH-RISK SEAFOOD ACTIVITIES ONLY.....	42
7.3.1	<i>Benefits of Option 2</i> .....	42
7.3.2	<i>Costs of Option 2</i> .....	43
7.4	OPTION 3 – A RISK-BASED PRIMARY PRODUCTION AND PROCESSING STANDARD TO IMPROVE THE OVERALL SAFETY IN THE SEAFOOD SUPPLY CHAIN .....	44
7.4.1	<i>Benefits of Option 3</i> .....	44
7.4.2	<i>Costs of Option 3</i> .....	46
<b>8.</b>	<b>CONSULTATION ON THE DRAFT ASSESSMENT REPORT .....</b>	<b>49</b>
8.1	CONSULTATION ON THE DRAFT ASSESSMENT REPORT. ....	49
8.1	WORLD TRADE ORGANIZATION NOTIFICATION.....	51
<b>9.</b>	<b>CONCLUSIONS.....</b>	<b>51</b>
<b>10.</b>	<b>RECOMMENDATION .....</b>	<b>53</b>
<b>11.</b>	<b>IMPLEMENTATION, MONITORING AND REVIEW .....</b>	<b>54</b>
	<b>ATTACHMENT 1 - DRAFT VARIATIONS TO THE AUSTRALIA NEW ZEALAND FOOD STANDARDS CODE .....</b>	<b>56</b>
	<b>ATTACHMENT 2 - THE POLICY AND REGULATORY FRAMEWORK FOR THE DEVELOPMENT OF FOOD STANDARDS .....</b>	<b>67</b>
	<b>ATTACHMENT 3 - THE SEAFOOD SECTOR.....</b>	<b>71</b>
	<b>ATTACHMENT 4A - CONSULTATION ON INITIAL ASSESSMENT REPORT .....</b>	<b>75</b>
	<b>ATTACHMENT 4B - CONSULTATION ON DRAFT ASSESSMENT REPORT .....</b>	<b>83</b>
	<b>ATTACHMENT 5A - SUMMARY OF SUBMISSIONS AT INITIAL ASSESSMENT.....</b>	<b>99</b>
	<b>ATTACHMENT 5B - SUMMARY OF SUBMISSIONS AT DRAFT ASSESSMENT.....</b>	<b>118</b>
	<b>ATTACHMENT 6A - SUMMARY OF SUBMISSIONS BY ISSUE AT INITIAL ASSESSMENT .....</b>	<b>161</b>
	<b>ATTACHMENT 6B - SUMMARY OF SUBMISSIONS BY ISSUE AT DRAFT ASSESSMENT .....</b>	<b>170</b>
	<b>ATTACHMENT 7 - AUSTRALIA NEW ZEALAND FOOD STANDARDS CODE REQUIREMENTS FOR SEAFOOD.....</b>	<b>186</b>
	<b>ATTACHMENT 8 - AVAILABLE CODES OF PRACTICE FOR THE SAFE PRODUCTION OF SEAFOOD.....</b>	<b>188</b>
	<b>ATTACHMENT 9 - THE IMPORTED FOOD INSPECTION SCHEME AND SEAFOOD TESTING.....</b>	<b>190</b>
	<b>ATTACHMENT 10 - A RISK RANKING OF SEAFOOD IN AUSTRALIA (FEBRUARY 2005) .....</b>	<b>193</b>
	<b>SUMMARY .....</b>	<b>195</b>
	RISK RANKING METHOD .....	195
	FUTURE REVIEWS OF THE RISK RANKING .....	196
	FOOD SAFETY HAZARDS IN SEAFOOD .....	196
	SUMMARY OF RISK RANKINGS .....	196
<b>1.</b>	<b>SCOPE AND PURPOSE .....</b>	<b>200</b>

<b>2. INTRODUCTION.....</b>	<b>200</b>
SOURCES OF HAZARDS ASSOCIATED WITH SEAFOOD IN AUSTRALIA .....	201
FOOD-BORNE ILLNESS ASSOCIATED WITH AUSTRALIAN SEAFOOD.....	202
APPROACHES TAKEN IN THIS REPORT.....	203
ALTERNATIVE RISK RANKING METHODS .....	205
RISK RANKING MODEL EMPLOYED .....	207
<b>3. RISK RANKINGS .....</b>	<b>214</b>
FOOD SAFETY RISKS DUE TO MOLLUSCAN SHELLFISH.....	214
FOOD SAFETY RISKS DUE TO CEPHALOPOD MOLLUSCS .....	221
FOOD SAFETY RISKS DUE TO CRUSTACEA.....	223
FOOD SAFETY RISKS DUE TO FINFISH.....	229
<b>4. DISCUSSION OF RELATIVE RISK RANKINGS.....</b>	<b>239</b>
HIGH RELATIVE RISK RANKINGS .....	239
MEDIUM RELATIVE RISK RANKINGS .....	243
LOW RELATIVE RISK RANKINGS .....	248
<b>5. UNCERTAINTY AND VARIABILITY.....</b>	<b>248</b>
<b>6. CONCLUSIONS.....</b>	<b>249</b>
<b>REFERENCES.....</b>	<b>250</b>
<b>APPENDIX 1 - HAZARDS ALONG THE SEAFOOD PRODUCTION AND PROCESSING SUPPLY CHAIN.....</b>	<b>255</b>
MOLLUSCAN SHELLFISH .....	255
CEPHALOPOD MOLLUSCS .....	259
CRUSTACEA .....	260
FINFISH .....	267
<b>APPENDIX 2 - EPIDEMIOLOGICAL DATA .....</b>	<b>276</b>
<b>APPENDIX 3 - SEAFOOD CONSUMPTION IN AUSTRALIA BY GENDER AND AGE.....</b>	<b>279</b>
LIMITATIONS OF THE DIETARY MODELLING .....	279
MOLLUSCAN SHELLFISH .....	279
CEPHALOPOD MOLLUSCS .....	280
CRUSTACEA .....	281
FISH AND FISH PRODUCTS .....	282
<b>APPENDIX 4 - HAZARD IDENTIFICATION/HAZARD CHARACTERISATION .....</b>	<b>284</b>
BACTERIAL PATHOGENS .....	284
VIRAL PATHOGENS .....	301
PARASITES .....	303
CHEMICAL CONTAMINANTS.....	307
REFERENCES IN APPENDIX 4.....	328
<b>APPENDIX 5 - PEARL OYSTER MEAT AND OFFSHORE SCALLOPS .....</b>	<b>343</b>
BACKGROUND: REQUIREMENTS FOR PRODUCERS OF BIVALVE MOLLUSCS.....	343
SCIENTIFIC ISSUES .....	343
APPLYING THE RISK RANKING METHODOLOGY .....	345
REFERENCES .....	345

## EXECUTIVE SUMMARY

This Report proposes, for the first time, that there be a single, national food safety standard for the primary production and processing of seafood.

Australia enjoys a high level of food safety protection but, like many other nations, we face the challenge of improving food safety. It is recognised that the risks from seafood are usually well managed and are therefore considered low. There are only a very small number of products that may present higher public health and safety risks.

Food-borne illness is a growing public health problem globally because of the increasing global trade in food, changes in the way food is produced and consumers' changing requirements. These changing patterns are causing new challenges in the way food safety is managed.

A recent study conducted by the food-borne illness surveillance network of Australia, OzFoodNet, estimates that there are 5.4 million cases of food-borne illness in Australia each year from a variety of foods. There is a need to ensure that there are appropriate strategies in place to effectively manage food safety across all food sectors in the current environment of global food trading and in light of the estimates of the incidence of food-borne illness.

A whole of government approach is now being taken in Australia to the management of food safety. Governments have agreed that food safety should be managed throughout the food supply chain. This approach aims to improve public health and safety and ensure that consumers continue to have the highest confidence in the safety of the food they consume.

FSANZ has been given responsibility for the development of food safety standards in the primary production and processing part of the food supply chain – in addition to its existing responsibilities for the manufacturing, retail and food service sectors. Under the FSANZ Act, the objectives for developing all food standards, in descending order of priority, are:

- the protection of public health and safety;
- the provision of adequate information relating to food to enable consumers to make informed choices; and
- the prevention of misleading or deceptive conduct.

Seafood is one of the first industries to be examined in relation to a national approach to improving the primary production end of the food supply chain. The seafood industry itself has encouraged this early work.

Seafood is an important part of the diet for consumers in Australia and New Zealand. The sector is an important part of the Australian food industry - the fourth largest after beef, wheat and milk – with a considerable focus on exports.

This Final Assessment Report outlines how industry and government currently achieve seafood safety in Australia – generally with a mixture of industry self-regulation, licensing schemes, and general and specific (albeit differing) State legislation. While providing a measure of assurance, this mix of arrangements, both voluntary and mandatory, creates some gaps in the management of food safety.

FSANZ has consulted widely in the development of this proposed Standard. A Standards Development Committee, consisting of representatives from State and Territory jurisdictions and New Zealand, and industry and consumer representatives, has carefully considered the results of committee discussions, opinion at public fora and written feedback from stakeholders on both the Initial Assessment Report and the Draft Assessment Report for this Proposal.

FSANZ, with assistance from the Seafood Standards Development Committee, has examined how to improve further the management of public health and safety issues in the sector in Australia. A number of options have been considered and these are outlined in the table below:

NATURE OF FOOD SAFETY CONTROL	OPTION 1 Status quo	OPTION 2 Mgt of higher risk only	OPTION 3 Basic Safety Provisions + Mgt of higher risk
<b>Current arrangements:</b> -General obligation under Food Acts to produce safe food -Food Std Code provisions (except for primary production) -State and Territory schemes (NSW, VIC) -Voluntary industry codes of practice	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓
<b>General Provisions:</b> Food safety practices applied to primary production end of seafood sector (similar to current hygiene requirements for the manufacturing, retail and food service sectors but tailored to seafood industry)			✓
<b>Specific Provisions:</b> Standard 3.2.1 (Food Safety Programs) or equivalent applied to higher risk activities of the seafood industry		✓	✓

States and Territories will be responsible for compliance with and enforcement of this Standard. Government costs may vary from State to State, but overall arrangements for industry will be more efficient by having a single national standard.

A regulatory impact analysis has been undertaken to consider which option provides the maximum public health protection, with least impost on industry. The estimated benefits of introducing Option 2 (before costs) is \$26.4 million per year, while benefits of introducing Option 3 are estimated between \$30 million to \$75 million per year. The preferred option is Option 3.

Option 3 is preferred as it provides a single set of national standards to protect public health and safety (the primary objective of the FSANZ standard-setting process under section 10 of the FSANZ Act). It would do this by requiring an approach that is more rigorous for the higher risk products, which were identified from a review (risk ranking report) of the public health and safety risks associated with the consumption of seafood. The products include oysters and other bivalve molluscs (with some exceptions).



For seafood businesses producing bivalves<sup>1</sup>, compliance with pre-harvest provisions of the Australian Shellfish Quality Assurance Program and the implementation of food safety programs for the post-harvest sector up to the beginning of the retail sector is proposed. Food safety requirements for retail and the food service sector are already covered under Chapter 3 of the Code.

For the majority of the seafood industry - that poses lower risk (medium and low risk categories according to the risk ranking report) – a basic set of food safety provisions (called general provisions) are proposed. Such provisions would include requirements to ensure that food is not contaminated during its production or handling, that adequate temperature control of food is maintained and that staff have the skills and knowledge about food safety that is necessary for the work they undertake. Some of the medium risk products may benefit from more specific risk management strategies. However, these may vary according to geographic/climatic and other factors, as well as existing jurisdictional and industry infrastructures.

For this reason, the proposed Standard does not prescribe a documented seafood safety management system for the lower risk products as for the high risk products. Nevertheless, the Standard will require a seafood business to systematically examine all its primary production operations to identify potential seafood safety hazards and implement controls that are commensurate with the food safety risk. The extent of hazard identification, implementation of control measures and verification required should also be commensurate with the level of food safety risk involved. This is most appropriately determined by State and Territory jurisdictions in consultation with industry, taking account of local environmental factors. Where possible, State and Territory jurisdictions should use national forums such as the Implementation Subcommittee (ISC) of the Food Regulation Standing Committee to develop nationally consistent approaches to verification.

The philosophy behind this approach is about taking a preventive approach to managing food safety hazards and for industry, at all parts of the food supply chain, to play their role in minimising such hazards.

Option 3 proposes an approach based on risk – where risk is lower, the requirements are basic and where risks are higher, more significant requirements are proposed to manage food safety. The Australia and New Zealand Food Regulation Ministerial Council (Ministerial Council) made a decision in December 2003 – that food safety management approaches be based on risk and that food safety programs only be introduced where the benefits outweighed the costs of their implementation. Ministers also decided, based on the outcomes of the National Risk Validation Project, to require the introduction of food safety programs for oysters and other bivalves, up to the back door of the retail sector. The proposed Standard will implement the decision of Ministers.

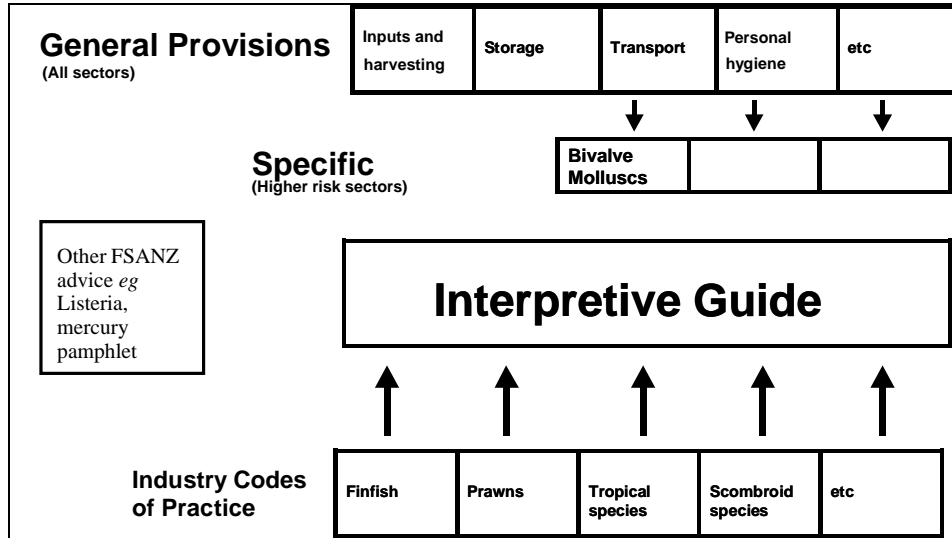
Specific recommendations are made in this Draft Assessment about implementation (effectively over a two year period) and a draft of the proposed Standard is included at Attachment 1.

---

<sup>1</sup> Bivalve molluscs means all molluscan bivalves with the exclusion of spat, and scallops and pearl oyster meat where the only part of the product consumed is the adductor muscle.

The Standard will be supported by an interpretive guideline for enforcement officers, developed by FSANZ, and industry developed guides to assist industry comply with the Standard. The framework for Option 3 is outlined below.

### Proposed Regulatory framework for food safety management in seafood



Consideration has also been given to fish names labelling requirements. While a comprehensive regulatory analysis has not been undertaken to support a case for mandating prescribed labelling of all fish species in all circumstances across the catching/production, processing, wholesale and retail sectors of industry, consultations have been undertaken with Standards Australia on the development of a national fish names standard for fish names.

To assist industry, FSANZ has facilitated discussions and agreements with various Australian government and industry agencies, to help develop an Australian Standard for fish names that could serve as a reference document for action under trade practices laws. Following implementation of these arrangements, further consideration will be given (through FSANZ's standards development processes) to whether any further coverage in the Code is required.

## **1. Introduction**

### **1.1 Food safety is a public health issue**

Food-borne illness is a significant public health issue. In Australia, a national survey of gastroenteritis during 2001-02<sup>2</sup> estimated that 5.4 million cases are due to contaminated food, resulting in the loss of 6.5 million days of paid work. This means that about one in four Australians get sick annually from eating unsafe food.

On the basis of these findings, together with costing data from a previous study<sup>3</sup>, the Australian Government Department of Health and Ageing has estimated that food-borne illness comes at a substantial economic and social cost to the Australian community – estimated at \$3.75 billion annually.

Food-borne illness impacts on health, consumer confidence in the food supply as well as on local and global trade in food. It is therefore important for consumers, industry, and governments that effective measures are put in place to ensure the safety of food.

The public is increasingly aware of the potential health risks posed by pathogenic micro-organisms and chemical substances in the food supply. Such challenges to food safety must be met by a fully effective food safety system that protects public health, builds confidence of consumers in the food supply and has a positive effect on food trade. Such a system needs to have capacity to meet future challenges. Food safety regulation should also be sensitive to, and supportive of, the needs of the food industry. It should result in the lowest achievable regulatory costs on industry and facilitate industry innovation and growth. In order to achieve these dual aims of consumer protection and industry support, it needs to be based on sound scientific evidence and be commensurate with the risks.

Since 1996, international agreements have resulted in the World Trade Organization (WTO) being an interested party in the work of the Codex Alimentarius Commission (Codex), which is responsible for developing international food standards. Those agreements have significantly changed approaches to food safety by all WTO members, including Australia, as they oblige Member States to set health and safety standards on the grounds of protecting public health. Such standards must be justified by a sound, scientific risk assessment.

Australia's approach to food safety, modelled on international principles, addresses food safety across the entire food chain and manages hazards that pose a significant risk to public health. Australia takes a preventive approach to managing food safety and national standards are framed to achieve outcomes, rather than prescribe approaches, to provide businesses with flexibility in how they achieve the outcomes.

### **1.2 Australian food standards**

The Code sets standards for chemical and microbiological safety, composition and labelling of food, approves new foods and foods using new technologies, and establishes food safety standards for the hygienic production and handling of food.

---

<sup>2</sup> OzFoodNet Working Group (2003), *Foodborne disease in Australia: incidence, notifications and outbreaks. Annual report of the OzFoodNet network, 2002, Communicable Diseases Intelligence*

<sup>3</sup> Food Science Australia & Minter Ellison Consulting (2002), *National Risk Validation Project - Final Report*.

The existing food safety standards apply from processing and manufacturing through to the retail sector of the food chain. However, these food safety provisions do not apply to primary production.

In 2000, the Council of Australian Governments (COAG) agreed to major changes to the food regulatory system. As part of these changes, Food Standards Australia New Zealand (FSANZ) received a mandate to address food safety across the entire food chain where appropriate<sup>4</sup>. This facilitates a preventive approach to significant food safety risks across the food supply chain.

FSANZ must adhere to specific legislative requirements and guidelines when developing food standards, and receives policy guidance from the Ministerial Council.

Further details about the policy and regulatory framework for the development of food standards is contained at Attachment 2.

In December 2003, the Ministerial Council developed Ministerial Policy Guidelines for Food Safety Management in Australia, whereby food safety programs were made mandatory for identified highest risk sectors where the benefit to cost ratio justified their implementation. These Ministerial Guidelines identify specific high-risk business sectors where food safety programs should be made a mandatory regulatory requirement in accordance with Standard 3.2.1 of Chapter 3 of the Code. These were:

- food service in which potentially hazardous food is served to vulnerable populations (e.g. hospitals and nursing homes);
- producing, harvesting, processing and distributing raw bivalve molluscs
- catering operations serving food to the general public; and
- producing manufactured and fermented meat.

The Ministerial Council noted in its Guidelines that in relation to raw bivalve molluscs, FSANZ would address this sector in the Draft Assessment process for the primary production and processing Standard for seafood.

It is within this context that FSANZ is developing the first primary production and processing Standard for the seafood sector in Australia. The principle purpose of FSANZ's food standards is to protect public health and safety (and may also address consumer information needs) under the objectives for standard-setting under the FSANZ Act. In developing this Standard, FSANZ must follow its statutory standard-setting processes to implement the decision of the Ministerial Council in relation to bivalve molluscs.

---

<sup>4</sup> Primary production standards are not covered by the Treaty between Australia and New Zealand for the development of joint standards.

## **2. Background**

### **2.1 The seafood sector**

The seafood industry is the fourth largest sector of the Australian food industry (by value) after beef, wheat and milk. The gross value of production (GVP) during 2000-01 was \$2.44 billion<sup>5</sup>. Since 1992, the GVP has increased, on average, by 10 per cent per annum<sup>6</sup>. Approximately 87 per cent of the value and 34 per cent of the edible volume of Australian seafood production is exported.

At 11 million square kilometres, the Australian fishing zone is the third largest in the world. Most wild fish stocks are fished at their optimal sustainable level, with aquaculture making an increasing contribution to the industry. Between 1991-92 and 2001-2, aquaculture was responsible for approximately 24 per cent of the total volume of seafood produced in Australia.

During 2001-02, 186,777 tonnes of seafood were produced in Australia, covering approximately 600 marine and freshwater seafood species. Approximately 66 per cent was consumed domestically, with the remainder exported. A further 144,474 tonnes were imported, mainly from Thailand and New Zealand.

Further details about the seafood sector, its nature and the value and volume of production, can be found at Attachment 3.

### **2.2 Development of a primary production and processing standard for seafood**

Proposal P265 – Primary Production and Processing Standard for Seafood, was raised by FSANZ in December 2002 under its mandate to develop domestic standards for the primary production and processing of food.

Recently, some State Governments have developed seafood safety schemes to ensure that a ‘boat to plate’ (i.e. paddock to plate) approach to seafood safety was implemented across the seafood supply chain. However, other Governments are not yet at that point, leaving the primary production end of the domestic seafood chain largely unregulated.

The seafood sector is also increasingly aware that food safety issues are vital to the continued growth of the industry, and has developed a national voluntary seafood safety Standard. The industry has also produced a number of guidance documents on food safety across a range of sectors. It is therefore considered an opportune time to move these developments forward nationally to further improve food safety outcomes.

As required by the Ministerial policy guidelines, a Standards Development Committee (SDC) was appointed in September 2002 by the FSANZ Board to assist in the development of the Standard. The SDC contributes a broad spectrum of knowledge and expertise covering industry, government, research and consumers.

---

<sup>5</sup> ABARE, Australian Fisheries Statistics 2003

<sup>6</sup> During 2002-03, although total production volumes rose to 249,000 tonnes, the GVP fell to \$2.3 billion. This has been largely attributed to the lower export values for many species. Media Release 18 February 2004, Australian Seafood Industry Council.

Since December 2002, FSANZ, with the assistance of the SDC, has:

- considered the written submissions received in response to the public consultation on the Initial Assessment Report and the Draft Assessment Report and;
- conducted face-to-face consultations with stakeholders (see Attachments 4, 5 and 6);
- undertaken an evaluation of public health risks and identified sectors of the seafood industry that pose a potential high risk to safety;
- considered current strategies to manage those risks and determined what, if any, residual risks need to be managed;
- considered options for the management of these residual risks that aim to ensure the safety of seafood;
- conducted an impact analysis of the options to identify the option that meets the minimum effective regulation requirements that would effectively address public health and safety risks associated with seafood production;
- recommended a preferred option;
- considered the implementation of the preferred option; and
- drafted a proposed Standard consistent with the preferred option.

This Report forms the third stage in the process of developing a primary production and processing Standard for seafood. It takes into account the matters raised above and other deliberations of the Seafood SDC. Industry, government, agencies, consumers and other interested parties are invited to comment on these or any other matters relating to the development of a primary production and processing Standard for seafood.

### **2.3 Labelling of fish names**

Ministers with responsibility for food regulation in Australia and New Zealand have stated that primary production standards should be developed to focus primarily on food safety matters and be complementary to, and not inconsistent with, the other chapters of the Code. These other sections of the Code contain generic and specific standards for all foods as well as standards for hygienic production of food. A primary reason for this separation of issues is that primary production standards will apply in Australia only and under the Treaty between Australia and New Zealand, the composition and labelling provisions of the Code apply in both Australia and New Zealand.

Labelling requirements for foods are determined following analysis against the objectives for standards set out in the FSANZ Act, COAG policy requirements for minimum effective regulation that is not anti-competitive and relevant Ministerial policy guidelines<sup>7</sup>.

---

<sup>7</sup> As set out in the Australia New Zealand Food Regulation Ministerial Council's *Overarching Policy Guideline On Primary Production And Processing Standards*.  
[http://www.foodstandards.gov.au/\\_srcfiles/ANZFRMC%20OVERARCHING%20POLICY%20GUIDELINE%](http://www.foodstandards.gov.au/_srcfiles/ANZFRMC%20OVERARCHING%20POLICY%20GUIDELINE%20)

During the development of the primary production Standard for seafood, some sectors of the fishing industry have advocated the need for mandatory labelling of fish names to prevent or limit consumer deception, a view that has also been supported by a major supermarket. Furthermore, the Australian Seafood industry Council (ASIC), the peak industry body for seafood, has incorporated the Australian Fish Names List in the industry voluntary Standard. Part 1.2 – Labelling and other Information Requirements, could be amended if a need were demonstrated, following a comprehensive analysis of the consumer risks, the regulatory options, and the likely costs and benefits to consumers, industry<sup>8</sup> and governments and public comment on the analysis. This analysis is required in the development of any standard in the Code to ensure that it receives Ministerial agreement and enforcement support by the States and Territories.

Discussions have also included reference to the existing protection consumers have against false and misleading claims in the various trade practices laws in Australia and New Zealand and the general principle of not duplicating legislation if this can be avoided.

In the meantime, following extensive discussions with industry (through the Seafood SDC), Standards Australia, the Australian Competition and Consumer Commission, the Australian Government Department of the Treasury (the agencies responsible for developing and administering Australia’s consumer protection and business development laws) and with the Office of Regulation and Review, the following steps have been initiated by FSANZ and industry:

1. FSANZ and the seafood industry has entered into discussions with Standards Australia to develop an Australian Standard for fish names, based on the existing list of fish names developed by the fishing industry.
2. Preliminary discussions with the ACCC indicate that such a standard could be used as a reference document to assist in enforcement by the ACCC under the fair trading laws.
3. Once there is a formally recognised Australian Standard for fish names, consideration could be given to an Application to amend the Code to refer to the resulting Australian Standard on fish names. The nature of the reference (mandatory or voluntary; in all circumstances or only where there is a demonstrated health risk) would be determined at that time following FSANZ’s normal assessment procedures.

### **3. Current management strategies to address seafood safety**

The safety of Australian seafood is controlled under a variety of schemes from primary production through processing, manufacture, wholesale, retail and food service. Regulatory and non-regulatory approaches are taken and these are outlined below.

---

20-%20PP%20STDs.pdf)

<sup>8</sup> Across the full range of industry, including catchers/producers, processors, wholesalers and retailers.

### 3.1 Domestic Production - regulatory requirements for food safety

#### 3.1.1 Australia New Zealand Food Standards Code - adopted nationally under State/Territory legislation

Domestic seafood production and imported seafood sold in Australia are subject to the requirements of the Code, as adopted under State and Territory legislation. State and Territory governments enforce compliance with the Code under their Food Acts.

Management of the public health and safety risks and consumer information needs associated with wholesale trade, processing, manufacture, retail and foodservice of seafood products are covered by existing standards.

Chapter 1 of the Code specifies permissions for the use of food additives, processing aids and pesticides and also sets maximum limits for chemical and microbiological contaminants in seafood. There are also requirements for the labelling of seafood. Chapter 2 of the Code contains specific requirements for fish and fish products.

Chapter 3 of the Code contains provisions for the hygienic processing and handling of food, and voluntary provisions covering the application of Food Safety Programs to the processing and retail part of the food chain. The Food Safety Standards in Chapter 3 do not currently apply to the primary production of seafood, except where there is direct sale to the public or the primary producer substantially processes the seafood.

It should be noted that the point in the processing part of the food chain at which the Food Safety Standards apply is not the same in all jurisdictions. Generally, the Standards do not apply on board vessels for activities such as gutting and filleting.

Attachment 7 provides a summary of these national standards impacting on seafood.

#### 3.1.2 State and Territory regulations for the primary production of seafood

Different regulatory arrangements for seafood are in place in each of the States and Territories. These schemes are outlined in the sections below. (See also Table 1.)

**Table 1: Seafood activities covered by food safety standards (Chapter 3) and State primary production food safety schemes**

State/Territory	Seafood industry activities covered by	
	State/Territory Primary Production food safety schemes	Food Safety Standards (Chapter 3) under the Code and State/Territory Food Acts
New South Wales	<ul style="list-style-type: none"> <li>▪ Capture/harvest to wholesale*</li> <li>▪ Bivalve molluscs</li> </ul>	Manufacturing, retail and food service
Queensland**	<ul style="list-style-type: none"> <li>▪ Bivalve molluscs</li> </ul>	Manufacturing, retail, food service
Victoria ***	<ul style="list-style-type: none"> <li>▪ Capture/harvest, processing, wholesale, transport and retail fresh fish outlets</li> <li>▪ Bivalve molluscs</li> </ul>	Retailers selling cooked seafood
South Australia	<ul style="list-style-type: none"> <li>▪ Bivalve molluscs</li> </ul>	Gutting or filleting off-vessel or off-farm, bivalve molluscs from storage onwards (cleaning, grading, packing, shucking), wholesale, manufacture, retail, foodservice



Western Australia	▪ Bivalve molluscs	From land based seafood-processing facilities to retail sale. Shellfish - handled after harvest
Tasmania	▪ Bivalve molluscs	Shellfish - bagging, holding tanks, shucking. Finfish - filleting, thermal packaging, smoking and other manufacturing, retail sale and foodservice
Northern Territory	-	Wholesale, manufacture, retail, food service
Australian Capital Territory	-	Wholesale, manufacture, retail, food service

\* State-based scheme under NSW Food Production (Seafood Safety Scheme) Regulation 2001.

\*\* Initial/preparatory work on a Queensland Seafood Safety Scheme, which covers capture/harvest, gutting and filleting, shucking, boiling, freezing and wholesaling fresh fish. Note this scheme is not yet in place (pending outcome of the development of a national seafood standard)

\*\*\* Victorian scheme under the Seafood Safety Act.

### 3.1.2.1 New South Wales

The NSW seafood industry is regulated under the NSW Food Production (Seafood Safety Scheme) Regulation 2001. The original requirement for HACCP-based food safety programs<sup>9</sup> for all seafood businesses has subsequently been modified to match the rigor and complexity of the food safety systems, and the degree to which they are to be audited, with the level of risk to public health and safety.

For example, a food safety plan for a low risk business will not fully implement all HACCP principles and will only need to cover activities that impact on hygiene, sanitation and any necessary temperature controls. Roll-out of the system is being staggered, with the catch/harvest sector (excluding shellfish aquaculture), deemed to be mostly low-medium risk, being the first sector considered.

The NSW Food Production Regulation 2001 also incorporates a shellfish quality assurance program. Principles of the Australian Shellfish Quality Assurance Program (ASQAP) have been incorporated into the mandatory Shellfish Program to ensure safety in the consumption of bivalve molluscs.

### 3.1.2.2 Victoria

In Victoria, legislation for a new seafood safety system came into effect on 1 July 2003, with the exception of the wild catch and aquaculture sectors, which will come under the new legislation on 1 July 2004. The Seafood Safety Act extends the responsibilities of the Victorian Meat Authority (now called Primesafe) to cover the primary production, processing and retail sectors of the seafood industry. All seafood businesses must be licensed by Primesafe, and operate to approved food safety programs audited under the authority of Primesafe.

Seafood processors, wholesalers and retailers of fresh fish transferred from supervision under the Victorian Food Act to Primesafe on 1 January 2004. Victoria will adopt the national primary production and processing standard for seafood under this legislation.

In addition to the requirements imposed on primary production and processing of seafood under the proposed Seafood Safety Act, supermarkets and businesses engaged in retail sale of cooked seafood, such as fish and chip shops and restaurants, are required to implement a food safety program under provisions of the Food Act 1984.

---

<sup>9</sup> HACCP – Hazard Analysis and Critical Control Point (HACCP) system – is a science based and systematic documented system that identifies specific hazards and measures for their control to ensure the safety of food.

### 3.1.2.3 Queensland

Queensland commenced consultation and development work on a seafood safety scheme, but is now waiting for the development (by FSANZ) and gazettal of the national primary production and processing Standard for seafood in the Code.

### *3.1.3 Australian Shellfish Quality Assurance Program (ASQAP)*

The safe production of bivalve molluscs is effectively managed through a single management system, the ASQAP. ASQAP is a national program modelled on the United States Food and Drug Administration's National Shellfish Sanitation Program. The Program was initially developed to meet AQIS export requirements and adapted to local conditions by the Australian Shellfish Quality Assurance Advisory Committee (ASQAAC), to provide guidelines for the safe production and marketing of bivalve molluscs for domestic production.

Bivalve molluscs are filter feeders, extracting phytoplankton, bacteria and suspended organic and inorganic particles (including heavy metals, toxins, enteric pathogens and endogenous marine pathogens) from the surrounding water. Waters from which bivalves are harvested may be subjected to pollution from discharges of untreated or poorly treated human waste, direct discharges of industrial wastes and runoff from urban and agricultural areas. Bivalves have been associated with numerous outbreaks of human illness because of their ability to bio-accumulate pathogens and toxins derived from contaminated waters, and because they are often eaten raw or only lightly cooked with their gastrointestinal tract intact.

The most commonly used approach for managing these risks involves harvesting shellfish only from waters that are shown to be free from harmful contaminants or pathogenic micro-organisms.

Federal, State and (sometimes) local government agencies share administrative responsibilities for the management of bivalves; sanitation controls for growing areas (including sanitary surveys and water classification); harvesting controls; and post-harvest processing and handling of bivalves consumed in Australia. ASQAP is administered on a co-operative basis by these agencies. For bivalves destined for export markets, AQIS administers sanitation controls for post-harvesting processing and handling of product.

In each State, the State Government regulates and manages the strict water and environmental monitoring provisions in the State program e.g. QSWAMP (Queensland Shellfish Water Assurance Monitoring Program), VSQAP (Victorian Shellfish Quality Assurance Program), TSQAP, SASQAP, NSWQAP, WASQAP etc. Under these arrangements, there is a State Shellfish Control Authority (SSCA) that undertakes shoreline sanitation surveys, sanitation reviews, and risk management procedures.

Under ASQAP, harvest areas must be classified by the SSCA on the basis of the shoreline sanitary survey and an on-going water-sampling program. Production areas are classified as: *Approved*; *Approved conditional*; *Restricted*; *Restricted conditional*; and *Prohibited*. ASQAP also imposes controls on bivalve harvesting and ensures protection from contamination after harvesting.

The success of the program is based on continual and extensive monitoring of all commercial growing areas. It entails a precautionary approach, resulting in the closure of a harvesting area following a trigger event such as heavy rainfall or toxic algal bloom. Rainfall can flush microbiological and other pollution into harvesting areas and may also lead to conditions that encourage blooms of toxic phytoplankton.

Australian States and Territories also regulate bivalve safety through aquaculture licences, making it a condition of the licence to be part of the State shellfish quality assurance program. The approach under this system, while not embedded in the food regulation system, is recognised to be effective.

### **3.2 Voluntary industry standards and guidelines for domestic production**

Many seafood businesses comply with voluntary industry guidelines and codes of practice developed by industry peak bodies to address seafood quality and safety issues. Examples of industry guidelines and codes of practice are listed in Attachment 8.

There are no data on the extent to which these guides are implemented by industry, but large operations and those that perceive a market advantage tend to implement and adhere to guidelines, while smaller, resource-constrained businesses are less likely to adopt them.

### **3.3 Imported seafood - regulatory requirements for food safety**

Imported foods must meet the same standards as domestic foods.

At the border, the safety of imported seafood is regulated under the *Imported Food Control Act 1992* administered by AQIS. FSANZ and AQIS have joint responsibility for regulating the safety of imported food, with their roles defined by a memorandum of understanding. FSANZ is responsible for conducting risk assessment of imported food, and AQIS provides operational services at the border, including inspections, verifications and tests in line with FSANZ's advice and to ensure that imported foods comply with the Code.

Imported seafood that is currently classified as 'Risk' food and therefore subjected to 100 per cent inspection levels, consists of the following:

- crustaceans, cooked and chilled or cooked and frozen. Includes cooked peeled prawns but excludes canned product that is commercially heat treated;
- fish (whole, filleted, further processed or dried), all shark (including Dogfish), *Rexea solandri* (Gemfish) and tuna;
- smoked vacuum packed fish and smoke flavoured vacuum packed fish;
- marinara mix - chilled or frozen, whether blanched or not. Excludes canned product that is commercially heat treated; and
- molluscs ready for consumption, whether chilled or frozen. Includes all bivalve molluscs such as mussels, clams, cockles and scallops. Excludes canned product that is commercially heat treated.

All other imported seafood products are included in the random surveillance category and inspected at a rate of 5 per cent. For further details on the current tests applied to imported seafood refer to Attachment 9.

FSANZ and AQIS are undertaking a review of the random and active surveillance categories. This review is considering existing limits in the Code, the risks to public health and safety and imported food data. The new imported food surveillance system is intended to reward those importers with a good history of compliance, and to allow greater flexibility in relation to inspection frequencies.

The involvement of domestic surveillance agencies in the review of imported food surveillance will result in a more inclusive consideration of issues and allow a greater integration of surveillance functions. It will also ensure that a broader range of information sources is considered when developing surveillance priorities.

The review of the imported foods random and active surveillance categories has been substantially progressed by FSANZ. In the next few months, proposals on inspection rates for classes of foods will be presented to State and Territories and industry for their comment. It is expected that implementation of the new, more flexible system will be in a phased approach with different rates of inspection being applied to some food categories by the end of 2004.

Importers can avail themselves of two mechanisms to reduce the level of inspection and testing at the border. These include (a) recognition of quality assurance arrangements and (b) certification provided by overseas governments (see below).

### *3.3.1 Recognised quality assurance arrangements*

AQIS may enter into quality assurance arrangements with individual overseas manufacturers that are able to demonstrate that they operate to a HACCP based quality management system that ensures their products meet the requirements of the Code and other requirements of the *Imported Food Control Act 1992* and are therefore eligible for importation into Australia. Shipments from that company will be monitored by AQIS at reduced rates. To be eligible to enter into an agreement a company must be certified by a third party certification body to the ISO 9000 quality management standards and be able to meet requirements of relevant Codex Codes of Practice. There are currently no such agreements in place.

### *3.3.2 Certification provided by overseas governments*

Australia has voluntary arrangements to accept assurances from a number of governments on the safety of the food exported to Australia. Food that is accompanied by certificates issued by these governments will generally be released with document inspection only and without routine inspection of the food. Inspections will only be carried out for verification checks of the certification arrangement or if AQIS has concerns about a particular consignment. The certification arrangements may apply to risk, active or random surveillance foods from any country and to risk foods from New Zealand under terms of the Trans-Tasman Mutual Recognition Arrangement.

Currently certification is provided for a range of foods, including seafood, from at least nine countries.

### 3.3.3 *Monitoring for food safety by States and Territories*

In addition to border inspection, States and Territories test imported food to ensure it meets requirements of the Code at the point of sale. States and Territories also undertake specific food surveillance surveys on food sold in Australia. These surveys cover domestically produced and imported foods. Specific surveys on fish and fish products have been undertaken (see Table 2).

**Table 2: State and Territory surveys of fish and fish products sold in Australia (covers domestic and imported products)**

Survey Title	State	Year	Foods
Listeria Monocytogenes in nil-tolerance products	QLD	1995	Smoked Fish Products
Heavy Metals/Pesticides in Brisbane River seafoods	QLD	1996	Seafood (Fish/Prawns)
Microbial quality of marinara mix	ACT	1997	Marinara mix
Biogenic amines in fish and fish products	ACT	1997	Fish and fish products
How safe are smorgasbord foods?	WA	1998	Cooked Prawns
Sulphur dioxide in cooked prawns	QLD	1999	Prawns
Mobile seafood vendor survey	NSW	2000	Seafood
Metal contamination of major NSW fish species	NSW	2001	Fin fish
Metal contamination of major NSW fish species	NSW	2001	Crustaceans
Metal contamination of major NSW fish species	NSW	2001	Molluscs
Histamines – Storage Conditions in Fish	VIC	2002	Finfish
Fish speciation, Cairns Public Health Unit	QLD	2002	Fish
Fish substitution survey	National	2003	Finfish
Shelf life of Sushi products Nigiri pieces and Nori rolls	VIC	2003	Fish products

These surveys may provide information on compliance with the Code at point of sale, hazards in seafood and in some instances insights into hazards that may commonly be associated with particular foods. In relation to any public health and safety impact arising from food/hazard combinations, this would need to be established through epidemiological investigations.

In 2000, the OzFoodNet project was established in Australia as a collaborative project between the Commonwealth and States and Territories to enhance the surveillance of food-borne diseases and to provide a means for facilitating the national investigation of and determine the causes of food-borne illness. It is anticipated that as a result of these activities and over time, Australia will have access to improved information about the sources of food-borne illness.

### 3.3.4 *Enforcement of process standards for imported food*

Consumers need to have confidence that the food they consume is safe, irrespective of its source. Mandatory national food standards in the Code apply to both domestically produced and imported foods. However, the mechanisms used to determine that food is safe may differ between domestic and imported foods.

For imported foods, the monitoring system aims to achieve the same outcome i.e. that only safe and suitable food is sold on the Australian market. The monitoring of imported foods often examines the end point of production and tests against agreed microbiological or chemical residual limits in the Code.

For example, instead of being able to check that specified processing requirements were applied during the production and processing of food, product safety is determined by testing, for example, for coagulase-positive staphylococci, salmonella, *E. coli* or histamine etc.

End point testing can have limitations in terms of being able to reliably ensure safe food outcomes. Therefore, FSANZ and AQIS, in conjunction with the States and Territories, have begun to examine systems that can more reliably monitor the safety of imported foods. It is expected that the Implementation Sub-Committee of the Food Regulation Standing Committee will consider the outcome of this work in 2005.

### 3.3.5 *Importation of seafood from New Zealand*

Seafood imported from New Zealand operates under the Trans Tasman Mutual Recognition Agreement. The Imported Food Control Act of 1992 applies the standards in the Code to risk categorised food imported from New Zealand.

## 3.4 **Food safety and exported seafood**

Seafood exports must comply with national legislation for export control administered by AQIS. This legislation includes the *Export Control Act 1982*, Export Control Prescribed Goods (General) Orders and more specifically the Export Control (Processed Foods) Orders. These provide Government-to-Government certification to assist in fulfilling importing country food safety requirements and trade description for seafood exports.

Export processing establishments (including some vessels) must be registered by AQIS and have, as a minimum, procedures to address the risks associated with the processing of different seafood products to assure an appropriate level of food safety. International market access for Australian fish product exports are facilitated and maintained through this process, and the country's competitive position as a supplier of safe products is enhanced.

AQIS systems for exported seafood are based on the auditing of processing of seafood managed under two approved arrangements. The two systems currently available are:

- *Approved Quality Assurance (AQA)* - based on the company having a fully documented quality management system (similar to ISO 9002 but including technical standards) audited by AQIS at least twice a year.
- *Food Processing Accreditation (FPA)* - a simpler system than AQA, requiring only documentation of a process flow chart and HACCP plan, and Good Manufacturing Practice (GMP), which is managed as part of a premise's registration. Registered establishments are audited at a frequency based on the risk rating of their products, past compliance with their documented system and legislative standards.

## 3.5 **Summary of regulation of the Australian seafood sector**

The existing regulatory arrangements for domestically produced, imported and exported seafood are summarised in Table 3.

There is no nationally consistent approach to seafood that obliges all of the industry to manage the safety of their product at the primary end of the food chain. The fragmented, and at times voluntary nature of existing management systems, creates gaps and an uneven approach to food safety.

**Table 3: Seafood regulation in Australia**

Sector → Market ↓	PRIMARY PRODUCTION Catching Sector and Aquaculture	PROCESSING AND TRANSPORT	RETAIL AND FOOD SERVICE
<b>Exports</b>	Export Control (Processed Food) Orders - HACCP based-food safety programs required.	Export Control (Processed Food) Orders - HACCP based-food safety programs required.	Not applicable
<b>Domestic seafood</b>	Variable regulation: - NSW and Vic regulate primary production sector of the seafood chain requiring food safety programs. - Various industry food safety and quality assurance guidelines, schemes and codes. - Shellfish growers required to meet ASQAP requirements	State and Territory legislation (including requirements of Code). Requirement for good hygiene practices etc. - Considerable variation as to what point in the supply chain the Food Safety Standards apply. - Various industry food safety and quality assurance guidelines, schemes and codes.	State and Territory legislation (including requirements of Code). Requirement for good hygienic practices etc. - More consistent application except in Victoria, where food safety programs are mandatory. - Various industry food safety and quality assurance guidelines, schemes and codes.
<b>Imported seafood</b>	In country production requirements. - Some AQIS certification requirements in place e.g. fish products imported from Thailand.	In country production requirements. - Some AQIS certification requirements in place e.g. fish products from Thailand.	Imports are evaluated by AQIS against requirements of the Imported Food Inspection Scheme and the Code and inspected and tested for compliance to the Code. Seafood from New Zealand operates under the Trans Tasman Mutual Recognition Agreement and the Imported Food Control Act of 1992 applies the standards in the Code to risk categorised food imported from New Zealand.

## 4. Regulatory problem

Before Governments act to regulate any sector of business, it is necessary to describe what the regulatory needs are – ‘the regulatory problem’.

### 4.1 Growing global burden of food-borne illness

Australia and most other countries in the world, as well as the World Health Organization (WHO)<sup>10</sup>, recognise the increasing burden of food-borne illness worldwide. The growing burden of food-borne illness may be attributed largely to a rapidly changing global environment. The growth in global food trade – where food grown in one country can now be transported and consumed halfway across the world, changing patterns of food production and distribution, and evolving consumer preferences for food are some of the elements of the changing environment and it is likely that these will continue in the future. These changes create an environment that favours the emergence and re-emergence of new pathogens and contaminants in food, and the resulting food-borne illness in our population.

<sup>10</sup> Brundtland, G.H. ‘Food Safety – A World-Wide Challenge’, Food Chain 2001, WHO Food Safety Strategy, 2001.

## 4.2 Impacts of food-borne illness in Australia

Consumers typically respond to outbreaks of food-borne illness in seafood by reducing their demand for seafood products. For example, following contamination of NSW oysters in 1997, NSW consumers immediately reduced their demand for oysters by 85 per cent. They also immediately reduced their demand for all seafood products by 30 per cent, indicating that consumers readily generalise a specific seafood risk to the broad category of seafood products<sup>11</sup>.

However, despite consumers' immediate reactions to outbreaks of food-borne illness, demand for seafood recovers over time. Notwithstanding 24 outbreaks associated with raw-ready-to-eat seafood<sup>12</sup> during the 1990s, consumer demand for seafood has increased steadily over the medium term<sup>13</sup>. The implication is that while consumers immediately perceive costs when outbreaks of food-borne illness occur, these short-term costs are not sufficient to outweigh the perceived benefits of seafood to consumers over the medium-term.

Each outbreak of food-borne illness imposes an immediate cost on industry, by reducing sales revenues for the implicated product and with follow-on effects to the seafood industry more generally<sup>14</sup>.

## 4.3 A new approach to food safety

In this environment, the effectiveness of the existing food safety management systems needs to be examined and strategies identified to further improve food safety management. Traditional food safety systems have tended to focus on testing food at the end of the food chain, often after an outbreak of food-borne illness or an incident has been reported. While this approach assists prosecution of offending parties, it rarely prevents food-borne illness.

The more recently introduced HACCP approach to food safety offers a preventive approach to food safety, but does not approach the management of food safety from a priority perspective, i.e. it makes little distinction between controlling hazards that translate into significant risks to public health as opposed to hazards that lead to a relatively low risk to public health. The HACCP system is relatively costly to implement, and in an environment of limited resources, may not be cost-effective for all food sectors or activities.

The Ministerial Council has recognised the need for Australia to develop a new approach to managing food-borne risks to human health. This approach includes a nationally consistent, whole-of-chain food safety management system that is preventive in nature, focuses on food safety outcomes rather than prescriptive requirements and identifies management systems that are commensurate with public health risks.

A nationally consistent, preventive approach has recently been adopted in Chapter 3 of the Code, specifying baseline food safety provisions for the hygienic production of food in the manufacturing and retail sectors. Chapter 3 also sets out voluntary provisions for food safety programs.

---

<sup>11</sup> NRVP page 87.

<sup>12</sup> NRVP page 39.

<sup>13</sup> FRDC/Ruello and Associates, *op. cit.*

<sup>14</sup> As the NRVP case study of contaminated bivalve molluscs in NSW showed.



As identified earlier, the Ministerial Council recently agreed that food safety programs should become mandatory for certain food sectors identified as posing a higher risk to public health, where food safety programs would be cost-effective.

However, the provisions in Chapter 3 do not apply to the primary production end of the food chain. For many industry sectors and activities, hazards introduced at the primary end of the food chain may not be able to be managed effectively further up the food chain, resulting in public health incidents. The effective management of hazards of public health significance at the primary end of the food chain makes the task of managing hazards in the later part of the food chain easier and more effective, resulting in safer food and improved public health outcomes.

Section 3.5 highlighted the inconsistent approaches being taken at the primary production end of the seafood supply chain in Australia. These gaps in the coverage of current regulation and industry compliance with voluntary management systems may have implications in terms of public health and safety. This will need to be considered in light of the inherent public health and safety risks presented by seafood and the current strategies used to minimise these risks.

#### **4.4 Identification of public health and safety risks posed by seafood**

The Risk Ranking Report (Attachment 10) provides the scientific basis for the development of a Primary Production and Processing Standard for seafood. The report qualitatively ranks the public health and safety risk posed by consumption of seafood in Australia. Overall the risks from seafood are usually well managed and are therefore considered relatively low.

The risk ranking compares the relative risks associated with the wide variety of seafood commodities available in Australia – domestically produced and imported. It takes into account the chemical and biological food safety hazards potentially present, and assigns each commodity or group of commodities to a broad relative risk category: low, medium or high. There are only a very small number of products that may present relatively high public health and safety risks.

The ranking brings together the available scientific and technical information on food safety hazards in seafood and identifies seafood commodities of higher priority for the development of risk management strategies in the context of the Primary Production and Processing Standard for seafood.

##### *4.4.1 Risk ranking method*

FSANZ estimated relative public health risks by considering the severity of any adverse health effect resulting from the presence of a particular hazard in a seafood commodity, together with the likelihood of that adverse health effect occurring.

Estimates of the severity of illness due to the presence of hazards in seafood followed an internationally accepted procedure, which considers the duration of illness, likelihood of death and potential for ongoing adverse health effects.

Estimates of the likelihood of adverse health effects were based on:

- the link between the hazard and illness due to consumption of the particular seafood (epidemiological data);
- the prevalence and concentration or level of the hazard in seafood;
- patterns of consumption of the specific seafood (i.e. frequency of consumption, amount consumed);
- the impact of existing regulatory and non-regulatory risk management systems; and
- data and information on the following factors related to the properties of the hazard and the effect of production, processing and handling, particularly in terms of how they might influence hazard levels at the point of consumption:
  - the capacity for microbiological pathogens to survive or grow in the commodity;
  - any other relevant properties of the hazard (e.g. toxigenic or infectious dose);
  - the probable effect of production, processing and handling on the presence and level of the hazard; and
  - the likely effect of consumer handling (including cooking and product shelf life) on hazard levels.

Using a ranking matrix, FSANZ combined the severity and likelihood estimates into a broad relative risk estimate for each hazard that might be found in a seafood commodity (e.g. prawns) or group of similar commodities (e.g. oysters and other bivalve molluscs). An overall relative risk ranking for each commodity (or group of commodities) was then obtained by determining the highest relative risk ranking estimated for the commodity.

#### 4.4.2 *Future reviews of the risk ranking*

The risk ranking is based on the best current knowledge and data. Such rankings are dynamic, with their evolution reflecting increasing knowledge about the hazards and the consumer's exposure to them. For example, the introduction of new technologies, modified production practices, and changes in management strategies may influence the need to review the rankings.

FSANZ will maintain a watching brief of the scientific literature and international activities, e.g. Codex Alimentarius, which may impact on the risk ranking. Where significant data gaps impacting upon the risk ranking process are filled by the results of ongoing scientific studies and surveys of the prevalence and levels of food safety hazards in seafood in Australia, the robustness of the risk rankings can be better assessed and the rankings may be further refined.

#### 4.4.3 *Food safety hazards in seafood*

Seafood can contain food safety hazards derived from several different sources. Some of these hazards occur naturally in the environment in which seafood lives and grows and are unavoidable contaminants of seafood when it is harvested. Others are a consequence of the impact of human activities on the environment.

In the pre-harvest phase of production, feed components, veterinary drugs and other chemicals employed in aquaculture production may also present a public health risk. In addition to these, food hazards can be introduced into seafood, or caused to increase to potentially hazardous levels, through direct contamination by food handlers and contaminated utensils and equipment and by inadequate handling (e.g. temperature abuse, cross-contamination, inadequate processing).

The extent to which any food safety hazard is likely to be present in seafood depends on a number of factors. These factors include the biology of the particular seafood species, its growing environment, and the conditions along its production and processing supply chain. Therefore, the broad biological classes of seafood species (bivalve and cephalopod molluscs, crustacea and finfish), and the public health risks posed by hazards associated with specific commodity groups within those classes, have been considered separately.

#### 4.4.4 Summary of risk rankings

The relative risk rankings described in this report demonstrate the generally high level of safety of seafood products. Under current risk management practices – both voluntary and mandatory – public health risks are relatively low for the majority of seafood. A small number of commodities present a higher public health risk than other seafood, taking into account the impact of existing regulatory and non-regulatory risk management systems.

The Report concludes that the following seafood sectors are ranked in the higher relative risk category:

- oysters and other bivalve molluscs (except when the consumed product is only the adductor muscle, e.g. roe-off scallops) harvested from growing environments likely to be exposed to faecal contamination and/or not under a shellfish safety management scheme; and
- ready-to-eat cold-smoked finfish (and other ready-to-eat cold-smoked seafood products), when consumed by population sub-groups susceptible to invasive listeriosis.

**Table 4: Seafood commodities ranked as higher relative risk**

Risk Ranking	Commodity
High	Molluscs - oysters and other bivalve molluscs
	Finfish - cold-smoked (including other cold-smoked seafood)

##### 4.4.4.1 Oysters and other bivalve molluscs

Oysters and other bivalve molluscs (except when the consumed product is only the adductor muscle, e.g. roe-off scallops) harvested from growing environments vulnerable to faecal contamination and/or not under a shellfish safety management scheme present a relatively high risk to public health, mainly due to the likelihood of illness caused by contamination with hepatitis A virus and algal biotoxins (particularly Neurotoxic Shellfish Poisoning [NSP]; and Amnesic Shellfish Poisoning [ASP]). These hazards are introduced in the pre-harvest phase of bivalve production.

This relatively high risk ranking is consistent with other studies based on recent epidemiological data that reflected a situation where inconsistent risk management systems were in place across Australia.

Food-borne illness due to oysters and other bivalve molluscs in Australia have resulted in a number of small outbreaks and sporadic cases due to *Vibrio* species and a few large outbreaks due to enteric viruses in oysters harvested from polluted and inadequately controlled waters.

While adoption of risk management strategies has improved the safety of bivalve shellfish in recent times, some risk remains. While monitoring of harvest waters for indicators of sewage pollution (e.g. faecal or total coliforms) helps to manage the risks due to enteric pathogens, bacterial and viral, it cannot predict levels of *Vibrio* species and enteric viruses in oysters. Oysters harvested from waters without a risk management system in place have a higher risk of contamination by algal toxins. Therefore, where oysters and bivalves are harvested from waters managed under a comprehensive shellfish safety scheme, such as the Australian Shellfish Quality Assurance Program (ASQAP), the risk is significantly reduced, notably, the likelihood of a food-borne illness is very low.

The risk rankings for oysters and other bivalves were the same regardless of whether they were to be cooked or eaten raw, as the hazards leading to the risk rankings are not greatly affected by the light cooking normally applied to these products.

#### 4.4.2 Cold-smoked seafood

Ready-to-eat cold-smoked finfish (and other ready-to-eat cold-smoked seafood products) present a higher risk to public health relative to other seafoods due to the possibility of contamination with *Listeria monocytogenes* and the potentially severe illness it causes in at-risk population sub-groups such as pregnant women. *L. monocytogenes* is a ubiquitous organism often found in processing environments, and may also be present in fish at the time of harvest. Cold smoking is not a listericidal<sup>15</sup> process.

Recognition of the risks by both regulators and the industry has resulted in a high level of management of *L. monocytogenes* in Australia and a lower risk of illness to the general population. FSANZ has previously recognised the inherent risk to the general population due to *L. monocytogenes* in cold-smoked seafoods by including a microbiological limit standard for the organism in ‘ready-to-eat processed finfish, other than fully retorted finfish’ in the Code. When the food safety risks are managed such that cold-smoked seafoods meet this regulatory requirement, the relative risk ranking for the general population is low, although the relative risk ranking for susceptible populations (e.g. pregnant women, newborn and young children and the elderly) is high. FSANZ is currently reviewing its dietary advice to these at-risk sub-groups in order to manage their food safety risks due to *L. monocytogenes* from all food sources.

If the food safety risks are not properly managed, such that cold-smoked seafoods do not meet the microbiological limit standard for *L. monocytogenes*, the relative risk ranking is high for at-risk sub-groups and medium for the general population.

This takes account of the relatively long shelf life of the product and the high standards of hygiene and sanitation in processing and good temperature controls across the food supply chain, up to and including the consumer, that is required to ensure the safety of the product.

#### 4.4.3 Other seafood commodities

FSANZ ranked other seafood commodities as presenting a low or medium relative public health risk.

---

<sup>15</sup> A listericidal process is one which would normally involve heat processing, usually 70°C for 2 minutes or equivalent, to achieve a 6D reduction in the pathogen load. The D value is the time required at a given temperature to destroy 90% of the population of a given micro-organism.

The vast majority of whole and filleted finfish was ranked in the low relative risk category. A few groups of fish species were ranked in the medium relative risk category:

- larger specimens of certain species of tropical and sub-tropical finfish, due to the potential for illness due to the accumulation of ciguatoxins; and
- large, long living or predatory fish, such as swordfish, shark/flake and some tuna, which tend to accumulate higher levels of methylmercury than other fish species. The ranking applies to the at-risk sub-population (the foetus) when the mother consumes mainly those species.

A medium ranking was also assigned to the following commodity groups (due to the listed hazards):

- univalve molluscs (e.g. abalone) and roe-off scallops (from algal biotoxins causing amnesic shellfish poisoning and paralytic shellfish poisoning);
- prawns (*V. cholerae* O1, *Salmonella* Typhi, arsenic);
- canned seafood (*Clostridium botulinum*);
- hot-smoked fish products (*C. botulinum*); and
- some whole and filleted finfish (arsenic).

In most cases, hazards linked to these medium risk commodities are already regulated in the Code (e.g. *Salmonella* in prawns, arsenic in finfish) or through longstanding and effective industry codes of practice (e.g. *C. botulinum* in low-acid canned foods).

Of the seafood commodities ranked in the medium risk category, prawns and some finfish (whole or as fillets) have been linked to several outbreaks of food-borne illness in Australia in recent years. For prawns, the associated food safety hazards have been primarily microbiological hazards, while for finfish, ciguatoxin, histamine fish poisoning and escolar wax esters account for the great majority of the outbreaks.

The majority of seafood commodities presented a lower risk to the general population. For some of these commodities, the limited consumption of the products was the main factor in leading to the conclusion that the likelihood of adverse health effects from associated hazards was very low. For others, the probable effects of downstream processing and consumer handling in reducing hazard levels were factors leading to a low likelihood of illness.

**Table 5: Summary of selected seafood commodities including current risk management\*.**

Commodity	Hazard/Environment or species	Severity	Likelihood	Relative risk Ranking <sup>1</sup>	Current risk management
Raw Oysters	<i>V. vulnificus</i>	Serious	Likely	Medium	ASQAP/Ch 3 <sup>2</sup>
	<i>V. cholerae</i> O1/O139	Severe	Unlikely	Medium	ASQAP/Ch 3 <sup>2</sup>
	Noroviruses/Uncontrolled <sup>3</sup>	Moderate	Very likely	Medium	
	Noroviruses/Managed <sup>4</sup>	Moderate	Unlikely	Low	ASQAP
	Hepatitis A virus/Uncontrolled <sup>3</sup>	Serious	Very likely	<b>High</b>	
	Hepatitis A virus/Managed <sup>4</sup>	Serious	Unlikely	Low	ASQAP
	Algal biotoxins/Uncontrolled <sup>3</sup>	Severe	Likely	<b>High</b>	Ch 1
	Algal biotoxins/Managed <sup>4</sup>	Severe	Unlikely	Medium	ASQAP/Ch 1
Cooked Oysters	Arsenic, Cadmium, Lead	Severe	Unlikely	Medium	ASQAP/Ch 1
	<i>V. cholerae</i> O1	Severe	Unlikely	Medium	ASQAP/Ch 3 <sup>2</sup>
	Noroviruses/Uncontrolled <sup>3</sup>	Moderate	Very likely	Medium	Ch 3 <sup>2</sup>
	Noroviruses Managed <sup>4</sup>	Moderate	Unlikely	Low	ASQAP/Ch 3 <sup>2</sup>
	Hepatitis A virus/Uncontrolled <sup>3</sup>	Serious	Very likely	<b>High</b>	
	Hepatitis A virus/Managed <sup>4</sup>	Serious	Unlikely	Low	ASQAP
	Algal biotoxins//Uncontrolled <sup>3</sup>	Severe	Likely	<b>High</b>	Ch 1
	Algal biotoxins/Managed <sup>4</sup>	Severe	Unlikely	Medium	ASQAP/Ch 1
Cooked abalone /roe-off scallops	Arsenic, Cadmium, Lead	Severe	Unlikely	Medium	ASQAP/Ch 1
Green prawns	Algal biotoxins	Severe	Unlikely	Medium	Ch 1
	<i>V. cholerae</i> O1 <sup>5</sup>	Severe	Unlikely	Medium	Ch 3 <sup>2</sup>
	<i>Salmonella</i> Typhi <sup>5</sup>	Severe	Unlikely	Medium	Ch 1/Ch 3 <sup>2</sup>
Cooked prawns	Arsenic	Severe	Unlikely	Medium	Ch 1
	<i>V. cholerae</i> O1 <sup>5</sup>	Severe	Unlikely	Medium	Ch 3 <sup>2</sup>
	<i>Salmonella</i> Typhi <sup>5</sup>	Severe	Unlikely	Medium	Ch1/Ch 3 <sup>2</sup>
Chilled/ frozen whole fin fish and fillets	Arsenic	Severe	Unlikely	Medium	Ch 1
	Mercury, Ciguatoxin <sup>6</sup>	Serious	Unlikely	Low	Ch 1/Advisory Notes
	Ciguatoxin/Tropical <sup>7</sup>	Serious	Likely	Medium	Advisory Notes
	Mercury/Predatory species <sup>8</sup>	Serious	Likely	Medium	Ch 1/Advisory Notes
Canned fish products	Arsenic	Severe	Unlikely	Medium	Ch 1
	<i>C. botulinum</i> <sup>4,9</sup>	Severe	Unlikely	Medium	GMP/GHP
Cold-smoked fish products	<i>C. botulinum</i> <sup>4,9</sup>	Severe	Unlikely	Medium	GMP/GHP
	<i>L. monocytogenes</i>	Serious	Unlikely	Low <sup>10</sup>	Ch 1/Ch 3 <sup>2</sup> /Advisory
	<i>L. monocytogenes</i>	Severe	Likely	<b>High</b> <sup>10,12</sup>	Ch 1/Ch 3 <sup>2</sup> /Advisory
	<i>L. monocytogenes</i>	Serious	Likely	Medium <sup>11</sup>	
	<i>L. monocytogenes</i>	Severe	Very likely	<b>High</b> <sup>11,12</sup>	
Hot-smoked fish products	<i>C. botulinum</i> <sup>4,9</sup>	Severe	Unlikely	Medium	GMP/GHP

Footnotes for Table 5:

\* Relative risk rankings are under constant review to identify emerging significant information.

1. Risk ranking reflects current practice for that commodity/seafood sector. The risk ranking is based on the severity of the hazard and an estimate of the likelihood of illness that takes into account various factors, including current risk management practices.
2. Chapter 3 provisions in the Code apply to the processing sector only.
3. Uncontrolled describes a growing environment not under a shellfish safety management scheme and/or likely to be exposed to faecal contamination. Includes growing waters adjacent to urban areas and rural habitation. In contrast, a growing environment considered pristine is unlikely to be exposed to faecal contamination. Pristine environments would typically include growing waters remote from human habitation and even if uncontrolled, present similar risk to managed waters for enteric pathogens. Algal toxins remain a risk for pristine environments.
4. **Where a food safety hazard is controlled under a management system/program, the likelihood of illness is very low.**
5. For product from intensive farming systems or estuarine harvest areas subject to human faecal contamination.
6. Majority of finfish present a low risk to consumers (Serious x Unlikely) due to mercury or ciguatoxin.
7. Ciguatoxin may be found in larger specimens of particular species of tropical and sub-tropical finfish from certain fishing areas. It is predominantly a problem in the recreational fishing sector (See Appendix 4, Table 19).
8. Predatory species – mercury is a problem in big, long living or predatory fish, such as swordfish, shark/flake and some tuna. These fish tend to accumulate higher levels of methylmercury than other species. The relative risk ranking is medium for the at-risk sub-population (the foetus) when the mother consumes mainly large, predatory or long-lived fish species.
9. Industry adherence to GMP, GHP and appropriate product formulation (e.g. pH, levels of salt, preservatives) control this hazard.

10. When correctly managed, the risk ranking is low for the general population (Serious x Unlikely), but high for at risk sub populations.
11. When not managed, i.e. processing, product handling and storage not adequately controlled, the risk ranking is medium for the general population and high for at risk populations.
12. *L. monocytogenes* is a severe hazard for at risk populations.

## **4.5 Examination of existing management systems and their control of identified risks**

The previous section concludes that there are a small number of seafood commodities that may pose a higher relative risk to public health and safety when compared with other commodities in the seafood sector. It also concludes that the remaining seafood commodities pose a lower individual risk, but that when the risk is aggregated, these contribute significantly to the background incidence of food-borne illness associated with seafood.

It is noted that in identifying risks, use was made of the available epidemiological data. However, this data is limited due to significant underreporting (one per cent of cases are estimated to be reported). With this in mind, well over 90 per cent food-borne illness related to seafood is likely to be unreported. However, the relative risk ranking took into account other information, as detailed previously, to develop a view of the overall risks posed. The following section of this Report further examines current management systems for higher risk sectors as well as the remaining sectors, to identify where these would benefit from application of additional or different risk management practices or a single integrated national scheme. Table 5 summarises current regulatory and food safety control measures in place for those seafood commodities ranked as either medium or higher relative risk.

### *4.5.1 Seafood ranked as high (relative to other seafood)*

#### 4.5.1.1 Oysters and other bivalve molluscs

Bivalves<sup>16</sup> were assessed as posing a higher relative risk to public health when harvested from growing environments likely to be exposed to faecal contamination and/or not under a shellfish safety management scheme.

The food safety of bivalves is controlled through State-based programs that utilise ASQAP as a guide to safe production and harvesting. All Australian producers must now comply with the State-based programs as a condition of their aquaculture licence.

State ASQAP programs adopt measures to prevent the growing and harvesting of bivalves from waters made unsuitable by the presence of biological or chemical hazards at levels likely to present a public health risk. These programs allow for the purification of bivalves from such waters, under certain conditions, through the application of techniques such as relaying and depuration. However, the vibrios, algal biotoxins and enteric viruses, in particular, tend to be removed ineffectively by these purification techniques, so that the higher inherent risk cannot be completely managed by these practices. Because of this, ASQAP prescribes the testing of bivalve flesh for biotoxins under certain circumstances, and requires temperature control to limit outgrowth of bacterial pathogens post-harvest.

---

<sup>16</sup> Bivalves molluscs means all molluscan bivalves with the exclusion of spat, and scallops and pearl oyster meat where the only part of the product consumed is the adductor muscle.

The State ASQAP programs are essential tools for the management of the safety of bivalve molluscs. It is clear that bivalve mollusc producers achieve a satisfactory level of safety for this inherently hazardous food through adherence to the requirements stated in ASQAP by the State Shellfish Control Authorities (SSCA). The use of very similar systems is mandated in many developed countries as the only recognised and effective means of producing safe bivalve molluscs. The control of waters from which the product is harvested is beyond the capacity of individual growers. Additionally, the current system ensures that the extensive sampling regime undertaken under the program is affordable for each grower.

The recent achievement of a national approach for industry compliance with the requirements set out in ASQAP for the safe production of shellfish has closed some of the gaps in the food safety management system for bivalves. The industry and the State regulators of the Program, through ASQAAC, have recommended to FSANZ that compliance with the pre-harvest requirements of ASQAP as well as biotoxins management plans be mandated in the Code and that food safety plans be mandated for certain post-harvest activities associated with these products. This aims to ensure that the current legislative basis for shellfish standards are based on food safety requirements, that States/Territories regulate shellfish safety through a nationally consistent standard and that there is a means to recognise ASQAAC as the body that maintains and updates ASQAP. Given the proven effectiveness of the ASQAP system, it would be appropriate to mandate compliance with requirements of the program as administered by the SSCA within the Code.

This approach would have the benefit of ensuring:

- an appropriate legislative basis by bringing it under the health umbrella;
- national consistency as all States would pick up the requirement uniformly and fully;
- once in the Code it would allow health portfolios to verify compliance by industry; and
- provide a mechanism for maintenance of guidelines that are essential for the safety of this food.

The development of mandatory documented risk management standards in the Code is consistent with the recent Ministerial decision and Guidelines on Food Safety Management Options in Australia.

In conclusion, the potential public health and safety risks associated with oysters and other bivalve molluscs are considered higher relative to other seafood and, therefore, voluntary or other non-regulated mechanisms to address this level of risk are not considered appropriate or sufficient to address the problem.

#### 4.5.1.2 Cold-smoked finfish

Cold-smoked finfish (and other cold-smoked seafood products) were found to present a higher relative risk to public health for at-risk population sub-groups, due mainly to the severity of illness caused by contamination with *Listeria monocytogenes*. Listeriosis is a serious food-borne illness that affects susceptible populations and can lead to death. Because of its long incubation period (up to three months), it is often difficult to identify the food vehicle responsible for the illness.

*Listeria* is a ubiquitous organism in the environment and because the cold-smoking process does not contain a listericidal step, it is difficult to eliminate this pathogen from the product.



Instead, strict adherence to good hygienic practices and proper maintenance of the processing environment are essential for controlling this organism. The long storage periods of the products at low temperatures favour the growth of the pathogen. Typically the shelf-life for vacuum packed cold smoked fish is up to 4 weeks at 5°C.

The Code sets a limit for *L. monocytogenes* in smoked fish and processors use this limit as one criterion for evaluating the safety of their products before release into the marketplace and in setting use-by-dates. Testing of products in the marketplace also contributes to recall of contaminated product. However, good hygienic practices and clean premises are essential tools in maintaining low levels of the pathogen in the product. These practices are already mandated for processing of this product in Chapter 3 of the Code.

In addition, FSANZ publishes and distributes information material to alert susceptible populations such as pregnant women to the high risk posed to them by this food. It must be concluded, however, that these current management strategies for *Listeria* in cold-smoked finfish leave a residual, albeit small, risk to public health.

One approach to manage the residual risks posed to public health by cold-smoked finfish would be to propose implementation of additional risk management systems. These could consist of a HACCP system or food safety program as described in the voluntary Standard 3.2.1 in the Code. It is clear that the risks lie mainly in the processing part of the food chain where the pathogen may be introduced, and also in the retail shop where *Listeria* growth may occur during the long shelf life of the product.

The implementation of HACCP or food safety programs would need to be justified by a positive benefit-cost ratio demonstrating that the burden would be clearly outweighed by the public health improvements. Such a benefit-cost study has not been done and until it is done, the proposal to mandate HACCP-based approach for this food would not meet with stakeholder agreement.

As the main sub-populations at risk are pregnant women and the elderly, improved education of these vulnerable populations may be the best approach, in the short-term, to manage the residual risk, combined with improved compliance and enforcement of the existing mandatory Standards in Chapters 1 and 3 of the Code. FSANZ has recently reviewed the *Listeria* pamphlet for pregnant women to broaden its audience to the main vulnerable population groups at risk.

In summary, at this point in the standard development process, no additional regulatory requirements are proposed for cold smoked finfish.

#### 4.5.2 Lower risk seafood

The majority of seafood commodities were ranked as presenting a lower public health risk than bivalve molluscs and cold-smoked finfish. The lower risk seafood products, when grouped together, do contribute to the overall level of food-borne illness and therefore have an impact on public health and safety. Because of the continuing burden this will have on the community and the consequent costs it imposes, there is an argument for the introduction of basic measures, at low cost, across the seafood industry that would have a broad impact in improving public health and maintaining the high level of consumer confidence in the consumption of seafood.

The existing food safety provisions in the Code recognise that good hygienic practices and pre-requisite programs must apply to all food businesses (other than primary production) to ensure a basic level of food safety for all food. Codex, in its General Principles of Food Hygiene<sup>17</sup>, also takes the approach that the primary production and processing of all food must meet basic requirements of food safety. The work of both the WHO and Codex indicates that reducing the hazards introduced at the primary end of the food supply chain will minimise food safety hazards at the later stages of the food chain.<sup>18</sup> The approach in Standards 3.2.2 and 3.2.3 of the Code that mandate minimum requirements for food safety do not apply to businesses in the primary production and processing sector - they apply to manufacturers through to retailers.

The various voluntary industry codes of practice and industry guidelines, in some cases, do pick up such requirements, but national consistency of coverage would be improved through the introduction of a single national scheme.

Therefore, there is a strong case to extend the basic food safety provisions of the Code throughout the primary production and processing supply chain to ensure there are basic food safety practices underpinning the production of all food, rather than at just one end of the supply chain. Some of the medium risk products may benefit from more specific risk management strategies; however, these may vary according to geographic/climatic and other factors, as well as existing jurisdictional and industry infrastructures. For this reason, the proposed Standard does not prescribe a documented seafood safety management system for the lower risk products as for oysters and other bivalve molluscs. Nevertheless, the Standard requires a seafood business to systematically examine all its primary production operations to identify potential seafood safety hazards and implement controls that are commensurate with the food safety risks. The extent of hazard identification, implementation of control measures and verification required should also be commensurate with the level of food safety risk involved. This is most appropriately determined by jurisdictions in consultation with industry, taking account of local environmental factors. Where possible, jurisdictions should use national forums such as the Implementation Subcommittee (ISC) of the Food Regulation Standing Committee to develop nationally consistent approaches to verification. One example of a specific risk management strategy that is required is in relation to escolar (or rudderfish), where specific advice may be required at the retail and consumer level to advise people of the risk of consuming wax esters that are found in this fish.

## **5. Objective**

The objective of the measures proposed in this draft assessment is to effectively address the public health and safety risks associated with seafood through the development of a single, nationally consistent, set of risk management measures that address food safety issues across the food chain, are preventive, outcomes-based and cost-effective.

---

<sup>17</sup> Recommended International Code of Practice: General Principles of Food Hygiene, CAC/RCP 1-1969, Rev. 3-1997, Amd. (1999)

<sup>18</sup> WHO Food Safety Strategy, 2001.

## **6. Regulatory options**

### **6.1 Scope of the Standard and Definition of Seafood**

Any mandatory regulatory approach for managing public health risks associated with seafood will be defined by the scope of the Standard and the definition of seafood. After consideration of issues raised by responses to the Initial Assessment Report and advice from the SDC and the Ministerial Council, it was determined that:

- The scope of the Standard should cover all aspects of primary production and processing, from harvest/capture (whether wild-catch or aquaculture) up to the point at which Chapters 1, 2 and 3 of the Code currently apply.
- The Standard should not cover indigenous/traditional fishers or recreational fishers, as the Standard applies only if the seafood is intended for sale.
- The Standard should be outcome-based, developed by utilising a risk-based approach, with the level of regulatory intervention to be commensurate with the level of public health risk.
- The Standard should apply to both imported and domestically produced seafood, and should avoid duplication of existing food safety Standards, such as Standards 3.2.2 and 3.2.3.

Options 2 and 3 are considered to be feasible and address the objectives of this proposal. Option 1 is included in the Impact Analysis for comparative purposes.

*Option 1:* The status quo - continuing the current regulatory arrangements.

*Option 2:* A Primary Production and Processing Standard targeting high-risk seafood activities only.

*Option 3:* A risk-based Primary Production and Processing Standard to improve the overall safety of the seafood supply chain.

### **6.2 Option 1 – The status quo**

The status quo option involves continuation of current State and Territory regulatory arrangements, including the obligation to produce safe food under the Food Acts, and application of the current provisions of the Code as administered and enforced by the States and Territories. This includes provisions applicable to seafood in Chapters 1, 2, and 3 of the Code. States and Territories and AQIS would continue to test for compliance against the Code and undertake other enforcement measures.

State-based standards for the primary production of seafood have been implemented in NSW and Victoria's scheme will commence for wild catch and aquaculture in 2004. It is likely that other States will develop their own standards if there is no nationally consistent standard. These schemes would continue to be enforced by States and Territories. The regulation of bivalve molluscs through aquaculture licensing arrangements would continue on a State-by-State basis.

The status quo would include the voluntary uptake of the Seafood Services Australia industry standard for seafood safety and the ongoing utilisation/implementation of various industry guidelines and codes of practice addressing seafood safety and quality (industry self-regulation).

### **6.3 Option 2 – A Primary Production and Processing Standard targeting high-risk seafood activities only**

A Primary Production and Processing Standard addressing only high-risk seafood activities will require identified high-risk seafood sectors (bivalve molluscs) to implement written food safety management systems such as Standard 3.2.1. It will not contain general provisions for the primary production and processing sector.

In the case of seafood businesses producing bivalve molluscs, it will be mandatory to comply with pre-harvest provisions identified in the Australian Shellfish Quality Assurance Program to ensure that bivalve molluscs are harvested under conditions that assure their safety. In addition, these businesses will be required to implement food safety programs for the post-harvest sector up to the back door of the retail sector.

### **6.4 Option 3 – A risk-based Primary Production and Processing Standard to improve the overall safety in the seafood supply chain**

A new Primary Production and Processing Standard to address food safety risks in two ways:

- basic hygiene requirements for all primary production of seafood; and
- a requirement for specific provisions for higher risk primary production of seafood.

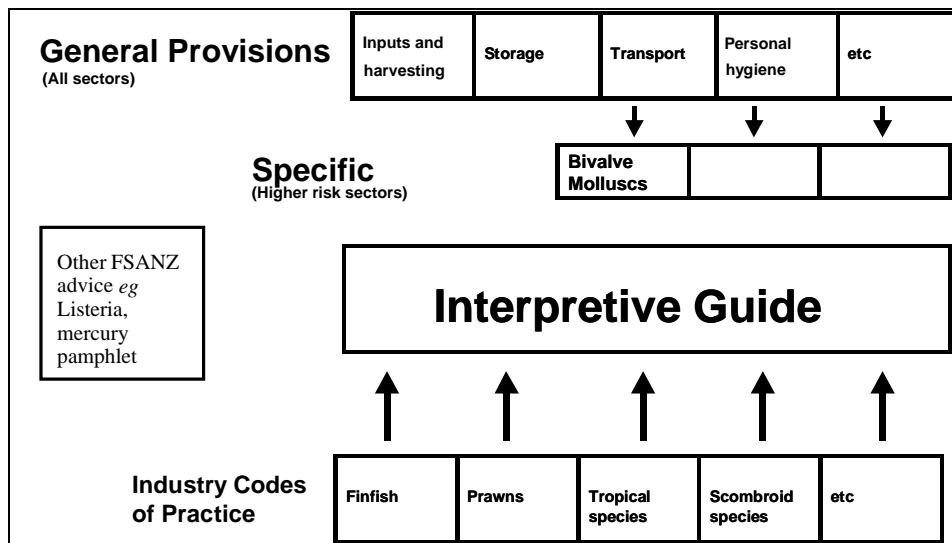
This Standard would provide a single, nationally consistent and risk based approach to facilitate the safe production of seafood. Having a consistent approach to the management of food safety during seafood primary production will positively impact on safety across the seafood supply chain.

The Standard (Documented as Chapter 4 in the Code) would be divided into two main components as follows:

- **General provisions** which set out basic food safety requirements for the hygienic primary production and processing of seafood, and
- **Specific provisions** for higher risk primary production seafood sectors, requiring the implementation of food safety management systems.

Figure 1 outlines the relationship between general provisions, specific provisions for higher risk sectors, and guideline documents that will assist regulators to interpret the Standard and industry to comply with the Standard.

**Figure 1: Regulatory framework for food safety management in seafood**



The general provisions are designed to minimise food safety hazards, and cover seafood primary production and processing activities that are not currently regulated under the Code. Such provisions are similar to the provisions in Chapter 3 of the Code (Standards 3.2.2 and 3.2.3), but tailored to the needs and situation of the seafood primary production sector. These provisions would include requirements to ensure that food was not contaminated during its production or handling, that adequate temperature control of the food is maintained, and that staff have the necessary skills and knowledge about food safety for the work they undertake. This option is intended to include simple on-vessel processing such as the gutting and filleting of finfish.

The specific provisions address identified higher risk seafood sectors, and require those seafood businesses to implement written food safety management systems such as Standard 3.2.1. In the case of seafood businesses producing bivalve molluscs, it will be mandatory to comply with pre-harvest provisions identified in the Australian Shellfish Quality Assurance Program. This will ensure that bivalve molluscs are only harvested under conditions that assure their safety. Additionally, these businesses will be required to implement food safety programs for the post-harvest sector up to the back door of the retail sector. This is consistent with the Ministerial decision of December 2003 on food safety management in Australia to only have requirements for food safety programs for sectors that have been identified as higher risk and where it has been demonstrated that the benefits will outweigh the costs. In this regard, Ministers agreed to specifically recommend the introduction of food safety programs for oysters and other bivalves following a benefit-cost analysis undertaken as part of the National Risk Validation Project.

Regulators will be assisted with enforcement by the development of an interpretive guide prepared by FSANZ, and industry will be assisted by tools such as guidelines and templates to comply with the Standard. States will replace any existing Standards with the new Primary Production and Processing Standard for Seafood (in the Code) and thus achieve a single, national, approach to food safety along the seafood supply chain.

## 6.5 Summary of options

The three options proposed above may be summarised as follows:

NATURE OF FOOD SAFETY CONTROL	OPTION 1 Status quo	OPTION 2 Mgt of higher risk only	OPTION 3 Basic Safety Provisions + Mgt of higher risk
<b>Current arrangements:</b> -General obligation under Food Acts to produce safe food -Food Std Code provisions (except for primary production) -State and Territory schemes (NSW, VIC) -Voluntary industry codes of practice	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓
<b>General Provisions:</b> Food safety practices applied to primary production end of seafood sector (similar to current hygiene requirements for the manufacturing, retail and food service sectors but tailored to seafood industry)			✓
<b>Specific Provisions:</b> Standard 3.2.1 (Food Safety Programs) or equivalent applied to higher risk activities of the seafood industry		✓	✓

The proposed options are considered further in the next section of the report where an impact (benefits versus cost) analysis of the various options is undertaken.

## 7. Impact analysis for seafood

FSANZ must consider the impact of various regulatory (and non-regulatory) options on all sectors of the community when it considers measures to mitigate public health and safety risks, including the seafood sector, governments, and consumers. The benefits and costs associated with any proposed amendment to the Code must be analysed using regulatory impact principles with the view to choosing the alternative with the maximum positive impact, whilst minimising the regulatory burden on industry.

### 7.1 Affected Parties

The main stakeholders in the introduction of a new Standard are:

- Consumers – Australian consumers of seafood and the community.
- Seafood industry – businesses involved in the primary production, processing, distribution and wholesaling of seafood products and those involved in the importation of seafood for the Australian market.
- Government – Government agencies (National, State and Territory, and Local) responsible for the enforcement of food safety regulations and for providing health care.

## 7.2 Option 1: the status quo

### 7.2.1 Benefits of Option 1

#### 7.2.1.1 Consumers and the community

Australian households spend about 2.5 per cent of their food budgets on seafood products, which is about the same level as for poultry<sup>19</sup>. A study of consumer attitudes in Sydney and Perth found that the perceptions that fish is healthier than meat and that it adds variety to the diet were major factors influencing consumption. However uncertainty about safety and contamination, a lack of knowledge about seafood and high prices were major barriers to increased consumption<sup>20</sup>. Public health professionals also advocate seafood in the diet as a means to address obesity and as a good source of omega-3 fatty acids<sup>21</sup>.

The consumption of seafood is valued by consumers and can confer considerable nutritional benefits. For example, fish is an excellent source of protein, is low in saturated fat, is a good source of some vitamins and is an excellent source of iodine.

#### 7.2.1.2 Seafood industry

Apart from the current obligation in Food Acts to produce safe food, the regulatory regime of most State and Territory governments, with some exceptions, places few specific food safety requirements on seafood businesses in the primary production sector. Only NSW and Victoria, the smaller seafood production States, have put in place mandatory safety and hygiene regulations over the entire seafood supply chain.

In the other jurisdictions, hygiene and safety outcomes are mainly influenced by industry guidelines and codes of practice and by the regulation of export establishments (where these establishments also supply the domestic market) based on HACCP programs<sup>22</sup>.

Industry bodies report that a significant majority of Australian seafood businesses do follow industry guidelines and codes of practice and incorporate good hygiene practices into their normal business operations<sup>23</sup>. The consequence of applying self-regulation is of commercial benefit to these businesses because good food safety practices enhance their capacity to meet market needs and achieve higher returns from their products<sup>24</sup>.

Seafood businesses that meet food safety needs through a formal food safety program report additional benefits including: reduced wastage, lower maintenance costs, production savings, enhanced understanding of their own business and improved management practices<sup>25</sup>.

---

<sup>19</sup> Australian Bureau of Statistics, 6535.0 *Household Expenditure Survey, Australia*.

<sup>20</sup> FRDC/Ruello and Associates (September 2002) *Retail Trade and Consumption of Seafood*, pp 14

<sup>21</sup> Mori, T. (2001). *A health promotion program incorporating fish for withdrawal of antihypertensive drugs in overweight hypertensives*, FRDC Project No. 2002/242, presented at Seafood Directions 2003. Also in FRDC (2001) *What's so healthy about seafood?*

<sup>22</sup> For more information, visit Australian Quarantine and Inspection Service website - [www.aqis.gov.au](http://www.aqis.gov.au)

<sup>23</sup> Information provided by industry members of the Seafood Standard Development Committee (SDC), Seafood Services Australia and the Sydney Fish Market.

<sup>24</sup> Information provided by industry, particularly the Sydney Fish Market.

<sup>25</sup> NRVP feedback from focus groups, page 108.

### 7.2.1.3 Government

The current regulatory regime places few specific safety requirements for the hygienic production and processing of the seafood in most jurisdictions. Hence there is little pressure on Government enforcement resources.

## 7.2.2 *Costs of Option 1*

### 7.2.2.1 Consumers and the community

Current regulatory arrangements mean that some businesses are not required to undertake specific action to effectively manage food safety. The current Food Acts have a general obligation for primary producers to produce safe food – but does not give industry any guidance on these obligations. Where there is unmanaged risk, this gives rise to food-borne illness and imposes costs on consumers. Costs include personal distress, medical treatment, and time off work (patients and carers), with possible implications for forgone household income.

Australians consume over 1.1 billion seafood meals annually<sup>2627</sup>. Demand for seafood continues to grow, reflecting its role in a balanced, nutritious diet. As with all food commodities, seafood is responsible for some of the burden of food-borne illness in the community. FSANZ has estimated the annual burden of food-borne illness that might be attributed to seafood in Australia, drawing on two studies published by the Food and Agriculture Organization (FAO)<sup>2829</sup> which reported that:

- (i) seafood accounted for between 4.4 and 16.1 per cent of food-borne illness outbreaks in Western countries, in cases where the food vehicle for the outbreaks was known; and
- (ii) seafood was involved in 10-25 per cent of food-borne disease outbreaks in developed countries.

Based on this information, FSANZ estimates that 10 per cent of all food-borne illness in Australia might be attributable to seafood (approximately 500,000 cases annually). Clearly, only a very small percentage of seafood meals cause food-borne illness.

---

<sup>26</sup> Based on the volume of seafood available for consumption in Australia, calculated from annual production, import and export figures given in: ABARE (2004) *Australian Fisheries Statistics 2003*, Australian Bureau of Agricultural and Resource Economics, Canberra.

<sup>27</sup> Based on consumption surveys in Sydney and Perth, summarised in: Ruello and Associates (2002) *Retail sale and consumption of seafood – revised edition*, Fisheries Research and Development Corporation, Canberra

<sup>28</sup> Martinez, I., James, D. and Loreal, H. (forthcoming) *Application of modern analytical techniques to ensure seafood safety and authenticity*, technical paper prepared by the Food and Agricultural Organisation of the United Nations.

<sup>29</sup> Cato, J.C. (1998) *Seafood Safety – Economics of Hazard Analysis and Critical Control Point programs*, FAO Fisheries Technical Paper – 381, Food and Agricultural Organisation of the United Nations.



The direct cost of food-borne illness to the Australian community was estimated by the Allen Consulting Group to be \$350 per case<sup>30</sup>. Hence, taking account of the 5.4 million cases of food-borne illness annually, discounting an estimated 20 per cent of cases for in-the-home contamination, provides an estimate of \$150 million per year as the cost of food-borne illness to the Australian community associated with the consumption of seafood.

Raw-ready-to-eat seafood (oysters and other bivalve molluscs) was ranked in the top five high-risk food industry sectors in Australia by the National Risk Validation Project<sup>31</sup>, on the basis of this sector's history of food-borne illness. The NRVP estimated the average cost of illness from eating raw-ready-to-eat seafood at \$4.87 per meal, far higher (by a factor of 10) than the cost of any other high-risk food sector considered in the report<sup>32</sup>.

Improvements in the risk management of bivalve molluscs since the NRVP collected this data imply that, currently, the costs to consumers should be lower than this estimate<sup>33</sup>.

Consumers typically respond to outbreaks of food-borne illness in seafood by reducing their demand for seafood products. For example, following contamination of NSW oysters in 1997, NSW consumers immediately reduced their demand for oysters by 85 per cent. They also immediately reduced their demand for all seafood products by 30 per cent, indicating that consumers readily generalise a specific seafood risk to the broad category of seafood products<sup>34</sup>.

However, despite consumers' immediate reactions to outbreaks of food-borne illness, demand for seafood recovers over time. Notwithstanding 24 outbreaks associated with raw-ready-to-eat seafood<sup>35</sup> during the 1990s, consumer demand for seafood has increased steadily over the medium term<sup>36</sup>. The implication is that while consumers immediately perceive costs when outbreaks of food-borne illness occur, these short-term costs are not sufficient to outweigh the perceived benefits of seafood to consumers over the medium-term.

#### 7.2.2.2 Seafood industry

Each outbreak of food-borne illness imposes an immediate cost on industry, by reducing sales revenues for the implicated product and with follow-on effects to the seafood industry more generally<sup>37</sup>. A succession of outbreaks will repeatedly reduce industry sales revenues in the short term. In addition, small remote communities that derive a very substantial part of their income from fishing would be particularly vulnerable to outbreaks of food-borne illness. An adverse incident would have very serious implications for the economic base for these communities<sup>38</sup>.

Apart from the bivalve mollusc sector, under current regulations, only seafood businesses in the primary production sector in NSW and Victoria incur compliance costs for food safety. These costs are very small.

---

<sup>30</sup> Allen Consulting Group (May 2002) *Food Safety Management Systems: costs, benefits and alternatives*.

<sup>31</sup> Food Science Australia & Minter Ellison Consulting (2002), *National Risk Validation Project*, Final Report (NRVP).

<sup>32</sup> NRVP page 87 and Appendix F.

<sup>33</sup> See discussion of public health risk in earlier section of this report, the Regulatory Problem.

<sup>34</sup> NRVP page 87.

<sup>35</sup> NRVP page 39.

<sup>36</sup> FRDC/Ruello and Associates, *op. cit.*

<sup>37</sup> As the NRVP case study of contaminated bivalve molluscs in NSW showed.

<sup>38</sup> NRVP page 83.

Under current arrangements, the bivalve mollusc sector must pay the majority of the cost incurred by their SSCA who implement and examine requirements set out by the ASQAP in their jurisdiction.

#### 7.7.7.3 Government

The current regulatory regime places few specified safety requirements on the primary production end of seafood supply chain in most jurisdictions. Hence there is little pressure on the resources of enforcement agencies. Only NSW and Victoria currently apply hygiene and safety regulation on the seafood industry from the production end of the chain; and only one seafood sector is regulated (through licensing arrangements and not under health legislation) by all jurisdictions: the sector producing oysters and other bivalve molluscs.

The public health system e.g. hospitals, provision of pharmaceuticals, etc contributes to the care of people with food-borne illness and hence any food-borne illness associated with seafood imposes cost on government.

### **7.3 Option 2 – A Primary Production and Processing Standard targeting high-risk seafood activities only**

#### *7.3.1 Benefits of Option 2*

##### 7.3.1.1 Consumers and the community

Consumers and the community will benefit from the greater assurance of the safety of the high risk seafood products: oysters and other bivalve molluscs. Outbreaks of food-borne illness have arisen from these high risk products in the past and imposed costs on consumers in the form of personal distress, incidents of death, costs of medical treatment, and time off work (patients and carers) which also implies some forgone household income. Under Option 2 the risk of future outbreaks will be minimised and hence the costs to consumers will be substantially reduced.

The benefits to the community of introducing food safety programs into the high risk bivalve mollusc industry were calculated by the National Risk Validation Project at \$26.4 million per year<sup>39</sup>. These benefits mainly accrue from a nationally consistent approach to managing bivalve safety, through a system that doesn't permit opt-out by any State or Territory, and which enables food safety portfolios in all jurisdictions to audit the system.

##### 7.3.1.2 Seafood industry

Improvement to the management of the safety for high risk seafood products will benefit industry because the recurring reductions in consumer demand and product sales that have resulted from incidences of food-borne illness, such as those that occurred as a result of the Wallis Lake outbreak, would be minimised under this option.

The consequence will be fewer incidents of food-borne illness and fewer highly visible outbreaks that have been a feature of the past and may still occur under the status quo.

---

<sup>39</sup> NRVP page 7.

The National Risk Validation Project showed that reductions in demand occur not only for the high risk product that caused the food-borne illness, but flow through to all seafood products. Ensuring that the safety of high risk products is appropriately managed on the basis of risk from boat to plate will improve safety overall and protect the sales revenues of the seafood industry. This is likely to have a positive impact on both the local and international markets.

Nationally consistent, mandatory requirements that ensure compliance with ASQAP and with food safety programs will contribute to a consistent record of safety for bivalves, thereby reducing the chance of something going wrong in one State and putting the entire sector at risk.

#### 7.3.1.3 Government

The government sector may benefit from the material improvement in the safety of seafood products and fewer incidents of food-borne illness through lower utilisation of public health services. While this is a true benefit to government it may not translate into lower public expenditure. For example, public hospitals have an obligation to provide health care for the whole community and for a broad range of ailments and medical emergencies, and will respond to lower utilisation of their services from food-borne illness by providing quicker services to patients with other ailments. In practical terms the benefits to government could be negligible<sup>40</sup>.

### *7.3.2 Costs of Option 2*

#### 7.3.2.1 Consumers and the community

This option will not impose costs on consumers or the community, over and above the costs incurred under the status quo.

#### 7.3.2.2 Seafood industry

The impact of Option 2 limited to the high risk industry sector producing oysters and other bivalve molluscs. Businesses in this industry sector already comply with State based versions of ASQAP and, in some States, are required to have post harvest food safety programs. These requirements are administered by the States and Territories as a condition of obtaining an aquaculture licence. The additional costs on oyster growers and other primary producers in this sector as a result of this option will impact on those not already required to have food safety programs post harvest.

The effectiveness of ASQAP requirements in addressing the health and safety risks in the pre-harvest shellfish sector (including biotoxin testing) is recognised by all jurisdictions, although only recently by NSW. The cost of mandating compliance in the Code with specific pre-harvest requirements (stated in ASQAP) and food safety programs for the post-harvest activities is expected to be small, as compliance is mostly in place.

---

<sup>40</sup> See discussion in the NRVP final report on page 79. The report states that any resources freed up in the health field because of lower incidence of food-borne illness will be used elsewhere (in the health field).

There will also be some additional compliance costs incurred further along the supply chain, for example by distributors and wholesalers, in meeting the requirements of a food safety program for these products.

### 7.3.2.3 Government

This option will not significantly expand the responsibilities of government enforcement agencies for the shellfish sector, as these arrangements already exist (e.g. ASQAP), and hence the impact on their resource requirements should be small.

## **7.4 Option 3 – A risk-based Primary Production and Processing Standard to improve the overall safety in the seafood supply chain**

### *7.4.1 Benefits of Option 3*

#### 7.4.1.1 Consumers and the community

Consumers benefit from the greater assurance of safety of the high risk seafood products of oysters and bivalve molluscs, as with the previous option.

In addition, Option 3 addresses safety risks comprehensively across the seafood industry so that consumers also benefit from greater assurance of the safety of all the lower risk products. This option will achieve a through-chain consideration of food safety, and eliminate gaps and inconsistencies in State and Territory approaches to the current management of seafood safety. It will improve on the status quo where there are inconsistencies in safety practices, particularly at the primary production and processing end of the seafood industry, and at the interfaces between the primary production and the processing sectors.

While the seafood industry has benefited from industry codes of practice and guidelines, these codes and guidelines are voluntary and a proportion of seafood businesses are not compliant with them<sup>41</sup>. The proposed Standard would make a clear statement, obliging all seafood businesses involved in primary production and processing to achieve an appropriate level of hygiene and safety. Basic food safety requirements across these sectors of the industry will improve the safety of seafood products for consumers by reducing food-borne illness.

The international literature shows that the burden of food-borne illness attributable to seafood is sourced from a broad range of products, the high risk and the lower risk products.<sup>42</sup> The consequence of implementing a comprehensive set of management strategies under this option, including for the majority of seafood products that are lower risk, will be to significantly reduce the likelihood and severity of food-borne illness in the Australian population. The costs to consumers of food-borne illness – personal distress, medical treatment, and time off work (both patients and carers) which implies some foregone household income – will be reduced under this option and the greater assurance of the safety of all seafood products will benefit consumers.

---

<sup>41</sup> Information provided by industry members of the Seafood SDC.

<sup>42</sup> Martinez, James and Loreal, *op cit*, and Cato, *op. cit*.

Imported seafood products will be required to demonstrate an equivalent level of safety to domestically produced products. This measure will ensure that consumers can feel secure in the knowledge that all seafood, regardless of where it is sourced, meets the same level of food safety.

If the current cost of food-borne illness associated with seafood is estimated to be \$150 million p.a. and the greater safety of the full range of seafood products under this option can reduce food-borne illness by between 20 and 50 per cent, then the benefit to the community would be in the range of \$30 million to \$75 million per year.

#### 7.4.1.2 Seafood industry

Industry will benefit from the reduction of the periodic disruptions to sales that occurred in the past in association with highly visible outbreaks of food-borne illness, because under this option (as with the previous option) these outbreaks will be further minimised.

This option also supports the widespread adoption of good hygiene practices, by all seafood businesses in all sectors of the industry. The minority of seafood businesses that currently do not follow industry codes of practice, and whose hygiene can be improved, will be required to comply with the new Standard. Hence the level of food-borne illness associated with poor hygiene practices in the industry can be reduced. For consumers, this means fewer experiences of food-borne illness and a higher regard for the safety of seafood. Industry will benefit from the greater consumer satisfaction with the safety of seafood, which translates into a lift in demand for its products and higher sales.

#### 7.4.1.3 Government

The government sector may benefit from the material improvement in the safety of seafood products under this option, compared with the status quo, because the lower incidence of food-borne illness should result in lower utilisation of public health services. While this is a true benefit to government, it may not translate into lower public expenditure. For example, public hospitals have an obligation to provide health care for the whole community and for a broad range of ailments and medical emergencies, and will respond to lower utilisation of their services from food-borne illness by providing quicker/enhanced services to patients with other ailments. In practical terms the benefits to government could be small<sup>43</sup>. However, government will benefit in terms of greater consumer confidence in the ability to ensure a safe food supply.

Mandating specific requirements for bivalve molluscs in the Code will provide government with a more appropriate legislative basis for regulation i.e. the approach is centred on food safety rather than existing aquaculture legislation that focuses on licensing rather than food safety. It will ensure a single, national approach to the safe production these higher risk products.

---

<sup>43</sup> See discussion in the NRVP final report on page 79. The report states that any resources freed up in the health field because of lower incidence of food-borne illness will be used elsewhere (in the health field).

## 7.4.2 *Costs of Option 3*

### 7.4.2.1 Consumers and the community

This option will not impose costs on consumers or the community, over and above the costs incurred under the status quo.

It is considered that the additional compliance costs incurred by seafood businesses under this option are unlikely to be passed on to consumers. However, if it did occur, any increase would be minimal, as the wholesale price of seafood is frequently set by auction. Furthermore, industry bodies have advised that the majority of seafood businesses already undertake basic safety practices.

Therefore, for these businesses, the proposed provisions would not adversely affect their operating costs and there would be no costs passed on to the consumers.

### 7.4.2.2 Seafood industry

The impact on producers of oysters and other bivalve molluscs under this option will be the same as under the previous option, essentially imposing some additional compliance costs where post harvest food safety programs are not yet in place.

In addition, the general provisions of this option mandate basic food safety obligations on all seafood businesses. The mandatory nature of the basic food safety obligations will be new for businesses in the primary production sector. Fulfilling the basic food safety provisions required by the general provisions under this option is anticipated to have little impact on those seafood businesses which either supply the domestic market to the standards required under export controls, or fully comply with the voluntary industry standards and codes of practice. Advice from industry bodies such as Seafood Services Australia and the Sydney Fish Market indicates that the majority of seafood businesses already undertake basic safety practices as set out in industry codes of practice and guidelines to at least the level required under this option. For these businesses, the proposed general provisions will not affect their operating costs.

FSANZ undertook a number of interviews with fisheries, enforcement agencies, inspection auditors and commercial fishers from around Australia's coastline, to obtain detailed information about the effect of mandating good hygiene practices on industry operating costs. The interviews revealed a consistent picture of hygiene practices across the seafood industry (although the examples differed). The principal themes are documented below.

- Good hygiene practice is basic and easily achievable by the seafood industry. Examples include: appropriate temperature control of the catch, typically an ice slurry or refrigerated holding tank; ensuring water for holding tanks is sourced from clean sea water, and changed as required; keeping bait and chemicals separate from the catch; ensuring there is no contamination of the catch; keeping haulage areas clear of weeds; regular cleaning of desks and protective clothing; appropriate vessel maintenance to address cracks and crevices in surface areas or holding tanks, and to ensure there are no oil leaks over the deck; use of gilling and gutting boards (rather than the boat's gunnels); regular cleaning of prawn cookers; and advice such as 'don't take your dog fishing'.

- The practice of good hygiene does not require additional equipment. Good temperature control is widespread across the industry and hence the equipment such as iceboxes and refrigerated holding tanks are already widely used (where required). Good hygiene practice will require some fishers to purchase tools such as gilling and cutting boards. Where this is the case, it is estimated that these boards would cost between \$100-\$200 and have a life expectancy of five years.
- Good hygiene practice is essentially a matter of the practical adaptation of hygiene and sanitation principles to fishers' work practices.
- Most fishers already incorporate hygiene into their work practices. They achieve hygiene outcomes through traditional methods and by following existing industry guidelines and codes of practice. While there are a large number of these guides and codes available, the industry Code of Practice developed in NSW for commercial fishers, could be considered indicative. This code is generally outcomes based and the little prescription that may bring a relatively small cost is the requirement to use a chemical sanitiser.
- The principal reason that some fishers do not comply with good hygiene practice is lack of awareness. When given clear guidance on the requirements of hygiene standards, advice from auditors in the NSW Food Authority or the Southern Rocklobster Fishery is that the fishers easily and enthusiastically embrace industry best practice. Some fishers follow traditional methods, which achieve hygiene outcomes in most circumstances, but training (a one-day workshop<sup>44</sup>) that explains why hygiene outcomes are achieved provides the fishers with the knowledge to achieve good hygiene in unusual circumstances too.
- A mandated hygiene standard, even where outcomes-based and allowing for variation in approaches between fishers and fisheries, will be superior to a voluntary industry code of practice in achieving good hygiene outcomes.
- Implementation of good hygiene practices is typically a matter of refining current work practices. This can be achieved easily. In NSW the Food Authority ran workshops in each of the fisheries, which cost the fishers \$50 and one day's participation at a workshop. The cost of foregone earnings to attend the workshops were minimised by scheduling a range of days when training was available and at times when boats were in port. The fishers left with the ability to develop a simple food safety plan for their operation (which is more than is required under the proposed general provisions of Option 3). Likewise the Southern Rocklobster Fishery provided training and support for its members in a comprehensive integrated program covering all aspects of fishing, at a cost of \$275 per operator, and by the end of 2004 the fleet will be performing at a level that will satisfy third party auditors.
- 
- The industry acknowledged that good hygiene practice is essential for high quality seafood. However the industry gave a qualified response as to whether quality would attract a price premium – *i.e.* whether the commercial incentives in the market supported hygiene practices and quality seafood.

---

<sup>44</sup> By the NSW Food Authority.

For example, one fishery acknowledged that market recognition of quality would take time, but in due course a price premium would be possible with effective branding. Other sectors mentioned that poor quality product would be penalised with a price discount, or not accepted at all by the wholesale markets. Another fishery achieved premium prices for its quality product at times of strong demand, but not all the time. However its reputation for quality product meant that it was able to sell its products all year round, hence it could depend on income throughout the year and on this basis plan to undertake investments to maintain the quality of its products. Continuing market access was a significant benefit from its focus on quality.

This information indicates that the seafood industry can readily achieve good hygiene outcomes through refinements to their work practices, with minimal impact on their costs of operation. Higher quality of product that is associated with good hygiene is recognised in the market, although what this means for price and sales revenue will depend on the type of product and market conditions. Overall, attention to good hygiene, with the outcome of higher quality product, appears to be commercially viable for the seafood industry. There may be costs to industry as a result of States' recovery costs to implement the proposed Standard. These costs may be comparable to those experienced by NSW in the implementation of their State-based hygiene and safety regulations.

In NSW there is a \$50 cost for a licence and annual fees have recently been introduced to cover enforcement costs. Annual fees for commercial fishers are \$310 and for finfish and crustacea aquaculture fees vary from \$250 (for businesses with less than 10 employees) up to \$2,000 for businesses with more than 50 employees.

Victoria has enacted legislation for a through-chain regulation of all seafood businesses. The legislation came into force on 1 July 2004 for wildcatch and aquaculture businesses and requires businesses to obtain a licence and demonstrate they are meeting the basic requirements of the Victorian Food Act. They are required to prepare a food safety plan by the end of the first year. The regulator, Primesafe, requires annual fees to be paid by businesses, dependent on the level of annual throughput. Hence the fees are less costly for the smaller operators (e.g. \$200 for lower annual catch) and more expensive for larger operators (up to \$800 for high annual throughput). Audit costs will be additional to these costs, however there is no advice on the likely audit costs.

The examples above of the flow on costs to industry of States' recovery costs to implement food safety schemes are indicative. It should be recognised that the costs to implement food safety schemes may vary across jurisdictions.

#### 7.4.2.3 Government

The new Standard will expand the responsibilities of government enforcement agencies at the primary production end of the seafood chain. The agencies have indicated that they are not expecting an increase in resources to address their new responsibilities and will respond to the situation by prioritising their efforts where enforcement will be most effective<sup>45</sup>.

---

<sup>45</sup> Information provided by government members of the Seafood SDC.



A possible management option would differentiate between the lower risk businesses, that could be licensed but not systematically inspected, and the higher risk businesses that would be subject to rigorous enforcement<sup>46</sup>.

Enforcement agencies will be assisted by the development of a guide developed by FSANZ, to aid in the interpretation of the Standard.

Some jurisdictions are likely to be faced with a major effort in implementing the new Standard. The experience of SafeFood Production NSW, bearing in mind that it is one of the smaller seafood producing jurisdictions, is that implementation can be accomplished within existing resources, where assistance to specific sectors of industry is staged over a period of years.

The staged implementation of the regulations in NSW - focusing initially on the wild catch sector and progressing to the smoked fish and aquaculture sectors - means that SafeFood Production NSW could apply the regulations within existing resources. The cost of running the training workshops for fishers was covered by industry (\$50 per fisher) together with a subsidy from the Australian Department of Agriculture, Fisheries and Forestry. Extending hygiene and safety regulations to the seafood industry in NSW did not, in practice, impose new costs on the NSW Government but will vary across States. It did incur costs on the Commonwealth government, and would result in additional costs if the program were rolled-out to other jurisdictions.

## **8. Consultation on the Draft Assessment Report**

### **8.1 Consultation on the Draft Assessment Report.**

FSANZ conducted face to face consultations in each State and the Northern Territory on the Draft Assessment Report to explain the draft assessment report and its implications to stakeholders and to receive feedback on the proposed Standard.

Twenty nine public submissions were received in response to the Draft Assessment Report.

The issues raised in the public submissions and at the face-to-face consultations at the Draft Assessment stage are detailed at Attachments 5 (Summary of each Submission) and Attachment 6 (Summary of Submissions by Issue Raised).

The SDC met on October 2004 to consider the issues raised during the public consultation process and responses to these issues, including modifications to the drafting of the Standard. FSANZ also undertook further targeted discussions with State and Territory governments and industry on a number of issues following the October SDC meeting.

Given the concerns of industry members on the SDC in relation to consistent implementation of the Standard, FSANZ raised these matters at the ISC meeting held in October 2004. ISC agreed to a process to engage with members of the group to address these issues as well as discuss issues related to guidelines to support the Standard.

---

<sup>46</sup> Suggestion made by a government member of the Seafood SDC.

A further meeting of the SDC was held in January 2005 attended by the Chair of ISC, to resolve the remaining issues to enable finalisation of the Standard. The meeting was also to agree on a process for further consideration of implementation issues.

The main issues at Draft Assessment included:

- drafting issues, including:
  - the divide between Chapter 3 and Chapter 4
  - the scope of the Standard for seafood
  - definitions such as ‘frozen’, ‘chilled’, ‘thermal centre’, ‘thawed’ ‘live seafood’ and the exclusion in the definition for bivalve molluscs
  - the definition of ‘primary production and processing’
- consistent implementation across the jurisdictions
- audit costs and third party audit arrangements
- the exclusion of mandatory fish marketing names from the Standard
- labelling of imported product
- enforcement of the Standard at the border
- the risk ranking report

In response to the issues raised at the Draft Assessment stage, the drafting of the Standard has been reconsidered. In summary, the Standard has been amended as follows:

- to clarify the issues around the scope and application of the Standard, including the division between Chapters 3 and 4 of the Code. This has been achieved through amendments to the definition of primary production and the processing of seafood, the purpose and commentary section and additional editorial notes;
- a number of definitions within the Standard have been amended or removed to address issues identified through the consultation process;
- other amendments to clauses to simplify the legal drafting, clarify the intent of the Standard or rectify other identified issues.

A number of issues relating to implementation of the Standard have been raised by industry. A process has been established with the Implementation Sub-Committee of the Food Regulation Committee and representatives of the SDC to consider implementation issues raised and assist with consistent implementation of the Standard. This matter is discussed further in the next section of this report.

Further details on the issues raised and their consideration are outlined at Attachment 4B of this Report.

## **8.1 World Trade Organization Notification**

As members of the World Trade Organization (WTO), Australia and New Zealand are obligated to notify WTO member nations where proposed mandatory regulatory measures are inconsistent with any existing or imminent international standards and the proposed measure may have a significant effect on trade.

The proposed regulatory measures, the inclusion of a primary production and processing Standard for seafood in Chapter 4 of the Code is likely to have an effect on trade for sanitary or phytosanitary reasons. Therefore a notification to the WTO under the SPS Agreement has been made by FSANZ. No responses to this notification were received.

## **9. Conclusions**

The existing system, as described in Option 1, includes regulation across the food chain for seafood in the two smaller jurisdictions, requirements in the Code, the current general obligation in Food Acts to produce safe food and a strong lead by the seafood industry to develop a voluntary food safety standard. However, it is clear that this approach can be further improved to minimise food safety risks and that arrangements under the status quo do not fully meet the objective of this proposal, to effectively address the public health and safety risks associated with seafood. Food-borne illness imposes costs on consumers, industry and governments, and while the current arrangements only partially manage the burden of food-borne illness estimated for seafood, they still contribute a net-benefit to the economy.

Option 2 will provide more benefits than the status quo by targeting businesses in the high risk bivalve mollusc sector, and requiring these businesses to manage their food safety risks through compliance with certain pre-harvest requirements and documented food safety programs for specified post-harvest activities. Consumers will benefit, in comparison with the status quo, from a greater assurance of the safety of these products and a reduction in incidents of severe food-borne illness. Industry also benefits because outbreaks of food-borne illness, which reduce sales of the high risk products and have flow on effects of reducing sales of other seafood products, will be minimised under this option. Additional industry compliance costs from this option are expected to be small. The impact of the targeted arrangements will be minimal on the sector because it must already comply with a comprehensive program and will require little change to satisfy the requirements of a food safety management plan program. However, it is expected to have an impact on food safety by ensuring that no opt-out of the current system is possible and that food safety portfolios are empowered to audit the sectors. In comparison with the status quo, Option 2 will more effectively achieve the objective of this Proposal.

Option 3 will provide all the benefits of the previous option but will also deliver additional higher value benefits because it will provide a single, consistent, national regulatory arrangement to manage seafood safety and the impost will be commensurate with the risks posed. The estimated benefits of introducing Option 2 (before costs) is \$26.4 million per year, while benefits of introducing Option 3 are estimated between \$30 million to \$75 million per year.

For the primary production and primary processing segment of the seafood industry, it will mandate basic food safety provisions and a requirement for businesses to systematically examine their operations to identify potential seafood safety hazards and implement controls that are commensurate with the food safety risks. It will also specifically address identified higher risk activities. It will deliver a material reduction in public health and safety risks and a greater net benefit by reducing food-borne illness in Australia, because it will require those businesses currently not adequately managing basic food safety to do so.

Consumers will benefit from the lower risk of food-borne illness and industry will minimise the periodic losses of sales revenues that have occurred following food-borne illness outbreaks. For the government sector, data on the new seafood regulations in NSW indicate that the introduction of food safety regulation into the seafood industry may be accomplished with minimal additional resources. However how jurisdictions implement the Standard and the related costs incurred will vary.

Option 3 will impose new costs on businesses only where they do not currently manage food safety adequately. Note that it is expected that a significant majority of seafood businesses will meet or exceed these basic requirements and the new Standard will, therefore, not affect their operating costs.

Overall, Option 3 will most effectively meet the objective of this proposal. It is superior to the previous option in that it has the capacity to deliver greater reductions in food-borne illness, as it will address a greater range of public health and safety risks in the seafood sector in comparison to Option 2. Additional compliance costs for industry appear to be small and, in comparison to the previous two options, Option 3 will provide superior net-benefits to the economy.

On a practical issue, one possible risk to achieving the potential benefits of Option 3 (as well as Option 2) is inconsistent implementation. SDC industry representatives have voiced concerns about the need for consistent implementation of the Standard across States and Territories and the resulting costs and uncertainty for industry of inconsistent implementation. The differing costs between States and Territories for licensing and registration are also of concern. Industry has also emphasised the need for collaboration between industry and government to provide the necessary guidance to industry to support the Standard. In response to these issues, ISC has agreed that once the standard-setting process is completed a process will commence with an ISC representative, members of the SDC and ASQAAC representatives to consider implementation issues and to progress issues in relation to the guidelines.

The preferred option is Option 3 (a Primary Production and Processing Standard - targeting higher risk activities and requiring minimum food safety requirements for lower risk activities/sectors), which combines general and specific provisions for seafood production and processing based on risk. This option is preferred because:

- it is consistent with the findings and conclusions of the scientific evaluation of public health and safety risk;
- the risk management strategy is commensurate with the level of public health risk identified in the risk ranking document and is in harmony with the approach agreed to by the Ministerial Council;

- the need for basic food safety and hygiene requirement is consistent with the requirement for the manufacturing and retail sectors to meet good hygienic practice as defined in Chapter 3 of the Code – Food Safety Standards 3.2.2 and 3.2.3;
- it represents a minimum effective standard with the highest net benefit, and the risk management approaches and their verification are commensurate with the risks posed; and
- it is consistent with Codex in requiring that all food production meet basic requirements of good hygienic practice.

In conclusion, Option 3 is preferred because it achieves the objectives of:

- effectively addressing public health and safety risks, and demonstrates the highest net-benefits to the Australian community;
- improving national consistency in the management of seafood safety;
- improving food safety management across the seafood supply chain;
- providing a preventive approach to the management of food safety;
- providing outcomes-based standards to allow maximum flexibility for business; and
- being cost-effective as demonstrated in the regulatory impact assessment.

A draft of the proposed Primary Production and Processing Standard for Seafood, consistent with Option 3 is located in Attachment 1.

## **10. Recommendation**

It is recommended that Option 3 (Primary Production and Processing Standard for Seafood as described in Attachment 1) be adopted. This option will manage food safety risks in two ways:

- the requirement to adopt basic food safety provisions for lower risk seafood; and
- more stringent food safety management requirements for higher risk seafood in the primary production and processing sector. Specifically, for bivalve molluscs there will be mandatory requirements to comply with pre-harvest provisions in the Australian Shellfish Quality Assurance Program so they are only harvested under conditions that assure their safety. In addition, businesses that deal with bivalve molluscs post-harvest up to (but not including) the retail sector will be required to implement food safety programs.

A nationally agreed date for commencement of the Primary Production and Processing Standard for Seafood of one year from the date of gazettal is recommended.

However, with provisions in the Code that allow for a compliance requirement of 12 months after gazettal of a variation to the Code, this means there is effectively a two year lead in period before businesses are required to comply.

This is also consistent with the decision by Ministers at their meeting in December 2003 where it was agreed that the implementation of national food safety management options for high risk businesses would be implemented by all States and Territories, no later than 2 years after gazettal of the Standard.

## **11. Implementation, monitoring and review**

Once accepted into the Code, the proposed Primary Production and Processing Standard for Seafood would become mandatory on a national basis. It would then be adopted into the appropriate legislation of each Australian State and Territory, providing each jurisdiction with the necessary legal basis for enforcement of the Standard.

Factors influencing successful implementation of the Standard include:

- implementation timeframe;
- provision of a suitable compliance timeframe for industry;
- implementation of appropriate audit management and inspection systems; and
- appropriate tools to provide assistance and guidance to industry (of which many currently exist – see Attachment 8).

Because of the non-prescriptive nature of the new seafood Primary Production and Processing Standard, interpretive documents are essential for enforcement officials (such as Environmental Health Officers) to assist with consistent implementation and for training organisations helping seafood businesses to meet the requirements of new standards. FSANZ will develop an interpretive guide to the Primary Production and Processing Standard to aid consistent interpretation of the Standard by enforcement agencies. The guide will be developed in conjunction with an advisory group comprising of SDC representatives and others and the Implementation Sub-Committee (ISC).

A qualitative review of the implementation of the Food Safety Standards (Chapter 3)<sup>47</sup> identified that the States and Territories were at different stages of implementation as a result of:

- dissimilar timing of adoption;
- diverse approaches to communicating with food businesses;
- widely different context of implementation; and
- different choices in aspects of implementation including inconsistencies in interpretation.

The Implementation Sub-Committee (ISC) of the Food Regulation Standing Committee is examining these issues.

---

<sup>47</sup> Campbell Research and Consulting (2003). Food Safety Standards Implementation Project. Report prepared for Dept of health and Ageing, Canberra, June 2003

In addition, the issues raised by industry SDC members about the consistent implementation of the seafood Standard will be facilitated through a process between industry SDC representatives and ISC. ISC is charged with responsibility for overseeing cross-jurisdictional agreement on consistent approaches to implementing and ensuring compliance with food standards.

ISC will have a major role in the implementation aspects of the Standard to ensure consistent interpretation of issues related to the implementation and enforcement of the Standard, and to encourage cost-effective approaches to compliance and enforcement.

FSANZ will undertake baseline qualitative research on businesses in the seafood sector to determine awareness, knowledge and behaviour in relation to safe food handling, current regulations, sources of information and staff training. Follow up research will be undertaken at least two years after the Standards are implemented in all States and Territories.

States and Territories will undertake routine surveillance of food for sale on the Australian market against the requirements of the Code as well as other specific surveillance activities. AQIS and FSANZ and the States and Territories will continue to work together to examine systems that can more reliably monitor the safety of imported foods.

## **ATTACHMENTS**

1. Draft variations to the *Australia New Zealand Food Standards Code*
2. The Policy and Regulatory Framework for the Development of Food Standards
3. The Seafood Sector
- 4A. Consultation on Initial Assessment Report
- 4B. Public Consultation on Draft Assessment Report
- 5A. Summary of Submissions at Initial Assessment
- 5B. Summary of Submission at Draft Assessment
- 6A. Summary of Submissions by Issue at Initial Assessment
- 6B. Summary of Submission by Issue at Draft Assessment
7. *Australia New Zealand Food Standards Code* Requirements for Seafood
8. Available Codes of Practice for the Safe Production of Seafood
9. The Imported Food Inspection Scheme and Seafood Testing
10. A Risk Ranking of Seafood in Australia.

**Draft variations to the *Australia New Zealand Food Standards Code***

**To commence: 12 months from gazettal**

**Note on commencement:**

Subclause 1(2) of Standard 1.1.1 applies to these amendments to the Food Standards Code. The effect of this subclause is that a food is taken to comply with Standard 4.2.1 (below) for a period of 12 months after the commencement of the Standard, provided the food otherwise complied with the Food Standards Code. This means that seafood producers have 2 years from the gazettal of Standard 4.2.1 before they are required to comply with the new requirements.

[1] *Standard 3.2.1 of the Australia New Zealand Food Standards Code is varied by omitting subclause 2(2), substituting -*

(2) Unless expressly provided elsewhere in this Code, this Standard applies to all food and primary food production businesses that are determined by the appropriate enforcement agency under the Act to be within a priority classification of food business from the commencement date for that priority classification of food business.

[2] *The Australia New Zealand Food Standards Code is varied by inserting after Standard 3.3.1 -*

**STANDARD 4.2.1**

**PRIMARY PRODUCTION AND PROCESSING STANDARD FOR  
SEAFOOD  
(AUSTRALIA ONLY)**

---

**Purpose and commentary**

This Standard sets out food safety and suitability requirements for seafood generally from pre-harvesting production of the seafood up to, but not including manufacturing operations. Chapter 3 of this Code applies to seafood manufacturing and retail sale activities.

Under this Standard, a seafood business must identify potential seafood safety hazards and implement controls that are commensurate with the risk.

Additionally, this Standard requires primary producers and processors of certain bivalve molluscs to implement a food safety management system. This particular requirement also extends to manufacturing activities relating to bivalve molluscs.



For primary producers and processors of bivalve molluscs, the food safety management system incorporates conditions on the areas from which the product may be harvested or harvested for depuration or relaying, along with conditions on the water used for wet storage.

## **Table of Provisions**

### Division 1 – Preliminary

- 1 Application
- 2 Interpretation

### Division 2 – General seafood safety requirements

- 3 General seafood safety management
- 4 Contamination and handling
- 5 Inputs and harvesting areas
- 6 Seafood storage
- 7 Seafood transportation
- 8 Seafood packaging
- 9 Seafood for disposal
- 10 Seafood receipt
- 11 Seafood tracing
- 12 Skills and knowledge
- 13 Health and hygiene requirements
- 14 Seafood premises and equipment

### Division 3 – Harvesting and other requirements for bivalve molluscs

- 15 Interpretation
- 16 Food safety management systems for bivalve molluscs
- 17 Co-mingling of bivalve molluscs

## **Clauses**

### **Division 1 – Preliminary**

#### **1 Application**

- (1) This Standard applies to seafood businesses and seafood handlers in Australia but not in New Zealand.
- (2) Unless the contrary intention appears in this Standard, Chapter 3 of this Code applies to seafood manufacturing and retail sale activities.

#### **Editorial note:**

This Standard applies to primary production and processing activities as defined in clause 2. The definition of 'processing of seafood' includes activities such as the killing, gutting, filleting, brining and shucking of seafood and the depuration of shellfish. However, other than the food safety management system requirements for bivalve molluscs, this Standard does not apply to manufacturing activities.

Manufacturing of seafood is defined in clause 2 as the canning, smoking or crumbing of the seafood or the addition of other foods to the seafood and other like activities.

Under the *Imported Food Control Act 1992*, Standards in this Code apply to imported food. However, this Standard does not fall within the scope of the 'Agreement Between the Government of Australia and the Government of New Zealand Concerning a Joint Food Standards System'. Accordingly, this Standard does not apply to food businesses in New Zealand. Furthermore, the Trans-Tasman Mutual Recognition Arrangement and the Australian and New Zealand legislation giving effect to that Arrangement apply to imported food.

This Standard does not apply to persons who harvest or catch seafood for recreational, cultural or traditional purposes, provided the activity does not come within the definition of a 'seafood business' – that is, the seafood harvested or taken is not intended for sale.

Clause 3 of this Standard does not affect the operation of Standard 3.2.1.

## 2 Interpretation

(1) Unless the contrary intention appears, the definitions in Chapter 3 of this Code apply for the purposes of this Standard.

(2) In this Standard –

**control** means a measure that prevents, eliminates or reduces to an acceptable level, a food safety hazard.

**deputation** means a process using a controlled environment to reduce the level of certain pathogenic organisms that may be present in live shellfish and crustaceans.

**harvesting** means the capture or taking of seafood and includes the capture or taking of seafood from an enclosure or pond used in aquaculture.

**inputs** includes any feed, chemicals or other substances used in, or in connection with, the primary production of seafood.

**live seafood premises** means a premises used for the primary production of live seafood, and includes sea cages.

**manufacturing of seafood** means the canning, smoking or crumbing of seafood or the addition of other food to seafood and other like activities.

**primary production of seafood** means the –

- (a) growing, cultivation, picking, harvesting, collection or catching of seafood; or
- (b) growing on of seafood; or
- (c) transportation or delivery of seafood; or
- (d) holding of live seafood;

and includes processing of seafood.

**processing of seafood** includes –

- (a) the killing, dismembering, filleting or cutting into portions, gill or gutting, or skinning of seafood; and
- (b) the depuration of shellfish and crustaceans; and
- (c) the shucking or peeling of seafood; and
- (d) the cooking, including steaming or boiling, of crustaceans; and
- (e) the brining of seafood; and
- (f) the packing, treating, washing, freezing, refrigeration or storing of seafood; and
- (g) other similar activities.

**Editorial note:**

The definitions of ‘primary production of seafood’ and ‘processing of seafood’ operate for the purposes of this Standard and do not affect the definition of those terms in State and Territory Food Acts. The definitions in this Standard do not affect the legislative or administrative arrangements in the States and Territories concerning the administration and implementation of legislative schemes.

**seafood** means all aquatic vertebrates and aquatic invertebrates intended for human consumption, but excludes amphibians, mammals, reptiles, and aquatic plants.

**seafood business** means a business, enterprise or activity that involves the primary production of seafood intended for sale.

**seafood handler** means a person who engages in or supervises the primary production of seafood, for a seafood business.

**seafood premises** means any premises including land, vehicles, parts of structures, tents, stalls and other temporary structures, vessels, pontoons, and any other place declared by the relevant authority to be a premises under the Food Act, kept or used for the primary production of seafood (exclusively or otherwise), regardless of whether the premises are owned by the proprietor, including premises used principally as a private dwelling.

**temperature control** means maintaining seafood at a temperature of –

- (a) 5°C, or below if this is necessary to minimise the growth of infectious or toxigenic micro-organisms in the food so that the microbiological safety of the food will not be adversely affected for the time the food is at that temperature; or
- (b) another temperature — if the food business demonstrates that maintenance of the food at this temperature for the period of time for which it will be so maintained, will not adversely affect the microbiological safety of the food.

## **Division 2 – Seafood safety requirements**

### **3 General seafood safety management**

A seafood business must systematically examine all of its primary production and processing operations to identify potential seafood safety hazards and implement controls that are commensurate with the food safety risk.

#### **Editorial note:**

The ‘controls’ referred to in this clause should include –

- a. Measures to control hazards from air, soil, water, bait and feedstuffs, fertilizers (including natural fertilizers), pesticides, veterinary drugs and any other agent used in primary production of seafood; and
- b. Controls to protect food sources from faecal and other contamination.

### **4 Contamination and handling**

- (1) A seafood business must take all necessary steps to prevent the likelihood of seafood being or becoming contaminated.
- (2) A seafood business must take all reasonable measures to ensure that seafood handlers handle seafood or surfaces likely to come into contact with seafood in a way that is not likely to compromise the safety or suitability of seafood.

### **5 Inputs and harvesting areas**

- (1) A seafood business must take all reasonable measures to ensure inputs do not adversely affect the safety or suitability of the seafood.
- (2) A seafood business must not harvest seafood in an area if it is known, or ought reasonably be known at the time, that the seafood, if harvested in the area, may not be safe or suitable when sold for human consumption.

### **6 Seafood storage**

- (1) A seafood business must, when storing seafood, other than live seafood, store the seafood under temperature control and have a means of monitoring the temperature of the seafood.
- (2) A seafood business must, when storing live seafood, store the seafood in such a way that the conditions under which it is stored will not adversely affect the safety or suitability of the seafood.

## **7 Seafood transportation**

- (1) A seafood business must, when transporting seafood, other than live seafood, transport the seafood under temperature control and have a means of monitoring the temperature of the seafood.
- (2) A seafood business must when transporting live seafood, transport the seafood under conditions that will not adversely affect the safety or suitability of the seafood.

### **Editorial note:**

For clauses 6 and 7 -

The term 'temperature control' is defined in clause 2 of this Standard.

## **8 Seafood packaging**

A seafood business must, when packaging seafood –

- (a) only use packaging material that is fit for its intended use; and
- (b) only use packaging material that is not likely to cause contamination of the seafood; and
- (c) take all reasonable measures to ensure that the seafood does not become contaminated.

## **9 Seafood for disposal**

- (1) A seafood business must ensure that seafood for disposal is held and kept separate until it is –
  - (a) destroyed or otherwise used or disposed of so that it cannot be used for human consumption; or
  - (b) returned to its supplier; or
  - (c) processed in a way that ensures its safety or suitability; or
  - (d) ascertained to be safe and suitable for sale.
- (2) A seafood business must clearly identify any seafood that is held and kept separate in accordance with subclause (1) as returned seafood, recalled seafood, or seafood that is or may not be safe and suitable.

### **Editorial note:**

'Seafood for disposal' has the same meaning as 'food for disposal' as defined in Standard 3.2.2, clause 11 – that is – the seafood is subject to a recall, or has been returned, or is not safe or suitable, or is reasonably suspected of not being safe or suitable.

## **10 Seafood receipt**

- (1) A seafood business must take all reasonable measures to ensure it only accepts seafood that is protected from the likelihood of contamination.

(2) A seafood business must, when receiving seafood, other than live seafood, take all reasonable measures to ensure it only accepts seafood that is under temperature control.

(3) A seafood business must, when receiving live seafood, take all reasonable measures to ensure that it receives seafood that has been transported in such a way that has not or will not adversely affect the safety or suitability of the seafood.

## **11 Seafood tracing**

A seafood business must maintain sufficient written records to identify the immediate supplier and immediate recipient of seafood for the purposes of ensuring the safety of the seafood.

## **12 Skills and knowledge**

A seafood business must ensure that seafood handlers have –

- (a) skills in food safety and food hygiene; and
- (b) knowledge of food safety and food hygiene matters;

commensurate with their work and the food safety risks.

## **13 Health and hygiene requirements**

(1) A seafood handler must exercise personal hygiene and health practices that are commensurate with the food safety risks and that do not adversely affect the safety or suitability of the seafood.

(2) A seafood handler who –

- (a) has a symptom that indicates the handler may be suffering from a food-borne disease; or
- (b) knows he or she is suffering from a food-borne disease; or
- (c) is a carrier of a food-borne disease;

must not engage in any handling of seafood where there is a reasonable likelihood of seafood contamination as a result of the disease.

(3) A seafood business must take all reasonable measures to ensure that seafood handlers exercise personal hygiene and health practices that are commensurate with the food safety risks and that do not adversely affect the safety or suitability of the seafood.

## **14 Seafood premises and equipment**

(1) A seafood business must ensure that seafood premises, including live seafood premises, and equipment used in the primary production of seafood are –

- (a) so far as is reasonably necessary, kept clean; and
- (b) designed, constructed, maintained and operated;

such that the safety or suitability of the seafood will not be adversely affected.

(2) For the purposes of subclause (1), a seafood business must comply with –

- (a) Division 5 of Standard 3.2.2 and Standard 3.2.3 of this Code; or
- (b) a set of requirements recognised by the Authority.

**Editorial note:**

Where the cleaning of equipment such as fishing nets and oyster racks would not affect the safety or suitability of the seafood, the cleaning of this equipment will not be necessary to meet the requirements in paragraph 14(1)(a).

### **Division 3 – Specific requirements for bivalve molluscs**

#### **15 Interpretation**

In this Division –

**approved** means approved by the Authority.

**area** means an area where bivalve molluscs are grown or harvested.

**ASQAP Manual** means the Australian Shellfish Quality Assurance Program Operations Manual - Version 3 of 2002.

**Authority** means the State, Territory or Commonwealth government agency or agencies having the legal authority to implement and enforce this Division.

**batch** means a quantity of bivalve molluscs which is harvested, depurated or handled from the same lease number and with the same harvest date.

**bivalve molluscs** include cockles, clams, mussels, oysters, pipis and scallops intended for human consumption, but excludes scallops and pearl oysters, where the only part of the product consumed is the adductor muscle, and spat.

**growing on** means the process where juvenile bivalve molluscs are translocated to a classified area for a sufficient period to enable their development prior to sale.

**relaying** means the transfer of bivalve molluscs from one area to another for the reduction of contaminants in the bivalve molluscs.

**spat** means juvenile bivalve molluscs taken for the sole purpose of growing on.

**Editorial note:**

If spat are harvested for human consumption then the product falls within the definition of 'bivalve mollusc'. In that case, the requirements in this Division for bivalve molluscs apply to the product.

**wet storage** means the temporary storage of bivalve molluscs from an area in containers or tanks containing natural or artificial seawater for purposes other than depuration.

## **16 Food safety management systems for bivalve molluscs**

(1) A seafood business that engages in the primary production or processing of, or manufacturing activities concerning, bivalve molluscs must implement a documented food safety management system that effectively controls the hazards.

### **Editorial note:**

‘Hazard’ is defined in Standard 3.1.1 as a biological, chemical or physical agent in, or condition of, food that has the potential to cause an adverse health effect in humans.

Under subclause 1(2) of this Standard, the requirement for a food safety management system in subclause 16(1) does not apply to retail sale activities concerning bivalve molluscs.

(2) A seafood business is taken to comply with subclause (1) if it implements –

- (a) a food safety program set out in Standard 3.2.1; or
- (b) a food safety management system set out in the Commonwealth Export Control (Processed Food) Orders; or
- (c) the Codex Alimentarius Hazard Analysis and Critical Control Point System (HACCP) for food safety management set out in Annex C to CAC/RCP 1-1969, revision 4 (2003); or
- (d) any other Hazard Analysis and Critical Control Point (HACCP) based food safety management system recognised by the Authority.

(3) For the purposes of subclause (1), a seafood business must comply with –

- (a) the conditions of the ASQAP Manual specified in the Schedule to this Standard; or
- (b) conditions recognised by the Authority.

### **Editorial note:**

The ASQAP Manual is the National guideline for managing risks in the harvesting, relaying, depuration and wet storage of shellfish.

Subclause 16(3) does not require producers or processors of bivalve molluscs to classify or close harvesting areas. Under the ASQAP Manual the classification of these areas is the responsibility of the State Shellfish Control Agency (SSCA).

The Australian Shellfish Quality Assurance Advisory Committee (ASQAAC) maintains the ASQAP Manual.



'HACCP' has a technical meaning commonly understood by the food production and manufacturing industry.

## 17 Co-mingling of bivalve molluscs

A seafood business must ensure that each batch of bivalve molluscs harvested must be separated in a manner that prevents co-mingling of batches.

### SCHEDULE

#### ASQAP MANUAL CONDITIONS

Column 1 Activities	Column 2 Conditions
<p><b>Activity 1</b> Harvesting</p>	<p>The area -</p> <ul style="list-style-type: none"> <li>(a) has been classified by the Authority as –               <ul style="list-style-type: none"> <li>(i) approved; or</li> <li>(ii) conditionally approved; or</li> <li>(iii) approved as remote; or</li> <li>(iv) offshore; and</li> </ul> </li> <li>(b) is subject to a Marine Bio-toxin Management Plan; and</li> <li>(c) has an open status; or</li> <li>(d) is undergoing classification and is approved by the Authority subject to conditions, if any, specified by the Authority.</li> </ul>
<p><b>Activity 2</b> Harvesting for depuration or relaying</p>	<p>The area –</p> <ul style="list-style-type: none"> <li>(a) has been classified by the Authority as –               <ul style="list-style-type: none"> <li>(i) approved; or</li> <li>(ii) conditionally approved; or</li> <li>(iii) approved as remote; or</li> <li>(iv) restricted; or</li> <li>(v) conditionally restricted; and</li> </ul> </li> <li>(b) is subject to a Marine Bio-toxin Management Plan; and</li> <li>(c) has an open status for the purposes of depuration or relaying; or</li> <li>(d) is undergoing classification and is approved by the Authority, subject to conditions, if any, specified by the Authority.</li> </ul>

<p><b>Activity 3</b> Post harvest temporary wet storage</p>	<p>The water used must be -</p> <ul style="list-style-type: none"> <li>(a) sourced from an area that satisfies the conditions for Activity 1 (other than Condition (d)); or</li> <li>(b) of a quality that will not adversely affect the safety and suitability of the bivalve molluscs;</li> </ul> <p>and</p> <ul style="list-style-type: none"> <li>(c) effectively disinfected or maintained during the course of the wet storage in such way that it continues to satisfy the conditions for Activity 1 (other than Condition (d)).</li> </ul>
---	--

## The Policy and Regulatory Framework for the Development of Food Standards

### 1. Policy and regulatory framework for food standards

A broad framework exists in Australia to guide the development of all food regulation. A review of regulatory arrangements in 1998 resulted in new arrangements for food regulation in Australia and New Zealand, agreed to by the Council of Australian Governments (COAG) in 2000<sup>48</sup>. These arrangements included the formation of the Ministerial Council that provides policy guidance to FSANZ to assist in the development of food standards.

The new structure also included the formation of a single agency, FSANZ, a bi-national authority that sets joint food standards for composition and labelling of food for Australia and New Zealand. It sets food safety standards in Australia, and from July 2002, also develops food standards for the primary production sector in Australia. FSANZ must adhere to specific legislative requirements and guidelines when developing food standards.

#### 1.1 Council of Australian Governments

In Australia, there has been a major reorientation of the general regulatory framework and the processes for making regulations as well as to the framework for developing food regulation in Australia and New Zealand, and these have been endorsed by the Council of Australian Governments (COAG, 1997 and 2000<sup>49</sup>). The broader regulatory framework requires that regulation in Australia is pro-competitive, outcomes focussed, that the costs and benefits of any regulation are appropriately examined with the view to choosing the most effective alternative and that such regulation is regularly reviewed.

In 1997, the Prime Minister announced, in his statement *More Time for Business*, a review of food regulations in Australia<sup>50</sup>. The review aimed to examine the regulatory burden on business and to improve the clarity, certainty and efficiency of food regulatory arrangements, whilst protecting public health and safety. Following a review of the recommendations, the Commonwealth, State and Territory Governments, through COAG, agreed on a national response to the Food Regulation Review. Included in the significant recommendations flowing from the review was the agreement to a national paddock to plate approach to food regulation to protect public health and safety. This included the formation of a single national agency, Food Standards Australia New Zealand (FSANZ), to set food standards and the formation of a new Ministerial Council, called the Australia New Zealand Food Regulation Ministerial Council, to consider all food safety matters from paddock to plate.

In 2000, a Food Regulation Agreement was signed by COAG, to put in place the new food regulatory arrangements. The Agreement aimed to:

---

<sup>48</sup> Australian Government (2000). *Food Regulation Agreement* (Department of Prime Minister and Cabinet). <http://www.dpmc.gov.au/docs/DisplayContents1.cfm?&ID=86>

<sup>49</sup> Communique (1997). Council of Australian Governments Meeting. 7 June 1997. <http://www.dpmc.gov.au/docs/DisplayContents1.cfm?&ID=82>

Communique (2000). Council of Australian Governments Meeting. 3 November 2000. <http://www.dpmc.gov.au/docs/DisplayContents1.cfm?&ID=85>

<sup>50</sup> Howard, J. (1997). *More time for business*. Statement by the prime Minister, 24 March 1997. <http://www.pc.gov.au/orr/reports/external/mtfb/mtfb.pdf>

- provide safe food controls for the purpose of protecting public health and safety;
- reduce the regulatory burden on the food sector;
- facilitate the harmonisation of Australia's domestic and export food standards and their harmonisation with international standards;
- provide cost effective compliance and enforcement arrangements for industry, governments and consumers;
- provide a consistent regulatory approach across Australia through nationally agreed policy, standards, compliance and enforcement procedures;
- recognise the responsibility for food safety encompasses all levels of government and a variety of portfolios; and
- support joint Australia and New Zealand efforts to harmonise food standards.

The outcome of these arrangements has meant that for the first time in Australia, a single agency (FSANZ) develops all domestic food standards, including those for primary production and processing sectors.

The primary focus for these is on the protection of public health and safety. Under the Treaty arrangement with New Zealand, the promulgation of joint food standards for food hygiene measures is excluded. Therefore, primary production and processing standards under the Code will apply in Australia only.

## **1.2 *Food Standards Australia New Zealand Act 1991***

Under the FSANZ Act, the objectives for developing all food standards in descending order of priority are:

- the protection of public health and safety;
- the provision of adequate information relating to food to enable consumers to make informed choices; and
- the prevention of misleading or deceptive conduct.

In developing and varying standards, FSANZ must also have regard to the:

- need for standards to be based on risk analysis using the best available scientific evidence;
- promotion of consistency between domestic and international food standards;
- desirability of an efficient and internationally competitive food industry; and
- promotion of fair-trading in food.

Food standards developed under the Act form part of the *Australia New Zealand Food Standards Code*, which the States and Territories in Australia adopt or incorporate within their food legislation without amendment. As part of the regulatory reforms, States and Territories have agreed to adopt new model food legislation as part of improving the consistency of food legislation across the country.

Food standards developed by FSANZ are also guided by overarching policy guidelines developed by the Ministerial Council and by the legislation under the FSANZ Act. In the case of Primary Production and Processing Standards, the overarching Ministerial guidelines specify higher order policy principles, which state they will:

- be a set of outcomes-based national standards for the relevant primary production and processing sectors/commodities;
- have a consistent regulatory approach across the Standards;
- be consistent with the s10 objectives of the FSANZ Act, recognising that the protection of public health and safety has priority;
- be consistent with the approach outlined in Chapter 3 of the Code
- be consistent with internationally recognised Codex standards, save where, after consideration of a risk assessment, it is clear that the relevant standard does not sufficiently protect public health and safety in Australia;
- address food safety across the entire food chain where appropriate;
- facilitate trade;
- be not more trade restrictive and comply with Australia's obligations under World Trade Organization agreements;
- ensure that the regulatory framework promotes consumer confidence;
- ensure the cost of the overall system should be commensurate with the assessed level of risks and benefits;
- provide a regulatory framework that applies only to the extent justified by market failure; and
- provide for collaborative action among enforcement agencies to optimise the use of resources and effectiveness.

## **2. Development of a Primary Production and Processing Standard for Seafood (Proposal P265)**

Proposal 265 (P265) 'Development of a Primary Production and Processing Standard for Seafood' was raised by FSANZ in December 2002 under its mandate to develop domestic standards for the primary production and processing of food.

The seafood sector includes a number of products and activities that, unless well managed, may potentially have serious impacts on public health and safety. Recently, some State governments have developed seafood safety schemes to ensure that a 'boat to plate' (i.e. paddock to plate) approach to seafood safety was implemented across the seafood supply chain. However, other jurisdictions are not yet at that point, leaving the primary production end of the domestic seafood chain without mandated seafood safety schemes.

The seafood sector was also increasingly aware that food safety issues are vital to the continued growth of the industry, and was at an advanced stage of developing a national voluntary seafood safety standard. The industry has also produced a number of guidance documents on food safety across a range of sectors. It was therefore considered an opportune time to move these developments forward to a nationally mandated system.

As required by the Ministerial guidelines, a Standards Development Committee (SDC) was appointed in September 2002 by the FSANZ Board to provide advice to FSANZ on matters relevant to the standard development process. The SDC contributes a broad spectrum of knowledge and expertise covering industry, government, research and consumers.

In December 2002, the Board prepared a Proposal pursuant to section 12AA of the *Food Standards Australia New Zealand Act 1991* for the development of a Primary Production and Processing Standard for seafood.

The Board approved the Initial Assessment Report (Issues Paper) for release, agreed to seek public submissions, and directed the SDC to consider any available standards, including those developed by Seafood Services Australia Ltd, and the New South Wales and New Zealand Governments during its discussions and provision of advice on development of the mandatory national standard for seafood.

Since that time FSANZ, with advice from the SDC, has:

- considered the written submissions received in response to the public consultation on the Initial Assessment report and the Draft Assessment Report;
- undertaken an evaluation of public health risks and identified sectors of the seafood industry that pose a potential high risk to safety;
- considered current strategies to manage those risks and determined, what if any, residual risks need to be managed;
- considered options for the management of these residual risks that aim to ensure the safety of seafood;
- conducted an impact analysis of the options to identify the option that meets the minimum effective regulation requirements , but effectively addresses any public health and safety risks associated with seafood;
- recommended a preferred option;
- considered the implementation of the preferred option; and
- drafted a proposed standard consistent with the preferred option.

This Report forms the third stage in the process of developing a Primary Production and Processing Standard for seafood. It takes into account the matters raised above and other deliberations of the Seafood SDC.

### The Seafood Sector

#### 1. Seafood sector

Seafood is an important part of the Australian diet. Domestic demand for seafood continues to grow: between 1991 and 1999, consumption of seafood in Australia increased by 12 percent (from 13.5 kg to 15.1 kg per capita)<sup>51</sup>. Australian households spend about 2.5 per cent of their food budgets on seafood products, which is about the same as expenditure on poultry<sup>52</sup>. The last few decades have also seen changes in the way Australians eat seafood, such as increasing consumption of sushi and smoked fish.

This increase in consumer demand is met to some extent by importing seafood products and by producing seafood through aquaculture. Approximately half of all seafood consumed in Australia is produced domestically and the other half is imported<sup>53</sup>. This means that any proposed food safety management systems for the primary production sector must adequately address food safety for imported as well as domestically produced seafood and must take into consideration the increasing trend for seafood to be produced through aquaculture.

##### 1.1 Consumer attitudes to seafood safety

Public health professionals advocate seafood in the diet as a means to address obesity and as a good source of omega-3 fatty acids<sup>54</sup>. A study of consumer attitudes in Sydney and Perth found that the perceptions that fish is healthier than meat and that it adds variety to the diet were major factors influencing consumption. However uncertainty about safety and contamination, a lack of knowledge about seafood and high prices were major barriers to increased consumption<sup>55</sup>.

The role of food safety systems is to minimise risks to public health, and in the process, to maintain consumer confidence in the food supply. Consumers have responded to outbreaks of food-borne illness in the past by reducing their demand for seafood. For example, following contamination of NSW bivalve molluscs in 1997, NSW consumers immediately reduced their demand for bivalve molluscs by 85 percent. They also immediately reduced their overall demand for seafood products by 30 percent, indicating that consumers readily generalise a specific seafood risk to all categories of seafood products<sup>56</sup>. Consumers also tend to respond by expressing a lack of confidence in the capacity of industry and government to ensure food safety, a situation that may also impact on trade.

---

<sup>51</sup> FRDC (2002). *Retail sale and consumption of seafood* (revised edition). Fisheries Research and Development Corporation (FRDC), Canberra.

<sup>52</sup> Australian Bureau of Statistics, 6535.0 *Household Expenditure Survey, Australia*.

<sup>53</sup> ABARE, (2003). *Australian Fisheries Statistics 2002*. FRDC, Canberra.

<sup>54</sup> Mori, T. (2003) *A health promotion program incorporating fish for withdrawal of antihypertensive drugs in overweight hypertensives*, FRDC Project No. 2002/242

<sup>55</sup> FRDC/Ruello and Associates (September 2002) *Retail Trade and Consumption of Seafood*, pp 14

<sup>56</sup> NRVP page 87.

Other data, however, indicate that, despite a relatively short-term negative response to outbreaks of food-borne illness<sup>57</sup>, there is solid demand for seafood over the medium term. For example, the share of seafood expenditure in household's food budgets was similar in 1993-94 to the share in 1998-99<sup>58</sup>, indicating solid demand for seafood over the medium term. This demonstrates consumers perceive the benefits of seafood consumption to be greater than any risks associated with its consumption. Nevertheless, short-term negative responses can last up to a year and have a significant impact on some seafood producers or sectors, highlighting the importance of consumer confidence as an important issue for industry and government.

## 1.2 Nature of the industry

The Australian seafood industry markets a diverse range of approximately 600 marine and freshwater seafood species. The Australian fishing zone is 11 million square kilometres, the third largest in the world. Despite the size of the fishing zone, Australia is ranked 52<sup>nd</sup> in the world with respect to commercial tonnage. The industry ranges from tropical to sub-Antarctic, open ocean to estuarine, marine to freshwater, and operates in one of the world's cleanest environments.

As the industry is geographically dispersed, it has a predominantly regional and rural workforce. In 2003, the Australian Bureau of Statistics reported 19 627 people directly involved in the wild catch, aquaculture, and processing sectors. Indirect employment in the commercial sector, and in compliance, transport, storage, wholesaling, and retailing, is considerably higher, and may approach 80 000 people<sup>59</sup>. A more detailed analysis of the industry was included in the Initial Assessment Report, released for public comment in December 2002.

The volume of seafood harvested from the wild is limited by the capacity of fish stocks. Most stocks are fished at their optimum sustainable level and there is little capacity to expand wild catch volume<sup>60</sup>. However, land and sea-based aquaculture is making an increased contribution to the seafood industry. Between 1991-92 and 2001-02, aquaculture produced approximately 24 percent of the total volume of seafood produced in Australia.

## 1.3 Value of the industry

The seafood industry is the fourth largest sector of the Australian food industry (by value) after beef, wheat, and milk. The gross value of production (GVP) during 2000-01 was estimated at \$2.48 billion (adjusted figure)<sup>61</sup>. Since 1992, the GVP increased, on average, by 10 per cent per annum and aquaculture's share has risen from 15 per cent to 30 per cent.<sup>62</sup>

---

<sup>57</sup> NRVP page 39.

<sup>58</sup> Australian Bureau of Statistics, 6535.0 *Household Expenditure Survey, Australia*.

<sup>59</sup> FRDC (2000). *Investing for tomorrow's fish*. FRDC Research and Development Plan, 2000 to 2005. (FRDC, Canberra).

<sup>60</sup> Australia Bureau of Rural Sciences, (2002). *Fishery status reports 2000-2001*. (A. Caton, ed.) DAFF, Canberra.

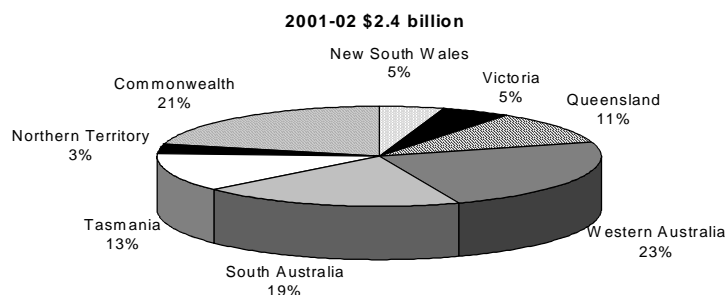
<sup>61</sup> ABARE, (2003). *Australian Fisheries Statistics 2002*. FRDC, Canberra.

<sup>62</sup> During 2002-03, although total production volumes rose to 249,000 tonnes, the GVP fell to \$2.3 billion. This has been largely attributed to the lower export values for many species. Media Release 18 February 2004, Australian Seafood Industry Council.

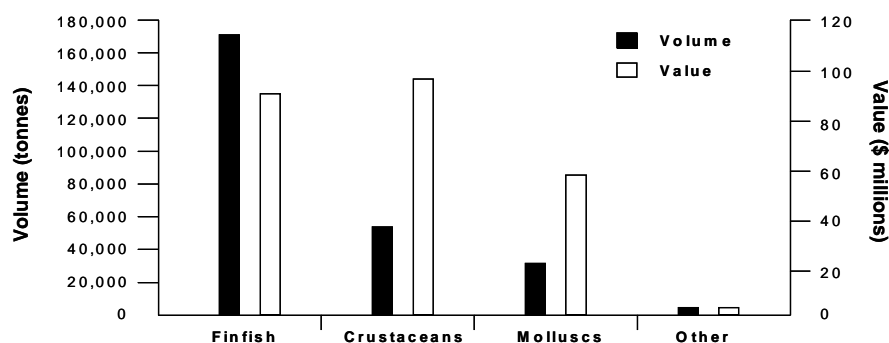


Most species cultured in Australia are high unit value species such as southern blue fin tuna, Kuruma prawns, bivalve molluscs and Atlantic salmon. A breakdown of production by the Australian commercial fishing industry is shown in Figures 1 and 2.

**Figure 1: State shares of fisheries production, by value (ABARE, 2003)**



**Figure 2: Australian seafood production (edible and non-edible), 2001-02 (ABARE, 2003)**

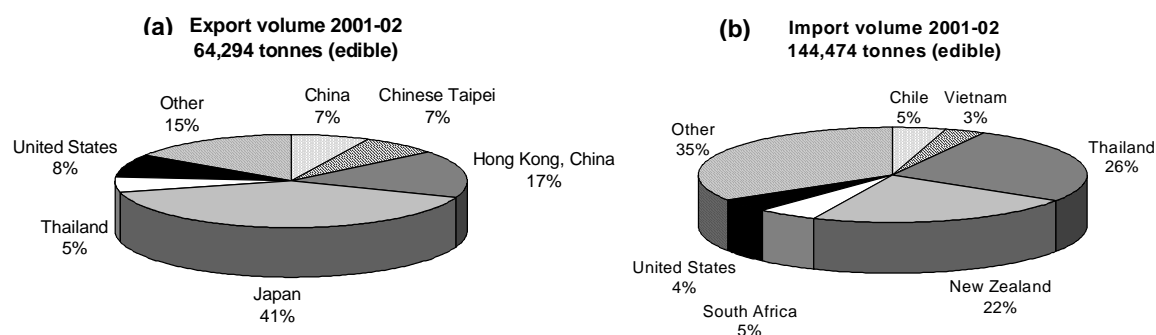


#### 1.4 Volume produced by the industry

Of the 186,677 tonnes of seafood produced in Australia during 2001-02, approximately 66 per cent (122,383 tonnes) was consumed domestically. During 2001-02, Australia imported 144,474 tonnes of seafood, mainly from Thailand and New Zealand (Figure 3b), which represents approximately half the total seafood consumed in Australia per annum (by volume). By value, imported seafood represented 77 per cent of the total value of seafood consumed in Australia.

Thirty four per cent by volume of domestically produced seafood is exported. The major export markets were Japan, Hong Kong, United States, China, Chinese Taipei, and Thailand, with these six markets making up 82 per cent of the total export volume (Figure 3a).

**Figure 3: Volume of Australian edible fisheries exports (a) and imports (b) by country (ABARE, 2003)**



In terms of the value of seafood produced in Australia, exports represented 87 per cent of total production. This comparison reflects Australia's position as an exporter of high value seafood species (e.g. rock lobster and abalone), with lower value species predominantly being traded in the domestic market.

### Consultation on Initial Assessment Report

FSANZ has a statutory obligation to consult with stakeholders in relation to food regulatory measures. This is undertaken through two rounds of public consultation: one following release of the Initial Assessment Report, and the other following the release of the Draft Assessment Report, as described on Pages (ii) and (iii).

In addition to statutory consultation, further consultative mechanisms have been built into the development process for the Primary Production and Processing Standard for Seafood. This reflects recognition of the need for close consultation with industry, regulators and consumers throughout the development of the Standard. This is considered particularly important as the setting of primary production and processing standards is a new function of FSANZ. Accordingly, in the early stages of standard development, the level of awareness of FSANZ processes in the community and within the primary production sector may be minimal.

In recognition of the need for broad and active consultation throughout the development of the seafood standard, FSANZ is committed to seeking stakeholder involvement via the following mechanisms:

- Seafood SDC - the role of the SDC is to provide input and advice from consumer, industry, government and research perspectives to FSANZ in the development of the Standard;
- Working Groups - the Seafood SDC has established working groups to address the health risks associated with seafood, to facilitate risk assessment and to propose and assess risk management measures;
- Meetings coordinated by regulators in partnership with FSANZ, held in each of the jurisdictions, to exchange information and allow consultation with industry and other community members throughout the development of a seafood standard. Meetings have already been held in many jurisdictions;
- Regular progress updates posted on the Primary Production and Processing Standards section of the FSANZ web site;
- An electronic executive bulletin intended for CEOs and other executives of organisations with an interest in the development of a new national food primary production and processing standard for seafood; and
- Updates and progress reports included in a range of industry publications.

## **PUBLIC CONSULTATION**

### **Written Submissions in Response to the Initial Assessment Report**

A total of twenty-five written submissions were received by FSANZ in response to the Initial Assessment Report of Proposal P265. Submissions originated from a range of organisations and individuals representing industry sectors across the supply chain and all levels of government. A summary of the individual submissions is presented at Attachment 5. A compilation of the responses to the specific issues raised for comment in the Initial Assessment Report is presented at Attachment 6. These issues mainly concerned:

- scope of the Standard, including:
  - the inclusion of chemical and biological hazards within the standard and the Code as a whole;
  - at what point within the seafood industry the Standard should commence and cease to apply;
  - the position of ready-to-eat seafood under the Standard; and
  - the position of harvesting, handling and processing seafood on board fishing vessels under the standard;
- definition of seafood, including whether aquatic plants, reptiles and mammals should be regulated under the Standard;
- scientific risk assessment process which underpins FSANZ's development of regulatory measures, and the provision of technical data for this purpose;
- suitability of existing standards, such as the industry-preferred voluntary standard (the Australian Seafood Standard), any State government standards and any international standards, to form the basis for the national mandatory standard; and
- options available to manage food safety risks, including:
  - costs and benefits of management options;
  - compliance and enforcement costs, mechanisms and concerns; and
  - the need for, and development of, guidelines.

The range of opinion on each of these issues is presented below, along with a short explanation of the approach taken in this Draft Assessment.

#### **The scope of the Standard**

A wide variety of opinions were expressed concerning the scope of the proposed standard. In general, submissions supported the principle of an outcomes based, non-prescriptive standard covering the entire seafood industry and focussed on food safety. Many expressed the view that the standard should impose requirements based on the level of public health risk posed by each industry sector. Some submissions supported a role for voluntary industry codes of practice and self-regulation. Divergent views were expressed by industry on the question of whether mandatory names for fish should be included in the standard.

In line with the Ministerial Council Guidelines, other policy advice and FSANZ's statutory objectives, the draft Seafood Standard (Attachment 1) put forward for comment in this Draft Assessment Report is an outcomes-based, non-prescriptive standard focussed on food safety. It covers the entire seafood industry to the extent determined by the level of public health risk posed by each industry sector and by the need to avoid duplication of, or inconsistency with, existing standards in the Code.

### **Inclusion of chemical and biological hazards within the Standard**

Submissions highlighted a number of food safety hazards that were perceived as not being adequately addressed in the Code. These included allergens and physical hazards (e.g. fish bones), escolar wax esters, ciguatoxin and some microbial pathogens.

It was also suggested that maximum residue levels (MRLs) for pesticides and veterinary chemicals in seafood needed to be reassessed. A range of strategies to address these various hazards were suggested, including relying on interpretive or advisory guidelines to the standard, referencing relevant sections of other Chapters of the Code, and including specific provisions in the Seafood Standard. Industry generally preferred that the current provisions in Chapters 1 and 2 of the Code should be relied upon and simply referred to in the Seafood Standard.

The scientific evaluation and ranking of the public health risks posed by hazards in seafood in Australia (Attachment 10), conducted by FSANZ to underpin the development of suitable risk management strategies in the seafood sector, did not highlight any hazards that should be addressed by amendment to Chapters 1 and 2 of the Code. The draft Seafood Standard does not contain requirements concerning maximum levels of physical, chemical or microbiological hazards in seafood.

Certain hazards mentioned in submissions cannot routinely be assayed e.g. ciguatoxin, escolar wax esters. Maximum Residue Levels for pesticides and veterinary chemicals are (re)assessed on a routine basis by FSANZ, in conjunction with the Australian Pesticides and Veterinary Medicines Authority (APVMA), taking into consideration total dietary exposure from all food sources.

### **Coverage of the production and processing supply chain**

Comments received on the coverage of the production and processing supply chain showed a broad range of opinion. Several submissions mentioned that the entire chain should be covered from harvest to retail, inclusive. However, others felt that it should only apply up to, but not including, the point of retail sale, or up to the point at which the Code currently applies. The question of whether the pre-harvest sector of aquaculture should be regulated also engendered varying opinions, with some believing that production inputs into aquaculture need to be covered by the standard.

The Seafood Standards Development Committee (SDC) advised that the seafood PPP Standard should cover all aspects of primary production and processing of seafood, from harvest/ capture (whether wildcatch or aquaculture) through to retail sale, to the extent determined by the level of public health risk posed by each industry sector.

The draft Standard covers the pre-harvest sector to the extent that it requires seafood businesses to adopt an ‘inputs’ approach, using only inputs that do not contaminate seafood or adversely affect its safety and suitability.

### **Ready-to-eat seafood**

The question of whether ready-to-eat seafood should remain covered under existing sections of the Code or be included in the Seafood Standard received comments supporting both views.

It is proposed that the primary production and processing of ready to eat seafood is covered in the draft seafood PPP Standard, to the extent determined by the level of public health risk posed by such products. Provisions elsewhere in the Code applying generally or specifically to such products will continue to apply.

### **Processing on board fishing vessels**

The extent to which the standard should regulate seafood harvesting, handling and processing on board fishing vessels was the subject of many comments from submitters. Recommendations ranged from the view that no standard should apply, as the risks were low, to suggestions that food safety plans should be required. Mandating Good Hygienic Practice, addressing the risks through a voluntary code of practice and implementing a receipt standard at the dock were also put forward as options. Several submissions advised that enforcing a standard on board vessels at sea would be difficult. The need for awareness programs or accredited food safety training was also raised.

The Seafood SDC advised that Good Hygienic Practices can and should be required of fishing vessels, including those only involved in harvesting and minor processing (such as gutting and gilling). The SDC recommended that the draft Standard require that fishing vessels must be constructed, maintained and used in ways that minimise the risks to the safety of seafood.

### **The definition of seafood**

Most submissions agreed that the term ‘seafood’ should be defined so as to cover aquatic vertebrates and invertebrates including finfish, molluscs and crustaceans but excluding aquatic plants, reptiles and mammals. Three submissions suggested inclusion of aquatic plants within the definition, and one suggested inclusion also of aquatic reptiles and mammals, along with a suitable definition of the point at which they are considered to become seafood and thus subject to the provisions of the standard. Most submissions were in agreement that seafood taken for traditional purposes should also be excluded.

The Seafood SDC agreed that ‘seafood’ should be defined as ‘all aquatic vertebrates and aquatic invertebrates, excluding amphibians, mammals and reptiles’. This definition excludes crocodile meat, seaweed and other aquatic plants, but includes ready-to-eat seafood. The SDC also recommended that the standard should not cover indigenous or traditional fishers, unless such seafood is offered for sale.

### **The scientific risk assessment process**

The scientific risk assessment process, which underpins the FSANZ regulatory approach, received broad support. However, comments were received on the need to consider risk assessment work undertaken by others and to apply risk analysis in context. One submission suggested that the process seemed to be more appropriate to the establishment of food product standards. Some individuals identified that they were willing to provide data necessary for the risk assessment process, noting that significant data gaps existed. In one case, data could not be provided unless confidentiality could be assured.

In order to estimate and compare the relative risks associated with consumption of seafood in Australia, FSANZ prepared a risk ranking report (Attachment 10). It takes into consideration the multiple hazards potentially present, and assigns each commodity or group of commodities to a broad risk category: low, medium or high. Through this process, sectors of the seafood industry posing a higher public health risk were identified.

In compiling the risk ranking report, a wide range of literature and information from Australia and overseas was reviewed and evaluated. The report also drew on recent risk assessments that have been undertaken on Australian seafood.

### **Suitability of existing standards**

Submissions generally suggested that existing voluntary regulations, codes of practice and guidelines should be recognised, in some form, under the Standard. The suitability of using the industry-developed Australian Seafood Standard as a basis for development of the Primary Production and Processing Standard for Seafood was discussed, with views ranging across the spectrum. In general, most submissions suggested it would need modification or could be used, in part or in total, as a guideline to the Standard.

Submissions also expressed the view that other regulations and standards, Australian and international, should be taken into account in developing the Seafood Standard, and parts used, as appropriate, in the standard or in the guidelines. The NSW Seafood Safety Scheme, the AQIS Export Control (Processed Food) Orders and the Codex Code of Practice for Fish and Fishery Products were mentioned as examples of existing measures that might be drawn upon.

FSANZ considered all appropriate existing seafood standards, regulations and codes of practice when developing the draft Seafood PPP Standard. Many of the principles upon which the industry-developed Australian Seafood Standard is based, also underpin the draft Standard.

### **Options available to manage food safety risks**

Submissions canvassed options for appropriate food safety management systems. Implementation of HACCP-based systems and food safety plans for areas where the public health risk was judged to be highest received broad support, although questions regarding industry and government support and resourcing were raised. Industry were concerned about the criteria to be used for determining the extent to which HACCP-based food safety programs would be required of businesses. Voluntary codes of practice and non-regulatory guidelines were mentioned as being suitable where risks were low.

The proposed strategy for management of public health risks in the draft Seafood PPP Standard is based on a requirement for Good Hygienic Practice for all seafood businesses, supported by guidelines and industry codes of practice, and the implementation of HACCP-based systems (food safety plans) for areas where the public health risk is judged to be highest.

### **Compliance and enforcement issues**

Industry bodies and representatives expressed concern regarding the impact of any standard on the industry and on practices within seafood businesses. In particular, industry expressed a desire to avoid unnecessary imposts and the potential for excessive cost-recovery revenue-raising by regulators at the expense of industry.

Industry and government submissions expressed the view that compliance and implementation costs associated with HACCP-based food safety plans were significant and had been under-estimated by FSANZ in the past. Information was provided detailing the costs of complying with current (HACCP-based) export certification schemes.

Industry also emphasised the need to avoid duplication of auditing and compliance activities (and hence costs) where a business supplied both domestic and export markets. Several submissions stated that businesses complying with export requirements should be deemed to comply with the domestic standard. Submissions also raised questions about the role, extent and system of audits that may be required under the standard.

A period of two to three years was generally nominated by industry as a preferred time frame for implementation of the Standard and for stock-in-trade provisions to apply. The need for government support to provide education and training was also raised.

Comment from government bodies covered issues including which level of government, and/or which government department, would have responsibility for regulation, implementation and enforcement of the standard. Audits were also discussed, incentive-based compliance schemes were generally supported, as was harmonisation with existing audit systems, such as those required by AQIS. Government bodies expressed a desire to avoid any duplication of current legislation, and to achieve genuine consistency on a national basis under the standard.

Once adopted into State and Territory legislation, enforcement of the Standard will become the responsibility of those jurisdictions. Policies regarding cost-recovery revenue-raising by regulators are set at that level of government in Australia.

FSANZ understands that a nationally agreed date for commencement of the Primary Production and Processing Standard will help to ensure national consistency, and will focus industry and regulators on the task at hand.

It is envisaged that a number of tools and resources will be developed to assist both industry and regulators in the implementation of the standard. A prime tool will be an interpretive guide to the Standard. This document will be developed by FSANZ in consultation with stakeholders. In addition, existing codes of practice developed and adopted by jurisdictions and industry, will provide further practical information. Existing codes of practice may be readily adapted to this purpose.



## **RESPONSES TO JURISDICTIONAL MEETINGS**

In the period since commencing the development of a primary production and processing standard for seafood, consultation meetings have been held in the following jurisdictions: Tasmania, Victoria, Queensland, Western Australian, South Australia, New South Wales and the Northern Territory. Innovative strategies have included the use of video conferencing to engage distant communities in Western Australia (i.e. Broome, Karratha, Carnarvon, Albany, Geraldton, and Esperance).

Participants at each consultation were invited to provide their views orally, as well as through written submissions. Industry participants at the workshops focussed on the impact of any regulatory measures on their businesses, while regulators were interested in jurisdictional issues and the responsibilities.

These consultations were held during the period leading up to and following the release of the Initial Assessment Report and prior to the release of the Draft Assessment Report. In the lead-up to the release of the Draft Assessment Report, consultations have continued and have elicited valuable industry data and considerable feedback on support for the regulatory options being proposed.

## **IDENTIFICATION OF POTENTIAL NON-SCIENTIFIC RISKS**

The development and implementation of good regulation can be influenced by a range of factors outside the potential hazards to the food supply that are evaluated in the scientific risk assessment. This broader set of risks typically includes factors such as community perceptions, political implications, regional implications and industry issues. In developing options for the regulation of the primary production and processing of seafood, FSANZ discussed this issue with State and Territory regulators, a consumer representative, and various members of the seafood industry. Such consultation assisted FSANZ to identify a range of non-scientific risks that, potentially, could affect the development and implementation of regulation for the seafood industry.

Consumer perceptions of seafood are ambivalent and pose a potential risk to the acceptance by consumers of any improvements to safety that new regulation may offer. A study of consumer attitudes revealed that, while consumers believe that seafood has some nutritional benefits, they lack sound knowledge about seafood products and are uncertain about the safety and possible contamination of seafood<sup>63</sup>. Furthermore, the study revealed that the correct labelling of fish was very important for 70% of consumers surveyed in Perth, and 73% of those surveyed in Sydney. Communication with consumers during the process of developing new regulation will continue to be important to foster greater consumer confidence.

Industry is concerned that implementation of any new regulation may bring with it large compliance costs, either through excessive regulation that is disproportionate to manage the hazards or through excessive government charges. Such concern, if not addressed, could result in a low level of compliance with new regulation and a lower level of benefit to the Australian community.

---

<sup>63</sup> FRDC/Ruello and Associates (September 2002), *Retail Sale and Consumption of Seafood*.

This concern can be addressed through a transparent process that demonstrates to all parties how the proposed regulatory measures relate to the scientific risk and provides benchmarks for industry to gauge the likely level of government charges.

The seafood industry contains a high proportion of small businesses, dispersed along rural and some remote coastlines, which potentially can make the implementation of any new regulation very difficult. Many regional communities are highly dependent on the continuing viability of their local seafood industry and may be resistant to change. These factors can be taken into account in the process of developing a new regulation, through a transparent process that demonstrates minimum effective regulation, and also the benefits to industry of consistently maintaining good hygiene and safety practices.

The staged approach to implementing food safety regulations in the NSW seafood industry indicates that regional dispersion of the industry need not be a barrier to the successful introduction of new regulations.

A further risk involves the potential for uneven implementation of a new regulation by the States and Territories. While each jurisdiction has responsibility to determine its priorities for enforcement, and the level of resourcing for its enforcement and auditing activities, there is nonetheless the issue that similar seafood activities anywhere in Australia should be subject to similar regulatory requirements.

The consequence of uneven implementation would be to reduce the credibility of the new regulation amongst industry, which would then be sceptical of its claims to be 'nationally consistent' and may doubt its other benefits. This risk can be addressed by clarity in the description of the new regulation, the provision of a comprehensive Interpretive Guide, and coordination between the jurisdictions in their implementation and enforcement of the Standard.

## **Consultation on Draft Assessment Report**

### **Written submissions in Response to the Draft Assessment Report**

A total of twenty-nine written submissions were received by FSANZ in response to the Draft Assessment Report of Proposal P265 during the period of consultation held from 26 May 26 through to 6 August 2004. Submitters originated from a wide range of organisations and individuals representing both industry sectors and government. A summary of the individual submissions is presented at Attachment 5B. A summary of the submissions grouped by issue is presented at Attachment 6B.

### **Responses to Jurisdictional Meetings**

Following the release of the Draft Assessment Report for public comment, a series of consultation meetings were held in the jurisdictions. Meetings were held in Hobart and Launceston (Tasmania), Darwin, (Northern Territory), Brisbane (Queensland), Adelaide (South Australia), Melbourne (Victoria), Sydney (New South Wales) and Perth (Western Australia). Video conferencing was utilised in the WA meeting to engage the distant communities of Broome, Karratha, Carnarvon, Albany, Esperance and Geraldton.

Invitations to the meetings were sent out to industry and other interested parties by the hosting jurisdiction. Participants at the consultation sessions were invited to provide their views on the proposed draft standard as included in the Draft Assessment Report. Meeting outcomes notes were circulated to the hosting jurisdictions and the issues raised were noted for consideration during amendment of the drafting.

### **Main issues**

The main issues raised in the submissions and during the consultation sessions were:

- drafting issues, including:
  - divide between Chapter 3 and Chapter 4
  - scope of the Standard for seafood
  - definitions such as ‘frozen’, ‘chilled’, ‘thermal centre’, ‘thawed’ ‘live seafood’
  - the definition of ‘primary production’
- consistent implementation across the jurisdictions
- audit costs and third party audit arrangements
- the exclusions of mandatory fish marketing names from the standard
- labelling of imported product
- enforcement of the standard at the border
- risk ranking report
- risk management
- fish bone injuries
- freshwater crayfish requirements in Victoria

- the use of guard dogs in premises
- the use of a marketing name for Salmon

## **DRAFTING ISSUES**

### **Draft Standard 3.3.1 (previously 3.2.1)**

One submission supported the intent to have 3.2.1 sit alongside of 4.2.1 and the splitting of requirements for shellfish businesses between the two Standards. The submission suggested that the applications of the two Standards should be based on the definition of primary production in the current Food Act and then consistent with the definition of ‘primary production of seafood’ as defined in standard 4.2.1.

See below under scope of draft Standard 4.2.1.

### **Scope of Draft Standard 4.2.1.**

Several submissions noted that one of the major issues in drafting the standard is the setting the scope of primary production and processing for seafood. The definition of the scope has an impact on the divide between Chapter 3 and Chapter 4 of the Code.

Provisions in Chapter 3 of the Code are more onerous than those in Chapter 4 of the Code. An example are the activities undertaken on board fishing boats where seafood is killed, gutted, boiled, frozen etc. According to the primary processing/Chapter 3 divide set out in Standard 3.1.1 these activities would not be primary production. Standards 3.2.2 and 3.2.3 would apply to these activities.

Various States and Territories have amended the primary production/Chapter 3 divide. Queensland, for example, has included a number of substantial transformation type activities in the legislative definition of primary production including filleting, gutting and boiling crustaceans. There have been similar amendments to the divide in other jurisdictions.

A practical solution to this issue is to set the scope of the seafood standard around both primary production as one set of activities and processing as another set of activities. It is therefore proposed to amend the definition of primary production to encompass the activities of growing, cultivation, picking, harvesting, collection or catching of seafood. The definition of processing of seafood would define the included activities of processing, such as filleting, gutting, shucking, boiling and freezing of seafood. Chapter 3 of the Code would apply to retail activities and any other activities not mentioned in Standard 4.2.1.

### **1 Application**

A submission recommended the removal of the words ‘and processing’ from the title of the standard on the basis that processing is not ordinarily associated with primary production. The redrafting of the definitions for ‘primary production’ and ‘primary processing’, which now clearly define the scope of the standard, has addressed this concern. The removal of the words ‘and processing’ was not considered necessary.

One submission stated that the seafood standard should not apply to retail, and that they supported the introduction of the proposed standard from harvest up to but not including retail.

The Standard does not apply to the retail sector. It applies only to the primary production and processing sector up to the back door of retail.

## **2 Interpretation**

### **‘CONTROL’**

One submission requested further explanation of the term ‘control’. This term is used in various places in the Standard, for example, clauses 3 and 20.

A definition of ‘control’ has been included in the definitions in Clause 2 Interpretation.

### **‘FROZEN SEAFOOD’**

A number of submissions identified problems with the definition of ‘frozen seafood’. As drafted, the definition included ‘temperature control’ which, according to the definition of temperature control as detailed in the Editorial Note to Clauses 6 and 7 meant that seafood at 60 °C would fit the definition of ‘frozen’.

The reference to ‘thermal centre’ in the definition of frozen was also considered to be difficult to enforce, as it would require probing at the centre of the product. Various submissions proposed removing the definition of ‘frozen’, ‘thermal centre’ and also ‘chilled’. The term ‘frozen’ has an ordinary meaning that is enforceable. An important drafting principle is that where a term has an ordinary meaning it should not be assigned a definition, unless there is intention to depart from that ordinary meaning. Therefore, the definition of ‘frozen seafood’ was removed. As the definition made reference to ‘thermal centre’ and ‘thawed’, those definitions were also removed. The removal of ‘frozen’, ‘thermal centre’, ‘chilled’ and ‘thawed’ is consistent with the principle of using an ordinary meaning where applicable.

### **‘LIVE SEAFOOD PREMISES’**

One submission suggested this definition be removed, as there is no reference to it in the Standard.

This observation is incorrect. Clauses 10 and 14 make reference to the term. Therefore, the definition was retained.

### **‘PRIMARY PRODUCTION OF SEAFOOD’**

Several submissions raised the issue of the definition of ‘primary production’ and noted the confusion between what was covered by ‘primary production’ and what would be classed as ‘primary processing’. As noted earlier, this impacts on the point at which Chapter 4 no longer applies, and Chapter 3 of the Code commences.

The definition of ‘primary production of seafood’ has been amended to specifically encompass those activities considered to be ‘primary production’ and hence encompassed by Chapter 4 of the Code. A definition of those activities considered to be processing has also been included.

## **‘TEMPERATURE CONTROL’**

It was noted in one submission that this term was included in the PPP standard as it is defined in Chapter 3, which includes temperatures of 60°C or above. If applied in this way in Chapter 4, seafood would need to be cooked and this would not be appropriate for the seafood PPPS Standard.

The definition of ‘temperature control’ was redrafted for the specific purposes of the PPP Standard, with the definition omitting reference to 60°C. This definition is relevant to Clauses 6, 7 and 10 in the General Provisions.

### **3 General seafood safety management**

One submission suggested it would be difficult for regulators to verify Clause 3, and also difficult for small businesses to follow. It was suggested the clause be removed, with it being replaced by a policy statement in the preamble to the statement. Another submission also suggested that the words ‘and document’ be inserted in the standard after the words ‘systematically examine’.

This would, in essence, mandate a de-facto food safety program and this is not the intent of the standard for the low and medium risk products covered by the General Provisions (however, it may be one way that implementation could achieve these outcomes).

It is suggested that the editorial note be amended to state that the measures listed are not exhaustive (the words ‘should include’ have been added) and that the meaning of the word ‘control’ be defined in the Definitions.

### **4 Requirement to prevent contamination**

Several submissions stated that this requirement is covered by clauses 5 to 14 and that the general provision should be deleted. It was also noted that the Standard does not contain any general safe handling provision similar to clause 3 of Standard 3.2.2.

Clause 4 has now been amended to cover both contamination and handling.

### **5 Inputs and harvesting areas**

As originally drafted for the Draft Assessment Report, Clause 5 required businesses to ‘only use inputs’ that do not adversely impact on the safety of the seafood. It was noted that as worded this might be too onerous as there are limits in where a food business may exercise control. It was suggested that businesses should be required to take ‘reasonable measures’.

The Clause has been amended to state that the business must take ‘all reasonable measures’ to ensure inputs do not adversely affect the safety or suitability of the seafood.

### **6 Seafood storage**

One submission recommended that the words of 3.2.2 Clause 22 be added to Chapter 4, which would make temperature measuring devices a requirement. The same submitter also noted that there were no requirements to record temperatures.

The Clause makes mention of having a ‘means for monitoring the temperature of the seafood’, which would encompass temperature measuring devices. In regard to introducing requirements for recording temperatures, this would be similar to the requirements of a food safety program, which are not considered necessary for the General Provisions for low and medium risk seafood businesses.

Further discussion on this Clause with the SDC resulted in the simplification of the Clause from four parts down to two, covering seafood that is not live, and seafood that is live. It was agreed that the use of the term ‘under temperature control’ would suffice for stored seafood, other than live seafood. It was not necessary to specify chilled or frozen.

## **7 Seafood transportation**

It was suggested by one submitter that only refrigerated third-party carriers conduct transport of shellfish.

It is not practical to mandate the use of third party carriers only, particularly for businesses that are transporting goods within or between the grounds of their company. Businesses need the flexibility of alternative options. No change is suggested.

Further discussion with the SDC resulted in the agreement that it would be sufficient to state that transported seafood, other than live seafood, should be under temperature control. It was considered not necessary to mention chilled and frozen, for example.

## **Editorial Note to Clauses 6 and 7**

The definition of ‘temperature control’ in the Editorial Note made reference to 3.2.2, which made provision for maintenance of food at 60°C.

The definition of temperature that contained reference to food at 60°C was not appropriate for the seafood PPP standard and was removed in the redrafting of the Editorial Note. The new definition was included in Clause 2 of the standard.

## **8 Seafood packaging**

Comments from the SDC on this Clause as drafted for the Draft Assessment Report indicated that the words ‘no likelihood’ (in respect to prevention of contamination) could be problematic. It was suggested that words such as ‘all reasonable measures’ (to prevent contamination) might be more appropriate.

The Clause has been amended to remove the words ‘no likelihood’. The Clause now requires that businesses ‘take all reasonable measures to ensure that the seafood does not become contaminated’.

## **9 Seafood for disposal**

The clause requires that seafood for disposal be returned to the supplier. Submissions pointed out that it is not possible for a fisherperson to do this (as there is no supplier) short of throwing it back into the sea.

This provision would apply where seafood is being transported prior to the wholesale part of the seafood supply chain. The Clause has been retained.

A further comment on this Clause was the questioning of the need for different terms for a label. The submitter read the Clause to imply that food had to be labelled as ‘returned’, ‘recalled’ or ‘unsafe’.

The Clause does not mean that seafood must be literally labelled as ‘returned’ etc. It is merely a requirement that the seafood be identified as this, which does not necessarily mean labelled. It is up to the business as to how the food is identified.

## **10 Seafood receipt**

Two submissions queried the necessity of this clause as it was felt that if the standard only applies to seafood primary production, then there is no (second) business that will receive the seafood products. It was recommended that the clause be deleted.

The definition of primary production of seafood does allow for a range of activities, which may or may not take place on the same premises or by the same company. Therefore, primary production and processing seafood businesses may be involved in the receipt of seafood and the clause will be required.

The Clause has been amended in line with the Editorial Note to Clauses 6 and 7 to remove reference to keeping seafood at 60°C. In addition, a further part (4) has been added to cover the receipt of live seafood that has been transported.

## **11 Seafood tracing**

As originally drafted for the Draft Assessment Report, the Clause covered traceability and recall of unsafe seafood. One submission noted that the imposition of a written document places impost on businesses in situations where it might be difficult or impossible to contact sellers. Further, it was noted that it might be, for example in the case of fisherman, not possible for them to initiate recall. The submission made the recommendation to remove reference to ‘recall of unsafe or unsuitable seafood’. In subsequent discussions with the SDC and DFAT, it was noted that there are issues with the use of the term ‘traceability’, which has a distinct meaning in the international Codex arena. It was suggested to use alternatives terms to traceability in the drafting.

The Clause has been amended to limit it to seafood tracing and not recall. A seafood business will be required to maintain records to identify the immediate supplier and immediate recipient of seafood. The keeping of receipts will be adequate to satisfy the requirements for written records.

## **12 Skills and knowledge**

One submission commented that the wording of this clause was in conflict with Clause 3 of 3.2.2, as it does not apply to the persons supervising food handling operations.

The definition of ‘seafood handler’ includes reference to persons who supervise the primary production of seafood. No amendment is considered necessary.



### **13 Health and hygiene requirements**

Two submissions noted the differences in health and hygiene requirements between Standard 4.2.1 and Standard 3.2.2. The suggestion was made to either include Clauses 14 and 15 from 3.2.2, or alternatively, amend 3.2.2 in line with the provisions required for 4.2.1 for consistency.

It should be noted that the requirements for 3.2.2 in Clause 15 are far more detailed than the equivalent clause in 4.2.1. The distinction is that 4.2.1 is aimed at primary production and processing, whilst 3.2.2 is for an industry that in some cases will be preparing ready-to-eat food and therefore necessarily will need greater food safety requirements. However, it is noted that this Clause, as drafted for the DAR, failed to provide for an important provision contained in Chapter 3 concerning a seafood handler who may have a food borne disease (see paragraph 14(1) of Standard 3.2.2). A similar provision has been added to Clause 13 as a new part (2). Food borne illness is defined in 3.2.2 and the definition applies to Chapter 4.

### **14 Seafood premises and equipment**

One submission suggested that all operations on fishing vessels should be required to have some form of CODEX/HACCP-based food safety programs in place.

This view is inconsistent with the Ministerial Council guidelines that are based on the principle that risk management strategies should be commensurate with the food safety risk posed.

It was also noted that the clause did not have any requirement to use equipment made from materials that will not contaminate seafood or that are fit for use.

It was agreed that the term 'constructed' implied that the equipment would be made from appropriate materials.

The Clause has also been amended to take into account that some equipment used in the primary production of seafood only need to be kept reasonably clean as appropriate for the working environment. This would be applicable to, for example, scallop trolleys, nets, growing racks.

### **Division 3 – Harvesting and other requirements for bivalve molluscs**

#### **Incorporation of ASQAP directly into the Standard – the legal issues**

Two submissions suggested that the Standard should incorporate ASQAP either by reference or by incorporation of the text of ASQAP.

Division 3 now references ASQAP in a way that is legally supportable.

Discussions will also be held with ASQAAC and the ISC in regard to ASQAP and the ongoing role of ASQAAC in maintaining the manual.

## Clause 15 Definitions – SSCA, spat, bivalve molluscs

### ‘relaying’

It was suggested in one submission to modify the definition of relaying, specifically to remove the words ‘by using the ambient temperature as a treatment process’, as the remaining words adequately convey the intent.

The drafting has been amended accordingly.

### ‘bivalve molluscs’

The definition of ‘bivalve molluscs’ as drafted for the DAR excluded both scallops and pearl oysters where the only part consumed is the adductor muscle. Some submissions have questioned if is valid scientific evidence to support the exclusion, and pointed out that the ASQAP Manual does not exclude pearl meat in its definition of bivalve molluscs. In other submissions, the pearl industry indicated that they supported the exclusion of the meat, and provided scientific data on heavy metal analysis to support their stance in the two submissions received. They also submitted a proposal for a study into biotoxin accumulation and indicated that they were going to approach ASQAAC to request they change their definition to exclude pearl meat. The study is yet to commence.

Further, during a jurisdiction consultation session, SA advised that another bivalve mollusc, razorfish, is marketed for its adductor muscle only. It was suggested to make the exemption more general to include all current and future scenarios where the only part of the product consumed is the adductor muscle.

Following receipt of the submissions to the draft assessment report, discussions were held between representatives of the Western Australia pearl industry, the WA Departments of Health and Fisheries and FSANZ on the issue of whether to retain the exclusion for pearl meat.

In January 2005, a meeting of the Risk Assessment Working Group for the Seafood Primary Production and Processing standard was convened to discuss the issue. After considering the scientific issues for pearl meat, application of the risk ranking methodology to algal biotoxins in pearl meat led to a relative risk ranking of *Medium* on a whole-of-population basis. It was noted that considerable levels of uncertainty surrounded the ranking for the consuming population due to the lack of scientific literature relating to prevalence, concentration and distribution of algal biotoxins in pearl oysters. It is understood that the industry is prepared to undertake a suitable scientific study to remove the major point of uncertainty. The study will be undertaken in consultation with FSANZ and biotoxin experts during the two year period leading up to the standard taking effect.

It was recommended by the Risk Assessment Working Group that the Seafood Standards Development Committee examine specific management strategies for pearl meat. It was recommended and agreed that on the basis of the relative risk ranking of Medium for pearl oyster meat, that the exclusion of pearl oyster meat from the specific requirements of the Seafood Primary Production and Processing Standard should remain.

### **‘spat’**

It was indicated that spat is being sold in some QLD establishments as bottled oysters. Where this is the case, under the definition it would not be ‘spat’, and therefore the requirements for bivalve molluscs would apply.

For greater clarity, the definition of spat was redefined to clearly spell out that it is product taken solely for the purpose of ongrowing. In addition, an Editorial Note was added to state that if spat are sold for human consumption, then the product falls within the definition of ‘bivalve mollusc’ and the requirements of Division 3 for bivalve molluscs apply.

### **‘SSCA’**

A number of jurisdictions commented that this definition is not appropriate, as it would require the creation of a new agency. It was noted that the agencies responsible for implementing ASQAP vary from State to State across Australia.

Legally, the definition was not acceptable because it attempted to limit the definition to those agencies that perform certain functions of a corresponding nature to those specified in the ASQAP manual. This type of definition has been held to be unenforceable (*Gibbs v FCT* per Barwick CJ (1966) 118 CLR 628 at 635).

The definition was changed such that it could be legally implemented. References to ‘SSCA’ were changed to ‘Authority’, and a definition of ‘Authority’ – ‘means the State, Territory or Commonwealth government agency or agencies having the legal authority to implement and enforce this Division’ – was included in Clause 15 Interpretation.

### **‘growing on’ and ‘wet storage’**

It was noted in two submissions that these terms are used in the Division and it was suggested they need defining.

Definitions of both of these terms were included in the list of definitions in Clause 15 Interpretation.

### **‘batch’**

Clause 19 on co-mingling referred to ‘lots’. One submission suggested this should be ‘batch’ with an appropriate definition.

A definition of ‘batch’ was added to the list of definitions in Clause 15 Interpretation.

### **16 & 17 Harvesting – areas undergoing classification**

One submission noted that it takes two years to classify an area for collecting bivalves and this should be accommodated in the drafting.

It was also raised in two submissions that the requirement for bivalve molluscs to be harvested from areas that have been classified subject to a marine biotoxin management plan will have impact on the QLD wild oyster industry. It was suggested that it would be too onerous and uneconomical for the wild oyster industry to meet this requirement.

States and territories will be able to set their own requirements for what will be required for a Marine Biotoxin Management Plan, which will allow for flexibility in the implementation of the plans.

Clause 16 and 17 have been removed and a general reference to ASQAP has been made.

### **18 Wet storage of bivalve molluscs**

The wording of the clause was questioned in one submission in regard to the use of the terms ‘effectively disinfected’ and ‘those conditions’.

The clause has been removed and a general reference made to ASQAP.

### **19 Co-mingling**

It is suggested that there be a change to the wording of this clause, specifically the word ‘lot’ be changed to ‘batch’ and the definition of batch included in the Definitions.

The Clause has been amended with the use of the word ‘batch’. ‘Batch’ has been defined in the Definitions under Clause 15.

A number of submissions also sought a strengthening of the co-mingling clause to take it beyond primary production and into the retail sector.

Industry members of the SDC supported the clause to prevent co-mingling and acknowledged this is generally in place in the primary production part of the chain. It was noted that there are no clauses to prevent co-mingling in Chapter 3 and that lack of traceability was flagged at OzFoodNet as being an issue for a whole range of products in relation to the investigation of food-borne illness outbreaks. The possibility of including a clause to prevent co-mingling in Chapter 3 will be investigated. However, the issue of an amendment to Chapter 3 had not been discussed with retailers during the development of the seafood PPP Standard. As a matter of priority, FSANZ will develop a separate proposal for the prohibition of co-mingling of high risk products at the manufacturing and retail levels.

### **20 Food safety management systems for bivalves**

It is suggested that Clause 20 and the corresponding clause for Chapter 3 be redrafted to include the editorial material in the actual clause on the basis that the editorial note is not legally binding.

The Clause was redrafted such that the content of the editorial note forms part (2) of the actual Clause. The reference to ‘suitability’ in clause 20 was also removed to be consistent with the approach in standard 3.2.1, which deals only with food safety programs for safety purposes.

## **Miscellaneous amendments to the drafting**

A number of provisions referred to either ‘practical measures’ or ‘reasonable measures’ where there seems no reason for using different descriptions of the measure. In the context of the draft standard there appears little difference between ‘practical’ and ‘reasonable’. ‘Reasonable’ also has a more recognised legal meaning than ‘practical’.

All references to ‘practical measures’ were changed to ‘reasonable measures’.
---

The Standard contained a number of references to ‘safe and suitable’. It was suggested these references be amended to ‘safe or suitable’ to convey the disjunctive rather than conjunctive meaning.

The Clauses were amended accordingly.
---------------------------------------

## **OTHER ISSUES – NON-DRAFTING**

### **Mandatory General Provisions**

There was the suggestion in one submission that the General Provisions should be voluntary for low and medium risk sectors with mandatory requirements only for bivalve molluscs unless the standard as drafted is supported by industry. However, a submission from the SA Fishing Industry Council indicated that they supported the application of a seafood safety standard provided the Standard prescribes requirements only for the management of high-risk products.

The States and Territories that have indicated support in their submission for Option 3 - with General Provisions for the low and medium risk sectors and Specific Provisions for bivalve molluscs - include Tasmania, Qld and WA. In the consultation sessions, NT also indicated their support. Other support came from the Food Technology Association of Victoria, the Tasmanian Fishing Industry Council, Australian Food and Grocery Council, Australian Consumers Association and Seafood Services Australia.

### **Consistent implementation across the jurisdictions**

Several submissions noted their concerns about the scope for inconsistent application of the standard at the State level. This issue was also voiced at several of the consultation meetings with the States/Territories and by the SDC.

FSANZ raised the concerns around potential inconsistent implementation across the jurisdictions was raised with the Implementation Subcommittee (ISC) at their meeting in October. ISC indicated that they would be happy to take part in a meeting to discuss consistent implementation across the jurisdictions. The SDC will be discussing these issues with ISC in early 2005.

### **Other implementation issues**

One submission urged FSANZ to ensure that the national standard will not compromise regulatory measures already in place in NSW. As drafted, the proposed standard should not compromise the capacity of NSW to enforce their regulatory measures already in place.

One submission stated that it was imperative that FSANZ ensure that there is no duplication between this proposed standard and other standards already in existence or under preparation in South Australia. There are no existing standards in South Australia so there is no risk of duplication in this state.

### **Audits**

Several submissions made mention of concerns around ensuring recognition of third party audits and a process for recognition of equivalence. Further, there were concerns voiced about the cost of audits.

The concerns raised in the submissions around this issue were communicated to ISC at their October 2004 meeting.

Currently, ASQAP is in place for export with audits being conducted by AQIS (or by States on behalf of AQIS). Further discussions are occurring between AQIS and the States/Territories in relation to the States recognising AQIS audits without the requirement for further separate State requirements to determine compliance with the domestic standard. At the national level work is proceeding on the finalisation of food safety auditor competencies and ISC has commenced a body of work in relation to a national food safety auditor policy.

### **Exclusion of mandatory fish names from the Standard**

Seven submissions made mention of the exclusion of the fish names from the Standard.

Following extensive discussions this matter with the SDC an approach to this matter was agreed. This entails the development of an Australian Standard that can be used under fair trading laws as a reference document.

Once completed, FSANZ will consider an application to reference the Australian Standard in the Code following FSANZ's normal assessment processes.

To further assist in the process of correct use of fish marketing names, FSANZ has funded the development of posters through Seafood Services Australia and is working with the food industry to support the development of a Standards Australia standard.

### **New Zealand border issues**

The submission from the New Zealand Food Safety Authority made the suggestion of having a single consistent standard to be applied across Australian export and domestic shellfish products. This would not be appropriate, as the Export Orders require higher level HACCP requirements for all seafood. This would not be in line with the policy of minimum effective regulation across the low and medium risk products.

NZFSA also raised the issue of equivalence between the NZ Animal Products legislation and the instruments made under the legislation. It was noted that the proposed standard has far less controls than in New Zealand and that this would mean they have little choice but to continue their risk list protections for shellfish.

It is noted that importing countries have the prerogative to impose higher import requirements where justified. The Export Control (Processed Food) Orders require a higher level of requirements for all seafood products and growers who export bivalve molluscs will need to meet these requirements.

### **Imported product**

Two submissions called for the mandatory labelling of imported seafood at the food service level.

The Code stipulates that food must be labelled at the retail level but not at the restaurant level. Food service establishments are obliged to tell the truth when asked about the origin of the seafood.

Several submissions also made mention of imported product in terms of how the standard would apply at the border.

Discussions are progressing between AQIS and FSANZ on the development of a system to improve the enforcement of outcomes-based standards at the border.

### **The Risk Ranking Report and Risk Assessment Issues**

One submission contended that there were serious flaws in the model used for the Risk Ranking Report and therefore some of the conclusions for the risk rankings would be similarly flawed. It suggested that the RRR could not be used and that other input should be sought before any risk management decisions were made. The suggestion was made to take into consideration the number of seafood meals consumed per year the likelihood of an incident occurring at all. A second submission also called for the risk assessment to be completely reassessed to include the risk of a seafood safety incident happening at all. At the October SDC meeting, various industry members stated that they wanted to ensure recognition of the fact that alternative views to the Risk Ranking Report exist.

The Risk Ranking Report was submitted for international peer review. The results of the review were very positive and lead to minor amendments as appropriate. It is part of FSANZ's regular responsibilities to keep up to date with emerging scientific issues or data. FSANZ will also undertake a review of the Risk Ranking Report 3 years after gazettal of the proposed standard.

### **Risk Management issues**

One submission stated that the risk of a seafood safety accident happening at all should be clearly explained to the consumer in a manner that promotes the health benefits of eating seafood.

FSANZ released the Seafood Draft Assessment Report with a press release that emphasised the benefits of eating seafood and with a focus on protecting public health and safety.

One submission noted that the proposal deals principally with the high risk seafood and questioned what FSANZ proposes to do with medium risk seafood. Division 2 of the proposed standard - General Seafood Safety Requirements - addresses the requirements for all seafood (low, medium and high risk).

One submission called for mandatory food safety program for anyone producing hot or cold smoked seafood, together with mandatory instructions.

The DAR assessed hot smoked seafood as medium risk and therefore there were no requirements for specific provisions. Cold smoked products were assessed as high risk but in terms of the impact of *Listeria monocytogenes* in susceptible population groups. Current risk management strategies include requirements in Chapters 1 and 3 of the Code and a pamphlet on Listeria that provides specific advice to the susceptible groups. The implementation of specific food safety programs would need to be justified by a positive benefit-cost ratio – a policy principle agreed to by the Ministerial Council on Food Regulation in their discussions on the management of food safety in Australia.

### **Storage temperature of oysters**

It was noted in a submission that ASQAP has specified storage temperatures and depuration conditions for live oysters, with different types of oysters having different requirements.

This situation is addressed by Clause 6(3). This Clause states that a ‘seafood business must, when storing live seafood, store the seafood at a temperature that will not adversely affect the safety or suitability of the seafood’. Therefore, if certain live oysters require storage at different temperatures, then the onus is on the business to store them at the correct temperature.

### **Maximum Residue Limits**

One submission supported a review of the Maximum Residue Limits (MRLs) for seafood.

MRLs for pesticides and veterinary chemicals are (re)assessed on a routine basis by FSANZ, in conjunction with the Australian Pesticides and Veterinary Medicines Authority (APVMA), taking into consideration total dietary exposure from all food sources.

### **Salmon marketing name**

One submission stated that the salmon from Tasmania is recognised in Australian and export markets as ‘Tasmanian salmon’ and ‘Tasmanian smoked salmon’. The submitter stated that this is a unique marketing name and indicated that it must be allowed to be used in the future. This is not a food safety issue.

### **Impact on Yabby farmers**

Several submissions were received on the issue of impact of the Victorian Government’s implementation of the Seafood Safety Act 2003, and the enforcement of this Act through Primesafe together with the subsequent adoption of the FSANZ PPPS for Seafood. The request was made for the exemption of the sale of live yabbies (freshwater crayfish) from the regulation under the Victorian Seafood Safety Act 2003. It was stated that the yabby industry cannot continue to viably exist under the proposed Primesafe licensing and audit plans. This is not a matter for FSANZ consideration and has been referred to Victoria.



## **Guard Dogs**

One submission sought a rewording of Clause 24 in Division 6 of 3.2.2 to permit the use of guard dogs in processing areas under controlled circumstances, but not while processing is occurring.

This issue is not related to the Seafood Primary Production and Processing Standard.

## **Indigenous fishers**

It was noted during a jurisdiction consultation session that there were concerns in the seafood industry that Indigenous fishers may be entitled to higher bag limits than recreational fishers, and that they may then be engaging in trade or exchange with other groups.

It was clarified that should Indigenous fishers be engaging in trade with other groups, this would be considered selling and therefore would be covered as retail under the Code. The primary production standards apply up to the start of retail.

## **Fish bone injuries**

One submission suggested that the proposed standard should address the issue of physical hazards in fish marketed as filleted and boned.

Clause 2(4) of 3.1.1 refers to the suitability of food. Food would be deemed unsuitable if it contained an object or agent foreign to the nature of the food. A fish bone in a fish is not a foreign object and therefore does not affect the suitability of the fish for consumption. If fish was marketed as boneless and was found to have bones, this would then constitute a trade description issue. It is not a food safety issue.

## **Country of Origin**

The question of Country of Origin arrangements was raised at a jurisdiction consultation session. It was queried if the transitional arrangements will prevail or whether FSANZ would go back to review.

Advice on the status of this matter was provided directly to the jurisdiction in question.

## **Industry guidelines**

It was suggested in a jurisdiction consultation that there is a need for industry guides (scallops and calamari in particular) to guide individuals on good industry practice. Existing industry guidelines address this issue. A list of available industry codes of practice is available at Attachment 8 of this document.

## **Ready to eat Seafood guidelines**

One submission raised the issue of bacteriological pathogens that are currently absent from the Code (eg. *V. parahaemolyticus*, *V. vulnificans*, *Yersinia enterocolitica*, *Clostridium*). The submitter indicated that these pathogens need to be addressed in the ready-to-eat food guidelines.

*Vibrio parahaemolyticus* is referenced for seafood in the User Guide to Standard 4.6.1 – Microbiological Limits for Food with additional guideline criteria. The guide is intended to provide information to help retailers, caterers, manufacturers and food officers to interpret and apply Standard 1.6.1 – Microbiological Limits for Food. Standard 1.6.1 specifies the microbiological standards for nominated foods or classes of foods. Mandatory microbiological standards have been set where risk assessment has shown that the risk of food-borne illness associated with the consumption of certain foods is relatively high and that a standard could contribute to the management of the risks identified.

## Summary of Submissions at Initial Assessment

A public consultation period occurred from 18 December 2002 to 28 February 2003 for comment on the Initial Assessment of Proposal P265. During this period, 23 separate submissions were received by FSANZ. Two late submissions were also received.

The list of the submitters and a summary of their submissions is provided in the table below.

Organisation / Author (Abbreviation)	Summary / Major Points
Kanins Pty Ltd / Nigel Watt (Kanins)	<ul style="list-style-type: none"> <li>• comments on the health and safety risks associated with treatment of Black Spot (melanosis) in uncooked prawns in Australia</li> <li>• notes that they believe there are serious health and safety problems with the current control practice involving dipping in sodium metabisulphite</li> <li>• suggested alternative is dipping in EverFresh (active ingredient 4-hexylresorcinol), free from health and safety concerns</li> </ul>
Tasmanian Fishing Industry Council / Ralph Mitchell (TFIC)	<ul style="list-style-type: none"> <li>• supports utilisation of the national industry seafood standard (SSA/ASIC application submitted to FSANZ) as appropriate within the standard, perhaps as interpretive guidelines</li> <li>• suggests marine plants should be included, while crocodile and mammalian meat should be excluded from the scope of the standard</li> <li>• chemical and biological hazards would not need to be listed specifically in the standard, rather they could be referenced from previous chapters of the Code</li> <li>• the seafood standard should regulate up to, but not including, point of retail sale</li> <li>• fishing vessels producing a live product that can demonstrate little or no significant risk of introducing a hazard should be exempt from a certified food safety plan – in line with the theory of minimal impost to industry</li> <li>• fishing vessels that process or store product on board may not have the facilities to accommodate regulatory inspectors on board, in which case the vessel skippers could be encouraged to obtain accredited training to cover food safety training on board</li> <li>• an awareness program would be a useful means of reinforcing the basics of food safety on board fishing vessels</li> <li>• suggests that a receival standard, whereby regulation/enforcement begins at the wharf (the receiver would be responsible for ensuring that seafood received from the vessel is safe to eat), may be used to encourage compliance together with lessening impost</li> <li>• any risk assessment process utilised in standard development needs to be specific to the situation to which it is being applied, particularly in the case of fishing vessels; a ‘one size fits all’ approach would be inappropriate</li> <li>• existing standards, such as TASQAP and the NSW Seafood Safety Scheme, should be incorporated into the interpretive guidelines as appropriate</li> <li>• the industry could utilise industry documents, such as ASIC’s ‘A Code of Conduct for a Responsible Seafood Industry’ to provide objectives and principles, particularly where mandatory measures are ineffective</li> </ul>

	<ul style="list-style-type: none"> <li>•the seafood standard must apply equally to all seafood traded in Australia, regardless of its origin, in line with the WTO rules providing that a country cannot impose regulation on imports that do not apply domestically.</li> <li>•the time frame for standard implementation must be established through close consultation with industry, in accordance with the range of commodity types, business sizes, vessels and equipment, and communication skills involved in seafood production and processing in Tasmania</li> <li>•raises questions about the integrity of some aspects of the summary of the Wallis Lakes incident as an illustration of the cost to industry of risks associated with food-borne illness from seafood</li> </ul>
Northern Territory Seafood Council (NTSC)	<ul style="list-style-type: none"> <li>•supports the seafood standard as a means for providing consistency across Australia in regard to the safety of seafood</li> <li>•supports an outcome based, rather than a prescriptive standard, hence avoiding undue impost to industry and concurrently increasing consumer confidence in seafood</li> <li>•supports the SSA voluntary industry Australian Seafood Standard, as submitted to FSANZ</li> <li>•considers it essential that the seafood standard allow businesses to utilise solutions to any food safety risks as appropriate to the level of risk involved e.g. a HACCP plan or GMP may be appropriate in different situations</li> <li>•the seafood standard should cover from point of harvest through to point of retail</li> <li>•where there are already standards in place with which the retail sector must comply, the standard should refer to these rather than duplicate them</li> <li>•supports the SSA submission that the standard should recognise and reference the Australian Fish Names list</li> <li>•supports the SSA comment that the seafood standard must automatically recognise export establishments as complying with the standard</li> </ul>
Seafood Export Consultative Committee (SECC)	<p>Provides comments under two main headings:</p> <ul style="list-style-type: none"> <li>• incorporation of existing regulation into a PP&amp;PS for seafood <ul style="list-style-type: none"> <li>○ raises concerns that state regulators would not have the capacity to implement and police a single standard, and that a single mandatory standard may duplicate existing regulation of seafood by AQIS</li> <li>○ therefore the standard must contain provisions to recognise automatically export establishments as complying with the PP&amp;P Standard</li> <li>○ or alternately that mutual recognition of audits by AQIS and each state regulator</li> <li>○ AQIS should become a full member of the FSANZ SDC, given their extensive practical experience</li> </ul> </li> <li>•the costs of existing regulation <ul style="list-style-type: none"> <li>○ current costs to industry are presented</li> <li>○ duplication of existing regulation by State authorities would not be considered good value, or be accepted by industry</li> </ul> </li> </ul>
City of Unley / S. J. Sowter (Unley)	<ul style="list-style-type: none"> <li>•raises the issue of which jurisdiction would be responsible for regulation and implementation of the seafood PP&amp;P standard</li> <li>•suggests that production aspects would be best regulated by PIRSA</li> <li>•and processing aspects would be best regulated by the Department of Human Services</li> </ul>
Food Technology Association of Victoria / David Gill (FTAV)	<ul style="list-style-type: none"> <li>•the Technical Sub Committee of this association accepts the Issues Paper as presented and without further comment at this stage</li> </ul>

<p>Sontari Foods / Hope Kearney (Sontari)</p>	<ul style="list-style-type: none"> <li>•notes that food safety is a shared responsibility between the government (through FSANZ), industry, and the consumer</li> <li>•raises concerns about the definition of seafood – suggest that the standard should determine the point that aquatic product becomes food</li> <li>•notes that ABARE statistics regarding Australian seafood production volumes relate to green weight, hence there is an error in contribution of domestic consumption figures – imported seafood contributes around 65% to Australian seafood consumption volume</li> <li>•notes that importers may work with overseas suppliers who operate on strict codes of practice that are considerably tighter than those operating in Australia</li> <li>•agree that quality attributes and methodologies should not be enshrined in the code</li> <li>•believes that marine animals should be included in the standard</li> <li>•the seafood standard should apply through to point of sale, and should not exclude fishing vessels</li> <li>•upon consideration of the proposed SSA/ASIC standard, feels that a wider view is required for the Australian seafood sector than that of SSA, who does not engage with the considerable Australian seafood import sector</li> <li>•opposes formally incorporating the Australian Fish Names list into the standard, as suggested in the proposed SSA/ASIC standard</li> <li>•has considered the NSW Safe Food Production system and feels there are various deficiencies: <ul style="list-style-type: none"> <li>•as the certificate is issued at time of payment of the fee, it is therefore easy to be deceived into thinking that a food safety plan actually exists</li> <li>•insufficient industry extension work has been undertaken by Safe Food NSW</li> <li>•audits are only authorised by Safe Food officers, passing over a wide range and high standard of commercial auditors</li> <li>•the program does not carry through to the consumer</li> </ul> </li> <li>•notes that import legislation, although not perfect, seems to be working reasonably well</li> </ul>
<p>NT Government / John MacCartie (NT Govt)</p>	<ul style="list-style-type: none"> <li>•raises concerns regarding multiple audits – suggests that auditors need to be accredited to audit against more than one regime, or audit covering a lesser standard</li> <li>•questions whether consideration will be given to good corporate history e.g. an AQIS type bonus scheme</li> <li>•questions whether any national standard will have a national accreditation mark, or whether this will be left to individual jurisdictions</li> <li>•questions whether aquaculture and wildcatch ventures that sell at the door or over the gunwale will be subjected to the PP&amp;PS or the Code</li> <li>•suggests that aquaculture be regulated from the start of culture</li> <li>•suggests that if the onus is on the supplier to sell safe food it will negate the need for heavy regulation of the primary production end of the chain</li> </ul>

<p>Seafood Council (SA) Ltd (SASC)</p>	<ul style="list-style-type: none"> <li>•the PP&amp;PS should reference other parts of the Code where appropriate, further requirements should only be added where there are significant risks identified and public health benefits are greater than the cost of implementation</li> <li>•considers that the standard should not impose food safety regulations on businesses involved in the harvesting, handling and processing of seafood on board fishing vessels, as the public health risk relating to these activities is low</li> <li>•believes that a number of issues in the proposed SSA Standard need to be addressed prior to it being used to guide the national standard</li> <li>•specifically, the basis of the SSA Standard is the mandating of food safety programs for the whole seafood chain, whereas the Council believes that the standard should apply only to those elements of the chain that are at risk</li> <li>•believes that the principles underpinning ASQAP should be mandated through the Standard for all bivalve molluscs collected for human consumption</li> <li>•suggests that the Standard should not impose further requirements on sectors which are already meeting AQIS or other international requirements for food safety</li> <li>•believes that the industry should be encouraged to develop voluntary codes and that the Standard should provide for these to be mandated, or provided legislative recognition if requested by industry</li> <li>•believes there should be an option for sectors to demonstrate compliance with hygiene requirements by voluntary adoption of food safety programs with accredited third party auditors</li> <li>•does not support imposition of food safety programs on industry sectors unless there are strong public health reasons or there is strong industry support (and agreement by government)</li> <li>•considers that the frequency of audits should be appropriate to provide confidence that the system is under control, hence in the first instant there would be more frequent audits that would subsequently be reduced to an agreed level, with increased audits if there is evidence that the system is not under the level of control required</li> </ul>
<p>Environmental Health Unit, Queensland Health / Kerry Bell (Qld Health)</p>	<ul style="list-style-type: none"> <li>•concerned that there not be any duplication of existing legislation</li> <li>•current MRLs for seafood need revisiting: <ul style="list-style-type: none"> <li>○ current values have been derived in the main from mammalian studies</li> <li>○ MRLs do not related directly to health issues particularly when considering the low level of seafood consumption in Australia</li> <li>○ fish in particular metabolise fats at a much more rapid rate than mammals, therefore some residues can be purged within practical timeframes, as opposed to mammals</li> </ul> </li> <li>•consistency is required between the states and the national standard in relation to the inclusion or exclusion of aquatic plants under the definition of seafood</li> <li>•questions whether the current Australian Standard for Hygienic Production of Crocodile Meat for Human Consumption is adequate</li> <li>•suggests that risk profiling is necessary to determine where higher standards are required, such as for ready-to-eat seafood, compared to seafood that has undergone a pathogen reduction step, such as cooking</li> <li>•suggests aquaculture products should be covered from production to point of retail sale</li> </ul>

	<ul style="list-style-type: none"> <li>•considers that a thorough Risk Assessment process has been applied within the Australian seafood industry, however some areas require attention, specifically aquaculture and chemical/pesticide residue accumulation as a consequence of prior land use</li> <li>•suggests there are various anomalies within the proposed SSA/ASIC Australian Seafood Standard</li> <li>•believes that food safety risks should be managed according to the degree of risk</li> <li>•audits should be seen as one of a suite of tools, there may be room to include incentive based compliance in the form of reduced frequency of audit, or other forms of rewarding good practice</li> <li>•the plethora of industry Codes of Practice available need to be reviewed for adequacy and equivalence</li> </ul>
Tasmanian Salmonid Growers Association (TSGA)	<ul style="list-style-type: none"> <li>•challenges the FSANZ assumption of the need for a PP&amp;P Standard for seafood</li> <li>•alternately, believes that by removing the exemption for primary production in Chapter 3 of Code and qualifying the standards to allow for the conditions in primary production of seafood, would sufficiently cover food safety issues for seafood</li> <li>•believes that Chapters 1 &amp; 2 of Code cover the hazards of concern, or could be easily modified to do so</li> <li>•the standard should clearly state the seafood species that the histamine requirements apply to, as TSGA members have experienced problems around testing for histamine – as this is expensive and has been demanded by customers and their auditors, despite it being irrelevant to cold-water salmon</li> <li>•duplication of standards should be avoided, and cost to industry minimised by any standard</li> <li>•consideration of controls at point of receipt of fish may be an alternative to fishing vessel inspection</li> <li>•risk assessment must be thoroughly and methodically applied to each seafood group before regulation is proposed</li> <li>•HACCP and Listeria monitoring programs are recognised as important for cold smoked salmon and any move to mandate food safety plans for these products would be welcomed</li> <li>•any technical data provided to FSANZ must be maintained in confidence, particularly in relation to individual company data</li> <li>•self-regulation is encouraged to be considered ahead of government regulation, for example the GMP guidelines produced by SSA and other industry Codes of Practice should be implemented, together with effective training of food handlers</li> <li>•expresses concern that any FSANZ proposals are not more onerous on Tasmanian processors than those in New Zealand, as the proposed standard will apply only in Australia</li> </ul>

<p>Centre for Food Technology, The Agency for Food and Fibre Sciences, QDPI / Clare Winkel (AFFS)</p>	<ul style="list-style-type: none"> <li>• fishing boats should not be required to have a full food safety plan unless processing occurs on board, otherwise they should only be required to implement Good Hygienic Practices</li> <li>• the information in the Safe Food NSW Seafood Safety manual should be used as the Australian Standard</li> <li>• believes that in relation to animals with high value to indigenous communities, such as turtles and dugongs, it is the preparation of these animals rather than their catching that carries food safety risks, and considers that this is covered by local health workers</li> <li>• the author refers to the ASS and makes the following comments:</li> <li>• the seafood industry should be asked only to comply with the current version of the Code, i.e.: sections 3.1.1, 3.2.2 and 3.2.3</li> <li>• chilling temperature should remain between <math>-1^{\circ}\text{C}</math> and <math>5^{\circ}\text{C}</math>, and the freezing temperature should remain at <math>-18^{\circ}\text{C}</math></li> <li>• Section 9 &amp; 10 of the SSA/ASIC Standard, on operational hygiene and construction of premises, seems suitable for use in premises used for live fish and on trawlers</li> <li>• it is very necessary for harvesters to identify the date and place of the catch to enable identification of product caught in areas found later to be contaminated</li> </ul>
<p>SA Department of Human Services / Brian Delroy (SA DHS)</p>	<ul style="list-style-type: none"> <li>• in addition to those hazards already addressed in the Code, escolar, often sold as ‘rudderfish’, may need to be addressed in the Code</li> <li>• the seafood standard should not overlap with the matters covered by Chapters 1 and 2 of Code</li> <li>• the current definition of seafood within Code is considered adequate</li> <li>• the proposed standard should not cover aquatic plants, reptiles and mammals</li> <li>• the standard would ideally regulate activities on a fishing vessel, however as it is recognised that there are difficulties with enforcement; a code of practice may need to be developed to assist vessel operators</li> <li>• DHS has carried out numerous surveys concerning microbiological and heavy metal hazards in oysters, histamine in canned fish, micro in prawns etc., and can provide this information if requested</li> <li>• the SSA standard is seen as providing helpful input, but is not supported in its present form for a number of reasons, including that it appears to mandate the equivalent of Standard 3.2.1 of Code, and that it overlaps with Standard 3.2.2 and Chapter 1</li> </ul>
<p>South Australian Seafood Marketers and Processors Association Inc / Mark Cody (SASMPA)</p>	<ul style="list-style-type: none"> <li>• suggests that the seafood definition used by Codex would appear to be suitable</li> <li>• suggests that the scope must be the whole supply chain with emphasis on retail, hospitality sectors</li> <li>• the standard should apply specifically to those areas that pose a risk, and must pay regard to current arrangements, such as compliance with market driven and AQIS standards</li> <li>• notes that the risks associated with on-board processing in Australia are negligible, in contrast to those in New Zealand, due to their large scale processing vessels and foreign crews</li> <li>• notes that sushi and sashimi specialty shops need to be considered in the standard, as these represent raw, ready-to-eat seafood in a fast growing consumer market</li> <li>• recognise that a risk assessment process is vital in the standard development process, but also suggest that a different approach may need to be adopted for any ‘external’ or ‘end-user’ risks that are evident</li> </ul>



	<ul style="list-style-type: none"> <li>• suggest that caution should be exercised in interpreting health outcomes from epidemiological data in a simplistic model</li> <li>• believe that HACCP must be the base for all food safety management systems, and suggest that AQIS and existing supplier systems must be considered in any management system, and a tailored approach used taking into account whether a high or low risk is involved</li> <li>• believe that the cost of any proposed management system must be considered, for example duplicate audits must be avoided and there must be interstate consistency</li> </ul>
<p>Sydney Fish Market Pty Ltd / Bryan Skepper (SFM)</p>	<ul style="list-style-type: none"> <li>• believes the proposed standard should apply to all seafood that is produced or traded commercially in Australia, including seafood: <ul style="list-style-type: none"> <li>○ produced in Australia by commercial fishing or aquaculture</li> <li>○ exported from, or imported into Australia</li> <li>○ sold on the Australian domestic market</li> </ul> </li> <li>• believes the proposed standard should not apply to: <ul style="list-style-type: none"> <li>○ recreational catch (unless sold for consumption)</li> <li>○ seafood taken by Aboriginal or Torres Strait Island people for traditional or cultural reasons (excluding sale for consumption)</li> <li>○ crocodile and seaweed</li> </ul> </li> <li>• believes that the definition of seafood should not include crocodile and seaweed</li> <li>• believes that the standard should regulate the production of seafood through to the final retail sale, and that this should be further reinforced with a public education program</li> <li>• agrees that the proposed standard must be outcomes based, but suggests that fishing vessels may not require a full Codex HACCP system e.g. where risk to food safety is low, instead utilising other features</li> <li>• for such activities and products that carry a high food safety risk, a full HACCP plan would be warranted</li> <li>• risk assessment and profiling should rely on work that has already been undertaken by various authorities and the seafood industry</li> <li>• is prepared to assist where possible with the provision of technical data for incorporation into the scientific risk assessment process</li> <li>• the industry developed Australian Seafood Standard (SSA) should form the basis of a regulatory PP&amp;P Standard as it was developed through an exhaustive consultative process, and most of the issues have already been debated and agreed during its development</li> <li>• believes that the work undertaken by Safe Food Production NSW should also be taken into account in development of a national PP&amp;P Standard for seafood, as well as the issues raised in the ‘Section 73’ review into the Integration of the NSW Food Safety System (conducted by the Hon. John Kerin, published Nov. 2002)</li> <li>• believes the standard must be outcomes focused and based on food safety risk</li> <li>• where risk to food safety is demonstrated to be low, non-regulatory guidelines and codes of practice could be an effective means of achieving the overall outcome of providing safe seafood for customers</li> <li>• raises concern that multiple audits be imposed on industry by both government and other industry sectors, and therefore suggests that mutual recognition of audits by government agencies and acceptance of third party audits conducted by competent auditors must be considered <ul style="list-style-type: none"> <li>○ past audit performance of a seafood business must also be taken into account as well as the food safety risk profile of the business</li> </ul> </li> </ul>

	<ul style="list-style-type: none"> <li>• Includes the following relevant points from the NSW SIC submission to the Kerin 'Section 73' Review: <ul style="list-style-type: none"> <li>o food safety should be managed using a preventative approach based on through-chain risk management, with standards implemented in consultation and partnership with industry</li> <li>o believes that scientific risk assessment of food safety risks is needed for each industry and for each link in the chain, and that the management focus and costs should be directed towards those segments that present the greatest risk</li> <li>o suggests an increase in public good e.g. education and training, which must be supported by a significant increase in government contribution</li> <li>o believes that there should be a national approach aimed at eliminating inconsistencies between states</li> </ul> </li> </ul>
<p>Master Fish Merchants' Association of Australia / John Roach (MFMAA)</p>	<ul style="list-style-type: none"> <li>• believes the proposed standard should apply to all seafood that is produced or traded commercially in Australia, including seafood: <ul style="list-style-type: none"> <li>o produced in Australia by commercial fishing or aquaculture</li> <li>o exported from, or imported into Australia</li> <li>o sold on the Australian domestic market</li> </ul> </li> <li>• believes the proposed standard should not apply to: <ul style="list-style-type: none"> <li>o recreational catch (unless sold for consumption)</li> <li>o seafood taken by Aboriginal or Torres Strait Island people for traditional or cultural reasons (excluding sale for consumption)</li> <li>o crocodile and seaweed</li> </ul> </li> <li>• believes that the definition of seafood should not include crocodile and seaweed</li> <li>• believes that the standard should regulate the production of seafood through to the final retail sale, and that this should be further reinforced with a strong, well funded public hygiene education program specifically aimed at handling of food for 'in home' consumption, as well as an education program for food service businesses</li> <li>• agrees that the proposed standard must be outcomes based, but suggests that fishing vessels may not require a full Codex HACCP system e.g. where risk to food safety is low, instead utilising other features</li> <li>• for such activities and products that carry a high food safety risk, a full HACCP plan would be warranted</li> <li>• risk assessment and profiling should rely on work that has already been undertaken by various authorities and the seafood industry</li> <li>• the MFMA is prepared to assist where possible with the provision of technical data for incorporation into the scientific risk assessment process</li> <li>• the industry developed Australian Seafood Standard (SSA) should form the basis of a regulatory PP&amp;P Standard as it was developed through an exhaustive consultative process, and most of the issues have already been debated and agreed during its development</li> <li>• believes that the work undertaken by Safe Food Production NSW should also be taken into account in development of a national PP&amp;P Standard for seafood, as well as the issues raised in the 'Section 73' review into the Integration of the NSW Food Safety System (conducted by the Hon. John Kerin, published Nov. 2002)</li> <li>• believes the standard must be outcomes focused and based on food safety risk</li> <li>• where risk to food safety is demonstrated to be low, non-regulatory guidelines and codes of practice could be an effective means of achieving the overall outcome of providing safe seafood for customers</li> </ul>

	<ul style="list-style-type: none"> <li>• raises concern that multiple audits be imposed on industry by both government and other industry sectors, and therefore suggests that: <ul style="list-style-type: none"> <li>○ mutual recognition of audits by government agencies and acceptance of third party audits conducted by competent auditors must be considered</li> <li>○ past audit performance of a seafood business must also be taken into account as well as the food safety risk profile of the business</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>• Australian Institute of Environmental Health, South Australian Division / Michael Livori (AIEH SA)</li> </ul>	<ul style="list-style-type: none"> <li>• acknowledges that there are some areas of the food industry where sections are now not regulated in relation to food safety, such as seafood</li> <li>• agrees that an outcome-based standard focusing on food safety for sectors that are currently unregulated will help improve food safety</li> <li>• believe that the new standard should apply only to seafood production, including fishing, cultivating, growing and harvesting,</li> <li>• suggests further discussion and agreement is required with regard to enforcement and implementation</li> <li>• suggests that seafood production activities (including fishing, cultivating, growing, harvesting) would be best regulated by PIRSA, whereas regulation of activities involving substantial transformation of seafood (processing or storage on land prior to distribution) would fall within the jurisdiction of the local authority and the Department of Human Services</li> <li>• believe that all businesses involved in handling and selling seafood, including retail and businesses selling ready-to-eat seafood should remain covered under the current arrangements</li> </ul>
<p>Safe Food Queensland / John Burke (SFQ)</p>	<ul style="list-style-type: none"> <li>•believes that the current MRLs for seafood need to be revisited: <ul style="list-style-type: none"> <li>○ current values have been derived in the main from mammalian studies</li> <li>○ MRLs do not related directly to health issues particularly when considering the low level of seafood consumption in Australia</li> <li>○ fish in particular metabolise fats at a much more rapid rate than mammals, therefore some residues can be purged within practical timeframes, as opposed to mammals</li> </ul> </li> <li>•believes the scope will inevitably involve some crossover into quality aspects, and regards this as not undesirable</li> <li>•supports the inclusion of aquatic plants, as they are already included in Queensland legislation</li> <li>•believes that crocodile processing contains inputs very similar to aquaculture inputs, and though already included in meat standards is not adequately dealt with there</li> <li>•believes that food safety objectives are still relevant to Native Rights, and that the seafood involved will generally have a low risk profile, and hence is best addressed through risk communication</li> <li>• believes that aquaculture should be covered from production inputs to point of retail sale</li> <li>•industry should be encouraged to fill the few existing gaps in the current Australian risk assessment data</li> <li>•one area that requires attention relates to residue accumulation as a consequence of prior land use in aquaculture</li> <li>•regards SSA's industry preferred standard as a good framework for a national standard, but perceives various anomalies in this standard</li> <li>•believes that food safety risk in the seafood industry should be managed according to the degree of risk</li> <li>•audits should be seen as one of a suite of tools, there may be room to include incentive based compliance in the form of reduced frequency of audit, or other forms of rewarding good practice</li> <li>•the plethora of industry Codes of Practice available need to be reviewed for adequacy and equivalence</li> </ul>

Springs Smoked Salmon (Springs)	<ul style="list-style-type: none"> <li>•believes the Code should be reviewed and readdressed, as it does not allow for health claims associated with the positive health benefits of Omega 3 oil content in certain fish products</li> <li>•all foods should come under the proposed food standard, as the current food standard addresses food consumed by humans</li> <li>•the standard should cover the entire seafood industry, as the quality and food safety status of the food is affected from the point of harvest, and any resulting processes will be carried through the processing and to the retail point</li> <li>•businesses carrying ready-to-eat seafood should be considered under the same food standard regulations as other food establishments, as they carry the same, if not higher, risks to the eating public</li> <li>•the regulation should address the activities on board fishing vessels at point of harvest, in the same manner as that of food processing establishments</li> </ul>
New Zealand Food Safety Authority / Carole Inkster (NZFSA)	<ul style="list-style-type: none"> <li>•no specific comments at this stage</li> <li>•a reference to the New Zealand standards for seafood provided</li> </ul>
Simplot Australia Ltd (Simplot)	<ul style="list-style-type: none"> <li>•raises concerns with the potential lack of harmonisation between Australian states and territories, New Zealand and other countries – this is relevant as a significant portion of seafood is caught internationally and may undergo a range of processes, hence necessitating a very broad approach</li> <li>•agrees with the principles of minimum effective regulation and an outcome based approach</li> <li>•welcomes legislation that promotes consumer understanding and acceptance of a highly skilled and sophisticated seafood industry is welcomed</li> <li>•raises concerns relating to any erosion of the trans-Tasman principle that may occur as a result of the seafood standard applying to Australia only</li> <li>•recommends that assessment is required of special techniques, the use of antibiotics, hormones and GM,</li> <li>•of particular note are the ongoing processes re mercury in ‘predatory’ fish – suggests that this be resolved through advisory guidelines</li> <li>•recommends that the scope of the standard follows that Codex Alimentarius Draft Code of Practice unless it is agreed that a particular section is too vague (such as micro standards)</li> <li>•believes that EU or FDA regulations are acceptable in such cases as they are accepted internationally for export / import</li> <li>•believes that issues of deceptive or misleading conduct should be left to the Trade Practices legislation to regulate and control</li> <li>•believes that an outcomes based approach is preferred</li> <li>•suggests that the seafood definition should be revisited to provide clarity for the various seafood groups, and that the definition should not include aquatic plants, reptiles and mammals</li> <li>•believes that the standard across the supply chain of aquaculture should commence at the point of harvest and end at point of sale</li> <li>•recommends an outcome based approach for harvesting, handling and processing of seafood at sea</li> <li>•suggests that businesses selling ready-to-eat seafood should remain covered by the PP&amp;P standard with reference to Chapter 3 of the FSC</li> <li>•believes that the same standards that apply to land based processing of seafood should also apply to seafood aboard fishing vessels, and these should be based on HACCP principles</li> <li>•cold chain compliance throughout the supply chain is recommended</li> </ul>

	<ul style="list-style-type: none"> <li>•believes the FSANZ Risk Assessment process is acceptable, and does not recommend that prior studies be duplicated except where gaps are identified</li> <li>•attention should be given to particular allergen issues related to seafood where they are not covered by the Code</li> <li>•risks beyond microbiological factors must be addressed e.g. dangerous bones in a food product can be highly hazardous and may require specification in the standard</li> <li>•believes that Australia must create a single, comprehensive seafood standard so that any state and territory legislation can be repealed, and duplication for industry is avoided</li> <li>•considers that the standard should preferably have international recognition, especially from New Zealand</li> <li>•sees a need for greater awareness and training in the use of HACCP, especially in small business</li> <li>•believes that any import legislation should be based on Codex, and that strengthening of micro criteria should be in line with EU or FDA requirements if this is required</li> <li>•any legislation should not extend labelling obligation beyond those in the existing Code</li> <li>•suggests a three year compliance time frame, with a two year stock in trade provision</li> <li>•suggest that auditing should remain in the realm of market forces, and believes that non-compliance is already covered under provisions already in place under the Food Act</li> <li>•raise concern that the number of skilled auditors for seafood in Australia is very small</li> <li>•considers guidelines a vital support for any legislation, to provide clarity for industry and visibility throughout the primary production process for the public</li> </ul>
<p>South Australian Department of Primary Industries and Resources / Barry Windle (PIRSA)</p>	<ul style="list-style-type: none"> <li>•suggested hazards for which appropriate process controls should be implemented are: <ul style="list-style-type: none"> <li>○ scombrototoxin – histamine poisoning</li> <li>○ microbiological, biotoxin and heavy metal contamination of shellfish</li> <li>○ ciguatera toxins</li> <li>○ Vibrio and prawns</li> <li>○ ag and vet chemical residues, especially antibiotics, in aquaculture</li> </ul> </li> <li>•believes that the standard should apply to known/identified food safety hazards within the entire seafood industry (whole of chain)</li> <li>•believes that a sufficient definition for seafood would include: fish, crustaceans, molluscs and other marine invertebrates</li> <li>•believes that aquatic plants, reptiles and mammals should not be included in the standard unless significant risks to public health are identified e.g. the risk assessment should consider heavy metals in aquatic plants (such as arsenic in seaweed sold in health stores)</li> <li>•believes that if the risk mitigation processes that are proposed do not fit readily within the overall Standard then it may be more appropriate to develop a separate Standard</li> <li>•believes that the Standard should regulate seafood production (aquaculture) to the point of retail sale, if hazards are identified that require additional process controls for the retail sector</li> </ul>

	<ul style="list-style-type: none"> <li>•believes that food safety standards 3.1.1, 3.2.2 and 3.2.3 should continue to apply to all ‘food businesses’ and the PP&amp;P Standard should only add requirements where there are specific risks identified and public health benefits are greater than the cost of implementation, and that the Standard should reference other parts of the Code where appropriate</li> <li>•believes that in general the government should not be imposing food safety regulations to the harvesting, handling and processing of seafood on board fishing vessels, given the public health risk for these activities is low</li> <li>•recognises that there may be specific risks identified that may require mandated controls e.g. cooking prawns of boats</li> <li>•suggests that a voluntary code of practice for good handling and hygiene, and vessel design, may also be useful</li> <li>•will support provision of technical data for incorporation into the FSANZ scientific risk assessment process</li> <li>•believe that industry may support mandating of hygiene standards for some sectors, to minimise the current low level of risk;</li> <li>•and note that it there is broad government and industry support for these sectors around Australia - SA would support including them in the Standard, provided industry is prepared to meet the regulatory costs attributable to industry</li> <li>•in general, supports industry developing and implementing voluntary industry standards e.g. the SSA Standard;</li> <li>•however, do not support currently using the SSA Standard as a voluntary basis for a national mandatory PP&amp;P Standard for seafood, for the following reasons: <ul style="list-style-type: none"> <li>○ it mandates food safety programs for the whole seafood chain, which is not believed to be in line with the principle of minimum effective regulation and may not demonstrate a positive cost-benefit ratio (based on public health savings versus the cost of implementation)</li> <li>○ would not accept SSA, a non-government body, developing and maintaining the guideline documents that would form the basis for regulatory application of a Standard</li> <li>○ believes there are definitions and principles in the SSA Standards that appear to be in conflict with the Food Act, with which all regulatory instruments should comply</li> </ul> </li> <li>• believes that in general, for specific hazards identified as a significant risk there should be mandated control processes in addition to existing controls specified in the FSC</li> <li>• recommends the following food management systems <ul style="list-style-type: none"> <li>○ mandating the principles underlying ASQAP for all bivalve molluscs collected for human consumption</li> <li>○ food safety programs mandated for bivalve mollusc production, harvesting, processing and distribution</li> <li>○ food safety programs mandated for control of <i>Listeria</i> in cold smoked salmon, as a high risk operation</li> <li>○ mandated controls for retail outlets to minimise the risk of rudderfish ‘poisoning’ e.g. mandating correct identification of fish and/or warning signs</li> <li>○ development of a voluntary code for all harvesters and catchers of seafood as, in general, most sectors are low risk</li> </ul> </li> <li>• believes that compliance with food safety programs should be by third party auditors, approved by government, paid for by the industry, with reporting protocols to the regulators:</li> </ul>
--	--

	<ul style="list-style-type: none"> <li>○ this audit system would be flexible enough to allow for government and contracted audit services, and validation systems should be part of the whole system</li> <li>● believes that compliance with mandated hygiene requirements in the catching and harvesting sectors should occur through government inspection, and that there should be an option for sectors to demonstrate compliance with hygiene requirements by voluntary adoption of food safety programs with accredited third party auditors</li> <li>● believes there are significant additional costs for successful implementation of food safety programs, and that these programs should not be implemented unless there is strong industry and government leadership supported by appropriate resources</li> <li>● believes that imposition on industry sectors should not occur unless there are strong public health reasons or there is strong industry support (and agreed to by government)</li> <li>● supports mechanisms that allow recognition of industry systems that demonstrate compliance with the Standard</li> <li>● notes that currently the PP&amp;P Standard for seafood would be given legal effect via the SA Food Act</li> <li>● notes the SA is considering development of primary industry legislation to cover the pre-harvest part of the seafood chain, in which case the part of the Standard applicable to the pre-harvest sector would be applied under this legislation and the remainder under the Food Act</li> <li>● believes that implementation time frames for food safety systems will vary according to the food safety system required and the starting point of the industry sector</li> <li>○ notes that an industry with a low level of preparedness would need over two years for implementation</li> <li>● believes that audit frequency should be necessary such as to provide confidence that the system is under control - in general there would initially be more frequent audits that would reduce to an agreed level, with more frequent audits if there is evidence that the system is not under control, and that regulators would determine the frequency of audit, based on reports from auditors and other agencies</li> <li>● supports the use of supporting guidelines for an outcome based Standard, and suggests that it would aid national consistency to have them developed nationally wherever possible</li> </ul>
Seafood Services Australia / Ted Loveday (SSA)	<ul style="list-style-type: none"> <li>● detailed comment is provided on the position of the ASS in relation to the various issues raised in the Issues Paper throughout the submission</li> <li>● believes that the proposed PP&amp;PS for seafood should rely on relevant provisions in the Code to ensure that chemical and biological hazards associated with seafood are adequately expressed</li> <li>● the provisions in the Code relating to chemical and biological hazards associated with seafood, within the agreed definition of seafood, should be checked for accuracy and reviewed consistent with normal FSANZ processes</li> <li>● believes that the scope of the proposed PP&amp;PS for seafood should cover the entire seafood industry</li> <li>● the proposed PP&amp;PS and the ASS should have consistent definitions, and an agreed process for considering proposals to change definitions should be developed</li> <li>● believes that the PP&amp;PS for seafood should also recognise the status of the Australian Fish Names list and reference it in the standard</li> </ul>

	<ul style="list-style-type: none"> <li>•notes that the PP&amp;PS for seafood should not consider policy and regulatory issues other than food safety e.g. native fishing rights are considered in other fora</li> <li>•notes that the ASS has worked in consultation with government and industry to establish agreed definitions for inclusion in the ASS, that there have been many comparative studies of definitions used internationally and nationally, and that SSA has established the Fish Names Committee to act as a forum for initial debate on definitions to be considered for the ASS</li> <li>•notes that the underlying policy principle for the ASS is for jurisdictional issues not to be embedded in the Standard, rather, the Standard is outcome focused, takes a ‘water to waiter’ approach and in based on management of risk</li> <li>•believes that, similar to the ASS, the PP&amp;PS for seafood should not allow jurisdictional issues to compromise integrity and focus</li> <li>•believes that with respect to regulation of harvesting, handling and processing of seafood onboard fishing vessels, the PP&amp;PS for seafood should consider the approach taken by the ASS <ul style="list-style-type: none"> <li>○ the ASS is not prescriptive about how a seafood business should achieve the required seafood safety and suitability outcomes, thereby providing flexibility</li> </ul> </li> <li>•believes that the Issues Paper does not properly consider risk analysis in context or have regard to the significant amount of data already available to seafood businesses to assist them in implementing a HACCP based standard, rather, it appears to place undue emphasis on a sub-set of risk assessment more appropriate to the establishment of food product standards</li> <li>•believes that under a risk management system (consistent with Chapter 3 of the Code), the analysis required to relate production processes to hazards identified should be undertaken after the standard is established and should not impede the development of a uniform national standard</li> <li>•comments that the ASS is the industry preferred food safety standard, development of which has involved significant time and effort of industry members while utilising input from Commonwealth government agencies as well as state and territory regulatory bodies</li> <li>•notes that the ASS will continue to be developed and implemented by SSA Ltd as a voluntary food safety standard for seafood businesses</li> <li>•it is expected that the process will run concurrently with any PP&amp;PS for seafood, such that a seafood business demonstrating compliance with the ASS will achieve recognition as complying with any nationally mandatory PP&amp;PS for seafood</li> <li>•believes that all existing standards applying to seafood should be considered as part of the process of developing a national mandatory PP&amp;PS for seafood, such as the NSW Food Production (Seafood Safety Scheme) Regulation 2001, and any international standards</li> <li>•suggests that when considering the suitability of any particular standard as a model it is important that the SDC consider an approach with maximum flexibility without compromising the achievement of food safety outcomes; an overly prescriptive standard may impose unnecessary costs on individual seafood businesses</li> <li>•considers that the Regulatory Impact Statement (RIS) prepared by FSANZ in support of the adoption of Chapter 3 of the CODE is relevant to consideration of the benefits/risks of possible risk management approaches <ul style="list-style-type: none"> <li>○ the RIS asserts that HACCP-based food safety programs, in combination with good hygienic practices and education of food handlers, are seen as pivotal to reducing the incidence of food-borne illness</li> </ul> </li> </ul>
--	--



	<ul style="list-style-type: none"> <li>• comments that Ministerial Council has established that risk management in relation to PP&amp;P standards is to be consistent with Chapter 3 of the Code i.e.: HACCP based, and uses a model requiring businesses to implement HACCP based food safety programs based upon their risk classification (with high risk business to being required to implement first), and indicates that ASS has taken this approach in regard to fishing, farming, harvesting and processing businesses</li> <li>• notes that SSA will continue to help industry sectors to develop codes and guides based on industry demand and available resources</li> <li>• comments in relation to the costs and benefits of the food management systems, that consumer confidence that seafood is ‘safe’, ‘clean’ and ‘green’ is vital to the well-being of the seafood industry, the tens of thousands of jobs it supports, and regional coastal communities around Australia, and notes that ASS reflects the industry’s commitment to providing seafood for human consumption that is produced in accordance with internationally recognised standards and which meets and where possible exceeds the requirements of domestic and international customers and food safety authorities</li> <li>• believes that agreement on national standards for seafood safety and suitability would facilitate establishment of a national and compatible certification framework that enables seafood businesses to demonstrate compliance with regulatory requirements in all relevant jurisdictions, through a single audit</li> <li>• suggests that the PP&amp;PS for seafood must include provisions that automatically recognise export registered establishments as complying with the standard, inclusive of those establishments registered for export by AQIS or under AQIS approved arrangements such as state or third party certification</li> <li>• note that SSA is working with the Joint Accreditation System Australia and New Zealand (JAS-ANZ) and participating in the intergovernmental process for developing a national framework for food safety auditing, to help develop an accreditation and certification system that enjoys the confidence of the public, seafood consumers, the industry and government</li> <li>• believes that codes of practice or guides to best management practice need to be developed, in conjunction with industry, and that risk assessments that identify hazards and CCPs that will apply to all businesses in particular industry sectors need to be undertaken – these initiatives will avoid unnecessary duplication of efforts at the business level</li> <li>• note that several codes of practice and guides already exist as a consequence of projects such as the Australian Seafood Industry QA Program (ASIQAP), Australian Prawn Promotion Association’s code of practice for wild caught prawns, etc</li> <li>• states that SSA will continue to help industry sectors develop GMP guidelines and other resources based on industry priorities, demand and availability of resources, and has a number of guidelines currently available, which are currently being reviews to ensure consistency with the ASS and the PP&amp;PS for seafood, and to incorporate outcomes from industry case studies that are piloting the adoption of the ASS</li> </ul>
<p>Australian Government Department of Agriculture, Fisheries &amp; Forestry (DAFF)</p>	<ul style="list-style-type: none"> <li>• supports access to safe food products</li> <li>• supports outcomes based regulations, based in science</li> <li>• recognises the Australian Seafood Standard (ASS), and the consultative process through which it was developed, as well as its broad industry acceptance</li> <li>• recommends the ASS should at least be a starting point from which to</li> </ul>

	<p>develop the Seafood Standard</p> <ul style="list-style-type: none"> <li>• suggests FSANZ clarify the intent of the statement ‘Primary Production and Processing Standards shall apply in Australia only’ - will the Seafood Standard will apply in Australia but not New Zealand, or in Australia but in no other country?</li> <li>• believes general provisions for microbiological criteria should be included, similar to those in Chapters 1 and 2 of the Code for food chemicals, i.e.: no residues are allowed unless there is a specific permission</li> <li>• reminds FSANZ that enforceability at the border must be considered, and sees competing requirements if FSANZ is to move away from such general provisions and criteria as are currently required</li> <li>• suggests the Standard should address the hazard ciguatera, perhaps through ancillary risk management programs such as size limits, or prohibitions on the sale of some species, or avoidance of harvesting hot spots etc</li> <li>• public health issues surrounding consumption of escolar and other oilfish species that contain indigestible wax ester oils should be considered</li> <li>• recognises parasites, including nematodes, cestodes, trematodes as significant potential hazards in raw, cold-smoked and undercooked fish and fish products</li> <li>• suggests the Standard should address bacterial pathogens currently absent from the Code, such as <i>Vibrio parahaemolyticus</i>, <i>V. vulnificus</i>, <i>Yersinia enterocolitica</i>, <i>Clostridium botulinum</i> (type E in particular), <i>Salmonella</i> spp., <i>Staphylococcus aureus</i> (except in the cases of raw and cooled crustacea with respect to the latter two microbes)</li> <li>• suggests that the Australian Shellfish Quality Assurance Program (ASQAP) be cited within the Standard</li> <li>• other aquaculture situations, including farming of crustaceans and finfish, may require consideration with respect to animal health concerns, as viruses can replicate in these intensive farming situations</li> <li>• suggest that ‘seafood sold in Australia’ may be better worded ‘For sale in Australia’ or ‘intended for sale in Australia’</li> <li>• advise that the term ‘cold-blooded’ is technically incorrect for seafood, and the term ‘shellfish’ is ambiguous</li> <li>• suggests a definition for ‘seafood’ or for ‘fish’ – ‘aquatic vertebrates and aquatic invertebrates, including finfish, molluscs and crustacea, but excluding aquatic mammals’</li> <li>• advise that the regulation of crocodiles is already addresses under the Australian Standard For The Hygienic Production of Crocodile Meat for Human Consumption</li> <li>• consider that there is little need for regulatory control of aquatic plants in a food safety context</li> <li>• suggest that if crocodiles and aquatic plants are to be considered under the Standard, risk profiling should be conducted for these products</li> <li>• advise that Australia does not currently commercially harvest mammals, hence their inclusion in the Standard would not be appropriate</li> <li>• suggests that the Standard should consider pre-harvest conditions such as growing and feeding in relation to aquaculture</li> <li>• believes the Standard should reference other appropriate standards in the Code, in relation to standards for retail sale</li> <li>• recognises that feedstuffs are covered by current state regulations, sees development of the Standard as an opportunity to include feedstuff issues, or to call up and reference feedstuffs</li> </ul>
--	--

	<ul style="list-style-type: none"> <li>•regulation of harvesting, handling and processing of seafood onboard fishing vessels should be determined according to the extent to which specific onboard practices might introduce new hazards or compromise the safety of the final product (as determined by risk analysis)</li> <li>•supports FSANZ's current approach to scientific risk assessment</li> <li>•indicates that AQIS provides data associated with analysis of imported food to FSANZ on a regular basis</li> <li>•indicates that the Export Control (Processed Food) Orders should be considered as a base for the Standard</li> <li>•indicates also that the Codex Code of Practice for Fish and Fishery Products has useful elements that could be considered</li> <li>•suggests that AQIS may have useful information to contribute regarding compliance, as has regulated the export sector for approximately 15 years</li> <li>•suggests that industry compliance with export legislation should be deemed to comply with the food safety management options</li> <li>•consideration should be given to Commonwealth recognition of equivalent enforcement systems; enforcement of the national Standard should be consistent across all jurisdictions</li> <li>•the framework for judging the ability of a system to deliver the same level of food safety should be adapted from the CCFICS Draft Guidelines on the Judgement of Equivalence of Sanitary Measures Associated with Food Inspection and Certification Systems</li> <li>•notes that the Export Control (Processed Food) Orders rewards high level compliance with reduced audit system, as does the Imported Food Inspection System, where good compliance history reduces the rate of inspection</li> <li>•notes that comprehensive guidelines are useful as support for regulations – both for compliance and for interpretation</li> <li>•suggests that the level of prescription contained in the Standard will affect whether guidelines are needed</li> <li>•DAFF is more than happy to provide assistance to the SDC or FSANZ on any matter pertaining to the experience gained during the evolution of the Export Fish Program, with regard to the strengths and weaknesses in the current system, industry compliance and enforcement issues</li> </ul>
Coles Supermarkets (Coles)	<ul style="list-style-type: none"> <li>•strongly feels that the Standard should not apply to retail</li> <li>•notes that the primary control over seafood safety at retail relates to temperature control, and existing standards in the Code are adequate and well enforced</li> <li>•notes also that any significant hazards after delivery of stock is accepted are already identified and appropriately addressed through hazard analysis</li> <li>•notes that if the Standard apply to retail, it would add another layer of enforcement and auditing fees for supermarkets, which they believe to be unreasonable when they believe the risk is being adequately managed</li> <li>•is concerned about duplication of activity if a separate enforcement agency is introduced for seafood, which is a small segment of the supermarket product range</li> <li>•believes that the need for specific expertise in the enforcement agency is restricted to the primary production sector of the seafood industry</li> <li>•believes that businesses selling ready-to-eat seafood should remain under the current arrangements</li> <li>•strongly believes that the Standard should cover activities on board fishing vessels, through requiring implementation of HACCP based food safety systems</li> </ul>

	<ul style="list-style-type: none"> <li>•considers the ASS a sound basis for the Standard</li> <li>•supports the requirement of HACCP based food safety programs (Std 3.2.2) for all seafood businesses, rather than just those demonstrating the highest risks</li> <li>•recommends that a Code of Practice or guidelines incorporating generic templates be developed, in conjunction with industry</li> <li>•believes businesses should also have the option of developing their own food safety programs and having them independently approved</li> <li>•believes the Standard should recognise other similar existing schemes and auditing bodies, to allow compliance to be achieved through a single audit</li> <li>•believes FSANZ has consistently underestimated costs to industry associated with implementation of HACCP based food safety programs</li> <li>•nonetheless believes that the benefits, in terms of food safety, outweigh the costs</li> <li>•notes benefits such as increased consumer confidence, fewer resources required to investigate complaints, lower likelihood of litigation etc</li> <li>•suggests a minimum of 2 years compliance period upon introduction of the Standard</li> <li>•notes a general concern that not all States and Territories may chose to adopt the FSANZ Standard; leading to national inconsistencies</li> <li>•believes the normal FSANZ review process should apply to any future amendments to the Standard</li> <li>•believes identification and nomenclature is an important issue not sufficiently addressed in P265</li> <li>•suggests that the Australian Fish Names list (SSA) should be recognised/referred to by the Standard, and believes this would help prevent deceptive conduct associated with the naming and sale of seafood, as well as providing a means of consumer education</li> </ul>
--	--

**Abbreviations used:**

ASQAP- Australian Shellfish Quality Assurance Program

GMP – Good Management Practice

PP&P – Primary Production and Processing

PP&PS – Primary Production and Processing Standard

MRL – Maximum Residue Limit

TASQAP – Tasmanian Shellfish Quality Assurance Program

## Summary of Submissions at Draft Assessment

A public consultation period occurred from 26 May through to 6 August 2004 for comment on the Draft Assessment Report. During this period, 29 separate submissions were received by FSANZ.

The list of the submitters and a summary of their submissions is provided in the table below.

Organisation / Author	Summary / Major Points
Dr Christine Halais	<p>Comments that whilst it is clear that Option 3 would provide maximum public health protection, she understood that there were no plans to impose similar standards on imported seafood. Remarks that if this were indeed the case, seafood in Australia would fall into two safety categories with the onus being on the consumer to distinguish between these – ‘a poor public health strategy’.</p> <p>The DAR identifies bi-valve molluscs, with some exceptions, as high risk product, internationally. The priority is to introduce higher standards for this category of seafood (e.g. Option 2) and to apply these uniformly to domestic and imported products.</p> <p>Comments that only after this measure has been successfully implemented should we move on to Option 3, with similar restrictions on all imported seafood products.</p>
Mike Oakley Manager Oakley Food Advisory Services	<p>Provides comments under two main headings:</p> <ul style="list-style-type: none"> <li>• <b>RE: Subdivision 3 Health and Hygiene Requirements</b> <ul style="list-style-type: none"> <li>○ Comments that the Editorial Note states that seafood businesses must comply with Div 4 of Std 3.2.2. References Division 6 of 3.2.2 regarding not permitting live animals in areas in which food is handled, other than seafood or other fish or shellfish.</li> <li>○ Seeks a rewording of this clause to have guard dogs in seafood processing areas under controlled circumstances and not while processing is going on, but in remote areas where security is required in the seafood, other fish and shellfish industry.</li> </ul> </li> <li>• <b>Shellfish (oysters &amp; mussels)</b> <ul style="list-style-type: none"> <li>○ Comments that shellfish (oysters &amp; mussels) must enter the cold chain within 24 hrs of harvest.</li> <li>○ Recommends a labelling amendment to verify this in terms of a harvest time being added to the label so that random checks could be made.</li> <li>○ Recommends transport of shellfish should be by a refrigerated vehicle (3rd part carriers) and should only be accepted if product is less than 10 deg at time of collection. Refrigerated transport should not be used as the first point of cold chain management.</li> </ul> </li> </ul>

Organisation / Author	Summary / Major Points
David Gill, President - FTA Vic Food Technology Assoc. of Victoria Inc	Agrees with Option 3 – to approve the introduction of a risk-based Primary Production and Processing Standard to improve the overall safety in the seafood supply chain.
Neil R Smith Principal Policy Officer Dept. Primary Industries and Fisheries, Queensland	Provides comments against three headings: <ul style="list-style-type: none"> <li>• <b>Div. 3 – Harvesting and other requirements for bivalve molluscs</b> <ul style="list-style-type: none"> <li><b>15 Interpretation</b> <ul style="list-style-type: none"> <li>○ Suggests a definition of ongrowing is included as this term is referred to in the definition of spat. Ongrowing is defined in the Australian Shellfish Quality Assurance Program (ASQAP) Operations Manual as the process whereby shellfish are translocated to a classified area for a sufficient period to permit their development as a marketable product. The period shall not be less than 60 days.</li> <li>○ Definition of bivalve molluscs excludes spat, scallops and pearl oysters where the only part of the product consumed is the abductor muscle. ASQAP Operations Manual differs to this and excludes only spat and scallops when the consumed product is only the abductor muscle. Scallop abductor muscle is exempt based on scientific evidence showing the deposition of algal biotoxins and other contaminants is considerably less in the abductor muscle. Pearl oyster meat is not excluded under ASQAP Operations Manual as there is no such evidence available for pearls.</li> </ul> </li> <li>• <b>16 Harvesting bivalve molluscs for human consumption</b> <ul style="list-style-type: none"> <li>○ Standard requires a seafood business may only harvest bivalve molluscs for sale for human consumption from areas that have been classified, subject to a marine biotoxin management plan – believes this requirement will have major ramifications for Queensland’s oyster industry and will represent a significant cost to harvesters and any new operations that commence and may delay harvesting of product until classification of their area is complete. Believes this increase in costs may detract people from entering the industry.</li> <li>○ Talks about oyster areas in Queensland with 111 areas in Central Queensland that harvest wild oysters from natural stocks on rocky headlands. All of these areas would need to be classified under this standard, probably as remote areas.</li> <li>○ Due to the remoteness of the wild oyster areas of central Queensland, (there is no human habitation and no impact of actual or potential pollution sources), it is reasonable to expect that oysters would be safe from non-biotoxin hazards. The practical limitations imposed by the total distance the oyster areas cover make it impossible to classify all areas as remote.</li> <li>○ Queensland Shellfish Quality Assurance Monitoring Program (QSWAMP) is administered by Fisheries and is responsible for classification of oyster growing areas in Queensland.</li> </ul> </li> </ul> </li> </ul>

Organisation / Author	Summary / Major Points
	<ul style="list-style-type: none"> <li>○ States that given the distance the oyster areas are spread over, many of the areas would need to be classified individually and this would represent a substantial task for the authority responsible for administering the QSWAMP. Remarks in many cases it would simply not be practical given the costs involved to classify areas to enable the harvester to sell product for human consumption.</li> <li>○ Believes that the need to apply the monitoring required under this Standard is excessive and there should be some acknowledgement of the reduced food safety risk for these operations.</li> <li>○ Suggests a less comprehensive monitoring program for these oyster areas could be included as part of the oyster harvester's food safety program which is required for all food businesses that handle bivalve molluscs.</li> <li>○ States that the standard will not impact on Queensland's scallop industry as all product is marketed as abductor muscle only and is therefore exempt.</li> <li>○ States that any future marine aquaculture planning will need to consider the need for classification of growing areas as this will influence possible locations of new areas.</li> <li>● <b>18 Wet Storage</b> <ul style="list-style-type: none"> <li>○ No wet storage of bivalve molluscs.</li> </ul> </li> </ul>
<p>Dr David Mills  Manager – R&amp;D  Paspaley Pearling Company  Pty Ltd</p>	<p>Supports the current recommendation in the DAR regarding the classification of pearl meat using solely the abductor muscle. Specifically that it has been excluded, along with other similar products, from the high risk 'Bivalve Mollusc' class of product.</p> <p>Attaches a draft review completed by WA Fisheries showing that bivalve abductor muscle, such as pearl meat and scallops, are one of the safer forms of seafood available.</p> <p>To their knowledge, there have been no instances of food poisoning or other illness caused by consumption of pearl adductor meat in over 50 years.</p> <p>Over 1000 people working for or with the company with access to pearl meat with no ill effects.</p> <p>Pearl farms are located in remote pristine wilderness areas in northern Australia, with no permanent populations or pollution sources.</p> <p>Paspaley Pearling has also commissioned a heavy metal analysis from pearl farms across 5 sites carried out by NT Environmental Laboratories (NATA accredited) and the results show all of the values for heavy metals in the pearl meat at all sites are below the maximum limits as outlined in the Code – attaches a copy of analysis report.</p>



Organisation / Author	Summary / Major Points
	<p>Heavy metal analysis results: inorganic arsenic (max 1 mg/kg) – results 0.17-0.89; cadmium (max 2 mg/kg) – results 0.20-0.62; lead (max 2 mg/kg) – results &lt;0.01-0.04; zinc (no max) – results 10.3-75.2</p> <p>Also attached – an outline of a proposal to do laboratory-based feeding experiments to quantify any accumulation of algal biotoxins in the adductor and viscera of pearl oysters. Experiment proposal submitted by Janet Howieson and Walter Arrow.</p>
<p>Ralph Mitchell Executive Officer Tasmanian Fishing Industry Council</p>	<p>Endorses the Standard in its current form, recommending that (7.4) Option 3 be adopted.</p> <p>Raises a concern about ‘co-mingling’. Believes that while co-mingling of seafood from different sources may not in itself present an elevated level of risk of food safety, for traceability and consumer confidence reasons, the Standard should ensure that co-mingling is not permitted in the market place.</p> <p>States that from a state/region perspective, traceability via the provision of not permitting the practice of co-mingling produce from various sources at the market, would allow adaptive management of the program to prevent any further illness in the event of food-borne illness.</p>
<p>Cassandra Melrose Assistant Manager Melshell Oysters, Tasmania</p>	<p>Applauds the introduction of a nationally mandated standard for the seafood industry. Provides comments on two issues:</p> <ul style="list-style-type: none"> <li>• <b>The regulation of the proposed Standard</b> <ul style="list-style-type: none"> <li>○ Disappointed that the standard is outcome based not directional or prescriptive. Believes this causes ambiguity for auditing and will add expense to producers with numerous audits required to understand what is expected.</li> <li>○ Concerned with regard to bivalve production and processing that the individual states will interpret the standard differently. For example, the problem of Tasmanian products not being accepted by Victorian processors may arise.</li> </ul> </li> <li>• <b>Clause 19 – co-mingling of bivalve molluscs</b> <ul style="list-style-type: none"> <li>○ Pleased to see the introduction of Clause 19.</li> <li>○ Believes clause as it stands will not aid the tracing of contaminated products to their origin. The lease number and harvest date is critical information required to identify lots. Therefore the definition for lots as in standard 1.1.1 is not appropriate for this clause.</li> <li>○ Suggests that a definition is added to Clause 15 – interpretation, to read: ‘Batches – means a quantity of food which is harvested, depurated or handled from the same lease number with the same harvest date.’</li> <li>○ Suggests changing Clause 19 to read: ‘For the purposes of clause 11, each batch of bivalve molluscs harvested must be separated in a manner that prevents co-mingling of batches.’</li> </ul> </li> </ul>

Organisation / Author	Summary / Major Points
<p>Geoff Raven  Manager Food Safety  Program  Primary Industries and  Resources SA</p>	<p>In considering the DAR, the Department of Primary Industries &amp; Resources SA consulted with the Department of Health. Both agencies support the attached submission.</p> <p>General Recommendations: South Australia supports:</p> <ul style="list-style-type: none"> <li>○ mandatory requirements for bivalve molluscs;</li> <li>○ the gazettal, as a voluntary standard, of the requirements for the remaining seafood businesses; and</li> <li>○ the splitting of the requirements for shellfish businesses between standards 3.2.1 and 4.2.1 and the imposition of food safety programs (standard 3.2.1) on shellfish food businesses up to the back door of retail premises.</li> </ul> <p>Discussion:</p> <ul style="list-style-type: none"> <li>○ SA agrees with the assessment of bivalve molluscs in uncontrolled waters as a potentially high public health risk and supports the application of draft standard 4.2.1 to bivalve molluscs.</li> <li>○ SA does not have intensively farmed or contaminated estuarine harvest waters for prawns and as such does not see a public health need for mandatory requirements for prawn harvesting in SA. Notes that most harvesting of prawns in SA is covered by AQIS systems.</li> <li>○ SA supports the assessment of finfish as medium risk for ciguatera toxin, mercury and arsenic, but notes that draft standard 4.2.1 does not address these risks as they are managed by alternate strategies.</li> <li>○ SA acknowledges the potential risk to abalone and roe-off scallops from algal biotoxins, but notes that abalone and roe-off scallops are excluded from the relevant risk management tool i.e. application of Division 3 in 4.2.1. SA supports the exclusion but notes that if further data indicates an increased risk this may need to be reassessed.</li> <li>○ Notes that the risk assessment did not identify any high or medium risks for primary seafood production, beyond bivalve molluscs, that would be mitigated in SA by application of draft standard 4.2.1.</li> <li>○ SA contends that the contribution from poor handling and primary risks in primary seafood production, apart from estuarine/farmed prawns and bivalve molluscs and ciguatera toxin, is a minor contributor to food-borne illness and that post-harvest cross-contamination and poor handling is by far the major contributor.</li> <li>○ States that if the food-borne illness risk from the low risk sectors in primary seafood production is significant, then so too will be the costs to correct them. However, if there are minimal public health issues with primary seafood production then the implementation and compliance costs will be relatively low, but then the rationale for imposing the standard is also limited.</li> <li>○ On the basis of a limited positive benefit cost ration, the SA government does not support the mandating of hygiene requirements for primary seafood production apart for bivalve molluscs.</li> <li>○ SA will reassess its position if data is presented that supports the contention that the poor handling of primary seafood production, excluding shellfish, makes a significant contribution to food borne illness.</li> <li>○ Notes that there are indirect benefits for industry in implementing 4.2.1 eg improved consumer perception and improved shell-life, that may improve the benefit-cost ratio. As such, if primary seafood production sectors believe that the benefits outweigh the costs and support implementation of the standards, then SA would not oppose implementation of 4.2.1 for non-shellfish primary seafood production.</li> </ul>

Organisation / Author	Summary / Major Points
	<ul style="list-style-type: none"> <li>• DPIR South Australia provided specific comments on the draft standard. These are detailed below:</li> </ul> <p><b><u>Defining the split between standards 3.2.1 and 4.2.1</u></b></p> <p>The split between applications of 4.2.1 and 3.2.1 needs to be based on, and consistent with, the definition of ‘primary food production’ in the current Food Act and then be consistent with the definition of ‘primary production of seafood’ in standard 4.2.1.</p> <p>Currently the words in clause 15 of 4.2.1 mean that bivalve molluscs are extended beyond the definition of ‘primary production of seafood’. They also conflict with the words ‘<u>primary production</u> of bivalve molluscs’ under the table in clause 20. The additional words also seem to be superfluous for applying the clauses relevant to bivalve molluscs under 4.2.1</p> <ul style="list-style-type: none"> <li>• Suggests the definition of <b>bivalve molluscs</b> under clause 15 has the following words removed, ‘... either shucked or in the shell, fresh or frozen, ....., or processed....’.</li> </ul> <p style="padding-left: 40px;">The current words in the table to paragraph 2(2)(b) in 3.2.1 extend the application of 3.2.1 to the production of bivalve molluscs, as ‘handling’ includes production. As the intent is to now have 3.2.1 and 4.2.1 sit alongside each other then this table needs to be amended to exclude the primary production of bivalve molluscs from standard 3.2.1.</p> <ul style="list-style-type: none"> <li>• Suggests the words be added: ‘other than the primary production of bivalve molluscs’ after ‘handling of bivalve molluscs’ in the table.</li> </ul> <p><b><u>Frozen Seafood</u></b></p> <p>Suggests that the following words could be removed as the remaining words adequately convey the intent:</p> <p><b>frozen seafood</b> remove ‘...has been changed into a different state by the reduction in temperature and...’.</p> <p>It is unclear why there is a need to have a definition for ‘frozen seafood’, ‘thermal centre of seafood’ and ‘thawing’. In general, unless there has been penetration of a seafood animal, microbiological contamination will not occur in the centre of the animal and hence the need to ensure a specific temperature is achieved at the core of an animal would not seem to help in significantly reducing any public health risk. Enforcement would also be an issue as an inspector would need to probe into the centre of an animal to verify compliance with the standards. Appropriate chilling soon after capture or harvest would seem to be sufficient.</p> <p>suggests the definitions for ‘frozen seafood’, ‘thermal centre of seafood’ and ‘thawing’ be removed.</p> <p><b><u>Live Seafood Premises</u></b></p> <p>It appears that there may have been a need in earlier versions of the standard for the definition of live seafood premises. However now it appears that there is no longer a need as there is no longer a reference to live seafood premises in the standard.</p> <p>suggests the definition for <b>live seafood premises</b> be removed.</p> <p>Seafood Safety Management and Preventing Contamination</p>

Organisation / Author	Summary / Major Points
	<p>Clauses 3 and 4 will be difficult to verify by regulators in the absence of a documented program. Clause 3 will also be difficult for small operators who will tend to seek a list of actions, or advice on actions, that they need to follow, rather than doing a primary assessment of the hazards. Both clauses also seem to be covered by subsequent clauses 5 to 14.</p> <p>suggests clauses 3 and 4 be deleted. Clause 3 may become a policy statement in the preamble to the standard.</p> <p><b>Storing at High Temperature</b>  The Editorial Note for clause 6 and 7 indicates that temperature control means maintaining food at or above 60 degrees Celsius. South Australia was unable to think of an example where pre-harvest seafood would be held at a high temperature. This is a requirement for retail or food service businesses that cook and hold food. Even where animals are cooked on board boats, eg prawns, the animals are then cooled for transport and storage.  Suggests the Editorial Note reflect this standard is for pre-harvest seafood.</p> <p><b>Seafood for Disposal</b>  As primary seafood production businesses are the primary (first) businesses in the food chain they are unable to return seafood products to a supplier.  Suggests clause 9(1)(b) 'returned to its supplier' be removed.</p> <p><b>Seafood Receipt</b>  This clause was relevant when the standard was likely to extend beyond primary production, i.e. when product would be received by a seafood business up the food chain. However now that the standard only applies to seafood primary production there are no (second) businesses that will receive seafood products. There could be packing or grading operations but they will be part of the same seafood business.  Suggests clause 10 be deleted.</p> <p><b>Recall</b>  SA supports the recall provisions in clause 11 for bivalve molluscs as there are significant risks that may lead to recall of product. However believes there are no other high risks identified in the risk assessment that would be expected to lead to a recall by the operator. Difficult to envisage a situation where a fisher would know their product has become dangerous to the public and order retailers, wholesalers and processors to return or dispose of the product. As such, the requirement for a documented recall system means that an operator without the paperwork commits an offence. This imposition is significant with limited or no public health benefit.  Believes, however, there may be situations where seafood becomes contaminated through the chain and having a mechanism to trace the product back would aid in establishing the potential source of the contamination.</p>

Organisation / Author	Summary / Major Points
	<p>Suggests clause 11 becomes ‘a seafood business must have in place a system for ensuring the traceability of their products.’ suggests the current clause 11 be moved to Division 3 and be made specific for bivalve molluscs.</p> <p><b>Division 3 – Interpretations</b> Suggests the following words could be removed as the remaining words adequately convey the intent: <b>Spat</b> ‘...not immediately intended for human consumption...’ <b>Relaying</b> ‘...by using the ambient environment as a treatment process...’</p> <p>States that there appears to be no evidence that pearl oyster meat will not accumulate biotoxins or heavy metals as has been shown by the abductor muscle of scallops. Believes FSANZ should consider deleting the reference to pearl oyster flesh from the definition.</p> <p>Suggests the following change could add clarity to the definition for bivalve molluscs:</p> <p>Change <b>bivalve molluscs</b> to ‘... but excludes scallops where the only part of the product consumed is the abductor muscle, and spat.’</p> <p>Believes a definition for ‘wet storage’ will aid clarity, suggests: ‘<b>Wet storage</b> means the temporary storage of shellfish from classified areas in containers or tanks containing natural or artificial seawater for purposes other than depuration. Wet storage may be used to purge sand.’</p> <p><b>Division 3 – Sale from areas under classification</b> States that it usually takes 2 years to classify an area for the collection or harvest for sale of bivalve molluscs for human consumption. For wild shellfish that have been collected from existing fisheries for a number of year, clause 16 and 17 will, in effect, close the fisheries until classification is complete. Also new aquaculture leases will be unable to sell shellfish for 2 years. The authority responsible for food safety should be able to allow existing wild fisheries to continue and new aquaculture operations to sell some product during the start up phase. Data collected during the first year will assist in deciding the conditions under which sales could be permitted.</p> <p>Suggests clauses 16 and 17 be amended by adding: ‘(d) is undergoing classification and has the approval of the appropriate authority, subject to specified conditions’.</p> <p><b>Division 3 – State Shellfish Control Authority</b> The State Shellfish Control Authority (SSCA) is an effective term in the ASQAP Manual. However there may be difficulty with using SSCA, as defined, as a legal entity in legislation. Particularly where the legal authority is split between agencies and/or legislation.</p> <p>Suggests the term ‘SSCA’ is replaced by the term ‘appropriate authority’ or ‘controlling authority’.</p>

<b>Organisation / Author</b>	<b>Summary / Major Points</b>
	<p><b>Seafood Management Systems</b></p> <p>This clause is in division 3 that is specific for bivalve molluscs. As such it should specifically refer to primary production of bivalve molluscs and the table removed.</p> <p>However, the clause and table are obviously structured for future flexibility so that, if agreed, seafood management systems can be applied to another category of seafood business. In this case, clause 20 should be shifted out of division 3 and be placed after clause 15, i.e. in the general seafood businesses section of the standard.</p>

Organisation / Author	Summary / Major Points
<p>Ian Doughty Laister Consulting Services P/L Carole Theobald Cormorant Technical Services P/L</p>	<p>Comments provided on DAR identify areas where industry may find it difficult to comply with the standard and areas where enforcement officers may find it difficult to enforce them.</p> <p><b>Standard 4.2.1 Primary Production &amp; Processing Standard for Seafood</b> This title includes the word ‘processing’ which is not ordinarily associated with primary production. No definition is provided in Standard 4.2.1 to differentiate the use of this word in this Standard to the use of the word “process” in Standard 3.2.2.</p> <ul style="list-style-type: none"> <li>- recommends the words “and processing” be removed from the title of the Standard.</li> </ul> <p><b>2 Interpretation / Clause 6 Seafood Storage</b></p> <ul style="list-style-type: none"> <li>o <u>Temperatures referenced in Standard</u> (where it is stated “unless the contrary intention appears, the definitions in Chapter 3 of this Code apply for the purposes of this Standard”).</li> </ul> <p>Questions whether there is a need for a chilled or frozen seafood definition. States they are only referenced in clauses 6 &amp; 7 as examples of types of food. These definitions may lead to enforcement difficulties as an enforcement officer would not know which standard to apply.</p> <p style="padding-left: 40px;">For example:</p> <ul style="list-style-type: none"> <li>- should a frozen product be hard, below -18°C or another temperature that ensures the safety of the food;</li> <li>- if the product is between -2°C and -17°C it is under temperature control, is safe and suitable, but is outside the definitions of chilled seafood or frozen seafood. How would this be enforced? In reality, there would be a conflict of standards so standard 3.2.2 (temperature control definition) would prevail (clause 1(2)). Therefore, why put the conflicting definitions in the Seafood Standard in the first place?</li> </ul> <p>Believes the reference to the thermal centre of the seafood after thermal stabilisation adds unnecessary complexity to the standard. The thermal centre is not always easily and readily identifiable and will be dependent on external influences at the time of freezing. Every block of fish will be different. It would therefore be virtually impossible to demonstrate compliance with this requirement and similarly difficult to enforce it.</p> <p>States that in Standard 3.2.2 there is no reference to thermal centres for either hot or cold foods, so to maintain consistency, the reference to thermal centre after thermal stabilisation should be removed.</p> <ul style="list-style-type: none"> <li>- recommends these definitions/descriptions be removed or replaced as editorial notes as guidance for good practice</li> </ul> <p><b>Seafood Storage (Clause 6(4))</b> Notes that Food Safety Standard 3.2.2 clause 22 requires food businesses to have a temperature measuring device where potentially hazardous food is handled that is: readily accessible and can accurately measure the temperature of potentially hazardous foods to +/- 1°C.</p>

Organisation / Author	Summary / Major Points
	<p>Comments that given Standard 4.2.1 is also measuring potentially hazardous food, it would seem appropriate that the same standard applies i.e. device accessible and accurate.</p> <ul style="list-style-type: none"> <li>- recommends the wording from 3.2.2 clause 22 be included in 4.2.1</li> </ul> <p>Notes that temperatures are monitored and are not recorded. This is in line with 3.2.2 but is not an acceptable standard as a business is unable to demonstrate they have complied without written records.</p> <p><b>3 General seafood safety management</b></p> <p>Comments that the current wording does not require a business to document that it has systematically examined its operations. Therefore, a business will not be able to demonstrate that it has complied with the standard.</p> <ul style="list-style-type: none"> <li>- recommends that the words “and document” be inserted in the Standard after “systematically examine” or alternatively:</li> <li>- delete clause 3 as it would be impossible to enforce.</li> </ul> <p><b>5 Inputs and harvesting areas / Division 3 (16) harvesting bivalve molluscs for human consumption and (17) harvesting bivalve molluscs for depuration or relaying</b></p> <p>Comments that Clause 5(2) adequately addresses the issue of harvesting seafood from only ‘safe areas’.</p> <p>Believes these clauses duplicate this requirement in much unnecessary detail for bivalve molluscs. Clause 5(2) and clauses 16 and 17 provide the same outcome. Believes the reference to the SSCA requirements may place an unnecessary financial burden on small fishermen.</p> <p>Cites an example if a scallop fisherman was harvesting scallops from many different areas, he would be required to supply and pay for the water analysis from each place the scallops were caught. This could involve many areas on one trip. Results of analysis would only be available after the fresh scallops had been sold which makes the results superfluous to the fisherman especially if the fisherman may never return to exactly the same area.</p> <p>Samples from geographic areas need to be interpreted with weather conditions, currents and tides and the sea is an ever-moving object. In addition, fishermen would need to be trained on how water samples should be collected, stored and transported to ensure handling does not compromise results. However, the scallop fisherman would be able to demonstrate that scallops were not caught in restricted areas by recording the areas in which the catch was made and comparing them against the latest list of restricted areas. If State/Territory government(s) require water samples to be taken to provide them with more information to identify restricted areas, this would be outside the scope of the seafood standard.</p>



Organisation / Author	Summary / Major Points
	<p>As all States/Territories already operate the ASQAP, questions whether it is necessary to bring this <i>quality</i> requirement into a food <i>safety</i> standard?</p> <p><b>9 Seafood for disposal</b>  Comments that the wording in this clause implies that food must be labelled “returned”, “recalled”, or “unsafe” or “unsuitable”.</p> <p>States that the outcome required is that food for disposal is not accidentally used, so questions why specify the different terms for a label. Some businesses have marked ‘quarantine’ areas – these would not technically comply.</p> <p><b>10 Seafood Receipt</b>  Comments that this clause implies that food is being received by the primary seafood business. A primary industry is one at the beginning of the chain. If a business is receiving food it is actually the second link in the chain not the first, and does not fall under the definition of primary producer in 3.1.1.</p> <p>In addition, if food is received at 60°C or above it must have undergone substantial transformation. Therefore, the businesses would not satisfy the definition of primary producer.</p> <ul style="list-style-type: none"> <li>- recommends that the clause be deleted.</li> </ul> <p><b>12 Skills and knowledge</b>  Believes the wording is in conflict with clause 3 of Standard 3.2.2 as it does not apply to persons supervising food handling operations.</p> <ul style="list-style-type: none"> <li>- recommends the wording be the same in both Standards to avoid confusion along the food chain.</li> </ul> <p><b>13 Health and hygiene requirements</b>  Questions who determines which hygiene and health practices are commensurate with the food safety risks, especially if the supervisors are not required to have skills and knowledge of food hygiene or food safety matters. In addition, no guidance is provided about what the term “health practices” means.</p> <p>The editorial notes reference Division 4 of 3.2.2 for processing, but any contamination will already be in the seafood by the time the food reaches the processor, unless clear guidance is provided to the primary producers.</p> <ul style="list-style-type: none"> <li>- recommends that the following requirements be included in the seafood standard: <ul style="list-style-type: none"> <li>Standard 3.2.2 clause 14</li> <li>Standard 3.2.2 clause 15(1) a-g</li> </ul> </li> </ul>

Organisation / Author	Summary / Major Points
	<p>Standard 3.2.2 clause 15(2) Standard 3.2.2 clause 15 (3)</p> <p>Believes this will provide seafood businesses with the necessary guidance to supervise seafood handlers and protect food from contamination.</p> <p><b>18 Wet Storage of bivalve molluscs / 19 Co-mingling of bivalve molluscs</b> Questions whether these items need to be listed separately, especially if the seafood business is required to have a food safety program based on HACCP principles. The food safety program would identify all hazards and provide ways to control their risks.</p> <ul style="list-style-type: none"> <li>- recommends these clauses be deleted.</li> </ul> <p><b>15 Interpretation</b> States that if clauses 16-19 were removed, this clause would be redundant.</p> <p><b>20 Specified seafood safety management systems</b> Notes the editorial note provides a list of acceptable systems.</p> <ul style="list-style-type: none"> <li>- believes a reference to at least Standard 3.2.1 should be put in clause 20 (preferably Commonwealth Export Control Orders as well) as the editorial notes are not enforceable.</li> <li>- in addition 3.2.1 refers to 'food safety programs', but this draft standard refers to 'safety management system'. Believes this inconsistency in the use of terms may cause unnecessary confusion.</li> </ul> <p><b>Naming of seafood</b> Comments that this has not been included in the Seafood Standard on the grounds that it is considered a consumer fair trading issue.</p> <p>Believes this misses the main point of traceability. If seafood is called by different names along the food chain, it will be impossible to recall it at the consumer level. The primary producers are the ones who identify the fish for sale, so it would make sense to include reference to fish names in the primary producers' standard. This would help address traceability issues and the reference could be amended if an Australian Standard is developed.</p> <p><b>Unloading seafood in Victoria and New South Wales</b> Comments that both Victoria and New South Wales require seafood businesses to have in place a food safety program. If a fisherman on the state borders is forced by bad weather to land and sell fish in another state, they would fall foul of local state laws.</p> <p>Questions whether Victoria and NSW will accept the Primary Production and Processing Standard for Seafood for foods sold in their jurisdiction under such circumstances.</p>

Organisation / Author	Summary / Major Points
	<p>If not, believes consideration should be given to applying the food safety programs requirement to the entire sector around Australia in the interests of consistency and in order to overcome any internal trade barriers that may develop.</p> <p><b>Imported Foods</b>  Questions whether seafood imported into Australia will be required to demonstrate it has been grown/collected/harvested in accordance with this standard. Also questions whether food imported into NSW and Victoria and all bivalve molluscs imported into anywhere in Australia be required to demonstrate that they have food safety programs that comply with Standard 3.2.1. If not, believes we have a double standard and the local industry is being disadvantaged.</p>

Organisation / Author	Summary / Major Points
<p>Roy Palmer Director Fishy Business A Division of Tigrey Pty Ltd</p>	<p>Congratulates FSANZ on this the first Primary Production and Processing Standard. Makes the following comments and requests that these be taken into consideration before the Standard is finalised:</p> <p><b>Fish Names</b> States the clearly on the record was the agreement that Fish Names would not be included in the Standard on the proviso that an acceptable method to all parties be found to ensure that Imports do not escape control. Believes at this time, no advice has been given that such a method has been found, and this puts the agreement in jeopardy. Subject to this issue being resolved, it is their clear understanding that compliance and enforcement issues would be addressed. Express their opinion that whilst some states are looking to address these issues, some are showing clear reluctance to do this. Would appreciate FSANZ making it very clear to all jurisdictions that their efforts in this area are very important and not to be diminished.</p> <p><b>Mandatory labelling of Imported Seafood at the point of sale</b> States that this has taken on major significance and has been subject of many press releases by the Minister for Fisheries. States that it is difficult for the retailer to have knowledge of whether some product has been imported and that information must be passed on down the food chain. States that they have not heard any comment that sways them from their request that the provision of adequate information and prevention of false and deceptive conducted by the food service sector be mandated.</p> <p><b>National Standard across the jurisdictions</b> Fully endorse the concept of a National Standard as the aim is to create a level playing field. However, if the states/territories interpret the regulations in different ways, charge differing fees, create Audit strategies that are not risk-based, then the whole concept will be lost. Believes the industry will be in a worse position and the consumers will be more confused. Believes that FSANZ and all Ministers responsible for the standard in each state/territory must work through these issues with industry and ensure that the level playing field is created. Also believes that FSANZ should carry out a survey before the standard is actioned, taking real examples of similar situations in each state and territory, analysing the costs. The examples should be revisited annually over a 3 to 5 period to ensure there is real success in the creation of a level playing field.</p> <p><b>Third party audits across the jurisdictions</b> State that it has been brought to their attention that one jurisdiction has told operators that they will be required to have 3 or 4 audits, without looking at the risk elements involved. Consider this unacceptable as it adds unreasonable and unnecessary costs. Believe that the audit process must be orchestrated in accordance with the risk involved. The same jurisdiction also appears to have a willingness to create duplication in the audit process. Believe that FSANZ should ensure that where a business has a third party audited seafood safety plan that satisfies the conditions of the new Standard, the business will be deemed to be complying with the Standard.</p> <p><b>Promotion of health benefits of seafood and Listeria</b> Believes that the risk of a seafood safety accident happening should be clearly explained to the consumer in a manner that promotes the excellent health benefits of eating seafood, rather than in a manner that creates public uncertainty.</p>

Organisation / Author	Summary / Major Points
	<p>Is at a loss to understand the need to highlight the issue of Listeria and certain seafoods when the risk assessment cannot demonstrate incidents in Australia. The industry welcomes the opportunity of partnerships with FSANZ and other jurisdictions when it comes to educating and promoting the health benefits of eating seafood.</p>
<p>Australian Food and Grocery Council</p>	<p>Welcomes the opportunity to make a submission in response the to Proposal P265 and compliments FSANZ on the preparation of a such a detailed and thorough Draft Assessment Report. Makes comments under the following headings:</p> <p><b>Options</b> The AFGC has long supported a total through chain food safety system from raw material through the chain to final delivery to the customer. Although AFGC would prefer to see mandatory food safety programs in all areas of primary production, they support option three, as recommended by FSANZ.</p> <p><b>Drafting – Clause 13</b> This clause contains health and hygiene requirements that are broad and generic in nature. Considers a specific prohibition on a person suffering from a food-borne disease from handling any seafood where there is a reasonable likelihood of seafood contamination as a result of the disease, similar to that of subclause 14(1)(b) of Standard 3.2.2, should also be included. States that if FSANZ considers the generic provisions of Clause 13 are sufficient to control this then the provisions of 3.2.2 should also be made generic for consistency.</p> <p><b>Drafting – Clause 15</b> Considers that in the third line of the definition of State Shellfish Control Authority, ‘control and relaying’, is a typographical error and should read ‘and control relaying’. Considers also that there is a typographical error in line 4 and ‘that is contaminated or has’ should read ‘that are contaminated and have’.</p> <p><b>Drafting - Subclause 18(a)</b> Considers subclause 18(a) does not read correctly and the word ‘continue’ at the start of the second line should be preceded by the word ‘must’.</p>
<p>Ray Brown Manager Tasmanian Shellfish Quality Assurance Program Tasmanian Dept of Health and Human Services</p>	<p>Supports submission from the Chairman of ASQAAC that went to FSANZ in November 2003, and notes that the recommendations of that committee were supported in the recent draft. Aware that these comments, on behalf of DHHS, are duplication the ASQAAC input, but wishes to make them on behalf of this agency.</p> <p>Under Division 3 Clause 15 the definition of ‘bivalve molluscs’ excludes pearl oyster where the only part consumed is the adductor muscle. This exclusion is based on the assumption that there are no biotoxin issues with adductor meat of pearl oysters as is the case with scallop adductor muscle. Issue was raised at the last ASQAAC meeting and it was agreed that there was insufficient toxin data at this stage to exclude the adductor muscle. Recommends to not exclude pearl oyster adductor muscle meat from the definition until this work has been done and endorsed by ASQAAC.</p>

<b>Organisation / Author</b>	<b>Summary / Major Points</b>
	<p>The intent of Division 3 Clause 19 to prevent co-mingling of lots of bivalves is strongly supported. No doubt that this will represent an inconvenience to certain sectors of the seafood industry but the benefits to industry as a whole will outweigh this.</p> <p>States it is important that there are labelling requirements on the product through to the retail end to prevent co-mingling of molluscs. In addition to any general labelling provisions of the FSC, molluscan shellfish (not just oysters) should have the name of the harvest area and date of harvest attached to any containers/packets right through to retail outlets.</p> <p>Strongly supports the requirement for all food businesses handling bivalve molluscs for sale to have a food safety management system.</p> <p>Notes that an emerging issue for some states will be the shortage of appropriately trained and qualified food safety auditors.</p>
<p>Hans Heilpern, Chairperson for Warren Matthew Executive Officer, Operations NSW Seafood Industry Conference NSW Food Authority</p>	<p>Notes that the draft standard requires live seafood to be stored at a temperature that will not adversely affect the safety and suitability of the seafood (Sec 6(3)), and businesses involved in primary production of bivalve molluscs to implement a documented seafood safety management system (Sec 20). ASQAP has specified storage temperature and depuration conditions for live oysters and different types of oysters have different requirements. The optimal storage temperature for live Sydney Rock oysters is still a matter of some debate. States that FSANZ's clear guidance on this matter will be essential for consistent implementation and enforcement of the relevant provisions of the standard.</p> <p>The definition of bivalve molluscs in Sec 15 excludes pearl oysters. This would effectively exempt pearl oysters from the provisions specific to bivalve molluscs, including requirement of a marine biotoxin management plan. Seeks confirmation from FSANZ that there is sufficient scientific justification for the exemption.</p> <p>Concerned about the increased audit costs as a result of the introduction of the PPPS for Seafood. States that it is important that mutual recognition arrangements are put in place between states, commonwealth (AQIS) and commercial organisations to minimise duplication.</p> <p>The requirements of Division 3, subdivision 3 for a 'seafood business' are less stringent than the corresponding requirements in Chapter 3 of the Code for a 'food business'. Considers this appropriate when applied to primary production environments such as those found on fishing vessels, sea cages and live seafood premises. Notes that the Editorial Notes to Clauses 13 and 24 emphasis the point that any businesses engaging in activities beyond primary production will have to comply with Standard 3.2.2 and Standard 3.2.3. It is requested that FSANZ provide very clear criteria as to the boundary of 'primary production'. For example, questions if heading, gutting and/or filleting of fin fish onboard a vessel is within the scope of primary production.</p> <p>States that it is not clear how far down the supply chain the prohibition of co-mingling (sec 19) is intended to apply. Notes that as this requirement is only proposed for the PPPS for Seafood but is not currently in Chapter 3 of the Code, presumes that it is FSANZ's intent to allow co-mingling beyond primary production. Seeks FSANZ's advice on the rationale of this. Also reinforces the need to have a clear distinction between what is considered primary production. Questions whether shucking of oysters is considered primary production or processing.</p>

Organisation / Author	Summary / Major Points
	<p>Draw's FSANZ's attention to the fact that NSW is well underway in implementing the Seafood Safety Scheme developed by NSW Food Authority in consultation with industry. Urges FSANZ to ensure that the national standard will not compromise regulatory measures already set in place in NSW.</p> <p>Looks forward to receiving information on the status of ASQAP requirements in the draft standard and the time-line for the Transitional Standard for Country of Origin Labelling Requirements.</p> <p>Congratulates FSANZ on having made good progress on the development of the PPPS for Seafood, which is essential for ensuring consistent production of safe seafood in Australia.</p> <p><b>Second letter of 18 August 2004</b> Discussion at the last meeting of the NSW Seafood Industry Conference on August 9 concerning fish naming conventions and strategies to assist reducing fish substitution. Convention generally agreed that fish substitution could potentially lead to food safety issues and damage the good reputation of the seafood industry.</p> <p>Numerous examples of potential food safety issues through the misnaming of fish or fish substitution. Well known that some fish species contain higher levels of mercury than others and incorrect naming of fish may result in pregnant women consuming higher levels of mercury than expected thus increasing the risk of complications to the foetus. Other fish species are known to be associated with ciguatera poisoning. The main control in preventing ciguatera poisoning relies on banning these species from sale and restricting the sale of others based on size. Eating escolar or rudderfish may cause keriorrhoea (passing of oil) due to the presence of waxy oils. Correct naming of these fish allows the consumer to make an informed decision and not suffer potential embarrassment or concern</p> <p>These three examples demonstrate how incorrect naming of seafood can adversely affect the consumer and the reputation of the seafood industry.</p> <p>Believes that there is a need for legislative support for the adoption of common fish names across Australia. States that the Code would appear to be the most appropriate legal document for this purpose.</p> <p>Recommends the adoption of common fish names either in the Food Product Standard Section of the Food Standards Code, or within the proposed Primary Produce and Processing Standard (P265) with naming based on the work already undertaken by the Fish Names Committee.</p> <p>Believes that a mandatory requirement to correctly name fish would lead to better food safety protection for the general public and increase consumer confidence in seafood and in the seafood industry.</p>

Organisation / Author	Summary / Major Points
<p>Gary Bielby Assistant Director, Food Services</p> <p>Kerry Bell Principal Adviser, Foods Public Health Services QLD Health</p>	<p><b>Preferred option</b> Supports option 3. Prefers the wording on page 8 of the proposal as opposed to the wording on page 35.</p> <p><b>Spat</b> Believes that the mandatory requirements of a food safety program for bivalve molluscs should include spat with the exclusion of those bivalves where only the adductor muscle is consumed (eg roe-off scallops). The exclusion of spat from the definition is a food safety concern for QLD since the bulk of the industry in SE QLD relies on the relaying of spat from NSW. Currently, those 'not for sale as food' spat are transhipped to Qld and are required to have a minimum of 60 day depuration or equivalent on-growing period, prior to harvest and sale. As the shipped spat are not technically for human consumption, their movements are regulated by NSW Fisheries which has no jurisdiction in food safety matters. This anomaly results in a loophole of traceability whereby it has been impossible to adequately reconcile the movements of all spat across the border with the quantity of spat that is placed out on oyster leases. It is also known that product marked as spat has been processed in SE QLD as bistro and bottled small oysters.</p> <p><b>Wild oysters</b> Believes that the requirement of a biotoxin monitoring program and classification of areas of 'wild' oyster harvesting areas will be too onerous and uneconomical for North Qld oyster harvesters. As there has not been a proven record of serious food-borne illness associated with the northern industry, and as the harvest area is normally in isolated, more pristine areas, argues that the risk is reduced compared to the much larger southern aquaculture oyster industry that resides closer to large human population and recreational use areas.</p> <p><b>Medium risk seafood</b> Notes that the proposal deals principally with high risk seafood and there is little information addressing medium risk seafood. Views medium risk seafood to include: warm water ocean (reef) fish as a consequence of risk of ciguatera; shark and billfish due to potential heavy metal contamination; and scombroid species (eg tuna) due to potential formation of histamine as a consequence of improper temperature control.</p> <p>Questions what FSANZ proposes to do in respect to the issue of this medium risk seafood and how processing will have to meet the requirements of the Standard. Suggests that additional education might be considered.</p> <p><b>Cold smoked seafood</b> Believes that the mandatory requirements of a food safety program should be necessary for anyone producing hot or cold smoked seafood. This form of processing is 'technologically' advance and relies on compliance with a number of vital aspects of technology to achieve food safety. Notes that this is complicated further since smoked product is not usually cooked or heated again before consumption. Believes that there must be mandatory cooking instructions to accompany cold smoked seafood.</p>



Organisation / Author	Summary / Major Points
	<p><b>Voluntary adoption</b> Suggests that based on the risk assessment presented, other businesses could be encouraged to adopt these measures as a voluntary standard. This could include the acceptance of the industry supported Australian Seafood Standard.</p> <p>Believes such action would allow businesses to willingly accept a level of food safety management even where product risks are not currently high risk. Provides example of a number of aquaculture businesses have agreed to voluntarily implement Codes of Practice, monitor and control inputs and to report on contaminant residues to Safe Food Qld. Reports used to build an informed database and businesses provide d with Certificates of Endorsement by SafeFood Qld.</p> <p><b>Maximum residue levels</b> Seeks assurance that the MRLs for pesticides and veterinary chemicals relative to seafood will be reviewed by FSANZ in conjunction with the Australian Pesticides and Veterinary Medicines Authority, in an appropriate timeframe. Seeks advice when this review is proposed.</p> <p><b>Fish bone injuries</b> Believes the proposed standard needs to address the issue of physical hazards in fish marketed as filleted and boned.</p> <p><b>Ready-to-eat seafood guidelines</b> Believes that the issue of bacteriological pathogens currently absent form the Code, such as <i>Vibrio parahaemolyticus</i>, <i>V. vulnificans</i>, <i>Yersinia enterocolitica</i>, <i>Clostridium botulinum</i> (type E in particular) and <i>Salmonella</i> spp. needs to be addressed in the ready-to-eat food guidelines. The recent outbreaks of norovirus in Australia from Japanese oyster meat demonstrates the need exists, as well as the need for importers to demonstrate the safety of this product.</p> <p><b>General comments</b> Believes the proposed Standard must be capable of being applied to imported seafood.</p> <p>Subclause (2) of Clause 2 Interpretation In (b) of the Editorial note defining ‘primary food production’, there is a need for activities listed to apply to ‘on premises’ as well as ‘off site’. As an example, the wild harvesting of oysters in natural open areas would not be included in the definition as it presently appears.</p> <p>Clause 15 Interpretation in Division 3 ‘bivalve molluscs’ – the word ‘processed’ as used in this definition appears unwarranted particularly where there is reference to ‘shucked’ product. This definition also seems out of context with [c] of the Editorial note which defines ‘primary food production’</p>

<b>Organisation / Author</b>	<b>Summary / Major Points</b>
<p>Gillian Parton Quality Control Services Manager Coles Myer Ltd</p>	<p>Thanks FSANZ for opportunity to make comments, and also for taking on board comments provided in previous submission March last year.</p> <p>Would like to reiterate that the Seafood Standard should not apply to retail, which generally only involves the storage and display of seafood. Supports the introduction of proposed Standard from harvest, up to by not including retail sale. The Food Safety Standard 3.2.1 adequately addresses the issue of temperature requirements as do own good manufacturing practices (GMP) and food safety programs.</p> <p>With regard to fishing vessels and the regulation of harvesting, handling and on board processing of seafood, previously recommended that all these operations should be required to have some form of (CODEX) HACCP based food safety program in place. Notes that unfortunately the revised Standard does not reflect this, but rather states simple that ‘vessels must be constructed, maintained and used in ways that minimise the risks to safety’.</p> <p>Notes the omission from the revised Standard of reference to the book of Approved Fish Names. States that one of the obligations of FSANZ in creating standards is to minimise the possibility of misleading and deceptive conduct in the food industry. Believes that to some extent this could be achieved by mandating the use of this publication for the naming and sale of fish, via the Seafood Standard. States that if FSANZ still believes that this matter is more appropriately dealt with under trade practices law, the government support and resources will still be required to ensure that the development of an appropriate Australian Standard eventuates and within a reasonable time frame (i.e. 12 months).</p>
<p>Clare Hughes Food Policy Officer Australian Consumers’ Association</p>	<p>Supports ANZFRMC decision to develop through-chain standard to manage the safety of poultry meat (sic – seafood) from primary production to consumers.</p> <p>Believes it will enhance consumer confidence in the safety of seafood products and could result in increased sale and consumption of seafood.</p> <p>Supports mandatory food safety requirements for all seafood businesses.</p> <p>Feels there is a gap that needs to be addressed at the primary production and processing level and that the proposed standard will help achieve this.</p> <p><b>ACA’s Preferred Regulatory Option</b></p> <ul style="list-style-type: none"> <li>• Supports preferred regulatory Option 3 as the approach will result in seafood safety management systems that are commensurate to risk, with those products and sectors of the industry more likely to cause food-borne illness and/or create severe adverse health effects will require a greater degree of regulation.</li> <li>• Agrees that higher-risk seafood products should require a greater level of safety management and regulation.</li> <li>• Do not believe that lower-risk products should be exempt from implementing food safety schemes. Consumers have a right to expect that their food is safe and that governments will do everything in their power to ensure that the industry provides a safe and hygienic product.</li> </ul>

Organisation / Author	Summary / Major Points
	<ul style="list-style-type: none"> <li>• Believes that all seafood businesses must meet some minimum level of food safety management. Understands that many seafood businesses will already meet the minimum requirements. Believes consumers will welcome the requirement for businesses that don't already have safety management systems in place to change their practices.</li> </ul> <p><b>Fish Names</b></p> <p>Believes that a mandatory fish names list will meet all three of the FSANZ objectives:</p> <ul style="list-style-type: none"> <li>○ The protection of public health and safety</li> <li>○ The provision of adequate information relating to food to enable consumers to make informed choices</li> <li>○ The prevention of misleading and deceptive conduct</li> </ul> <p>Believes that members of the seafood industry at all levels of the supply chain should be required to label fish correctly.</p> <p>Acknowledges that a primary production and processing standard may not be the only place to incorporate a mandatory fish names list. Believes that a mandatory fish names list has a place in the Food Standards Code. Disappointed that FSANZ has decided not to address the issue.</p> <p>Prepared to accept the compromise position of the development of the Australian Standard for fish names through the Standards Australia process. Notes that at the last SDC meeting, FSANZ gave an undertaking to revisit the issue in the future once the AS had been developed and implemented.</p>
<p>Peter Clarke Australian Freshwater Crayfish Association Yabby Growers of Victoria</p>	<p>Expresses grave concerns over the regulatory impact of the Victorian government's implementation of the Seafood Safety Act 2003 and the enforcement of this Act through Primesafe and this dept's subsequent adoption of the FSANZ Primary Production and Processing Standard for Seafood.</p> <p>Not the view of the stakeholders in the Yabby industry to undermine nor underestimate the importance of food safety throughout the food production chain. It is the regulatory impact and associated costs of the enforcement of the food safety laws that threaten the potential of the yabby growing industry.</p> <p><b>Background</b></p> <ul style="list-style-type: none"> <li>• Currently approximately 60 licensed growers in Victoria. Yabby farming is often carried out at the lowest and easiest level known as extensive aquaculture. Offers farmers a way of diversifying their income through the utilisation of existing dam structures that are primarily used for stock watering.</li> <li>• Environmentally friendly as inputs are minimal. Yabbies are particularly sensitive to pesticides and herbicides.</li> <li>• The sale of yabbies in Victoria is almost exclusively through the trade of live product. Believes that food safety risks associated with live yabbies are extremely low.</li> <li>• Microbial risks associated with yabbies are negated given that yabbies are fully cooked in boiling water prior to consumption. Believes the low fat content of yabbies means that they are at low risk of bioaccumulation of chemical hazards either through environmental or through farming practices. The physiological nature of the animal is such that the animal will die when exposed to even low levels of toxicants used in the agricultural sector or naturally occurring in the environment.</li> <li>• Minimal risks are supported by:</li> </ul>

Organisation / Author	Summary / Major Points
	<ul style="list-style-type: none"> <li>➤ FSANZ DAR P265 where yabbies are ranked as low risk</li> <li>➤ Fisheries Victoria Research Report Series 12 'Risk Assessment of Pesticides for Yabby Farmers April 2004'</li> <li>➤ National Residue Survey</li> </ul> <ul style="list-style-type: none"> <li>• The subsequent costs of government regulating these risks to the yabby aquaculture industry is disproportionately high considering the transport and sale of live finfish (including eels which are grown under similar farming conditions and have a much higher fat content) are exempt from regulation under the Victorian Seafood Safety Act 2003</li> <li>• Requests this burden be eased by exempting the sale of live yabbies from the regulation and that any food safety risks be controlled through agreed industry codes of practice. The Victorian Yabby Producers manual (NRE) provides a code of practice that could be considered by government and industry in this context.</li> </ul> <p><b>Regulatory problem</b></p> <ul style="list-style-type: none"> <li>• In line with the Overarching Ministerial Guidelines for the development of primary production and processing standards, implementation of control measures by government designed to mitigate food safety hazards should not put undue burden on industry.</li> <li>• Regulatory burden on yabby industry in Victoria threatens to outweigh the profits of the entire sector and therefore is in conflict with the principles of the COAG agreement and the Guidelines.</li> <li>• States that in their views, the measures do not enhance the safety of the yabby product when sold in the live state.</li> </ul> <ul style="list-style-type: none"> <li>• Aquaculture sector of the seafood industry needs to comply with several state regulatory authorities. From 1 July 2004, Primesafe under the auspices of the Victorian Seafood Safety Act 2003 are requiring yabby growers to be licensed and have an approved food safety program. The cost of licensing with Primesafe is in addition to the cost associated with a Victorian Fisheries aquaculture licence which in itself is due to increase substantially in the next 12 months. Growers wishing to adopt the option of a multi-waters licence will pay over 400% increase in this fee.</li> </ul> <p>Current Fee for multiwater licence = approx \$300 + \$30 for addition applications to add other waters to the Aquaculture licence.  New fee soon to be introduced \$1300  Proposed cost recovery over the next four years fee = \$4000 per annum</p> <p>[Editorial Note: The abovementioned fees relate to fisheries resource management and not to food safety standards.]</p> <ul style="list-style-type: none"> <li>• Although these fees are proposed by Fisheries Victoria and out of FSANZ's jurisdiction they are another yearly cost in addition to Primesafe regulatory costs which mandate annual fees and 3rd party audits fees associated with the verification of on farm food safety programs.</li> <li>• From July 1st 2004 yabby farmers who stock farm dams with juvenile yabbies to supplement naturally occurring stock are required to pay State government mandated levies for commercial use of dams.</li> </ul>

Organisation / Author	Summary / Major Points
	<p><b>Food Safety Risks</b></p> <ul style="list-style-type: none"> <li>• When compared to other primary products such as wheat, sheep, safflower etc, yabbies are an extremely safe product to grow as they do not require any chemical inputs and other inputs in addition are minimal. The feeding of yabbies is usually with lupins because they are high protein readily obtainable easy to throw or spread and because lupins are the safest of all grains. No insect pests attack lupins in storage so no chemicals are needed as evidenced by National Residue Surveys.</li> </ul> <p><b>Microbiological Risks</b></p> <ul style="list-style-type: none"> <li>• Microbiological food safety issues are addressed by cooking yabbies for 5 minutes after water comes to boil - a time temperature combination recognised world wide by food safety regulators as an effective thermal process that renders food microbiologically safe the majority of food borne pathogens. Other food / pathogen combinations that may survive such a bactericidal step are not associated with yabbies and therefore pose little or no risk.</li> </ul> <p><b>Gill Washing</b></p> <ul style="list-style-type: none"> <li>• Gill washing assists in lowering potential pathogen contamination will not eliminate it on a live yabby and therefore has little to do with food safety, but more so a lot to do with the health and durability of the animal while alive. Most growers pull in their pots from the bank and in doing so disturb the sediments on the bottom .A yabby can live for many years in or out of the water as long as their gills are kept moist. When they first come out of the water they close their gills thus trapping any disturbed sediments in the gill cavity. These sediments can contain bacteria which if not flushed out can kill the animal in 3 days. Most growers overcome this by holding them for a minute or so in clean water to flush out their gills. It can also be overcome by pulling pots up from a boat thus ensuring the pots are pulled through clean water.</li> <li>• These issues have been looked at by Victoria Fisheries and others with no concerns.</li> <li>• Sheep and cattle manure are not significantly different to birds fish or other animals that live around the yabby environment and many other primary production environments for that matter. Currently all live animals stand in their own urine and faeces both in the paddocks or on transport. The FSANZ Draft Assessment does not mention any pathogens associated with faecal contamination with respect to the risk ranking of yabbies and these pathogens as with raw meat are killed by the cooking process as identified and recognized by FSANZ.</li> <li>• In addition seabirds defecating over an out door processing area of a boat either moored or processing fish at sea pose a food safety risk the difference there being the fish are deceased and therefore the food safety risks are significantly increased and must be controlled.</li> </ul> <p><b>Regulatory Problem</b></p> <ul style="list-style-type: none"> <li>• The FSANZ Draft Standard for PPP of Seafood does not mandate the use of ‘SANITARY ‘ equipment in these circumstances it states that equipment must be ‘CLEAN’. The yabby grower in Victoria at this stage remains uninformed as to the level of sanitary requirements that will be required under Primesafe to collect animals out of a dam and move them from one to another or to a purge system or to another growers purge system for what ever purposes.</li> </ul>

Organisation / Author	Summary / Major Points
	<ul style="list-style-type: none"> <li>• The Primesafe requirements do not provide the adequate cost benefit ratio where it comes to protecting the health of the public nor do the Primesafe proposals adequately reflect the nature of the product, the process of yabby growing, nor the current market (i.e. they are sold as a live animal) these measures do not apply to other live seafood unless they are a Shellfish.</li> </ul> <p><b>Chemical Risks</b></p> <ul style="list-style-type: none"> <li>• Background levels of Chemicals normally found in sea environments do not affect yabbies with FSANZ already identifying yabbies as the safest seafood with less heavy metals than rock lobster.</li> </ul> <p>Cadmium and mercury in our inland waters is much lower than in as in the sea as shown in the National Residue Surveys. Moreover AQIS have no concerns with yabbies from this point of view as indicated through the results of the last National Residue Survey. All other chemicals that are used in agriculture have withholding times and recommended uses. As long as farmers and growers of primary production comply with this use there is no issue with any live farm animal. This is also supported by the ‘Risk Assessment of Pesticides for Yabby Farmers April 2004’ conducted by Victorian fisheries.</p> <p><b>Multi - waters Licence, Auditing Structure and Fees</b></p> <ul style="list-style-type: none"> <li>• Currently there is much confusion in the industry with respect to the responsibly a yabby farmer has under PrimeSafe, and FSANZ. Auditing fees associated with the multi-water licence have not been articulated adequately to the industry with many issues still unresolved. If Farms are tacked onto a single licences how will Primesafe audit a large licence of say 300 growers (or in the case of Mary Neskes in WA 780 growers)? Currently Primesafe in contradiction to providing regulatory measures aimed to minimise food safety risk have changed their mind on this and will allow multiwaters licences to include growers who do not have to have an auditable food safe premises, nor a food safety plan nor indeed need to bare the costs of a Primesafe 3rd party audit as they come under the food safety plan of the licence holder.</li> <li>• If it is conceded that the food safety risks associated with other growers are the responsibility of the holder of a multi- waters licence then how is that part of a regulation seriously based on risk, when one grower can use this mechanism to avoid licence and audit costs and be next door to an independent grower and share equipment vehicles and the same environment.</li> </ul> <p><b>Regulatory Costs</b></p> <ul style="list-style-type: none"> <li>• Calculating the costs that will be faced by the industry is difficult as there has been little consultation and even less solid information on exactly how the auditing and verification processes will be carried out and what costs the industry will incur. The basic licence structure is a pay per volume arrangement with large processors paying the lion’s share. However yabby Growers are in the same baseline category under the Victorian Scheme as the abalone industry one which makes far more profit per Kg produces for more product and has different and understandable food safety risks and sustainability issues. All but o few of the 60 – 70 Victorian licensed yabby growers last year made less than \$1000 from the sale of product for human consumption. Adding in other sales such as bate and pets a good year in the last 8 for an average grower is overly estimated at around \$4000. It is not hard to see the serious nature of regulatory burden that is now being faced by the industry.</li> </ul>

Organisation / Author	Summary / Major Points
	<ul style="list-style-type: none"> <li>• The industry, through a small and largely inadequate consultation process with Primesafe has been told to expect 3-4 audits annually, especially in the first year in order to bring the industry up to a standard of compliance Primesafe says will protect the public from the associated food safety risks posed by this industry.</li> <li>• The industry was visited by representatives of Primesafe pre-1 July 04 to explain the changes that have to be made and given a year to comply. If anything has changed since then there has been no consultation.</li> <li>• Therefore the industry assumes on a viable farm of average size 80 acres compliance costs are estimated thus: <ul style="list-style-type: none"> <li>➤ 3-4 hr 3rd party audit. We have been quoted an hourly rate of \$140.</li> <li>➤ Travelling time has not been ruled out in writing by Primesafe so as farms are in the country 1 ½ hrs is not an unreasonable time say approx \$175</li> <li>➤ Time on farm 4 hrs \$560</li> <li>➤ Growers time while Audit takes place audits can't proceed without the licence holder being present \$80 at 20 hr</li> <li>➤ Time preparing paper trail would assume if they are here 4 hrs at least 2 hours paperwork at some stage \$40</li> </ul> </li> <li>• Therefore even conservatively it is estimated that in addition to annual licence fees it will cost a conservative minimum of \$855 per visit at Audits times 3-4 times per year for a reasonable sized and therefore viable farm.</li> <li>• The actuality of this figure is seen by experienced industry growers on smaller viable farms to be more in the region of 1500-\$2000 annually.</li> <li>• This envisaged cost burden is completely unacceptable to the Australian Fresh Water Crayfish Growers Association Vic and is seen by stakeholders as threatening their livelihood and that of the industry total.</li> </ul> <p><b>Black Market Trade</b></p> <ul style="list-style-type: none"> <li>• It is well known that Yabbies have been sold and are being traded illegally and it is therefore an even greater food safety risk to have unregulated product being sold in this manner.</li> </ul> <p>Such cost burdens will increase this dangerous and illegal activity to the further detriment of the industry as opportunistic traders take advantage of a market demand that will not be met as a result of the non- viability of the industry. It is important to note that this demand has never been met such is the nature of the market for this commodity.</p> <p><b>Comparative Costs to Other Industries</b></p> <ul style="list-style-type: none"> <li>• The industry has been unofficially told that the Audit Costs will be similar to a Butchers Shop at \$130 per visit. It is difficult to see this as Yabby Growing businesses are bigger more complex and safer but the Act could not be conceivable administered for compliance in under an hour.</li> <li>• The Coles Myer major meat supplier has about 30,000 acres of land in West Vic. They are audited and licensed through LPA for \$120 annually The inputs of truckloads of grain a day and hay of feedstuffs to cattle and sheep are higher in residues than anything currently used in the yabby growing industry.</li> <li>• Even if a private grower sells 2000 prime lambs a year LPA audits are less than \$50 annually.</li> <li>• Any person can get a food license to buy and cook anything including yabbies from a local council for \$170 annually including</li> </ul>

Organisation / Author	Summary / Major Points
	<p>compliance audits of their template food safety plan.</p> <ul style="list-style-type: none"> <li>• A food safety program for the dairy industry is \$200 annually in NSW similar in Vic including audits.</li> <li>• Yabby farmers in SA currently pay a 1 off fee of \$approx 115 for an Aquaculture Licence.</li> </ul> <p><b>Conclusion</b></p> <ul style="list-style-type: none"> <li>• The Australian Freshwater Crayfish Growers Association asks FSANZ to dutifully consider the above submission in light of the low food safety risks associated with the Aquaculture of Yabbies and assist the industry with respect to the regulatory impost currently being imposed by the Victorian Government.</li> <li>• It is also asked that the concerns raised in this submission be canvassed and considered by the Office of Regulatory Review and the Development and Implementation Subcommittee (DISC) and any other committees empowered to review regulatory burdens and Cost Benefit Ratios with respect to the mitigation of food safety risks through nationally enforceable food safety standards.</li> <li>• Please see attachment 1 for further information pertaining to the indictment of the Victorian government with respect to this industry's issues.</li> </ul> <p>Attachment 1  Article explaining the situation of the Victorian Yabby Growers  Source: Grow fish, Gippsland Aquaculture Industry Network 23/06/2004  Title: 'Victorian yabby growers pushed to the wall'  Main points mentioned:  Recent regulatory changes in Victoria, hiking up the Fisheries licence fees by up to 400% immediately and up to over 1000% over the next three years.  Victorian Govt claiming to be forced into its actions by forces beyond its control.  Fledgling industry feels betrayed by the very govt and agencies that should be encouraging their development and the increased sustainable use of on-farm resources.  Under policy of 'cost recovery' each supplier of yabbies to a multi-water licence holder must pay a \$200 per annum licence fee in addition to the \$125 commercial dam fee.</p> <ul style="list-style-type: none"> <li>• Vic Govt claimed that fee hike was mandated by the Federal Govt's National Competition Policy and unless they apply the additional charges they will be fined millions of dollars.</li> <li>• The Seafood Safety Act (Vic) 2003 has placed responsibility for the maintenance of seafood safety in Vic in the hands of the former Victorian Meat Authority – re-badged under the name PrimeSafe Victoria.</li> <li>• The Act specifically exempts live finfish producers where the product is processed off site.</li> <li>• The Act does not extend the same exemption to crustaceans such as yabbies that are sold live, kept live by the down stream purchaser and cooked immediately prior to consumption.</li> <li>• There has been no food poisoning event with yabbies to the knowledge of the oldest industry hands.</li> <li>• Traceability already exists in the yabby industry, as all produce must be labelled with its source.</li> </ul>



Organisation / Author	Summary / Major Points
	<ul style="list-style-type: none"> <li>• Southern Rural Water have recently advised the Gippsland Aquaculture Industry Network (GAIN) that yabby growers will have to pay licence fees on their dams. The new Farm Dam Rules incorporated in the Water Act (Vic) 1989 require farmers to register their dams prior to 30 June 2004 or else pay a registration fee.</li> <li>• If dam owner stocks dam with juvenile yabbies an annual fee for a commercial dam of \$125 will apply.</li> <li>• A new dam or yabby farm will require an application and associated fee.</li> <li>• Gippsland Yabby Growers' Association estimate that more than 90% of existing growers will choose to leave the industry.</li> </ul>
<p>Mary Ferguson Export and National Marketing Springs Smoked Seafoods</p>	<p><b>RE: Salmon (<i>Salmo salar</i>)</b></p> <ul style="list-style-type: none"> <li>• States that the farmed Salmon from Tasmania is recognised in Australian and Export markets as 'Tasmanian Salmon' and 'Tasmanian Smoked Salmon'.</li> <li>• States that this is a unique marketing term and must be allowed to be used in the future.</li> </ul>
<p>Trevor Domaschcz Vice President Victorian Yabby Growers Association</p>	<p><b>Email 1</b></p> <ul style="list-style-type: none"> <li>▪ Requires four licences to grow yabbies.</li> <li>▪ Under FSANZ will require licence for all other products.</li> <li>▪ Unviable under PrimeSafe and Fisheries licensing structures to continue to grow yabbies without FSANZ intervention.</li> <li>▪ Will end up with 20 licences.</li> <li>▪ Yabbies have been assessed by FSANZ as the safest seafood which makes live yabbies near to nil risk. FSANZ philosophy clearly states nil risk nil regulation.</li> <li>▪ Any practical food safety issues are addressed by the standard means of cooking for 5 minutes after they reach boiling point.</li> <li>▪ Yabbies can aestivate for many years out of water as long as their gills are kept moist thus storage and transport of yabbies has no detrimental effect on yabbies or on food safety.</li> <li>▪ Yabbies cannot tolerate pesticides</li> <li>▪ The yabby industry cannot afford Primesafe style audits.</li> <li>▪ In Victoria live finfish are exempted but not live yabbies. Eels and fish are often caught in the same water bodies as yabbies.</li> </ul> <p><b>Email 2</b></p> <ul style="list-style-type: none"> <li>▪ Levels of cadmium and mercury in inland waters are lower than in the sea as shown in the National Residue Surveys.</li> <li>▪ AQIS have no concerns with yabbies.</li> </ul> <p><b>Email 3</b></p> <ul style="list-style-type: none"> <li>▪ Has been told to expect 3-4 audits annually.</li> <li>▪ Has calculated the cost to be \$855 per visit, including costs for hourly rate of \$140, plus audit travelling time \$175; plus time on farm 4 hours \$560; his time at \$20 per hour for four hours; plus time preparing paper trail at \$40.</li> <li>▪ Average yabby grower in Victoria last year earned less than \$1000.</li> <li>▪ Have run at a loss for the past 8 years.</li> </ul>

Organisation / Author	Summary / Major Points
	<ul style="list-style-type: none"> <li>▪ Other costs that are hard to pin down are the compliance costs for sheds and potable water.</li> </ul> <p><b>Email 4</b></p> <p>'Risk Assessment of Pesticides for Yabby Farmers' April 2004, Fisheries Victoria, Fisheries Victoria Research Report Series No. 12.</p> <ul style="list-style-type: none"> <li>▪ Study assessed the risk posed to the food quality of yabbies grown in farm dams as a result of normal farm practices.</li> <li>▪ The model integrated land use practices with application methods and properties of pesticides, as well as combining the effects of several applications of multiple pesticides during the course of a growing season.</li> <li>▪ A model that provided a qualitative 'indicator' which evaluated potential impact was considered the most appropriate for this study.</li> <li>▪ To verify the results from the model, samples of yabbies from selected dams were submitted for chemical analysis.</li> <li>▪ Farmers were also asked to answer a questionnaire on their pesticide use. Nineteen out of 49 responded. Only five stated that pesticides were used in the dam catchment area where the yabbies are grown. Ten did not use pesticides. Four were no longer farming yabbies.</li> <li>▪ The information from the growers who applied agricultural chemicals to their farmland was used in the mathematical model to assess environmental risk of the pesticide to the yabbies.</li> <li>▪ Respondents also asked about distance of septic tanks. In all cases, septic tanks were further than 100m from dams and therefore the risk of contamination from pathogens from this source was considered minimal.</li> <li>▪ Study revealed there was a low risk of contamination by agricultural chemicals for yabbies grown in farm dams.</li> </ul> <p><b>Email 5</b></p> <ul style="list-style-type: none"> <li>▪ Original email that was responded to by FSANZ and redirected to Margaret Darton.</li> <li>▪ Very concerned about new regulations being applied to live yabbies.</li> <li>▪ Has sold \$2000 of live yabbies for human consumption in the last five years and is expected to pay at least \$800 annually for a very low risk product.</li> </ul> <p><b>Email 6</b></p> <ul style="list-style-type: none"> <li>▪ Correspondence with Jayne Gallagher of SSA and Don Nicholls of WA.</li> <li>▪ WA does not currently have FSP or audit requirements for yabbies in WA. Have developed a post-harvest COT that is available on the SQMI website.</li> <li>▪ Have found that processors are putting in place a requirement for his or an internally developed COP.</li> <li>▪ Agrees with assessment of risk.</li> </ul> <p>Attached also two-page fax from PrimeSafe detailing the licensing requirements from 1 July 2004 for yabby farmers plus a reminder letter to renew application for a licence.</p> <ul style="list-style-type: none"> <li>▪ All seafood businesses involved in the harvesting of yabbies for human consumption will be required to be licensed by Primesafe from 1 July 2004.</li> <li>▪ Prescribed application fee is \$200 for up to 15 tonnes</li> <li>▪ Yabbies need to comply with the requirements of the Code.</li> </ul>

Organisation / Author	Summary / Major Points
	<ul style="list-style-type: none"> <li>▪ Live seafood is required to be transported a licensed vehicle.</li> <li>▪ All seafood businesses need to develop food safety plans and have audits. Audits will not be required until after 1 July 2005. PrimeSafe staff will conduct inspections until this time.</li> </ul> <p>Attached one-page fax from NSW Fisheries with physiological information on yabbies, confirming that they can survive many years out of water in a state of suspended animation (aestivation) provided their gills are kept moist.</p>
<p>Chris Chan Director, Science and Risk Management NSW Food Authority</p>	<p>Appreciates opportunity to participate in process of developing standard and commenting on draft. Provides comments under nine headings:</p> <p><b>Sec. 2(2) definition of frozen seafood</b></p> <ul style="list-style-type: none"> <li>• Meaning of phrase ‘change into a different state’ is not clear. When read in conjunction with sub-clause (b), different interpretations can be arrived at. For example, live seafood that is iced and kept at 5°C would be technically changed into a different state (no longer live) but would not be frozen despite fitting the description.</li> </ul> <p><b>Clause (d) of the Editorial note under Sec. 2(2)</b></p> <ul style="list-style-type: none"> <li>• Important to explain the term ‘substantial transformation’ in terms of the seafood industry as this is an important part of the definition of primary food production and hence the delineation of businesses that have to comply with the proposed Standard as opposed to Chapter 3 of the Code.</li> <li>• Requirements of Division 3, subdivision 3 of proposed standard for a ‘seafood business’ are less stringent than the corresponding requirements in Chapter 3 for a ‘food business’.</li> <li>• Notes that editorial notes to Clauses 13 and 24 emphasis that any businesses engaging in activities beyond primary production will have to comply with Standard 3.2.2 and Standard 3.2.3.</li> <li>• Infrastructure costs for business will vary depending upon whether it is considered to be engaging in primary production or beyond that.</li> <li>• FSANZ needs to provide clear criteria on the boundary of ‘primary production’ and what constitutes ‘substantial transformation’ in the seafood context.</li> <li>• Questions whether heading, gutting and/or filleting of fin fish on board a vessel is within the scope of primary production.</li> </ul> <p><b>Clause a of the Editorial note under Sec. 2 of Division 2, subdivision 1</b></p> <ul style="list-style-type: none"> <li>• States that the verb ‘control’ needs explanation and questions the degree of control to constitute sufficient control.</li> <li>• Questions if it means prevent, eliminate, minimise, keep at such a level as to not render the seafood unsafe or unsuitable, or something else.</li> </ul> <p><b>Sec. 4 and Sec. 10(1)</b></p> <ul style="list-style-type: none"> <li>• Requests clarification on the wording in Sect 4.</li> <li>• Believes it is not reasonable to require businesses that wild-catch seafood to prevent seafood still in the water from contamination.</li> </ul>

Organisation / Author	Summary / Major Points
	<ul style="list-style-type: none"> <li>• Related issue in Sect 10(1). Questions if ‘seafood that is protected from the likelihood of contamination’ refer to seafood that is so protected <u>after harvest</u>.</li> <li>• If so, believes it is not a sufficient assurance that the seafood is safe, because contamination could have occurred before harvest. Notes that there is no requirement in Sec. 10 or elsewhere in the draft standard that requires a seafood business to receive only seafood that is safe.</li> </ul> <p><b>Definition of bivalve molluscs in Sec. 15</b></p> <ul style="list-style-type: none"> <li>• Notes that pearl oysters are excluded from definition of bivalve molluscs. Seeks confirmation from FSANZ that there is sufficient scientific justification to exempt pearl oysters from the provisions specific to bivalve molluscs, including the requirement of a marine bio-toxin management plan.</li> </ul> <p><b>Sec. 18(a) Wet storage of bivalve molluscs</b></p> <ul style="list-style-type: none"> <li>• The meaning of ‘those conditions’ is not clear. Presumes ‘the conditions specified in clause 16’ refers to the various <u>statuses</u> of a harvest area. Questions if ‘those conditions’ means the quality parameters of water required for the area to be classified as one of the statuses. If so, requests more clarity in those terms.</li> <li>• Notes that the clause also seems to require the water used to be actually sourced from an area that has an acceptable status, rather than requiring the water to conform to a certain quality standard, regardless of its source. Questions if this is intentional and if so, why.</li> </ul> <p><b>Sec. 18(b) Wet storage of bivalve molluscs</b></p> <ul style="list-style-type: none"> <li>• States that the clause appears to be unnecessary. ‘Effectively disinfected...’ is simply a means of achieving the required (microbiological) water quality (which is not defined in the clause anyway, unless effective disinfection is meant to mean sterility – which is unnecessary). The second part of 18(a) already requires the water ‘continue to satisfy those conditions during the course of the wet storage’. Disinfection could well be the means of achieving this requirement, but not necessarily the only means of doing so.</li> </ul> <p><b>Sec. 19 Co-mingling</b></p> <ul style="list-style-type: none"> <li>• It is not clear how far down the supply chain the prohibition of co-mingling is intended to apply. Given it is not in Chapter 3 of the Code, presumes it is FSANZ’s intention to allow co-mingling beyond primary production. If so, seeks FSANZ’s advice on the rationale of this. Notes that this reinforces the need to have a clear distinction between what is considered primary production. Questions if shucking of oysters is considered primary production or processing, and if co-mingling of oysters is allowed in the premises of an oyster shucking business.</li> </ul> <p><b>Table to Clause 20</b></p> <ul style="list-style-type: none"> <li>• Table to clause 20 specifies ‘primary production of bivalve molluscs’ as the activity for which a seafood business must implement a documented seafood safety management system. Notes that the DAR states that ‘..implementation of food safety programs for the post-harvest sector up to the beginning of the retail sector is proposed’.</li> </ul>

Organisation / Author	Summary / Major Points
	<p>States that if these two references are to be in agreement, then shucking of oysters (e.g. into half shells and bottled oyster meat), storage and delivery of processed oysters to retail would have to be considered as within the scope of 'primary production of bivalve molluscs'. This would appear not to be consistent with the definition of the term <b>primary production of seafood</b> in Sec. 2(2). Comments that there is a need for a clear distinction between what is primary production and what is beyond that.</p>
<p>Jayne Gallagher Business Development Manager Seafood Services Australia</p>	<p>Supports the draft variation to the Code as detailed in Attachment 1.</p> <p>Hopes that FSANZ will continue to be involved and take leadership during the implementation of the standard at state level and thereby ensure that the intended outcomes of having nationally consistent food safety standards are achieved.</p> <p><b>1. Inclusion of the Australian fish Names list</b> States that standardised Fish Names should be mandatory in the Code. Believes this is consistent with the objectives for developing standards as described in the FSANZ Act i.e. the protection of public health and safety; the provision of adequate information relating to food to enable consumers to make informed choices; and the prevention of misleading or deceptive conduct. Welcomes the assurance and commitment by FSANZ that once the Australian Standard process is complete, they will ensure that a process for enforcing the use of Standardised Fish Names, imported and domestically produced, is implemented and the desired outcomes of mandating fish names are achieved. States that it is important to note the potential WTO implications of this.</p> <p><b>2. Risk Ranking Report (Attachment 10 of DAR)</b> Contends that there are serious flaws in the model and therefore in some of the conclusions for the risk rankings drawn. General comments from SSA are attached. The comments are not detailed but concentrate on general comments against CODEX principles for such activities. Suggests that the Risk Ranking Report, in its current form, not be used by risk managers as definitive, and that other input be sought before risk management decisions are made. Further suggests that the RRR be put into proper context i.e. consider the number of seafood meals consumed per year and the likelihood of an incident occurring at all.</p> <p><b>Mandatory labelling of imported seafood at the point of sale</b> Notes that there remains the anomaly of imported seafood not having to be labelled as such at the food service level. States that this is inconsistent with objectives 1, 2 and 3 of the FSANZ Act.</p> <p><b>Consistency in implementation</b> Notes that there is already evidence of the scope for inconsistent application of the standard at the State level. Asks that FSANZ drive the process of achieving consistent implementation at the State level to ensure that the potential benefits of the PPPS for seafood are realised.</p>

Organisation / Author	Summary / Major Points
	<p><b>Recognition of equivalence</b> Notes that it is important that the PPPS for seafood is harmonised with other relevant standards and that a process for recognition of equivalence be implemented. Notes that duplication of audits has the potential to add significant costs to the seafood business. Recognition of equivalence and the ability to demonstrate compliance with standards through a single audit system remains a high priority for industry. Welcomes the commitment of FSANZ to this process.</p> <p><b>Cost Recovery</b> Remains concerned at the potential for unrealistic expectations of State Governments for cost recovery by their food safety regulators. Believes expectations may result in unnecessary requirements being implemented at State level as revenue raisers and may impede achievement of food safety outcomes. Recognises that this is a state jurisdictional issue, but believes that FSANZ has to be committed to resolve this or risk non-achievement of nationally consistent standards and the expected outcomes as detailed in the DAR.</p>
<p>Brett McCallum Executive Officer Pearl Producers Association</p>	<ul style="list-style-type: none"> <li>▪ Welcomes the current recommendation in the DAR regarding the classification of pearl meat using solely the adductor muscle.</li> <li>▪ Supports the definition of the high risk ‘bivalve mollusc’ class of product excluding pearl oysters where the only part of the product consumed is the adductor muscle.</li> <li>▪ Notes that the Standards Development Committee for the PPPS decided that the definition of Shellfish by ASQAP was flawed, hence the correct definition in the PPPS based on the real level of risk.</li> <li>▪ Notes that the only shellfish which have an elevated level of risk according to the FSANZ Risk Assessment are ‘whole’ bivalve molluscs harvested from unmanaged fisheries and eaten raw or lightly cooked.</li> <li>▪ States that there is abundant literature showing that bivalve adductor muscle, such as pearl meat and scallops, are one of the safer forms of seafood.</li> <li>▪ Notes that review on literature by Janet Howieson of WA Fisheries Dept previously forwarded (also see Submission #5).</li> <li>▪ States that in over 50 years of corporate knowledge, there has not been any instance of food poisoning due to consumption of pearl adductor meat. Over 1000 people working in the industry in any given year.</li> <li>▪ Notes that pearl farms are located in remote pristine wilderness areas with the watersheds surrounding the areas generally having no permanent populations and no point or diffuse sources of pollution.</li> <li>▪ Notes that while there is little data available on potentially toxic algal species in tropical Australian waters, notes that a comprehensive survey of Darwin Harbour by Padovan (1991) found no toxin producing species.</li> <li>▪ States that as a result of the lack of associated problems with the consumption of pearl meat, the industry has not seen the need to conduct any structured program to provide supporting documentation.</li> <li>▪ The industry considers that this history and the position taken on scallop adductor muscle is compelling argument that pearl oyster adductor meat is a safe product. States that this position now supported by SDC for the PPPS.</li> <li>▪ Notes differences in definition of bivalve shellfish between the draft PPPS (which exempts pearl oyster adductor muscle) and the ASQAP Operations Manual (includes pearl oyster adductor muscle). Notes that FSANZ Risk Assessment resulted in the exemption of the product in the definitions in the draft Seafood PPPS.</li> </ul>

Organisation / Author	Summary / Major Points
	<ul style="list-style-type: none"> <li>▪ States that a strong argument will be put to ASQAAC to change the definition in the ASQAP Operations Manual on the basis of FSANZ RA.</li> <li>▪ Notes that as raised with Jenny during the Perth seminar, there is a process issue that PPA requests needs careful consideration in the finalisation of the draft PPPS. Should there be any consideration of a change to the exclusion of pearl oyster adductor muscle from the definition of high risk bivalve molluscs, the PPA would require the opportunity to consider the basis for any change and to formally comment or take action to further support the current draft.</li> <li>▪ Analysis results for heavy metal analysis from pearl farms from 5 sites attached (same as for submission #5). All the values for heavy metals are below the maximum limits as outlined in the Code.</li> <li>▪ States there be a need, the industry is prepared to undertake laboratory feeding experiments to quantify any accumulation of algal biotoxins in the adductor and viscera of pearl oysters. General outline of this testing as been developed (see attached to Submission #5).</li> </ul>
<p>John van den Beuken Programme Manager Carole Inkster Director, Food Standards New Zealand Food Safety Authority</p>	<p><b>General comments</b></p> <ul style="list-style-type: none"> <li>▪ Has undertaken a preliminary equivalence assessment by comparing it with New Zealand legislation. Comparison is limited to a comparison of clauses in the proposed standard with equivalent existing New Zealand controls. Further work is yet to be done to compare areas where NZ legislative controls are in place but no equivalent measure is present in the Australian standard. This assessment will be made available to FSANZ as soon as possible.</li> <li>▪ This Standard does not have many of the features of the NZ regulatory environment under the Animal Products Act that generally regulates primary production of seafood in NZ.</li> <li>▪ Of particular concern is that the standard does not regulate many of the matters pertaining to bivalve molluscan shellfish that are currently regulated under the Industry Agreed Implementation Standard IAIS005.1 in NZ which is soon to be superseded by the animal Products (Specifications for Bivalve Molluscan Shellfish) Regulations and Specification, a Regulated Control Scheme under the Animal Products Act 1999. NZ sees no different between the health needs of its domestic consumers and those in countries to which it exports shellfish and has effectively a single standard that applies to both domestic and export production. <ul style="list-style-type: none"> <li>➤ Suggests a single consistent standard be applied across Australian export and domestic shellfish products.</li> </ul> </li> <li>▪ Notes that the ASQAP Manual contains requirements that are similar to many aspects of the NZ requirements. Notes that compliance with this Australian programme is currently mandatory under the Australian export food control programme. Cannot understand why this programme is not required to be mandatory for all shellfish production throughout Australia under the proposed standard given that bivalve molluscan shellfish are identified as high risk and consistent application of effective controls is internationally recognised as being critical to ensuring shellfish safety for the consumer. Allowing discretion about the extent to which the many aspects of the ASQAP that are not replicated in the proposed standard will promote inconsistency between control authorities and may expose consumers to risk. <ul style="list-style-type: none"> <li>➤ Strongly recommends that Australia consider fully adopting ASQAP by reference or replication in the PPPS for seafood to overcome these potential issues.</li> </ul> </li> </ul>

Organisation / Author	Summary / Major Points
	<ul style="list-style-type: none"> <li>▪ Notwithstanding the Trans-Tasman Mutual Recognition Agreement, while such deficiencies in regulation are in place, NZ will continue to treat Australian shellfish as high risk foods under imported food control programme. These products are included in the list of risk foods currently being considered by officials from FSANZ, AQIS and NZFSA under TTMRA and harmonisation of the risk list.</li> </ul> <p><b>Equivalence Assessment – Australian Primary Production and Processing Standard for Seafood: General Comments on Equivalence of Standard</b></p> <p>All products produced under the Animal Products Act regime are subject to significantly greater controls than those proposed in the draft Australian Standard. Principal requirements relevant to seafood under the Animal Products regime are contained in the following legislation and specifications (Abbreviations used in text are in brackets):</p> <ul style="list-style-type: none"> <li>▪ Animal Products Act 1999 (APA)</li> <li>▪ Animal Products Regulations 2000 (APR)</li> <li>▪ Animal Products (Regulated Control Scheme-Limited Processing Fishing Vessels) Regulations 2001 and specifications (FVRCS)</li> <li>▪ Animal Products (Exemptions and Inclusions Order 2000) (APEIO)</li> <li>▪ Animal Products (Definition of Primary Processor) Notice 2000 (APDOPP)</li> <li>▪ Animal Products (Specifications for Products intended for Human Consumption) Notice 2004 (HC Specs)</li> <li>▪ Animal Products (Risk Management Programmes Specifications) Notice 2003 (RMP Specs)</li> <li>▪ Meat Act 1981 (To be fully revoked 1 July 2006)</li> <li>▪ Fish Export Processing Regulations 1995 pursuant to the Meat Act 1981 (FEPR) (To be revoked 1 July 2006)</li> <li>▪ Industry Agreed Implementation Standard 005.1 (IAIS005.1) issued pursuant to the Fish Export Processing Regulations 1995. (To be replaced by the Bivalve Molluscan Shellfish Regulated Control Scheme (BMSRCS) under the APA in 2005)</li> <li>▪ Animal Products (Residue Specifications) Notice 2004</li> </ul> <p>New Zealand is nearing the end of a transition phase with premises progressively coming under the ambit of the Animal Products Act 1999. The main products still covered by the superseded Meat Act 1981 and its subordinate legislation are the growing and harvesting of bivalve shellfish which will soon be under a prescribed Regulated Control Scheme under the APA. The shellfish Regulated Control Scheme is proposed to incorporate the previous IAIS requirements and include some new requirements. This scheme will be consulted on later in 2004.</p> <p>For the purposes of this equivalence assessment the IAIS 005.1 has been considered as the current export shellfish standards as they are currently in force in New Zealand.</p> <p>The equivalent controls in Australia for exported products only are applied through the Australian Quarantine Inspection Service Export Food Control Orders.</p>



Organisation / Author	Summary / Major Points
	<p>These are not considered further in this equivalence assessment because products exported to New Zealand may be permitted entry without restriction from Australia under the Trans-Tasman Mutual Recognition Agreement (TTMRA) unless risk listed.</p> <p>The following classes of seafood products are risk listed:</p> <ul style="list-style-type: none"> <li>• crustaceans (cooked and raw) including shrimps, prawns and canned product</li> <li>• molluscs (cooked and raw shell fish) including clams, cockles, mussels, oysters, scallops</li> <li>• shark and marlin (chilled and frozen)</li> <li>• tuna (including canned)</li> <li>• manufactured and minced fish (surimi and marinara mix)</li> <li>• smoked and smoke flavoured vacuum packed fish</li> </ul> <p>Virtually all primary production of seafood for export is covered under the Animal Products Act regime.</p> <p>It is not clear to New Zealand how consistent implementation of national standards is undertaken in Australia, partly because each State retains its own primary legislation and regulatory resources are variable for jurisdiction to jurisdiction.</p> <p><b>Shellfish</b></p> <ul style="list-style-type: none"> <li>▪ The New Zealand Shellfish Regulated Control Scheme currently being developed is effectively an update of the previous Industry Agreed Implementation Standard IAIS005.1. Currently all New Zealand commercial shellfish growing areas have chosen to come under this standard, even though it is mandatory for export only.</li> <li>▪ The IAIS005.1 forms one of the base documents on which the Australian Shellfish Quality Assurance Programme (ASQAP) is based. Implementation of ASQAP is believed to be variable amongst the States as only those growing areas that wish to be listed for export are audited by AQIS.</li> <li>▪ Of particular note, for example, is that depuration of shellfish in tanks is practiced in Australia for shellfish from areas which New Zealand might classify as restricted due to potential for microbiological contamination. Depuration is recognised as being ineffective for virus removal from shellfish. <ul style="list-style-type: none"> <li>➤ Likely that depurated Australian shellfish produced under ASQAP from areas not classified as remote approved or conditionally approved could present a greater potential risk to New Zealand consumers than New Zealand grown shellfish.</li> </ul> </li> </ul> <p><b>Clause by Clause Evaluation (NZ Animal Products Act Regime information is detailed under the equivalent heading from standard)</b></p>

Organisation / Author	Summary / Major Points
	<p><b>Division 1 – Preliminary 1 Application</b></p> <ul style="list-style-type: none"> <li>▪ Applies to all primary production and secondary processing where official assurances are required. (APA S13). Also see Animal Products (Definition of Primary Processor) Notice 2000) Covers 90% of fish and shellfish processed in New Zealand at secondary processing level also, but exempts retail. (APEIO) All seafood products exported to Australia are produced under the APA and certified.</li> </ul> <p><b>2 Interpretation</b></p> <ul style="list-style-type: none"> <li>▪ Definitions in APA and HC Specs. Direct equivalence of interpretation section unnecessary unless interpretation leads to significant differences in standards. This is addressed in specific standards comments.</li> </ul> <p><b>Division 2 – General seafood safety requirements</b></p> <p><b>Subdivision 1 – Primary production controls</b></p> <p><b>3 General seafood safety management</b></p> <ul style="list-style-type: none"> <li>▪ Tailored Risk Management Programmes are required (APA S13) except where negligible risk exists or risks are specifically managed through a RCS.</li> </ul> <p><b>4 Requirement to prevent contamination</b></p> <ul style="list-style-type: none"> <li>▪ Covered by RMP requirements S17 APA.</li> <li>▪ FVRCS Regulation 12, 13,</li> <li>▪ HC Specs Clauses 62(1) and 102</li> </ul> <p><b>5 Inputs and harvesting areas</b></p> <ul style="list-style-type: none"> <li>▪ Covered by RMP requirements S17 APA.</li> <li>▪ APR Regulations 5,6,9-13.</li> <li>▪ HC Spec 62</li> <li>▪ FVRCS Regulation 12, 13,</li> <li>▪ IAIS005.1, EFPR reg. 5</li> </ul> <p><b>6 Seafood storage</b></p> <ul style="list-style-type: none"> <li>▪ Covered by RMP requirements S17 APA.</li> <li>▪ APR Regulation 9.</li> <li>▪ HC Specs 62, 102-104</li> <li>▪ General NZ temperature requirements comparable.</li> <li>▪ Chilled whole fish -1oC to +1oC</li> <li>▪ Chilled Fish Product -1oC to +4oC</li> <li>▪ Frozen fish or fish product (including shellfish) -18oC</li> </ul>

Organisation / Author	Summary / Major Points
	<ul style="list-style-type: none"> <li>▪ Brine Frozen fish -15oC</li> <li>▪ Includes additional requirement to validate chilling/freezing processes to thermal centre.</li> </ul> <p><b>7 Seafood transportation</b></p> <ul style="list-style-type: none"> <li>▪ Covered by RMP requirements S17 APA.</li> <li>▪ APR Regulations 9.</li> <li>▪ HC Specs 62, 102-104, 143-147</li> </ul> <p><b>8 Seafood packaging</b></p> <ul style="list-style-type: none"> <li>▪ Covered by RMP requirements S17 APA.</li> <li>▪ APR Regulations 16.</li> <li>▪ HC Specs 29, 30</li> <li>▪ And general requirements on prevention of contamination in HC Specs 62, 102-104</li> </ul> <p><b>9 Seafood for disposal</b></p> <ul style="list-style-type: none"> <li>▪ Covered by RMP requirements S17 APA.</li> <li>▪ APR Regulations 11</li> <li>▪ RMP Spec 11(2)</li> <li>▪ HC Specs Part 2</li> <li>▪ FEPR Reg. 13</li> </ul> <p><b>10 Seafood receipt</b></p> <ul style="list-style-type: none"> <li>▪ Covered by RMP requirements S17 APA.</li> <li>▪ APR Regulations 5</li> <li>▪ And general requirements on prevention of contamination in HC Specs 62, 102-104</li> <li>▪ IAIS 005.1 Clause 5.9.2, 5.10</li> </ul> <p><b>11 Seafood recall</b></p> <ul style="list-style-type: none"> <li>▪ Covered by RMP requirements S17(2)c APA.</li> <li>▪ RMP Spec 12</li> </ul> <p><b>Subdivision 2 – Skills and knowledge</b></p> <p><b>12 Skills and knowledge</b></p> <ul style="list-style-type: none"> <li>▪ Covered by RMP requirements S 16,17 APA.</li> <li>▪ RMP Spec 13</li> <li>▪ HC Specs Part 4</li> </ul>

Organisation / Author	Summary / Major Points
	<p><b>Subdivision 3 – Health and hygiene requirements</b></p> <p><b>13 Health and hygiene requirements</b></p> <ul style="list-style-type: none"> <li>▪ Covered by RMP requirements S17 APA.</li> <li>▪ APR Regulations 12, 13, part 3</li> <li>▪ RMP Spec 13</li> </ul> <p><b>Subdivision 4 – Seafood premises and equipment</b></p> <p><b>14 Seafood premises and equipment</b></p> <ul style="list-style-type: none"> <li>▪ Covered by RMP requirements S17 APA.</li> <li>▪ APR Regulations 10, 11</li> <li>▪ HC Specs Part 1 and 2</li> </ul> <p><b>Division 3 – Harvesting and other requirements for bivalve molluscs</b></p> <p><b>15 Interpretation</b></p> <ul style="list-style-type: none"> <li>▪ Covered by IAIS 005.1</li> </ul> <p><b>16 Harvesting bivalve molluscs for human consumption</b></p> <ul style="list-style-type: none"> <li>▪ IAIS005.1 Section 3</li> <li>▪ APR Regulation 5</li> <li>▪ HC Specs 119-122</li> </ul> <p><b>17 Harvesting bivalve molluscs for depuration or relaying</b></p> <ul style="list-style-type: none"> <li>▪ IAIS005.1 Section 3, 7.5</li> <li>▪ APR Regulation 5</li> <li>▪ HC Specs 119-122, 128</li> </ul> <p><b>18 Wet storage of bivalve molluscs</b></p> <ul style="list-style-type: none"> <li>▪ IAIS005.1 Section 6</li> <li>▪ APR Regulation 5</li> <li>▪ HC Specs 123-127</li> </ul> <p><b>19 Co-mingling of bivalve molluscs</b></p> <ul style="list-style-type: none"> <li>▪ IAIS005.1 Section 8.2.2</li> <li>▪ HC Specs 138(2)c, 138 (3)e</li> </ul>

<b>Organisation / Author</b>	<b>Summary / Major Points</b>
<p>Dr Paul Van Buynder Chairperson Western Australian Food Advisory Committee</p>	<ul style="list-style-type: none"> <li>▪ Supportive of this proposal and of standards development, but has concerns regarding the definitions and interpretations where they could be inconsistent with or a duplication of Part 3 and Part 4 of the Food Standards Code.</li> <li>▪ The Committee supports the proposal to introduce mandatory FSP or equivalence to high risk sectors and also recognises that the seafood industry would benefit from national guidelines on GMP to ensure whole of chain food safety.</li> <li>▪ Notes that verification and enforcement of the proposed FSP and any GMPs hinge on requiring documentation and keeping of monitoring records for future records.</li> <li>▪ Recognises that the bivalve industry has been identified through risk profiling as requiring mandatory FSP. Notes that this sector is currently managed through the ASQAP quality systems, which has been adopted by all States and Territories where such industry exists. Notes that the consolidation of the ASQAP model into the Food Standards Code will enable a national consistent application of a recognised and proven FSP.</li> <li>▪ Recognises industry and consumer concerns about the uneven playing field for local and imported seafood, with local industry being expected to comply with higher standards without reciprocal requirement for imported foods. Consumers should have the same level of confidence in all available seafood supplies.</li> <li>▪ A similar requirement for imported foods should be considered to the extent permissible by Australia's international trade obligations.</li> <li>▪ Notes the confusion between 'primary production' and 'primary processing', and the uncertainty regarding the point in the seafood chain that Part 3 of the Code commences to apply. Suggests that Part 3 of the Code apply for finfish from the filleting process and beyond.</li> </ul>
<p>Neil Murphy General Manager SA Freight Council Inc</p>	<ul style="list-style-type: none"> <li>▪ Notes that inadequate and inappropriate transport and logistics activities represent a significant risk to the integrity of seafood products.</li> <li>▪ SAFC has several resources available to assist producers and transporters improve their handling of perishable goods, including a specific Seafood Handling Guideline.</li> <li>▪ Currently developing a Seafood element to its Food Export Logistics Training Program.</li> <li>▪ SAFC's Cold Chain Centre will be the national focus for the delivery of the Australian Quality Logistics (AQL1) program.</li> </ul> <ul style="list-style-type: none"> <li>▪ Suggests that it is imperative that FSANZ ensure that there is no duplication between this proposed standard and other standards already in existence or under preparation.</li> <li>▪ Suggests that all regulations and standards regarding food standards in Australia, including those relating to seafood, must be uniform between States and Territories.</li> <li>▪ Suggests that to ensure that product integrity is maintained, and potential contamination and deterioration of product is minimised, all perishable products including seafood products, must be handled within a secure cold chain environment. Any regulations aimed at achieving this objective must be uniform between States and Territories.</li> </ul>

Organisation / Author	Summary / Major Points
<p>Neil MacDonald General Manager SA Fishing Industry Council</p>	<ul style="list-style-type: none"> <li>▪ Supports the application of a seafood safety standard, provided the standard prescribes requirements only for the management of high risk products such as bivalve molluscs, or with agreement of affected jurisdictions, other specific species/activities that may be assessed as high risk.</li> <li>▪ Believes that with regard to the other areas of the seafood production sector, the proposed standard should be gazetted as a voluntary code, with the application of standard 4.2.1 being applied to the back door of a retail premise for bivalve molluscs.</li> <li>▪ States that individual jurisdictions have implemented State-based regulations and systems funded largely by industry to promote safe food processes by producers, or are considering some form of legislative mechanisms to capture those areas of primary food production that are considered to present the greatest risks to consumers.</li> <li>▪ States that the Code proposed should provide a framework which individual jurisdictions may draw on to strengthen identified weaknesses in food safety at a specific food production sector level, or where an industry sector chooses to obtain the market benefits of being associated with a regulated standard.</li> <li>▪ Preferred option is Option 2, but with the capacity for other species or sectors to be included within a schedule to the Standard where there is subsequent agreement to cover high risk products or for those sectors seeking a mandatory framework at a national level.</li> <li>▪ Believes that the Standard should be provided otherwise as a code of practice that can be adopted on a jurisdiction by jurisdiction basis within State-based legislative frameworks.</li> <li>▪ Option 3 is not preferred as this would oblige each State to mandate food safety programs for all primary producers of food safety and this would be inconsistent with the underlying principle of support for managing only high risk areas and the option for industry to adopt voluntary codes of practice for food safety.</li> <li>▪ Option 1 is not considered to have any merit.</li> <li>▪ Specific comments on the provisions within draft 4.2.1 as follows:</li> </ul> <p><b>Division 1 Clause 2 - Interpretation</b> Include a definition of substantial transformation and/or primary food production as these are critical factors in determining whether the product is considered to meet 3.1.1 or 4.2.1. It should only be necessary to look at one or the other standards to access what is the appropriate standard to apply rather than have to access both.</p> <p><b>Division 1 Clause 2 – Interpretation – Seafood and Seafood business</b> Believes the definitions should relate to the activities to be covered by the Standard e.g. High risk or other agreed activities/species. A schedule defining the range of regulated activities should be provided for such as is contained in the Table to clause 20.</p> <p><b>Division 2 Clause 3 - General seafood safety management</b> This provision should only cover the activities to be managed in the standard. Other low risk production should be encourage to meet the standard as a code of practice with the recognition of the Standard within the provisions of the code contained in the preamble to the Standard.</p>

Organisation / Author	Summary / Major Points
	<p><b>Division 2 Clause 4 – Requirement to prevent contamination</b> Believes that while the principle in this is fundamental, it is dealt with more specifically in the subsequent clauses.</p> <p><b>Division 2 Clause 9 – Seafood for disposal</b> The value of Option 2 – ‘return to supplier’ – is questioned as this provides a mechanism by which food considered to be at risk is able to be put back into the supply chain. The options offered should be in the order d, c and a.</p> <p><b>Division 2 Clause 10 – Seafood receipt</b> Questions whether the provision for a seafood business to accept product at 60C or above is appropriate. Not aware of any primary production process that requires the handling of seafood at that temperature. Any product at that temperature should be deemed to be processed as part of a primary food production business under Standard 3.1.1.</p> <p><b>Division 3 Clause 20 – Specific seafood safety management systems</b> This provision should relate to any and all activities or species that must be covered by the Standard and as such it should be in a Division 4 rather than in Division 3 which specifically only covers bivalve molluscs and so is superfluous in this division. The table should be part of defining the extent that there is a regulated need for a standard e.g. high risk foods or processes.</p>
<p>Phil Pond General Manager Safe Food Production QLD</p>	<ul style="list-style-type: none"> <li>▪ The Standard will need to expand the definition of Primary Production to include processing. Suggests that the definition in Section 11 of Food Production (Safety) Act 200 which in part includes the following: ‘the dismembering, filleting, peeling or shucking of seafood or added brine to seafood and the boiling of crustaceans’. This could be achieved by amendments to the editorial note. The opening para will also need to pick up on it. This will give consistency across the jurisdictions and allow for processing.</li> <li>▪ The definition of oysters needs to include spat.</li> <li>▪ The State Shellfish Control Authority (SSCA) will need to be reworded, as QLD does not have such a body and this does impose a new agency on QLD.</li> </ul>
<p>Graham Short Chief Executive Officer Western Australian Fishing Industry Council Inc. (WAFIC)</p>	<ul style="list-style-type: none"> <li>▪ Calls for a National Fish Names List and big fines for fish substitution to be included in the Primary Production Standard for Seafood.</li> <li>▪ Calls for the mandatory labelling of imported seafood at the point of sale.</li> <li>▪ Calls for the recognition of third party audits against the Standard.</li> <li>▪ Calls for the risk assessment to be completely reassessed to include the risk of a seafood safety incident happening at all.</li> </ul>

<b>Organisation / Author</b>	<b>Summary / Major Points</b>
<p>Department of Agriculture, Fisheries and Forestry (Richard Souness/Tom Black)</p>	<ul style="list-style-type: none"> <li>▪ Endorses a national regulatory approach with consistency across jurisdiction to the management of seafood safety.</li> <li>▪ Notes that the interpretive guide and standard may have been better developed at the same time.</li> <li>▪ Comments that it is difficult to assess whether the clauses are adequate for export requirements.</li> <li>▪ Notes that bivalve molluscs produced under this standard will not be eligible for export.</li> </ul> <p><b>Export Issues</b></p> <ul style="list-style-type: none"> <li>▪ Concerned that a standard that does not mandate the requirements for ASQAP will lead to significant downgrading of the requirements that are now in place.</li> <li>▪ Highlights the fact that all products for export are processed in accordance with a documented food safety plan and are subject to performance-based audits.</li> </ul> <p><b>Imports</b></p> <ul style="list-style-type: none"> <li>▪ The standard is not clear what the intention is in relation to imports.</li> <li>▪ Is of the view that an Australian standard is just that and cannot be mandated in other countries.</li> </ul> <p><b>Specific comments on Clauses</b></p> <p>Clause 3</p> <ul style="list-style-type: none"> <li>▪ Notes there is no requirement for a business to write anything down, nor to monitor the controls. Enforcement or demonstration of compliance will be difficult. Suggests the clause needs strengthening to require documentation and ongoing monitoring of controls.</li> </ul> <p>Editorial Note for Clauses 6 &amp; 7 and also Clause 10</p> <ul style="list-style-type: none"> <li>▪ The reference to temperatures at or above 60°C should be removed.</li> </ul> <p>Clause 15</p> <ul style="list-style-type: none"> <li>▪ Suggests the addition of words to indicate general criteria for judging equivalence of ‘an equivalent manual’ in the definition of ‘Manual’</li> </ul> <p>Clause 20</p> <ul style="list-style-type: none"> <li>▪ The Clause should be amended to refer to the ‘Export Control (Processed Food) Orders’.</li> <li>▪ Suggests strengthening the Clause with the addition of words to the effect that ‘the effectiveness of the controls should be scientifically validated’.</li> </ul> <p><b>Implementation</b></p> <ul style="list-style-type: none"> <li>▪ Notes the potential for inconsistency of enforcement across the States.</li> </ul>



## Summary of Submissions by Issue at Initial Assessment

<p><b>Are there any chemical or biological hazards either further to, or currently included in Chapters 1 and 2 of the Code, that need to be addressed in the proposed seafood standard, or that should be additionally included in the current chapters of the Code?</b></p> <ul style="list-style-type: none"> <li>- Need to revisit MRLs in seafood.</li> <li>- Should not be duplication of existing legislation.</li> <li>- Reference / rely on / review chemical and biological hazard standards from other Chapters.</li> <li>- Address these in an easily updated dynamic interpretive guideline.</li> <li>- Should specify the species that the histamine standard applies to.</li> <li>- Metabisulphites may cause serious health problems – 4-hexylresorcinol is a safe approved alternative.</li> <li>- Mercury in predatory fish should be resolved through advisory guidelines.</li> <li>- Attention needs to be given to allergen issues not covered by Code.</li> <li>- Non-micro risks such as fish bones must be addressed.</li> <li>- Need appropriate process controls for histamine, ciguatera, Vibrio in prawns, agvet chemicals in aquaculture (esp. antibiotics), and micro, biotoxin and heavy metal contamination in shellfish</li> </ul> <p>Escolar, often sold as rudderfish, may need to be addressed.</p> <ul style="list-style-type: none"> <li>- general micro criteria should be included, similar to for food chemicals, i.e.: no residues are allowed unless there is a specific permission</li> </ul>	<p>Qld Health, SFQ Qld Health TFIC, SASC, SSA TFIC TSGA Kanins Simplot Simplot Simplot PIRSA SA DHS DAFF</p>
<p><b>What should be the scope of the proposed seafood Standard?</b></p> <ul style="list-style-type: none"> <li>- Should cover the entire seafood industry.</li> <li>- Should have consistency between definitions in the PP&amp;PS and the SSA / ASIC standard, and an agreed process to change these.</li> <li>- Outcomes based, not prescriptive.</li> <li>- Outcomes focussed and based on food safety risk.</li> <li>- Refer to, but not duplicate, other Chapters.</li> <li>- Review Code as it does not allow health claims for omega 3 oil content.</li> <li>- All foods should come under the standard not just foods for human consumption.</li> <li>- Must apply equally to local and imported produce.</li> </ul>	<p>SSA SSA NTSC, Simplot SFM, SSA, MFMAA, AIEH SA, DAFF NTSC, SA DHS, PIRSA Springs Springs TFIC SFM, MFMAA</p>

<ul style="list-style-type: none"> <li>- Should apply to all seafood produced or traded in Australia, including imports and exports.</li> <li>- Should not consider policy and regulatory issues other than food safety, and should not consider jurisdictional issues.</li> <li>- Recognise and reference Australian Fish Names List.</li> <li>- Don't incorporate fish names.</li> <li>- Exclude quality attributes and production methodologies.</li> <li>- If the onus is on the supplier to source safe product, don't need to heavily regulate primary production.</li> <li>- Only regulate where significant risks and the benefits outweigh the costs.</li> <li>- Standard should allow for voluntary codes of practice for GHP.</li> <li>- Should simply apply Chapter 3 to primary production and processing, thus removing the need for a specific seafood standard.</li> <li>- Difficult to legislate marketing names, but if done then should include Tasmanian Atlantic salmon and ocean trout.</li> <li>- Self regulation is preferable to government regulation – use the SSA guidelines on GMP and specific industry codes of practice.</li> <li>- Where regulation is deemed necessary it must be targeted at addressing the specific food safety problem and not have general application.</li> <li>- Follow Codex Draft Code of Practice, except where too vague.</li> <li>- EU or FDA regulations and micro criteria acceptable for export / import.</li> <li>- Deceptive or misleading conduct best left to Trade Practices legislation.</li> <li>- Reference to cold chain compliance through supply chain recommended.</li> <li>- Should not extend labelling obligations beyond those in the Code.</li> <li>- Seafood industry should only have to comply with standards 3.1.1, 3.2.2 and 3.2.3.</li> <li>- Standards 3.1.1, 3.2.2 and 3.2.3 should continue to apply, with other requirements added where risk and cost-benefit indicates</li> <li>- Need to differentiate between low inherent risks and higher risks through external impacts, and manage pollution of waterways.</li> <li>- Will inevitably cross over into quality aspects – not undesirable.</li> <li>- Residue accumulation as a consequence of prior land use in aquaculture requires attention</li> <li>- Food safety risks should be managed according to the degree of risk.</li> <li>- Avoid prescriptiveness – deal with actual not hypothetical risks.</li> <li>- Must have regard to existing market- and export-driven HACCP-based QA systems.</li> <li>- A full HACCP plan warranted for activities and products that carry a high food safety risk.</li> <li>- Food safety should be managed using a preventative approach based on through-chain risk management, with standards implemented in consultation and partnership with industry.</li> </ul>	<p>SSA</p> <p>NTSC, SSA Sontari Sontari NT Govt</p> <p>SASC SASC TSGA</p> <p>TSGA</p> <p>TSGA</p> <p>TSGA</p> <p>Simplot Simplot Simplot Simplot AFFS</p> <p>PIRSA</p> <p>SASMPA</p> <p>SFQ SFQ</p> <p>SFQ SASMPA SASMPA</p> <p>SFM, MFMAA NSWFIC</p>
--	---

<p><b>Is the current definition of seafood in the Code adequate in terms of defining the commodities that the standard needs to cover?</b></p> <ul style="list-style-type: none"> <li>- Should be revisited to provide clarity.</li> <li>- Definition appears satisfactory.</li> <li>- The Seafood Definition used by Codex would appear to be suitable.</li> <li>- Should include fish, crustacea, molluscs and other marine invertebrates.</li> <li>- Definition should not include crocodile or seaweed.</li> </ul>	<p>Simplot SA DHS SASMPA PIRSA SFM, MFMAA</p>
<p><b>Should the proposed standard include aquatic plants, reptiles and mammals (which has implications for native fishing rights)?</b></p> <ul style="list-style-type: none"> <li>- No.</li> <li>- No, unless significant public health risks identified.</li> <li>- Include aquatic plants, exclude crocodile and mammalian meat.</li> <li>- Include these, but define the point at which they become seafood subject to the provisions of the standard.</li> <li>- Include aquatic plants, as some States already include these in legislation.</li> <li>- Questions whether the current crocodile meat standard is adequate.</li> <li>- Food safety still relevant to native rights, but low risk best addressed through risk communication</li> </ul>	<p><b>SADHS, SFM, MFMAA, SIMPLOT</b></p> <p>PIRSA TFIC Sontari</p> <p>Qld Health, SFQ Qld Health, SFQ SFQ</p>
<p><b>Should the standard regulate seafood production (aquaculture) from the point of harvest up to the back dock of retail establishments, or through to the point of retail sale?</b></p> <ul style="list-style-type: none"> <li>- Entire chain from harvest to retail, inclusive.</li> <li>- Aquaculture should be covered from production inputs to point of sale.</li> <li>- Aquaculture should be covered from harvest to point of sale.</li> <li>- Up to but not including point of retail sale.</li> <li>- From harvest up to point at which the Code currently applies.</li> <li>- Should only apply to seafood production.</li> <li>- Apply to whole chain, but focus on where the major risks and problems lie, in the lack of</li> </ul>	<p>NTSC, TSGA, Sontari, Qld Health, SFM, MFMAA, Springs, PIRSA</p> <p><b>SFQ SIMPLOT TFIC</b></p> <p>SA DHS AIEH SA SASMPA</p>

<p>knowledge of cold-chain management and seafood handling in the food service and retail sectors</p> <ul style="list-style-type: none"> <li>- Reference other standards in the Code in relation to retail</li> </ul>	<p>DAFF</p>
<p><b>Should businesses selling ready to eat seafood remain covered under the current arrangements, or should these businesses be covered by the Primary Production and Processing Standard for seafood?</b></p> <ul style="list-style-type: none"> <li>- Leave them under the current arrangements.</li> <li>- Incorporate in primary production and processing standards.</li> <li>- Should remain covered by the PP&amp;PS by reference to Chapter 3</li> <li>- Need to consider sushi and sashimi specialty shops.</li> </ul>	<p>SA DHS, AIEH SA, Springs Qld Health Simplot SASMPA</p>
<p><b>To what extent should the standard regulate harvesting, handling and processing of seafood onboard fishing vessels?</b></p> <ul style="list-style-type: none"> <li>- An outcomes based approach is recommended</li> <li>- Vessels may not need a full Codex HACCP system where risks are low.</li> <li>- Should include food safety plans / programs (FSPs) in line with the industry preferred standard</li> <li>- Should address in same manner as for food processing establishments.</li> <li>- The risks are low, so a standard should not apply.</li> <li>- Specific risks may need mandated controls e.g. cooking prawns on boats.</li> <li>- Voluntary code of practice for GHP and vessel design may be useful.</li> <li>- No need to have a FSP if only producing live catch.</li> <li>- Limited space on vessels may preclude on-board inspectors, so vessel skippers should obtain accredited food safety training.</li> <li>- Need an awareness program to reinforce the basics of food safety on-board.</li> <li>- One option is to have a receival standard with regulation / enforcement beginning at dock, to encourage compliance.</li> <li>- Need to apply GHP unless processing on-board, then need a FSP.</li> </ul> <p>May need to address by a code of practice, as a standard will be difficult to enforce on-board.</p>	<p>Simplot, SSA SFM, MFMAA Qld Health  Springs, Simplot SASC, PIRSA, SASMPA PIRSA PIRSA TFIC TFIC  TFIC  TFIC  AFFS SA DHS</p>
<p><b>Comment is sought on the scientific risk assessment process which forms the basis of the FSANZ regulatory measures.</b></p> <ul style="list-style-type: none"> <li>- Risk assessment process is supported.</li> </ul>	<p>SA DHS, Simplot, DAFF</p>

<ul style="list-style-type: none"> <li>- Risk assessment process needs to be appropriate for the level of risk.</li> <li>- Should rely on work already undertaken by authorities and the seafood industry.</li> <li>- Assessment required of special techniques , the use of antibiotics, hormones and GM.</li> <li>- A scientific risk assessment is needed for each link in the chain.</li> <li>- The FSANZ risk assessment process does not properly consider risk analysis in context, ignores data already available to aid businesses implement HACCP, and places undue emphasis on risk assessment more appropriate to the establishment of food product standards.</li> <li>- The analysis to relate production processes to hazards should occur after the standard is established</li> </ul>	<p>TFIC SFM, MFMAA Simplot</p> <p>NSWSIC SSA</p> <p>SSA</p>
<p><b>Technical data is sought from industry and relevant agencies for incorporation into the scientific risk analysis process.</b></p> <ul style="list-style-type: none"> <li>- The reported data for the relative amounts of local and imported seafood consumed in Australia is wrong – correct ratio is given.</li> <li>- Need more data on chemical / pesticide residues in aquaculture.</li> <li>- Industry should be encouraged to fill the few remaining gaps in Australian risk assessment data</li> <li>- Can supply data from food microbiological surveys, if required.</li> <li>- Supports provision of technical data for incorporation into the scientific risk assessment process</li> <li>- Prepared to assist with provision of technical data for incorporation into the scientific risk assessment process.</li> <li>- Won't supply data if confidentiality can't be assured.</li> </ul>	<p>Sontari</p> <p>Qld Health SFQ</p> <p>SA DHS</p> <p>SFM, MFMAA TSGA</p>
<p><b>Comment is sought on the suitability and/or any deficiencies of the industry-preferred standard proposed under the SSA/ASIC Application, if it were to be considered as a basis for a national mandatory Primary Production and Processing Standard for seafood.</b></p> <ul style="list-style-type: none"> <li>- Supports industry developing and implementing voluntary standards.</li> <li>- Don't use it as basis of seafood standard (reasons given).</li> <li>- Use the SSA / ASIC standard as an interpretive guideline.</li> <li>- Needs to be modified if to be used as a guideline.</li> <li>- Some parts would be useful as a guideline document.</li> <li>- Use it as a basis for the seafood standard.</li> <li>- Use it as a basis, but it has some anomalies.</li> <li>- Sections 9 and 10 should apply to trawlers and premises used for live fish.</li> <li>- A wider view is required.</li> </ul>	<p>PIRSA PIRSA TFIC SASC SA DHS NTSC, SFM, MFMAA, DAFF Qld Health, SA DHS, SFQ AFFS Sontari</p>

<p><b>Comment is sought on the suitability of any existing government standards, such as the NSW Food Production (Seafood Safety Scheme) Regulation 2001, and any international standards, as a model on which to base a national mandatory Primary Production and Processing Standard for seafood.</b></p> <ul style="list-style-type: none"> <li>- All existing Australian and international standards should be considered as part of the process of developing the PP&amp;PS for seafood.</li> <li>- Work undertaken by SafeFood NSW and issues raised in the NSW ‘Section 73’ review should be taken into account in developing the standard.</li> <li>- There is anecdotal evidence of complexity and cost in the NSW and VIC schemes.</li> <li>- NSW scheme is deficient for several reasons.</li> <li>- NSW seafood safety manual should be the standard.</li> <li>- Current legislation covering imports is working.</li> <li>- The NSW scheme is a regulation, not a standard, but some of the oyster management parts would be useful as a guideline.</li> <li>- Incorporate into interpretive guidelines as appropriate.</li> <li>- Utilise industry codes of practice <i>etc.</i> where mandatory measures would be ineffective.</li> </ul>	<p>SSA</p> <p>SFM, MFMAA TSGA</p> <p>Sontari AFFS Sontari Qld Health</p> <p>TFIC TFIC</p>
<p><b>Comment is sought on the range of options available to manage food safety risks in the seafood sector and their appropriateness, including the costs and benefits of such approaches.</b></p> <ul style="list-style-type: none"> <li>- Should mandate ASQAP principles for all bivalve molluscs.</li> <li>- should cite ASQAP</li> <li>- FSPs for bivalve mollusc production and handling and for control of <i>Listeria</i> in cold smoked salmon</li> <li>- Since seafood is mainly low risk, only need to apply minimum regulatory controls where necessary.</li> <li>- Management focus and costs should be directed towards those segments presenting the greatest risk.</li> <li>- HACCP must be the basis for food safety management.</li> </ul>	<p>SASC, PIRSA DAFF PIRSA</p> <p>SA DHS</p> <p>NSWSIC</p> <p>SASMPA</p>

<p><b>Stakeholders are invited to provide their views on issues relating to food safety management systems and whether options further to those raised in this paper should be considered in managing the potential public health and safety risks associated with seafood.</b></p> <ul style="list-style-type: none"> <li>- the Ministerial Council has established that risk management in relation to PP&amp;PS is to be consistent with Chapter 3, HACCP based and implemented according to risk classification.</li> <li>- The solution, whether HACCP or GMP, should be appropriate to the level of risk.</li> <li>- Develop voluntary code for harvesters, as low risk.</li> <li>- Only need effective risk communication and targeted industry education.</li> <li>- FSPs should only apply where the risk is high.</li> <li>- Non-regulatory guidelines and codes of practice could be effective where risks are low.</li> <li>- FSPs should not be implemented unless there is strong industry and government leadership and it is supported by appropriate resources.</li> </ul>	<p>SSA</p> <p>NTSC, SASC, Qld Health PIRSA Qld Health Qld Health SFM, MFMAA SA DHS, PIRSA</p>
<p><b>Information on the costs and benefits of the food safety management systems is sought.</b></p> <ul style="list-style-type: none"> <li>- The RIS in support of Chapter 3 of the Code is relevant.</li> <li>- Additional costs of implementation of FSPs are significant</li> <li>- Consumer confidence that seafood is safe is vital to the industry.</li> <li>- Information on the costs of compliance with, and administration of, the AQIS export certification program are presented.</li> </ul>	<p>SSA</p> <p>PIRSA</p> <p>SSA</p> <p>SECC</p>
<p><b>Comment is sought on issues relevant to compliance by the industry with respect to the food safety management options outlined in this paper.</b></p> <ul style="list-style-type: none"> <li>- Compliance with FSPs by 3<sup>rd</sup> party audit, approved by govt, paid by industry, reporting to regulators.</li> <li>- Compliance measures and costs need to be commensurate with risks.</li> <li>- There needs to be consistency between jurisdictions.</li> <li>- Complexity of compliance and difficulties with enforcement argue against regulation.</li> <li>- Will there be a national accreditation mark?</li> <li>- Will there be consideration for good compliance history?</li> <li>- Multiple audits are very undesirable.</li> </ul>	<p>PIRSA</p> <p>SA DHS SASMPA TSGA</p> <p>NT Govt NT Govt NT Govt, SASMPA, SASC, SFM, MFMAA</p>

<p><b>Comment is sought on food safety management options from an enforcement perspective. Specific issues that have been identified are listed below, but comment need not be confined to these issues:</b></p> <ul style="list-style-type: none"> <li>- <b>the costs of meeting current requirements and costs or difficulties in meeting the range of food safety management options that are mentioned in this paper;</b></li> <li>- <b>THIS IS NO TIME FOR A CASH GRAB VIA LICENSING FEES.</b></li> <li>- Information on the costs of compliance with, and administration of, the AQIS export certification program are presented.</li> <li>- <b>ways that industry could comply with the food safety management options, for example by compliance with current industry or legislative requirements;</b></li> <li>- A business complying with the SSA / ASIC standard should be recognised as complying with the PP&amp;PS standard.</li> <li>- Need to recognise export establishments as complying with the standard.</li> <li>- Industry would not support duplication of export and Australian domestic standards for seafood</li> <li>- <b>other methods of cost effective compliance;</b></li> </ul> <p>Need education and training supported by a significant increase in government contributions.</p> <ul style="list-style-type: none"> <li>- <b>how a Primary Production and Processing Standard for seafood would fit with any existing standards and State and Territory regulations governing primary products;</b></li> <li>- <b>additional matters at State/Territory level that the States and Territory governments may have to consider in order to ensure compliance and enforcement with any national standard;</b></li> <li>- Local government enforces Chapter 3, Health Chapters 1 and 2.</li> <li>- Seafood production best regulated by Primary Industry, processing by Human Services and local authorities.</li> <li>- Production should be regulated by Primary Industry, processing and retail sale by Health.</li> <li>- <b>how equivalence between existing requirements and any new standards could be established;</b></li> <li>- <b>the timeframes that industry may need to comply with the food safety management options;</b></li> <li>- Timeframes will vary according to the requirements of food safety systems and the readiness of the industry sector (over two years in some sectors).</li> <li>- Need 3 year compliance and 2 year stock in trade timeframes</li> </ul>	<p>TFIC SECC</p> <p>SSA</p> <p>NTSC, SECC, SASC SASMPA</p> <p>NSWSIC</p> <p>AIEH SA</p> <p>Unley</p>
--	--



<ul style="list-style-type: none"> <li>- Timeframes should be set in close consultation with industry.</li> <li>- <b>the role of incentive based compliance schemes, such as reduced frequency of audits;</b></li> <li>- An initial high audit frequency should be reduced, unless there is evidence that the system is not under control.</li> <li>- This is a real opportunity to incorporate incentive-based compliance.</li> <li>- <b>the need for comprehensive guidelines for those sectors of the seafood industry affected by a Primary Production and Processing Standard for seafood, including the role of industry and regulatory agencies in the development of any guidelines</b></li> <li>- Guideline a vital support to any legislation.</li> <li>- Supports nationally developed guidelines.</li> <li>- Many guides and codes of practice exist and SSA is helping industry develop GMP guidelines</li> <li>- Will need guidelines, but not all industry codes of practice will be acceptable – issues of adequacy and equivalence will need national review.</li> <li>- <b>Other Comments</b></li> <li>- State regulators are unlikely to have the capacity to implement and police a single standard that would also replace the AQIS requirements</li> <li>- Concerns with harmonisation with international standards.</li> <li>- Need mutual recognition of audits between AQIS and jurisdictions.</li> <li>- Need mutual recognition of audits and acceptance of third party audits. Past audit performance and risk profile need to be taken into account</li> <li>- How will producers / processors who are also retailers be regulated?</li> <li>- State regulators will require a major re-education to be able to police the standard.</li> <li>- Need to strengthen HACCP awareness and training.</li> <li>- Auditing should be in realm of market forces.</li> <li>- Number of skilled auditors for seafood in Australia is low.</li> <li>- Need a national approach aimed at eliminating inconsistencies between jurisdictions.</li> </ul> <p>SSA is working with FAS-ANZ on a national framework for food safety auditing, accreditation and certification.</p>	<p>PIRSA Simplot TFIC</p> <p>SASC, PIRSA Qld Health, SFQ</p> <p>Simplot PIRSA, SSA SSA</p> <p>Qld Health, SFQ</p> <p>SECC</p> <p>Simplot SECC, SSA SFM, SSA, MFMAA NT Gov SASMPA</p> <p>Simplot Simplot Simplot NSWSIC SSA</p>
--	--

## Summary of Submissions by Issue at Draft Assessment

Clause	Comments made in submissions
Standard 3.2.1	
<b>Standard 3.2.1</b>	<p>As the intent is to have 3.2.1 sit alongside of 4.2.1, suggests the addition of the words: ‘other than the primary production of bivalve molluscs’ after ‘handling of bivalve molluscs’ in the table to 2(2)b for 3.2.1. [PIRSA]</p> <p>SA supports the splitting of requirements for shellfish businesses between standards 3.2.1 and 4.2.1 and the imposition of food safety programs (standard 3.2.1) on shellfish businesses up to the back door of retail. [PIRSA]</p> <p>The split between applications of 4.2.1 and 3.2.1 needs to be based on the definition of ‘<i>primary food production</i>’ in the current Food Act and then consistent with the definition of ‘primary production of seafood’ in standard 4.2.1. [PIRSA]</p>
Standard 4.2.1	
1 Application	<p>Recommends removal of the words ‘and processing’ from the title as <i>processing</i> is not ordinarily associated with primary production and no definition is provided in 4.2.1 to differentiate this from the word ‘process’ in 3.2.2. [Laister Consulting]</p> <p>Questioned where the post-harvest requirements would commence. Identified three States that currently have post-harvest food safety requirements. [TAS *]</p> <p>The seafood standard should not apply to retail. Supports introduction of the proposed standard from harvest up to but not including retail. [Coles Myer]</p> <p>There are concerns in SA that Indigenous fishers may be entitled to higher bag limits than recreational fishers, and then may engage in trade/exchange with other groups. Although trade would be considered selling, and therefore should be covered under retail, the definition may need to be more explicit about this activity. [SA *]</p>
2 Interpretation	<p>Definition of FROZEN, THERMAL CENTRE, THAWED, CHILLED</p> <p>Suggests removal of ‘...has been changed into a different state by the reduction in temperature and...’ from the definition of <i>frozen seafood</i>. [PIRSA]</p> <p>Suggest the definitions for ‘<i>frozen seafood</i>’, ‘<i>thermal centre of seafood</i>’ and ‘<i>thawing</i>’ (<i>thawed</i>) be removed. [PIRSA]</p> <p>The meaning of ‘changed into a different state’ is not clear for the definition of <i>frozen</i>. [NSW Food Authority]</p> <p>Recommends the definitions for <i>chilled seafood</i>, <i>frozen seafood</i> and <i>thermal centre of seafood</i> be removed or replaced as editorial notes as guidance for good practice. Definitions only referred to in Clauses 6 and 7; lead to enforcement difficulties; there is conflict with 3.2.2. [Laister Consulting]</p> <p>The reference to <i>thermal centre</i> in the definition of <i>frozen</i> is not practical to enforce. [WA *]</p>

Clause	Comments made in submissions
	<p>Definition of LIVE SEAFOOD Suggests the definition for <i>live seafood premises</i> by removed as there is no need for reference to live seafood premises. [PIRSA]</p> <p>Definition of PRIMARY PRODUCTION AND PROCESSING Concerned about definitions and interpretation where they could be inconsistent with or a duplication of Part 3 and Part 4 of the Code. [Dept of Health WA]</p> <p>Need to provide clear criteria for the boundary of '<i>primary production</i>'. Reference to Clause 3 requirements for a 'seafood business' being less stringent than those of a Chapter 3 'food business', and that the editorial notes for Clauses 13 and 24 emphasise the need to comply with 3.2.2 and 3.2.3 for activities beyond primary production. [NSW Seafood Industry Conference]</p> <p>In the editorial note defining '<i>primary food production</i>', there is a need for activities listed to apply to 'on premises' as well as 'off site'. [QLD Health]</p> <p>Important to explain the term '<i>substantial transformation</i>' in terms of the seafood industry as this is an important part of the definition of primary food production and therefore the delineation of businesses that have to comply with 4.2.1 as opposed to Chapter 3. Requirements for a 'seafood business' under proposed standard are less stringent than those required for a 'food business' in Chapter 3. Need to provide clear criteria on the boundary of <i>primary processing</i>. [NSW Food Authority]</p> <p>A clear distinction between what is <i>primary production</i> and what is beyond that is needed. Given that Table 20 specifies the 'primary production of bivalve molluscs' and that food safety plans are to be implemented 'up to the beginning of the retail sector' then shucking of oysters will be considered within 'primary production'. Yet this will not be consistent with the current definition in 2(2). [NSW Food Authority]</p> <p>Notes the confusions between '<i>primary production</i>' and '<i>primary processing</i>' and the uncertainty regarding when Part 3 of the Code commences. Suggests that Part 3 of the Code apply for finfish from the filleting process and beyond. [Dept of Health WA]</p> <p>Include a definition of <i>substantial transformation</i> and/or <i>primary production</i> as these are critical factors in determining whether the product is considered to meet 3.1.1 or 4.2.1. [SA Fishing Industry Council] <i>Probably mean 3.2.1</i></p> <p>Need to expand definition of <i>primary production</i> to include processing. Suggests the definition from Section 11 of the Food Production (Safety) Act 2000 which in part includes: 'the dismembering, filleting, peeling or shucking of seafood or adding brine to seafood and the boiling of crustaceans'. Could be achieved by Editorial Note. [Safe Food QLD]</p> <p>The definitions of <i>seafood</i> and <i>seafood business</i> should relate to the activities to be covered by the standard. A schedule defining the range of regulated activities should be provided for such, as is contained in the Table to Clause 20. [SA Fishing Industry Council]</p> <p>Wild oyster harvesting is not included in the definition of '<i>primary food production</i>' as it presently appears. [QLD Health]</p>

Clause	Comments made in submissions
3 General seafood safety management	<p>Will be difficult for regulators to verify and for small businesses to follow. Appears to be covered by subsequent Clauses 5 to 14. Suggest removal of Clause 3. May become a policy statement in the preamble to the standard. [PIRSA]</p> <p>There is no requirement for a business to write anything down, nor to monitor the controls. Enforcement or demonstration of compliance will be difficult. Suggests the clause needs strengthening to require documentation and ongoing monitoring of controls. [DAFF]</p> <p>The verb '<i>control</i>' in Clause 3 Editorial note (a) needs explanation. Questions if it means prevent, eliminate, minimise, keep at such a level as to not render the seafood unsafe or unsuitable, or something else. [NSW Food Authority]</p> <p>Recommends that the words 'and document' be inserted in the Standard after 'systematically examine', or alternatively, delete Clause 3 as it would be impossible to enforce. [Laister Consulting]</p> <p>Believes the general requirements would require State s to mandate food safety programs and does not support this. Medium and low risk sectors should only be required to follow a voluntary code of practice. [SA Fishing Industry Council]</p>
4 Requirement to prevent contamination	<p>Will be difficult for regulators to verify in the absence of a documented program. Appears to be covered by subsequent Clauses 5 to 14. Suggests Clause 4 be deleted. [PIRSA]</p> <p>Requests clarification on the wording of Clause 4. Believes it is not reasonable to require businesses that wild-catch seafood to prevent seafood still in the water from contamination. [NSW Food Authority]</p> <p>While this principle is fundamental, it is dealt with more specifically in the subsequent clauses. [SA Fishing Industry Council]</p>
5 Inputs and harvesting areas	<p>Shellfish must enter cold chain with 24 hrs of harvest. Recommends a labelling amendment in terms of harvest time. [Oakley Food Advisory Services]</p>
6 Seafood storage	<p>Recommends the wording from 3.2.2 Clause 22 be included in 4.2.1 as it would be appropriate to have the same standard apply for storage of potentially hazardous food. Also notes that neither 4.2.1 nor 3.2.2 require temperatures to be recorded. This is not acceptable, as a business cannot demonstrate compliance without records. [Laister Consulting]</p>
7 Seafood transportation	<p>All perishable products including seafood must be handled within a secure cold chain environment. Regulations aimed at achieving this must be uniform between States and Territories. [SA Freight Council]</p> <p>Recommends transport of shellfish only by refrigerated vehicles (3<sup>rd</sup> party carriers) and should only be accepted if product is less than 10C at time of collection. Refrigerated transport should not be used as the first point of cold chain management. [Oakley Food Advisory Services]</p>
Editorial Note to Clauses 6 and 7	<p>Editorial note for Clauses 6 and 7 indicates that temperature control means maintaining food at or above 60°C. Not appropriate for pre-harvest seafood. Suggests the Editorial Note reflect that standard is for pre-harvest seafood. [PIRSA]</p> <p>The reference to temperatures at or above 60°C should be removed. [DAFF]</p>
8 Seafood packaging	<p><i>There were no comments against this clause.</i></p>

Clause	Comments made in submissions
9 Seafood for disposal	<p>Primary seafood businesses will be unable to return seafood products to a supplier, as they are the first in the food chain. Suggests Clause 9(1)(b) 'returned to supplier' be removed. [PIRSA]</p> <p>The value of option 2 – 'return to supplier' – is questioned as this provides a mechanism for at-risk food to be able to put back into the supply chain. The options should be re-ordered as d, c and a. [SA Fishing Industry Council]</p> <p>This clause requires labelling of return seafood, returned seafood or as unsafe or unsuitable. Why is this clause not the same as Chapter 3? [WA*]</p> <p>Comments that the wording in this clause implies that food must be <u>labelled</u> 'returned', 'recalled', or 'unsafe' or 'unsuitable'. Questions need for different terms for a label, when desired outcome is that food for disposal is not accidentally used. 'Quarantine areas' as used by some businesses would not technically comply. [Laister Consulting]</p>
10 Seafood receipt	<p>Standard only applies to seafood primary production so there are no (second) businesses that will receive seafood products. Suggests Clause 10 be deleted. [PIRSA]</p> <p>Comments that clause implies seafood can be received by the primary seafood business, which contradicts definition of primary producer in 3.1.1. Recommends that this clause be deleted. [Laister Consulting]</p> <p>According to the definition of seafood, other than for transportation, if you receive seafood you would not be a primary producer. [WA *]</p> <p>Questions if 'seafood that is protected from the likelihood of contamination' refers to seafood that is so protected after harvest. If so, this is insufficient. There is no requirement in Clause 10 or elsewhere for a business to receive only seafood that is safe. [NSW Food Authority]</p> <p>Questions whether the provision to accept product at 60°C or above is appropriate. Any product at that temperature would be deemed to be processed as part of a primary food production business under 3.1.1. [SA Fishing Industry Council]</p> <p>The reference to temperatures at or above 60°C should be removed. [DAFF]</p> <p>The reference to above 60°C means that food has been substantially transformed and therefore would not be primary produce. [WA *]</p>
11 Seafood recall	<p>The imposition of a written document places impost on businesses in situations where it might be difficult or impossible for a fisherman to contact sellers. Suggests Clause 11 become 'a seafood business must have in place a system for ensuring the traceability of their products'. Suggests the current Clause 11 be moved to Division 3 and be made specific for bivalve molluscs. [PIRSA]</p> <p>It was noted that traceability could be the biggest challenge for QLD, but it was acknowledged as an important part of the standard and of particular relevance in terms of ciguatera control. [QLD *]</p> <p>There was discussion at the VIC consultation about recall and traceability of finfish and how it might work using purchase records at each step of the chain. [VIC *]</p>
12 Skills and knowledge	<p>Wording is in conflict with Clause 3 of 3.2.2 as it does not apply to persons supervising food handling operations. Recommends the</p>

Clause	Comments made in submissions
	wording be the same in both standards. [Laister Consulting]
13 Health and hygiene requirements	<p>Questions who determines which hygiene and health practices are commensurate with the risk, especially if supervisors are not required to have skills and knowledge of food hygiene or food safety matters. Recommends the following requirements be added to the standard: Standard 3.2.2: Clauses 14, 15(1)a-g, 15(2), 15(3). [Laister Consulting]</p> <p>Subclause 14(1)(b) of standard 3.2.2 should be included for the specific prohibition of a person suffering from a food-borne illness. Or, if Clause 13 is deemed sufficient, then the provisions of 3.2.2 should be made generic for consistency. [Aust Food &amp; Grocery Council]</p>
14 Seafood premises and equipment	Submitter has previously recommended that all operations on fishing vessels should be required to have some form of (CODEX) HACCP-based food safety program in place. Standard does not reflect this. [Coles Myer]
Division 3 Harvesting and other requirements for bivalve molluscs	<p>The consolidation of the <b>ASQAP</b> model into the Code will enable a national consistent application of a recognised and proven FSP. [Dept of Health WA]</p> <p>Suggest incorporation of ASQAP by reference or by incorporation in the text. [NZ Food Safety Authority]</p> <p>Clause 6(3) requires seafood to be stored at a temperature that will not adversely affect the safety and suitability of the seafood, and Clause 20 requires bivalve mollusc businesses to have documented seafood safety management systems. States that ASQAP has specified storage temperatures and depuration conditions for live oysters. Different types of oysters have different requirements. FSANZ's guidance on this matter is essential for consistent implementation of the relevant provisions of the standard. [NSW Seafood Industry Conference]</p>
15 Interpretation	<p><b>Relaying:</b> suggests deletion of the words ‘..by using the ambient environment as a treatment process..’ as remaining words convey intent. [PIRSA]</p> <p>Suggests definition of <b>ongrowing</b> is included, such as the ASQAP definition, as this term is referred to in definition of <b>spat</b>. [QLD DPI &amp; Fisheries]</p> <p><b>Spat:</b> suggests deletion of the words ‘..not immediately intended for human consumption..’ as remaining words convey intent. [PIRSA]</p> <p>Believes mandatory requirements should include <b>spat</b> with the exclusion of those bivalves where only the adductor muscle is eaten. The inclusion of spat will aid in traceability of relayed spat across borders. Spat is also processed in SE QLD as bistro and bottled oysters for human consumption. [QLD Health]</p> <p>The definition of <b>oysters</b> needs to include <b>spat</b>. [Safe Food QLD]</p>

Clause	Comments made in submissions
	<p>Suggests deleting the reference to pearl oyster flesh from the definition of <i>bivalve molluscs</i>, as there is no evidence to support this in terms of heavy metals and biotoxin safety. [PIRSA]</p> <p>Suggests changing <i>bivalve molluscs</i> to: ‘but excludes scallops where the only part of the product consumed is the adductor muscle, and spat.’ [PIRSA]</p> <p>Seeks confirmation from FSANZ that there is sufficient scientific justification for the exemption of pearl oysters from the provisions specific to <i>bivalve molluscs</i> such as having biotoxin management plans. [Dept Health &amp; Human Services Tas]</p> <p>Questions the exclusion of pearl oyster meat from definition of <i>bivalve molluscs</i>. Differs from ASQAP Operations Manual. [QLD DPI &amp; Fisheries]</p> <p>Recommends to not exclude pearl oyster adductor muscle meat from the definition of <i>bivalve molluscs</i> until toxin work has been done and endorsed by ASQAAC. [Dept Health &amp; Human Services Tas]</p> <p>Seeks confirmation from FSANZ that there is sufficient scientific justification to exempt pearl oysters from the provisions specific to <i>bivalve molluscs</i>. [NSW Food Authority]</p> <p>Questions were raised over the basis for excluding pearl meat (gut removed) from the definition of bivalve molluscs. [NT *]</p> <p>Supports current exclusion of pearl oyster meat from <i>bivalve molluscs</i>. Provides supporting heavy metal analysis and biotoxin study proposal. [Paspaley Pearling]</p> <p>Supports the definition of <i>bivalve molluscs</i> excluding pearl oyster adductor meat. Notes that the SDC decided that the definition by ASQAP was flawed. Will put argument to ASQAAC to change definition on basis of FSANZ risk assessment. Should the definition be changed, PPA would require opportunity to consider and formally comment or take further action. [Pearl Producers Assoc]</p> <p>In SA a mollusc called ‘razorfish’ is marketed for its adductor muscle only. It is not harvested for sale in SA, but product from NSW and Victoria is sold on the SA market. Suggested that the definition of bivalve mollusc might need to be changed to include razorfish as well as pearl oysters and scallops. Alternatively, the definition could altered to be less specific e.g. ‘where only the adductor muscle and not the viscera is sold and consumed’. [SA *]</p>
	<p>The words of Clause 15 mean the bivalve molluscs are extended beyond the definition of ‘primary production of seafood’ and also conflict with the words under the table in clause 20. Suggests deletion of the following words from the definition of <i>bivalve molluscs</i> in Clause 15: ‘...either shucked or in the shell, fresh or frozen,.....or processed...’. [PIRSA]</p> <p>The word ‘processed’ in the definition of <i>bivalve molluscs</i> appears unwarranted particularly where there is reference to ‘shucked’ product. Definition also seems out of context with (c) of the Editorial note, which defines ‘<i>primary food production</i>’. [QLD Health]</p>
	<p>Suggests added definition to Clause 15: ‘<i>Batches</i> – means a quantity of food which is harvested, depurated or handled from the same lease number with the same lease date’. [Melshell Oysters] (<i>Relates to co-mingling</i>)</p>
	<p>Suggests addition of definition of <i>wet storage</i> to aid clarity: ‘Wet storage means the temporary storage of shellfish from classified areas in containers or tanks containing natural or artificial seawater for purposes other than depuration. Wet storage may be used to purge sand.’ [PIRSA]</p>

Clause	Comments made in submissions
	<p>The <i>SSCA</i> will need to be reworded as QLD does not have such a body and this does impose a new agency on QLD. [Safe Food QLD]</p> <p>Suggests the addition of words to indicate general criteria for judging equivalence of ‘an equivalent manual’ in the definition of <i>Manual</i>. [DAFF]</p> <p>Typographic errors: ‘control and relaying’ should read ‘and control relaying’, and in line 4, ‘that is contaminate or has’ should read ‘that are contaminated and have’. [Aust Food &amp; Grocery Council]</p>
<p>16 Harvesting bivalve molluscs for human consumption</p> <p>17 Harvesting bivalve molluscs for depuration or relaying</p>	<p>Clause 5(2) adequately addresses the issue of harvesting seafood only from ‘safe areas’. Clauses 16 and 17 duplicate this requirement in much unnecessary detail for bivalve molluscs. [Laister Consulting]</p> <p>It takes 2 years to classify an area for collection, therefore new leases will be unable to sell and wild shellfish fisheries will have to close until classified. Suggests Clauses 16 and 17 be amended by adding: ‘(d) is undergoing classification and has the approval of the appropriate authority, subject to specified conditions’ [PIRSA]</p> <p>Standard requires bivalve molluscs to be harvested from areas that have been classified subject to a marine biotoxin management plan. This will impact on QLD wild oyster industry. [QLD DPI &amp; Fisheries]</p> <p>Requirement for a marine biotoxin program and classification of areas for ‘wild’ oyster harvesting areas will be too onerous and uneconomical for NQLD harvesters. [QLD Health]</p> <p>Clause 5(2) adequately addresses the issue of harvesting seafood only from ‘safe areas’. Clauses 16 and 17 duplicate this requirement in much unnecessary detail for bivalve molluscs. Believe the reference to <i>SSCA</i> requirements may place unnecessary financial burden on small fishermen. [Laister Consulting]</p> <p>The issue of the practicality of biotoxin testing at remote sites was raised. [WA *]</p> <p>There is an issue with producers not being able to sell product prior to classification of the waters by WASQAP. This is particularly an issue in remote areas. [WA *]</p> <p>The <i>SSCA</i> is a term in the ASQAP Manual. May be difficulty using <i>SSCA</i> as defined as legal entity in legislation. Suggests the term ‘<i>SSCA</i>’ is replaced with ‘appropriate authority’ or ‘controlling authority’. [PIRSA]</p> <p>Believe the reference to <i>SSCA</i> requirements may place unnecessary financial burden on small fishermen. [Laister Consulting]</p>
<p>18 Wet storage of bivalve molluscs</p>	<p>Questions need to list this item separately given seafood businesses are required to have a food safety program based on HACCP, which will identify all hazards. Recommend the clause be deleted. [Laister Consulting]</p> <p>Clause 18(b) appears unnecessary. ‘Effectively disinfected’ is a means of achieving required water quality, which is already specified in 18(a). [NSW Food Authority]</p>



Clause	Comments made in submissions
	<p>The meaning of ‘those conditions’ in Clause 18(a) is not clear and requires clarification. Questions if it means the quality parameters of water required for the area to be classified as one of the statuses referred to in Clause 16. Also questions if it was intentional to infer that water used to be actually sourced from an area that has an acceptable status rather than a quality standard. [NSW Food Authority]</p> <p>Typographical error: Subclause 18(a) – the word ‘must’ should precede the word ‘continue’ at the start of the second line. [Aust Food &amp; Grocery Council]</p> <p>No wet storage of bivalve molluscs. [QLD DPI &amp; Fisheries]</p>
19 Co-mingling of bivalve molluscs	<p>Questions need to list this item separately given seafood businesses are required to have a food safety program based on HACCP, which will identify all hazards. Recommends that the clause be deleted. [Laister Consulting]</p> <p>Strongly supports Clause 19, and states that it will be important to have labelling requirements on the product through to the retail end. [Dept Health &amp; Human Services Tas]</p> <p>Co-mingling is a major concern for SA, as oysters from SA, Victoria and NSW are often combined and rumbled together (a form of washing). [SA *]</p> <p>There was agreement on the need for the clause and the meeting noted that this did not include lower risk product. [VIC *]</p> <p>Clause for co-mingling as it stands will not aid in tracing product to origin. The lease number and harvest date is critical information. Suggests definition of batches (<i>see above clause 15</i>). [Melshell Oysters]</p> <p>Suggests changing Clause 19 to: ‘For the purposes of clause 11, each batch of bivalve molluscs harvested must be separated in a manner that prevents co-mingling of batches’. [Melshell Oysters]</p> <p>Not sure how far down the supply chain Clause 19 is meant to apply as it is not in Chapter 3 of the Code i.e. is the intent for co-mingling to be permitted beyond primary production? [NSW Seafood Industry Conference]</p> <p>It is not clear how far down the supply chain the prohibition on co-mingling is intended to apply, given that it is not in Chapter 3. Seeks rationale on this. Reiterates need for clear definition of ‘primary production’. [NSW Food Authority]</p> <p>Standard should ensure that co-mingling is not permitted in the market place. [Tas Fishing Industry Council]</p>
20 Specific seafood safety management systems	<p>This Clause is in Division 3, which is specific for bivalve molluscs hence the table could be removed. Or, as the Clause and table are structured for future flexibility so that other categories could be added, then, Clause 20 should be shifted out of Division 3 and placed after Clause 15 in the General section. [PIRSA]</p> <p>The Clause should be amended to refer to the ‘Export Control (Processed Food) Orders’. [DAFF]</p>

Clause	Comments made in submissions
	<p>The Editorial note provides a list of acceptable systems. Believes reference to at least 3.2.1 should be put in Clause 20 (and preferably Export Control Orders too) as the editorial notes are not enforceable. Also notes that 3.2.1 refers to ‘food safety programs’ whereas this standard refers to ‘safety management systems’. Inconsistency in terms may cause confusion. [Laister Consulting]</p> <p>Suggests strengthening the Clause with the addition of words to the effect that ‘the effectiveness of the controls should be scientifically validated’. [DAFF]</p> <p>This provision should relate to any and all activities or species that must be covered by the Standard and as such it should be in Division 4 rather than in Division 3, which specifically covers bivalve molluscs and so is superfluous in this division. The table should be part of defining the extent that there is a regulated need for a standard e.g. high risk foods or processes. [SA Fishing Industry Council]</p>
Options – Supports Option 3 and/or Standard	<p>Agrees with Option 3. [Food Tech Assoc of Vic]</p> <p>Endorses Standard in its current form; recommends Option 3 be adopted. [Tas Fishing Industry Council]</p> <p>Applauds introduction of nationally mandated standard for seafood industry. [Melshell Oysters]</p> <p>Although AFG would prefer to see mandatory food safety programs in all areas of primary production, they support option three. [Aust Food &amp; Grocery Council]</p> <p>Strongly supports the requirement for all bivalve mollusc businesses to have food safety management systems. [Dept Health &amp; Human Services Tas]</p> <p>Supports option 3, using wording from p 8 as opposed to page 35. [QLD Health]</p> <p>Supports preferred Regulatory Option 3. Agrees that higher-risk seafood should require greater level of safety management and regulation. Does not believe that lower risk products should be exempt from implementing food safety schemes. [Aust Consumers’ Assoc]</p> <p>Supports draft variation of the Code as detailed in Attachment 1. [Seafood Services Aust]</p> <p>Supportive of this proposal. [Dept of Health WA]</p> <p>Endorses a national regulatory approach with consistency across jurisdictions to the management of seafood safety [DAFF].</p> <p>The discussion after the presentation indicated support for the proposed measure. [NT *]</p> <p>There is general agreement on the need for basic food safety requirements and general support for the proposed measure. [TAS *]</p>

Clause	Comments made in submissions
Options – does not support Option 3 and/or Standard	<p>The priority should be to introduce Option 2 and apply uniformly to domestic and imported, and only when successfully implemented, move on to Option 3. [Private - Ms Halais]</p> <p>SA supports only mandatory requirements for bivalve molluscs with the requirements for the remaining seafood businesses being gazetted as a voluntary standard. States that if the primary production sector supports the implementation of the standard, then SA would not oppose implementation of 4.2.1 for non-shellfish primary seafood production. [PIRSA]</p> <p>Supports application of a seafood safety standard provided the standard prescribes requirements only for the management of high risk products. Proposed standard should be gazetted as voluntary code for all other seafood sectors. Preferred option is Option 2, but with the capacity to include other species/sectors if there is agreement to cover high risk products or where sectors are seeking mandatory framework at national level. [SA Fishing Industry Council]</p>
Exclusion of mandatory fish names from the Standard	<p>WAFIC calls for a National Fish Names List and fines for fish substitution to be included in the PPP Standard for Seafood. [WAFIC]</p> <p>Believes the exclusion of the fish names from this standard misses the point with traceability. It would make sense to include reference to fish names in this primary producer's standard. Reference could be amended if an Australian Standard is developed. [Laister Consulting]</p> <p>States that clearly on the record is the agreement that Fish Names would not be included in the standard on the proviso that an acceptable method is found to ensure that Imports are controlled. Believes no such advice has been given and agreement is in jeopardy. Subject to resolution, compliance and enforcement issues will need to be addressed. [Fishy Business, Tigrey]</p> <p>Recommends the adoption of common fish names either in the Food Product Standard section of the Code or within the proposed PPS (P265). [NSW Seafood Industry Conference]</p> <p>Believes in the mandating of the use of the book of Approved Fish Names, via the Seafood Standard to prevent misleading or deceptive conduct. However, if FSANZ believes matter is best dealt with under TPA, then notes the development of the Australian Standard should be supported and resourced and occur with a reasonable time frame. [Coles Myer]</p> <p>Believes mandatory fish names list will meet all three of the FSANZ objectives and has a place in the Code. Prepared to accept the compromise position of the development via Standards Australia. [Aust Consumers' Assoc]</p> <p>States that standardised Fish Names should be mandatory in the Code and that this is consistent with the objectives of the FSANZ Act. Welcomes the assurance by FSANZ that once the AS process is complete, that a process for enforcing the use of fish names is implemented. [Seafood Services Aust]</p> <p>The exclusion of fish names from the standard was seen as contradictory in that fish names is regarded by some as one of the biggest health issues (e.g. identification of escolar). [SA *]</p>

Clause	Comments made in submissions
Consistent implementation across the jurisdictions	<p>Concerned that individual states will interpret the standard differently e.g. the problem of Tasmanian bivalve molluscs not being accepted by Victorian processes may arise. [Melshell Oysters]</p> <p>Believes the concept of a national standard may be lost unless FSANZ and all Ministers work through the issues of interpretation of regulation, fee charging, audit strategies etc. [Fishy Business, Tigrey]</p> <p>Notes that there is already evidence of the scope for inconsistent application at the State level. Asks FSANZ to be involved during implementation of the standard at state level to ensure the intended outcomes of a nationally consistent food safety standard. [Seafood Services Aust]</p> <p>All regulations and standards regarding food standards in Australia must be uniform between States and Territories. [SA Freight Council]</p> <p>Believes that FSANZ should carry out a survey before the standard is actioned, taking real examples, and analysing the costs. Examples should be revisited over a 3 to 5 year period to ensure success with level playing field. [Fishy Business, Tigrey]</p> <p>Believes consideration should be given to applying the food safety program requirements to the entire sector around Australia in the interests of consistency and in order to overcome any internal trade barriers. [Laister Consulting]</p> <p>Notes the potential for inconsistency of enforcement across the States. [DAFF]</p> <p>Questions how consistent implementation of national standards is undertaken in Australia. [NZ Food Safety Authority]</p> <p>There were concerns about the potential for inconsistent implementation of the standard across the States/Territories e.g. in terms of licensing fees. [SA *]</p> <p>The major issue raised by industry was about the lack of consistency in implementation of the standard across states and territories and the impact this had on industry and competition. [VIC *]</p> <p>The NSW Food Authority was keen to ensure that the national and NSW approaches were consistent. [NSW *]</p> <p>The issue of consistent enforcement by the States and Territories was raised. [TAS *]</p> <p>Concerns were raised about the cost of implementation for Victoria seafood businesses and whether those supplying to Victoria would need to meet similar licensing requirements. [WA *]</p>
New Zealand	<p>Suggests a single consistent standard be applied across Australian export and domestic shellfish products. [NZ Food Safety Authority]</p> <p>Raised the issue of equivalence between the NZ Animal Products legislation and the instruments made under the legislation. Notes that this standard has far less controls. State that they have little choice but to continue their risk list protections for shellfish. [NZ Food Safety Authority]</p>

Clause	Comments made in submissions
<b>Exports</b>	<p>It is difficult to assess whether the Clauses are adequate for export requirements. Notes that bivalve molluscs produced under this standard will not be eligible for export. [DAFF]</p> <p>Concerned that a standard that does not mandate the requirements for ASQAP will lead to significant downgrading of the requirements that are now in place. [DAFF]</p> <p>Highlights the fact that all products for export are processed in accordance with a documented food safety plan and are subject to performance-based audits. [DAFF]</p>
<b>IMPLEMENTATION (IN GENERAL) AND EXISTING STANDARDS</b>	<p>There is unresolved understanding of the arrangements in the NT for the implementation and enforcement of the standard. [NT *]</p> <p>There was strong interest in how the standard will be enforced by Tasmanian regulators. Questions were raised over who would implement the standard, and how it would be implemented, and the costs involved. Training would need to be low cost and user friendly. [TAS *]</p> <p>There is uncertainty about what the standard will require in practice for scalefish fishermen. [TAS *]</p> <p>There was discussion around the role of EHOs in implementation. EHO responsibility ends at the high water mark. [WA*]</p> <p>Urges FSANZ to ensure that national standard will not compromise regulatory measures already in place in NSW. [NSW Seafood Industry Conference]</p> <p>Imperative that FSANZ ensure there is no duplication between this proposed standard and other standards already in existence or under preparation. [SA Freight Council]</p> <p>Primesafe stated that there had been a broad policy decision by the government to the implementation of food safety programs to meet national food safety requirements. The Primesafe view is that the proposed national seafood standard proposes how to implement the standard for the high risk areas but does not for the remainder of the seafood sectors. [VIC *]</p> <p>Primesafe advised that Victorian requirements start at the point of harvest for seafood. [VIC *]</p> <p>There was support to ensure that the ASQAP manual is kept alive/amended and that a suitable national linkage was developed with the committee responsible for the manual. [NSW *]</p>

Clause	Comments made in submissions
Audits	<p>Believes that FSANZ should ensure that third party audited seafood safety plans that satisfy the conditions of the standard are deemed to comply with the standard. [Fishy Business, Tigrey]</p> <p>Important for PPPS for seafood to be harmonised with other relevant standards and a process for recognition of equivalence by implemented. [Seafood Services Aust]</p> <p>A high priority for industry is the ability to demonstrate compliance with the standard through a single audit system. [Seafood Services Aust]</p> <p>WAFIC calls for the recognition of third party audit against the Standard. [WAFIC]</p> <p>There is a need for a consistent approach to auditing of the measures required in the standard. [NT *]</p> <p>The issue of harmonisation between domestic and export requirements was raised. Primesafe gave an undertaking that they will be aiming to minimise duplication between AQIS and Primesafe audits (i.e. recognising AQIS audits). [VIC *]</p> <p>Questions raised about duplication of audit and discussion on possibilities to reduce e.g. recognition arrangements re export audits. [NSW *]</p> <p>WA would like to work towards recognition of AQIS audits. [WA *]</p> <p>Believes the outcome-based, non-prescriptive, standard will cause ambiguity in auditing and will add to expense. [Melshell Oysters]</p> <p>Concerned about increased audit costs as a result of the PPPS. Mutual recognition arrangements should be put in place between states, commonwealth (AQIS) and commercial organisations to minimise duplication. [NSW Seafood Industry Conference]</p> <p>Concerned about the potential for unrealistic expectations of State Govts for cost recovery by food regulators. This is a state jurisdictional issue, but believes FSANZ should be committed to resolve this or risk non-achievement of nationally consistent standards. [Seafood Services Aust]</p> <p>An emerging issue for some states will be the shortage of appropriately trained and qualified food safety auditors. [Dept Health &amp; Human Services Tas]</p> <p>QLD had concerns with implementation e.g. in terms of accreditation and of skills and knowledge of seafood handlers. [QLD *]</p>
Imported product –Labelling	<p>WAFIC calls for the mandatory labelling of imported seafood at the food service level as well as at retail. [WAFIC]</p> <p>Requests that the provision of adequate labelling of imported seafood and prevention of false and deceptive conduct by the food service sector be mandated. [Fishy Business, Tigrey]</p> <p>Notes that the anomaly of imported seafood not requiring to be labelled as such is inconsistent with objects 1,2 and 3 of the FSANZ ACT. [Seafood Services Australia]</p>

Clause	Comments made in submissions
Imported product – Imposition of standard	<p>Questions whether imported seafood will be required to demonstrate it has been grown/collected/harvested in accordance with this standard. Also questions whether food imported into NSW and Victoria and all bivalve molluscs into Australia will be required to demonstrate that they have food safety programs that comply with 3.2.1. [Laister Consulting]</p> <p>The standard must be capable of being applied to imported seafood. [QLD Health]</p> <p>Notes uneven playing field with local industry expected to comply with higher standard without reciprocal requirement for imported product. A similar requirement for imported food should be considered to the extent permissible by Australia’s international trade obligations. [Dept of Health WA]</p> <p>Understands that there are no plans to impose the standard on imported seafood. [Private - Ms Halais]</p> <p>The standard is not clear in what the intention is in relation to imports. [DAFF]</p> <p>Is of the view that an Australian standard is just that and cannot be mandated in other countries. [DAFF]</p> <p>There is uncertainty about how the measure will be applied at the border. There is the view that imported product should meet the same requirements as imposed domestically. [NT *]</p> <p>There were concerns about the standard would be enforced for imported product via end-point testing as opposed to inspection of their facilities. [SA *]</p> <p>How the standard would apply to imported product was an issue raised. [VIC *]</p> <p>Questioned how the standard will be enforced at the border for imported product. [NSW *]</p> <p>The issue of how imports will be dealt with was raised. [TAS *]</p> <p>The exclusion of NZ from the standard was an issue raised. [TAS *]</p>
<b>Risk Assessment</b>	<p>Contends that there are serious flaws in the model and therefore some of the conclusions for the risk rankings. Suggests that the RRR cannot be used and that other input be sought before risk management decisions are made. Suggest the RRR take into consideration the number of seafood meals consumed per year and the likelihood of an incident occurring at all. [Seafood Services Aust]</p> <p>WAFIC calls for the risk assessment to be completely reassessed to include the risk of a seafood safety incident happening at all. [WAFIC]</p>
<b>Risk Management</b>	<p>Believes that the risk of a seafood safety accident happening at all should be clearly explained to the consumer in a manner than promotes the health benefits of eating seafood, rather than in a manner that creates public uncertainty about seafood. Does not understand the need to highlight Listeria in certain seafoods when RA cannot demonstrate incidents in Australia. [Fishy Business, Tigrey]</p> <p>Notes that proposal deals principally with high risk seafood and there is little information addressing medium risk seafood. Questions what FSANZ proposes to do regarding medium risk seafood and how processing will have to meet the requirements of the standard. [QLD Health]</p>

Clause	Comments made in submissions
	<p>Believes that the mandatory requirements of a food safety program should be necessary for anyone producing hot or cold smoked seafood and mandatory instructions. [QLD Health]</p> <p>Seeks assurance that the MRLs for pesticides and veterinary chemicals relative to seafood will be reviewed by FSANZ in conjunction with the Australian Pesticides and Veterinary Medicine Authority. [QLD Health]</p> <p>Suggests that other businesses could be encouraged to adopt these measures as a voluntary standard. This could include the acceptance of the industry-supported Australian Seafood Standard. Would allow businesses to willingly accept a level of food safety management even where the products are not currently high risk. [QLD Health]</p>
Other sectors	Stakeholders sought information about whether other sectors would be required to have PP Standards and whether consideration had been given to having some basic requirements for all primary production sectors. [VIC *]
Ready-to-eat seafood guidelines	The issue of bacteriological pathogens currently absent from the Code (e.g. V. parahaemolyticus, Clostridium etc) needs to be addressed in the ready-to-eat food guidelines. [QLD Health]
Industry guides	There is a need for industry guides (scallops and calamari in particular) to guide individuals on good industry practice. [TAS *]
Country of Origin	Will the transitional arrangements prevail or will FSANZ go back to review? [NSW *]
Fish bone injuries	Believes the proposed standard needs to address the issue of physical hazards in fish marketed as filleted and boned. [QLD Health]
Freshwater crayfish/Yabbies	<p>Has concerns over impact of the Victoria governments implementation of the Seafood Safety Act 2003 and the enforcement of this Act through Primesafe and subsequent adoption of the FSANZ PPPS for Seafood. Requests the exemption of the sale of live yabbies from the regulation under the Victorian Seafood Safety Act 2003. Requests food safety risks be managed by agreed industry codes of practice. [Aust Freshwater Crayfish Assoc]</p> <p>Calls on FSANZ to exempt all low risk live seafood as the yabby industry cannot continue to viably exist under the proposed Primesafe licensing and audit plans. [Vic Yabby Growers Assoc]</p>
Guard dogs	Seeks rewording of Clause 24 in Division 6 of 3.2.2 to permit the use of guard dogs in processing areas under controlled circumstances but not while processing is going on. [Oakley Food Advisory Services]
<b>Salmon marketing name</b>	States that the farmed Salmon from Tasmania is recognised in Australian and export markets as ‘Tasmanian salmon’ and ‘Tasmanian smoked salmon’. States that this is a unique marketing name and must be allowed to be used in the future. [Springs Smoked Seafoods]



**Key to table:**

\* indicates additional issues raised/comments made at State and Territory public consultations that were not raised in written submissions.

**Key to abbreviations of Submitter's names used in Table:**

Aust Consumers' Assoc	Australian Consumers' Association
Aust Food & Grocery Council	Australian Food and Grocery Council
Aust Freshwater Crayfish Assoc	Australian Freshwater Crayfish Association
Coles Myer	Coles Myer Ltd
DAFF Department of Agriculture, Fisheries and Forestry	Forestry
Dept of Health WA	Department of Health Western Australia
Dept Health & Human Services Tas	Department of Health and Human Services Tasmania
Fishy Business, Tigrey	Fishy Business, Tigrey Pty Ltd
Food Tech Assoc of Vic	Food Technology Association of Victoria
Laister Consulting	Laister Consulting Services P/l and Cormorant Technical Services P/L
Melshell Oysters	Melshell Oysters
NSW	Consultation meeting with New South Wales State and industry representatives
NSW Food Authority	NSW Food Authority
NSW Seafood Industry Conference	NSW Seafood Industry Conference
NT	Consultation meeting with Northern Territory State and industry representatives
NZ Food Safety Authority	New Zealand Food Safety Authority
Oakley Food Advisory Services	Oakley Food Advisory Services
Paspaley Pearling	Paspaley Pearling Company Pty Ltd
Pearl Producers Assoc	Pearl Producers Association
PIRSA	Primary Industries and Resources South Australia
Private – Ms Halais	Ms Christine Halais, Private Submitter
QLD	Consultation meeting with Queensland State and industry representatives
QLD DPI & Fisheries	Department of Primary Industries and Fisheries, Queensland
QLD Health	Queensland Health
SA	Consultation meeting with South Australian State and industry representatives
SA Fishing Industry Council	South Australian Fishing Industry Council
SA Freight Council	South Australian Freight Council Inc.
Safe Food QLD	Safe Food Production Queensland
Seafood Services Aust	Seafood Services Australia
Springs Smoked Seafoods	Springs Smoked Seafoods
TAS	Consultation meeting with Tasmanian State and industry representatives
Tas Fishing Industry Council	Tasmanian Fishing Industry Council
VIC	Consultation meeting with Victorian State and industry representatives
Vic Yabby Growers Assoc	Victorian Yabby Growers Association
WA	Consultation meeting with West Australian State and industry representatives
WAFIC	Western Australian Fishing Industry Council

**Australia New Zealand Food Standards Code requirements for seafood**

<b>Code</b>	<b>NAME</b>	<b>AREA OF APPLICATION</b>
<b>1.1</b>	<b>Preliminary</b>	
1.1.1	Preliminary Provisions	Application, interpretation, and general provisions
<b>1.1A</b>	<b>Transitional Standards</b>	
1.1A.2	Health Claims	Specifies that health claims are not permitted, except where prescribed (none are prescribed for seafood).
1.1A.3	Country of Origin Labelling Requirements	Clauses 1,2 and 3 detail the country of origin labelling requirements for packaged and unpackaged seafood.
<b>1.2</b>	<b>Labelling and Other Information Requirements</b>	
1.2.1	Application of Labelling and Other Information Requirements	Sets out labelling requirements for food (including seafood) for retail sale and not for retail sale.
1.2.2	Food Identification Requirements	Specifies three types of information that must be included on a food label to identify the food in question – name of food, lot identification, name and address of supplier.
1.2.3	Mandatory Warning and Advisory Statements and Declarations	Sets out mandatory advisory statements and declarations that must be made in relation to certain substances. In relation to seafood, clause 4 sets a requirement that the presence of fish and fish products be declared.
<b>Code</b>	<b>NAME</b>	<b>AREA OF APPLICATION</b>
1.2.4	Labelling of Ingredients	Specifies requirements for labelling and naming of ingredients/compound ingredients
1.2.5	Date Marking of Packaged Food	Prescribes a date marking system for packaged food and the form in which these foods must be date marked. Applies to packaged seafood.
1.2.6	Directions for Use and Storage	Requires either direction for use and/or directions for storage of food, to be included on the label, where, for reasons of health and safety, the consumer should be informed of specific use or storage requirements.
1.2.8	Nutrition Information Requirements	Sets out nutrition information requirements in relation to food required to be labelled under the Code and for food exempt from these labelling requirements. Prescribes when nutritional information must be provided, and manner in which such information is provided. Note that where food is fish that comprises a single ingredient or category of ingredient, it is not required to carry a nutrition information panel.
1.2.9	Legibility Requirements	Sets out general and specific legibility requirements for labelling of packaged foods.
1.2.10	Characterising Ingredients and Components of Food	Specifies requirements for the declaration of the percentage of characterising ingredients and components of certain food products which are required to be declared. Includes methods for determining the proportion of characterising ingredient/s. Applies to packaged seafood.
<b>1.3</b>	<b>Substances Added to Food</b>	
1.3.1	Food Additives	Defines food additives and regulates their use in production and processing of food. Food additives not specified in this standard are not permitted to be added to foods.
1.3.3	Processing Aids	Regulates the use of processing aides in food manufacture, prohibiting their use in food unless there is a specific permission within this standard. Application may be relevant to processed seafood products.
1.3.4	Identity and Purity	Ensures that substances added to food in accordance with this Code meet appropriate specifications for identity and purity of food additives, processing aids, vitamins and minerals and other added nutrients. These are generally used by the international community. They may apply to imported seafoods.
<b>1.4</b>	<b>Contaminants and Residues</b>	
1.4.1	Contaminants and Natural Toxicants	Sets out the maximum levels (MLs) of specified metal and non-metal contaminants and natural toxicants in nominated foods. Those relevant to seafood include: arsenic (inorganic), cadmium, lead, mercury, tin, acrylonitrile, amnesic shellfish poisons, diarrhetic shellfish poisons, neurotoxic shellfish poisons, paralytic shellfish poisons, PCBs and vinyl chloride.

1.4.2	Maximum Residue Limits (Australia only)	Lists the maximum permissible limits for agricultural and chemical residues present in food e.g. benzocaine, cyhalothrin, cypermethrin, isoeugenol, oxolinic acid, oxytetracycline, phosphine, trifluralin, aldrin and dieldrin, BHC, chlordane, DDT, HCB, heptachlor, lindane.
1.4.3	Articles and Materials in Contact with Food	Provides permission for articles and materials to be in contact with food in accordance with the conditions set out in this standard. Standard 1.4.1 sets out the MLs for a number of metal and non-metal contaminants and natural toxicants that may be present in food as a result of contact with the articles and materials regulated in this standard.
<b>1.5</b>	<b>Food Requiring Pre-Market Clearance</b>	
1.5.1	Novel Foods	Regulates the sale of novel foods and novel ingredients. Lists the four novel foods that are currently permitted for use in foods, and the condition of use of these: HAD-rich dried marine micro-algae, DHA-rich oil derived from marine micro-algae, phytosterol esters, tall oil phytosterols. It is possible these may be ingredients added during production of fish product.
1.5.2	Food Produced Using Gene Technology	Regulates sale of food produced using gene technology, other than additives and processing aids. Prohibits sale and use of these foods unless they included under Division 1. Currently seafoods produced using gene technology are not permitted.
<b>1.6</b>	<b>Microbiological and Processing Requirements</b>	
1.6.1	Microbiological Limits for Food	Lists the maximum permissible levels of food-borne micro-organisms that pose a risk to human health in nominated foods, or classes of foods. Includes mandatory sampling plans. Micro-organisms relevant to seafood include - <i>Listeria monocytogenes</i> , coagulase-positive staphylococci, <i>Salmonella</i> , <i>Escherichia coli</i> .
<b>2.2</b>	<b>Food Product Standards – Meat, Eggs and Fish</b>	
2.2.3	Fish and Fish Products	Defines the term 'fish' and provides a compositional standard specific to histamine in fish and fish products. Also requires provision of certain cooking instructions for raw fish that has been joined using a binding system without the application of heat.
<b>3</b>	<b>Food Safety Standards (Australia only)</b>	
3.1.1	Interpretation/ Application	Apply to the other food safety standards set out in Chapter 3 of the Code.
3.2.2	Food Safety Practices and General Requirements	Sets out specific requirements for food businesses and food handlers that will ensure food does not become unsafe or unsuitable. Applies to establishments involved in processing and/or sale of seafood.
3.2.3	Food Premises and Equipment	Sets out requirements for food premises and equipment that will facilitate compliance by food businesses with the food safety requirements of Standard 3.2.2. Applies to establishments involved in processing and/or sale of seafood.

## Available Codes of Practice for the Safe Production of Seafood

- Australian Institute of Environmental Health (1993). National Code for the Construction and Fitout of Food Premises. AIEH; Deakin West.
- Australian Shellfish Quality Assurance Advisory Committee (2004) Australian Shellfish Quality Assurance Program Operations Manual, August 2004, Version 2002-03.
- Department of Agriculture, Fisheries and Forestry, FSQ Navigator – A web-based tool for Food Safety and Quality Contacts and Information.
- Department of Primary Industries, Queensland (1999). Queensland Australia Aquaculture Information Series: Code of Practice Post Harvest Handling of Farmed Barramundi.
- Department of Primary Industries, Queensland (1999). Queensland Australia Aquaculture Information Series: Code of Practice Post Harvest Handling of Farmed Black Tiger Prawns.
- Fisheries Research and Development Corporation and the Australian Prawn Industry Association (2002), Handling Prawns at Sea – A Guide to Prawn Trawler Crew at Level 1.
- Fisheries Research and Development Corporation and the Australian Prawn Industry Association (2002), Handling Prawns at Sea – A Guide to Prawn Trawler Skippers and Crew at Advanced Level.
- Fisheries Research and Development Corporation (2004), Code of Practice for the Yabby Industry.
- Fisheries Research and Development Corporation (2004), Rock Lobster Post Harvest Sub Program.
- Goodrick et al. (1999) How to improve the quality of farmed Southern bluefin tuna through modifications to post-harvest handling. Published by SSA.
- Jusseit, H and Robinson, E. (2003). Industry Code of Practice for Responsible Fishing. Eastern Tuna and Billfish Fishery. Mooloolaba, QLD.
- National Health and Medical Research Council (1987), Code of Hygienic Practice for Oysters and Mussels for Sale for Human Consumption, Australian Government Publishing Service, Canberra.
- New South Wales Silver Perch Growers Association (1998). Part 1: Quality Assurance. Part 2: Code of Practice.
- NSW Food Authority (2004), Code of Practice for the Transport of Primary Produce and Seafood, July 2004.
- NSW Food Authority (2004), Code of Practice for Seafood Handling Premises, July 2004.
- NSW Food Authority (2004), Code of Practice for Commercial Fishers, July 2004.
- Primary Industries and Resources SA (undated), South Australian Shellfish Quality Assurance Program – Monitoring the Environment.
- QLD Health (2003), Seafood Labelling and Compositional Standards for Industry.
- QSIA (1997), Best Practice: Mullet capture and processing. Available from SSA bookshop.
- QSIA (1997), Best Practice: Catching and processing wild caught prawns. Available from SSA.
- QSIA (1997), Best Practice: On-shore processing of wild caught prawns. Available from SSA.
- QSIA (1997), Best Practice: Harvest, processing and transport of farmed prawns. Available from SSA.
- QSIA (1997), Best Practice: Harvest, processing and transport of live prawns. Available from SSA.
- QSIA (1997), Best Practice: Catching and handling of live reef fish aboard the vessel. Available from SSA.
- QSIA (1997), Best Practice: Storage and delivery of live reef fish. Available from SSA.
- QSIA (1997), Best Practice: Catching and handling of spanner crabs. Available from SSA.
- QSIA (1997), Best Practice: Spanner crabs processing and delivery. Available from SSA.
- Ruello, N. (1997) The handling and value-adding of farmed barramundi. Published by SSA.
- Ruello, N. (2003), Blue Mussel Code of Practice. Published by SSA.
- Ruello, N. (undated), Trade Users Guide for Whole Blue Mussels. Published by SSA.
- SafeFood New South Wales (2001), New South Wales Shellfish Program Operations Manual.
- SeaQual<sup>1</sup> (1999), SeaQual Food Safety Guidelines for Seafood Harvesting.
- SeaQual<sup>1</sup> (1999), SeaQual Food Safety Guidelines for Seafood Retailing.
- SeaQual<sup>1</sup> (1999), From Catch to Distribution of Seafood. Food Safety System Guidelines.
- SeaQual<sup>1</sup> (2000), SeaQual Food Safety Guidelines for Seafood Processing.
- SeaQual<sup>1</sup> (2000), SeaQual Food Safety Guidelines for Seafood Aquaculture.
- SeaQual<sup>1</sup> (2000), SeaQual Guide to HACCP and Quality Assurance.
- SeaQual<sup>1</sup> (2001), SeaQual Guide to Food Safety Risks in Seafood.
- Seafood Services Australia (1998), Effects of stabilised chlorine dioxide on the rate of seafood spoilage.
- Seafood Services Australia (2002), Managing Seafood Safety – Step by Step.
- Seafood Services Australia (2003). Australian Seafood Standard - Version 9. Seafood Services Australia Ltd. <http://www.seafoodservices.net/>
- SA Seafood Marketers and Processors Association, Seafood Council of SA and Department of Human Services SA (undated) Food Safety for the Seafood Industry.

Slattery, S.L. (2003) Processing of redclaw crayfish for improvement of quality and shelf-life. Published by FRDC.

Slattery S.L, et al. (1998) How to extend the Shelf Life of Seafood Products through MAP Technology. Published by SSA.

Stevens, (1996) Improved post-harvest handling and marketing strategy for blue manna crabs. Published by SSA.

Sumner, J. (1997). ISO Best Practice Manual: Catching and Handling of Live Reef Fish Aboard the Vessel and Storage and Delivery of Live Reef Fish. Australian Seafood Industry QA Project.

Sumner, J. (1997). ISO Best Practice Manual: Catching and Handling of Mullet. Australian Seafood Industry QA Project.

Sumner, J. (1997). ISO Best Practice Manual: Catching and Handling of Spanner Crabs and Spanner Crabs Processing and Delivery. Australian Seafood Industry QA Project.

Sumner, J. (1997). ISO Best Practice Manual: Catching and Handling of Wild-Caught Prawns and On-Shore Processing of Wild-Caught Prawns. Australian Seafood Industry QA Project.

Sumner, J. (1997). ISO Best Practice Manual: Harvest, Processing and Transport of Farmed Prawns and Harvest, Processing and Transport of Live Prawns. Australian Seafood Industry QA Project.

Sumner, J. (1999). The Australian Cold Chain Food Safety Programs 1999. Australian Food and Grocery council, Australian Supermarket Institute and Refrigerated Warehouse and Transport Association of Australia.

Sumner, J. (1999). The Australian Cold Chain Guidelines 1999. Australian Food and Grocery Council, Australian Supermarket Institute and Refrigerated Warehouse and Transport Association of Australia.

Sydney Fish Market (2000). Seafood Handling Guidelines.

Tasmanian Salmonid Farming Industry (2004), Code of Practice. Working draft – June 2004. Produced for the Tasmanian Salmonid Growers Association Ltd by Dr S Percival – AD&VS Pty Ltd.

Tasmanian Shellfish Quality Assurance Program, Public and Environmental Health Service (2001) Code of Practice for Operational Practices in Live Shellfish Packing and Storage Premises in Tasmania.

Thomas, C.J., Holds, G.L, and Pointon, A.M. (2004) A framework to validate food safety and QA for prawns throughout the supply chain. Published by SSA.

WA Seafood Quality Management Initiative (1999). Handbook for On Board Handling of Fresh Fish.

WA Seafood Quality Management Initiative (undated), The Western Australian Quality Finfish Guide.

WA Seafood Quality Management Initiative (undated), Quality Finfish Checklist.

WA Seafood Quality Management Initiative (2001), Seafood Retailers Handbook.

WA Seafood Quality Management Initiative (1998), A Code of Practice for Handling Pilbara Trawl Fish.

WA Seafood Quality Management Initiative (1999), A Code of Practice for Handling Northern Demersal Scalefish.

WA Seafood Quality Management Initiative (2004), A Code of Practice for the WA Demersal Gillnet and Longline Fishery.

Warren, R. (1996). A Guide to the Safe Handling and Inspection of Seafood. Queensland Health; Queensland.

<sup>1</sup> *Now Seafood Services Australia Ltd.*

## The Imported Food Inspection Scheme and Seafood Testing

The Imported Food Inspection Scheme (IFIS) is the subject of a memorandum of understanding (MOU) between Food Standards Australia New Zealand (FSANZ) and the Australian Quarantine and Inspection Service (AQIS). FSANZ is responsible for developing risk assessment policies and undertaking risk assessments when required to recommend on the appropriate risk categorisation of selected foods.

### 1. Categories of Inspection

Using scientific risk assessment, food is placed into one of three inspection categories that determine the frequency of inspection:

- *Risk*,
- *Active surveillance* and,
- *Random surveillance*.

Foods in the *risk* and *surveillance* categories are determined and routinely reviewed by FSANZ. Upon advice from FSANZ, the Minister of Agriculture, Fisheries and Forestry may make an order specifying a food/test combination within the inspection categories.

All foods in the *risk* category are inspected and tested, whereas all foods in the *surveillance* category referred to IFP are inspected, but not all are tested.

***Risk categorised food*** is food that has the potential to pose a high risk to public health. At the point of entry, the Australian Customs Service (ACS) refers 100 percent of *risk* categorised foods, electronically, to AQIS for inspection status.

A performance-based approach applies. Food products from foreign producers with a consistent history of compliance are inspected less frequently than products from new suppliers or those with a history of failure against Australian standards. The three inspection rates are defined in the Imported Food Control Regulations, and any failure results in immediate intensification of the inspection regime. *Risk* categorised food remains subject to AQIS control pending the analytical results. The performance-based inspection levels are as follows:

- The first five shipments of a particular food first arriving from a particular producer are inspected; after five consecutively cleared shipments, inspection intensity drops to the next level;
- One in four shipments is then inspected (the other three are automatically released); after 20 cleared inspections and, if importation follows a steady pattern, inspection intensity drops to the next level;
- One in 20 shipments is then inspected (the other 19 are automatically released).

***Active surveillance category*** 10 percent of shipments of designated *active surveillance* foods, from every supplying country, are inspected. These products are released upon sampling. The test results of *active surveillance* foods are analysed by FSANZ to determine the appropriate category classification for the foods.

***Random surveillance category*** 5 percent of all consignments of foods not included in the *risk* or *active* categories are inspected. These products are released upon sampling. Neither AQIS nor the importer has the ability to predict which shipment or which foods will be selected for inspection.

A holding order can be issued where an *active* or *random surveillance* food does not comply with the standards. A holding order against a foreign supplier effectively raises the inspection category of the food to 'risk' status. This means that all future shipments of that food from the offending supplier are automatically detained and held until compliance with Australia's requirements is confirmed. After five clear inspections, the food reverts to its prior category.

## 2. Imported Seafood Testing

There are currently tests applied to imported seafood on the *random surveillance* category and the *risk* list.

## 3. Current random category requirements

Product Group	Tariff Group	Food to be inspected	IFIS Testing Requirements	Limits
Fish -fish fillets and other fish meat	0302 0303 0304	All fish - fish fillets and other fish meat - fresh chilled or frozen and <u>not on the risk</u> list. All farmed fish	Histamine and metals (mercury only)	Refer to Code
Fish dried, smoked, in brine and fish meal	0305	All fish and fish meal - dried, smoked, salted, or in brine whether or not cooked Farmed fish products  Ready-to-eat products	Histamine and metals (mercury only)  As for 'all' plus <i>Staphylococcus enterotoxin</i>	Refer to Code  nd
Crustaceans (raw)	0306	All crustaceans (raw) - chilled, frozen, dried or salted  All farmed crustacea –  Live crustaceans –	Metals (mercury only) and sulphur dioxide  PROHIBITED IMPORTS	Refer to FSC
Molluscs (including snails) – (raw).	0307  0307.6000	All Scallops, cuttlefish, octopus- (raw), chilled, frozen, salted or dried  Terrestrial snails  All unopened bivalve molluscs & live snails are >	Metals (mercury only)  (Cooked) - SPC and <i>E. coli</i>  PROHIBITED IMPORTS	Refer to FSC

**Note:** the following amendments will be made to the random surveillance category in the near future:

- an antibiotic screen will apply to all fresh farmed fish;
- the mercury test will be deleted for 'all fish and fish meal';
- sea urchins are to be tested for *L. monocytogenes* (*L. mono*/25g n=5, c=0, m=0);
- jellyfish are to be tested for *L. monocytogenes* (*L. mono*/25g n=5, c=1, m=0, M=100).

## Current risk list requirements

FOOD	RISK	ANALYSES	LIMITS
Crustaceans - (cooked & chilled) including cooked peeled prawns Excluding canned product that is commercially heat treated. <sup>1</sup>	H	<i>E. coli</i> SPC <i>Salmonella</i> SET <i>Vibrio cholera</i> <sup>2</sup>	10/g 10 <sup>6</sup> /g nd nd nd
Crustaceans - (cooked & frozen) including cooked peeled prawns. Excluding canned product that is commercially heat treated. <sup>1</sup>	H	<i>E. coli</i> SPC <i>Salmonella</i> SET <i>Vibrio cholera</i> <sup>2</sup>	9/g 10 <sup>5</sup> /g nd nd nd
Fish of the following kinds whether <u>whole, filleted or further processed, whether dried or not</u> . All Shark (including Dogfish), <i>Rexea solandri</i> (Gemfish, Note; sometimes mistakenly referred to as NZ hake), and tuna. ----- Canned tuna and tuna products -----	M  M #	Mercury Histamines  ----- Mercury and histamines -----	Refer FSC 200 mg/kg   Refer FSC, 200 mg/kg
Smoked vacuum packed fish and smoke flavoured vacuum packed fish	H	<i>Listeria monocytogenes</i>	nd
<i>Marinara mix</i> Chilled or frozen whether blanched or not. Excluding canned product that is commercially heat treated. <sup>1</sup>	H	<i>E. coli</i> SPC <i>Salmonella</i> Paralytic shellfish poison Domoic acid	See table 2 ' ' ' ' 0.8 mg/kg 20 mg/kg

Molluscs, ready for consumption, whether chilled or frozen. Bivalve molluscs, mussels, clams, cockles, scallops etc. Excluding canned product that is commercially heat treated. <sup>1</sup>	H	E. coli SPC Vibrio cholera Paralytic shellfish poison Domoic acid	See table 1 nd 0.8 mg/kg 20 mg/kg
----- Mussels, Marinated mussels that are ready for consumption whether chilled or frozen. (excluding goods packed in metal cans, glass jars or glass bottles that have been commercially heat treated). <sup>1</sup>	H	As for Molluscs plus Listeria monocytogenes	nd

In this document 'canned product that is commercially heat treated' means:

Food that is enclosed in hermetically sealed containers such as:

- metal cans,
  - retort pouches,
  - plastic containers that have heat sealed lids or lids closed by a double seam *e.g.* as for metal cans), but excludes those with snap on plastic lids,
  - glass jars with 'twist off' lids, but excludes those with screw top lids, and
  - glass bottles with 'twist off' caps but excludes those with screw top caps,
- where the food has been subject to commercial heat treatment (retorting) in the closed container or the food has been 'hot filled' into the containers before closing.

<sup>2</sup> *Vibrio cholerae*: if the presence of serotypes, 01, or 0139, or non 01, or non 0139 is confirmed in cooked crustacea whether chilled or frozen, the food must be deemed non compliant.

**Table 1: Molluscs, other than scallops**

Test	n	c	m	M
E coli	5	1	2.3	7
Standard Plate Count	5	1	10 <sup>5</sup>	5 x 10 <sup>5</sup>

**Table 2: Marinara mix (whether raw or cooked)**

Test	n	c	m	M
<i>E coli</i>	5	1	2.3	7
Standard Plate Count	5	2	10 <sup>5</sup>	10 <sup>6</sup>
Salmonella	Absent in 25g composite sample			

## Abbreviations

M # = medium risk – Food may be released after initial inspection.

**NOTE:** The exception being where another test and hold risk test is applied *e.g.* if an aflatoxin test is applied to products containing peanuts or peanut products as an ingredient, such as with canned tuna in satay sauce, the food must be held pending the result of the aflatoxin analysis.

H = high risk - Food must be held pending results of analysis.

Nd = not detectable

SET = staphylococcal enterotoxin

SPC = Standard Plate Count

**Note:** the following amendments will soon be made to the *risk* list

- the mercury test will be deleted for canned tuna';
- the histamine test will be deleted for all Shark (including Dogfish), *Rexea solandri* (Gemfish; sometimes mistakenly referred to as NZ hake), and tuna.



### **A Risk Ranking of Seafood in Australia (February 2005)**

This work is copyright. Apart from any use as permitted under the *Copyright Act 1968*, no part may be reproduced by any process without prior written permission from the Commonwealth available from the Department of Communications, Information Technology and the Arts. Requests and inquiries concerning reproduction and rights should be addressed to the Commonwealth Copyright Administration, Intellectual Property Branch, Department of Communications, Information Technology and the Arts, GPO Box 2154, Canberra ACT 2601 or posted at <<http://www.dcita.gov.au/cca>>.

### **Acknowledgements**

Food Standards Australia New Zealand gratefully acknowledges the support and assistance many organisations and individuals provided in the preparation of this report.

Special thanks are extended to Craig Dalton, Janet Li and Martyn Kirk for epidemiological data; to Tom Black, Ian McKay and Kate Hutchison for guidance during development of the risk ranking tool; and to members of the Seafood Standard Development Committee and the Risk Assessment Working Group for their ongoing advice and direction during the risk ranking activity.

Food Standards Australia New Zealand is grateful for advice and guidance provided by domestic and international peer reviewers. The early advice provided by Dr Tom McMeekin and Dr Tom Ross of the Australian Food Safety Centre of Excellence was most valuable. In the final stages of drafting the report, the support and direction provided by Dr Alan Reilly (Food Safety Authority of Ireland) and Dr Jeffrey Farber (Bureau of Microbial Hazards, Food Directorate, Health Canada) was highly appreciated.

## ***Glossary***

ANZFA	Australia New Zealand Food Authority
ASQAP	Australian Shellfish Quality Assurance Program
bw	bodyweight
cfu	colony forming units
Codex	Codex Alimentarius Commission
EHEC	Enterohaemorrhagic <i>Escherichia coli</i>
EIEC	Enteroinvasive <i>Escherichia coli</i>
EPEC	Enteropathogenic <i>Escherichia coli</i>
ETEC	Enterotoxigenic <i>Escherichia coli</i>
FAO	Food and Agriculture Organization of the United Nations
FDA	Food and Drug Administration
FSANZ	Food Standards Australia New Zealand
g, ng, µg, mg, kg	gram, nanogram, microgram, milligram, kilogram
HACCP	Hazard analysis critical control point
IAEA	International Atomic Energy Agency
ICMSF	International Commission on Microbiological Specifications for Foods
JECFA	Joint FAO/WHO Expert Committee on Food Additives
l, ml	Litres, millilitres
MU	mouse units – the unit of measure described in <i>Recommended procedures for examination of seawater and shellfish</i> , Irwin N. (ed.) 4th Ed. 1970. American Public Health Association Inc.
nm	nanometre
ppt, ppm, ppb	parts per thousand, parts per million, parts per billion
PTDI	Provisional tolerable daily intake
PTWI	Provisional tolerable weekly intake
RNA	Ribonucleic acid
WHO	World Health Organization

## Summary

This report provides the scientific basis for the development of a Primary Production and Processing Standard for seafood. The report qualitatively ranks the public health and safety risk posed by consumption of seafood in Australia. Overall the risks from seafood are usually well managed and are therefore considered relatively low.

The risk ranking compares the relative risks associated with the wide variety of seafood commodities available in Australia – domestically produced and imported. It takes into account the chemical and biological food safety hazards potentially present, and assigns each commodity or group of commodities to a broad relative risk category: low, medium or high. There are only a very small number of products that may present relatively high public health and safety risks.

The ranking brings together the available scientific and technical information on food safety hazards in seafood and identifies seafood commodities of higher priority for the development of risk management strategies in the context of the Primary Production and Processing Standard for seafood.

### Risk ranking method

Food Standards Australia New Zealand (FSANZ) estimated relative public health risks by considering the severity of any adverse health effect resulting from the presence of a particular hazard in a seafood commodity, together with the likelihood of that adverse health effect occurring.

Estimates of the severity of illness due to the presence of hazards in seafood followed an internationally accepted procedure that considers the duration of illness, likelihood of death and potential for ongoing adverse health effects.

Estimates of the likelihood of adverse health effects were based on:

- the link between the hazard and illness due to consumption of the particular seafood (epidemiological data)
- the prevalence and concentration or level of the hazard in seafood
- patterns of consumption of the specific seafood (frequency of consumption, amount eaten)
- the impact of existing regulatory and non-regulatory risk management systems
- data and information on the following factors related to the properties of the hazard and the effect of production, processing and handling, particularly in terms of how they might influence hazard levels at the point of consumption:
  - o the capacity for microbiological pathogens to survive or grow in the commodity
  - o any other relevant properties of the hazard (for example, toxigenic or infectious dose)
  - o the probable effect of production, processing and handling on the presence and level of the hazard
  - o the likely effect of consumer handling (including cooking and product shelf life) on hazard levels.

Using a ranking matrix, FSANZ combined the severity and likelihood estimates into a broad relative risk estimate for each hazard that might be found in a seafood commodity (for example, prawns) or group of similar commodities (for example, oysters and other bivalve molluscs). An overall relative risk ranking for each commodity (or group of commodities) was then obtained by determining the highest relative risk ranking estimated for the commodity.

### **Future reviews of the risk ranking**

The risk ranking is based on the best current knowledge and data. Such rankings are dynamic, with their evolution reflecting increasing knowledge about the hazards and the consumer's exposure to them. For example, the introduction of new technologies, modified production practices and changes in management strategies may influence the need to review the rankings.

FSANZ will maintain a watching brief of the scientific literature and international activities, for example, Codex Alimentarius, which may impact on the risk ranking. Where significant data gaps impacting upon the risk ranking process are filled by the results of ongoing scientific studies and surveys of the prevalence and levels of food safety hazards in seafood in Australia, the robustness of the risk rankings can be better assessed and the rankings may be further refined.

### **Food safety hazards in seafood**

Seafood can contain food safety hazards derived from several different sources. Some of these hazards occur naturally in the environment in which seafood lives and grows and are unavoidable contaminants of seafood when it is harvested. Others are a consequence of the impact of human activities on the environment.

In the pre-harvest phase of production, feed components, veterinary drugs and other chemicals employed in aquaculture production may also present a public health risk. In addition to these, food hazards can be introduced into seafood, or caused to increase to potentially hazardous levels, through direct contamination by food handlers and contaminated utensils and equipment and by inadequate handling (for example, temperature abuse, cross-contamination, inadequate processing).

The extent to which any food safety hazard is likely to be present in seafood depends on a number of factors. These factors include the biology of the particular seafood species, its growing environment, and the conditions along its production and processing supply chain. Therefore, the broad biological classes of seafood species (bivalve and cephalopod molluscs, crustacea and finfish), and the public health risks posed by hazards associated with specific commodity groups within those classes, have been considered separately.

### **Summary of risk rankings**

The relative risk rankings described in this report demonstrate the generally high level of safety of seafood products. Under current risk management practices – both voluntary and mandatory – public health risks are relatively low for the majority of seafood. A small number of commodities present a higher public health risk than other seafood.

The report concludes that the following seafood sectors are ranked in the higher relative risk category:

- oysters and other bivalve molluscs (except when the consumed product is only the adductor muscle, for example, roe-off scallops) harvested from growing environments likely to be exposed to faecal contamination and/or not under a shellfish safety management scheme
- ready-to-eat cold-smoked finfish (and other ready-to-eat cold-smoked seafood products), when eaten by population sub-groups susceptible to invasive listeriosis.

#### *Oysters and other bivalve molluscs*

Oysters and other bivalve molluscs (except when the consumed product is only the adductor muscle, for example, roe-off scallops) harvested from growing environments vulnerable to faecal contamination and/or not under a shellfish safety management scheme present a relatively high risk to public health, mainly due to the likelihood of illness caused by contamination with hepatitis A virus and algal biotoxins (particularly amnesic shellfish poison and paralytic shellfish poison). These hazards are introduced in the pre-harvest phase of bivalve production.

This relatively high risk ranking is consistent with other studies based on recent epidemiological data that reflected a situation where inconsistent risk management systems were in place across Australia.

Food-borne illness due to oysters and other bivalve molluscs in Australia have resulted in a number of small outbreaks and sporadic cases due to *Vibrio* species and a few large outbreaks due to enteric viruses in oysters harvested from polluted and inadequately controlled waters.

While adoption of risk management strategies has improved the safety of bivalve shellfish in recent times, some risk remains. Although monitoring of harvest waters for indicators of sewage pollution (for example, faecal or total coliforms) helps to manage the risks due to enteric pathogens, bacterial and viral, it cannot predict levels of *Vibrio* species and enteric viruses in oysters. Oysters harvested from waters without a risk management system in place have a higher risk of contamination by algal toxins. Therefore, where oysters and bivalves are harvested from waters managed under a comprehensive shellfish safety scheme, such as the Australian Shellfish Quality Assurance Program (ASQAP), the risk is significantly reduced – notably, the likelihood of a food-borne illness is low.

The risk rankings for oysters and other bivalves were the same regardless of whether they were to be cooked or eaten raw, as the hazards leading to the risk rankings are not greatly affected by the light cooking normally applied to these products.

#### *Ready-to-eat cold-smoked seafood*

Ready-to-eat cold-smoked finfish (and other ready-to-eat cold-smoked seafood products) present a higher risk to public health relative to other seafoods due to the possibility of contamination with *Listeria monocytogenes* and the potentially severe illness it causes in at-risk population sub-groups such as pregnant women. *L. monocytogenes* is a ubiquitous organism often found in processing environments, and may also be present in fish at the time of harvest. Cold smoking is not a listericidal process.

Recognition of the risks by both regulators and the industry has resulted in a high level of management of *L. monocytogenes* in Australia and a lower risk of illness to the general population.

FSANZ has previously recognised the inherent risk to the general population due to *L. monocytogenes* in cold-smoked seafoods by including a microbiological limit standard for the organism in ‘ready-to-eat processed finfish, other than fully retorted finfish’ in the *Australia New Zealand Food Standards Code*. When the food safety risks are managed such that cold-smoked seafoods meet this regulatory requirement, the relative risk ranking for the general population is low, although the relative risk ranking for susceptible populations (for example, pregnant women, neonates, immunocompromised people and the elderly) is high. FSANZ is currently reviewing its dietary advice to these at-risk sub-groups in order to manage their food safety risks due to *L. monocytogenes* from all food sources.

If the food safety risks are not properly managed, such that cold-smoked seafoods do not meet the microbiological limit standard for *L. monocytogenes*, the relative risk ranking is high for at-risk sub-groups and medium for the general population. This takes account of the relatively long shelf life of the product and the high standards of hygiene and sanitation in processing and good temperature controls across the food supply chain, up to and including the consumer, that is needed to ensure the safety of the product.

#### *Other seafood commodities*

FSANZ ranked other seafood commodities as presenting a low or medium relative public health risk.

The vast majority of whole and filleted finfish was ranked in the low relative risk category. A few groups of fish species were ranked in the medium relative risk category:

- larger specimens of particular species of tropical and sub-tropical finfish from certain fishing areas, due to the potential for illness as a result of accumulation of ciguatoxins
- large, long living or predatory fish, such as swordfish, shark/flake and some tuna, which tend to accumulate higher levels of methylmercury than other fish species. The ranking applies to the at-risk sub-population (the foetus) when the mother consumes mainly those species.

A medium ranking was also assigned to the following commodity groups (due to the listed hazards):

- univalve molluscs (for example, abalone) and roe-off scallops (from algal biotoxins causing amnesic shellfish poisoning and paralytic shellfish poisoning)
- prawns (*V. cholerae* O1, *Salmonella* Typhi, arsenic)
- canned seafood (*Clostridium botulinum*)
- hot-smoked fish products (*C. botulinum*)
- some whole and filleted finfish (arsenic).

In most cases, hazards linked to these medium risk commodities are already regulated in the Food Standards Code (for example, *Salmonella* in prawns, arsenic in finfish) or through longstanding and effective industry codes of practice (for example, *C. botulinum* in low-acid canned foods).

Of the seafood commodities ranked in the medium risk category, prawns and some finfish (whole or as fillets) have been linked to several outbreaks of food-borne illness in Australia in recent years. For prawns, the associated food safety hazards have been primarily microbiological hazards, while for finfish, ciguatoxin, histamine fish poisoning and escolar wax esters account for the great majority of the outbreaks.

The majority of seafood commodities presented a lower risk to the general population. For some of these commodities, limited consumption of the products was the main factor in leading to the conclusion that the likelihood of adverse health effects from associated hazards was very low. For others, the probable effects of downstream processing and consumer handling in reducing hazard levels were factors leading to a low likelihood of illness.

## 1. Scope and purpose

Food Standards Australia New Zealand (FSANZ) has qualitatively ranked the relative public health and safety risks posed by chemical and microbiological hazards in seafood products eaten in Australia. FSANZ has undertaken this ranking, using the best available scientific data, for the sole purpose of developing a Primary Production and Processing Standard for seafood.

The output of this report is presented as a qualitative risk ranking, rather than as a risk assessment of commodity/hazard pairs. Risk ranking, a form of comparative risk assessment [1,2], enables differentiation of the relative level of risk posed by microbiological and chemical hazards present in the diverse range of seafood commodities in the Australian marketplace – for example, molluscs, crustacea and finfish.

The report draws on data from a variety of sources including published risk assessments, and the format is based on the elements of risk assessment defined by the Codex Alimentarius Commission: hazard identification; hazard characterisation; exposure assessment; and risk characterisation [3]. The analysis was, to some extent, constrained by the limited epidemiological data on seafood-borne illness and the scarcity of information of the prevalence and levels of hazards in seafood products in Australia. A quantitative exposure assessment was therefore not undertaken.

A qualitative assessment was made of the exposure of consumers to hazards in seafood products, drawing on available information on patterns of seafood consumption and the prevalence and levels of hazards in seafood. This assessment also took into account the likely influences of the conditions of production, processing, storage and use of seafood commodities along the entire seafood production and processing supply chain. No attempt was made to evaluate the efficacy of different risk management options.

FSANZ has drawn on the risk rankings and associated information presented in this report as a basis for developing suitable risk management options and strategies for seafood eaten in Australia.

## 2. Introduction

This report draws on a number of risk assessments that have been undertaken on Australian seafood in recent times. For example, the Australia New Zealand Food Authority (ANZFA) undertook risk assessments of contaminants and microbiological hazards associated with seafood as part of its review of the Code in 1999 [4–7]. These assessments informed the establishment of various standards applying to seafood, including those specifying microbiological limits and maximum levels of contaminants. More recently, risk assessments and risk profiling covering many seafood commodity/hazard combinations have been commissioned by Seafood Services Australia Ltd (SSA) and Safe Food Production New South Wales (SafeFood NSW) [8–10].

In addition, a number of international risk assessments of seafood have been conducted, focusing particularly on *Vibrio* species and *Listeria monocytogenes* [11–13]. These and other assessments [14–16] have sought to identify and assess the risk associated with specific commodity/hazard combinations.



The goal of this risk ranking document is to provide a broader comparative overview of risks associated with seafood in Australia, with the purpose of identifying higher-risk industry sectors and commodity groups.

In compiling this risk ranking document, a wide range of scientific literature and information from Australia and overseas (including the risk assessments mentioned above) was reviewed and evaluated. The evaluation identified key hazards and assessed where in the seafood production and processing supply chain these food safety hazards might be introduced, increased, reduced or eliminated. This latter information is presented in Appendix 1 as important background information for risk managers.

To the extent possible within the scope and purpose, the principles for conducting risk assessment outlined in *Working Principles for Risk Analysis for Application in the Framework of the Codex Alimentarius* [3], as adopted at the 26th Session of the Codex Alimentarius Commission, were followed in the conduct of this risk ranking exercise.

The scope, purpose and form of output of this risk ranking are defined, and the extent to which the four steps of risk assessment have been incorporated is described, in Section 1. All available relevant quantitative and qualitative data have been taken into account, including information relating to through-chain factors impacting upon the relative level of risk. Constraints and uncertainties impacting on the process are described, along with the assumptions underpinning the comparative risk rankings. The risk rankings are presented in a format designed to help risk managers make informed decisions regarding strategies for risk minimisation.

### **Sources of hazards associated with seafood in Australia**

Seafood can contain microbiological, chemical, and physical hazards derived from different sources. Some of these hazards occur naturally in the environment in which seafood lives and grows and are unavoidable contaminants of seafood when caught. Examples include:

- endogenous bacterial species (for example, vibrios, aeromonads) which may or may not be pathogenic to the host species
- biotoxins (typically of algal or bacterial origin, occasionally metabolised by the host to other toxic forms)
- helminthic parasites (where the seafood species is typically an intermediate host)
- heavy metals (for example, mercury, cadmium) and other naturally occurring chemicals (for example, dioxins).

Seafood may also contain food safety hazards as a consequence of the impact of human activities on the environment. Such environmental pollutants include:

- bacterial and viral pathogens derived from human sewage and animal faecal pollution of seafood growing and harvesting areas (for example, *Salmonella* spp., Noroviruses)
- industrial chemical pollutants (for example, heavy metals, polychlorinated biphenyls)
- agricultural chemical run-off (for example, pesticide residues).

Other potential sources of contamination of seafood in the pre-harvest phase include feed components, veterinary drugs and other chemicals employed in aquaculture production.

In the post-harvest phase, hazards can be introduced into seafood, or grow to potentially hazardous levels, through:

- direct contamination by food handlers and contaminated utensils and equipment
- inadequate handling (for example, temperature abuse, cross-contamination, inadequate processing)
- processing operations and the processing environment.

In addressing chemical hazards, the report distinguishes between:

- those contaminants which are present in food as a result of deliberate addition to seafood or use in seafood production or agriculture
- those which are present as natural contaminants.

The former, including agricultural chemicals, pesticides and veterinary drugs, are subject to pre-market safety assessment and their presence in food is regulated under the Code. These chemicals are not addressed in this report. However, food safety hazards which are natural environmental contaminants of seafood, such as certain heavy metals, and which are inherent or unintentional components of foods, are evaluated along the production and processing supply chain.

Physical hazards associated with seafood have not been specifically addressed in this risk ranking report. Such physical hazards include intrinsic hazards (for example, bones, shell fragments, pearls in oysters) and extrinsic hazards (for example, grit in shellfish, hooks, metal and glass inclusions). The intrinsic physical hazards are less likely to cause injury because of consumer awareness of the potential for the hazard to be present in seafood [17]. Extrinsic physical hazards are potentially introduced at all steps of the production and processing supply chain. Sources for such contaminants include raw materials, badly maintained facilities and equipment, improper production procedures, packaging materials and poor employee practices [18].

Physical hazards may cause traumatic injury to the mouth, tongue, teeth, gums, throat, stomach and intestines, as well as presenting a choking hazard, and would normally be addressed by adherence to Good Manufacturing Practices (GMP), a hazard analysis critical control point (HACCP) system and requirements relating to safe and suitable food in state and territory legislation.

### **Food-borne illness associated with Australian seafood**

There have been a number of documented outbreaks of seafood-associated food-borne illness in Australia in recent years. Since 1987:

- outbreaks due to finfish have been caused by ciguatoxin, histamine (scombrototoxin) and wax esters (gempylotoxin)
- outbreaks due to crustacea have been caused by bacterial and viral pathogens, including *Salmonella* Typhi, *S. Typhimurium* PT 64, *Vibrio parahaemolyticus*, *V. cholerae* non-O1/ non-O139, hepatitis A virus and *Clostridium perfringens*
- outbreaks due to molluscs have been caused by Noroviruses, hepatitis A virus, *V. parahaemolyticus*, *V. vulnificus*, *S. Mississippi*, *Listeria monocytogenes* and diarrhetic shellfish poison (Appendix 2; [19]).

However, these outbreak data represent only a small component of the total morbidity due to seafood consumption in Australia. Sporadic cases of food-borne illness are not included in these datasets (unless a death results), and a low level of reporting of food-borne illness is generally understood to be a major problem. While physicians are required to report some specific illnesses with food-borne aetiology, many food-borne illnesses are not notifiable. Furthermore, most people do not seek medical attention for various mild forms of gastroenteritis, and even quite severe illnesses are typically significantly under-reported [20].

In 2003, OzFoodNet conservatively estimated that the number of cases of food-borne illness in Australia in a typical year from all food sources is between 4 million and 6.9 million cases (mid point 5.4 million cases) [21]. However, in the same report, data is given for outbreaks of food-borne illness in Australia in 2002, indicating there were 92 documented outbreaks affecting only 1819 people. The extent of under-reporting of food-borne illness evident in these datasets highlights the danger of relying solely on outbreak data in evaluating the public health risks due to food safety hazards.

## **Approaches taken in this report**

### *Grouping of seafood commodities*

The extent to which a food safety hazard is likely to be present in seafood and to give rise to a public health and safety risk depends on a number of factors. These factors are related to the biology of the particular seafood species, its growing environment, and the specific activities along its production and processing supply chain. To simplify consideration of these factors, this report considers separately the broad classes of seafood species (bivalve and cephalopod molluscs, crustacea and finfish), and subsequently considers hazards associated with specific commodity groups within these classes. For molluscs and crustacea, these groups are defined broadly in terms of species, genus or family (for example, bivalves, abalone, prawns), whereas for finfish, the groups are based on the different post-harvest processing steps undertaken (for example, canning, smoking, fermenting).

In cases where these relatively broad commodity classes mask a wide range of relative risk across species or between different geographical areas, the impact of these factors on the rankings are discussed more fully in the summary and conclusions. Examples include methylmercury in larger, predatory and long-lived fish species and viral and algal toxin contamination of oysters and other bivalves harvested from polluted and/or unmanaged waters.

### *Format of this report*

The method by which relative risk rankings were estimated for each commodity group is explained in Section 3. This section describes how consideration of the severity of adverse health effects due to hazards present in food and estimates of the likelihood of those adverse health effects occurring in the Australian population due to consumption of seafood are combined into commodity/hazard relative risk rankings. The method by which these rankings are used to provide the overall relative risk ranking for each commodity group is explained.

The relative risk rankings for individual seafood commodity groups are contained in Section 4. The likelihood and severity of adverse health effects due to the hazards potentially associated with each seafood commodity are described, and the estimated risk rankings tabulated. An overall ranking for the commodity is then generated by consideration of the highest relative risk level pertaining to that commodity. Those commodities ranked as relatively high or medium risk are discussed further in Section 5, with attendant uncertainties described in Section 6. The overall conclusions are in Section 7.

In order to avoid unnecessary duplication of material and to simplify this report, various sets of relevant data have also been collated in separate appendixes.

Appendix 1 contains information relevant to the through-chain assessment of hazards in seafood commodities. It includes:

- a description of the production and processing supply chain for each sector/commodity
- a discussion of the points along that supply chain at which specific hazards might be introduced, increased, reduced or eliminated
- a description of the effects of processing and handling and the impacts of existing food safety regulations and voluntary risk management practices on levels of hazards.

This information is important in assessing the level of food safety risk in cases where epidemiological and hazard prevalence data are scarce, and as an aid to developing appropriate risk management strategies.

Australian epidemiological data on outbreaks of food-borne illness linked to consumption of seafood between January 1995 and June 2002 are at Appendix 2.

Information on the consumption by (non-infant) Australians of various classes of seafood is at Appendix 3.

Detailed notes on the properties of identified food-borne hazards and their association with seafood commodities relevant to this evaluation are provided at Appendix 4.

The information includes data, where available, on the prevalence and concentration of hazards in seafood and further discussion of epidemiological evidence of food-borne illness due to the presence of each hazard in seafood in Australia or overseas. Much of the information in Appendix 4 has been drawn from formal quantitative and qualitative assessments of the risks associated with consumption of various classes of seafood, or with exposure to certain hazards within the total diet.

#### *Risk ranking method*

The public health and safety risks posed by particular seafood sectors have been ranked in general agreement with the principles for risk characterisation as outlined by the Codex Alimentarius Commission.

Codex defines risk as:

a function of the probability of an adverse health effect and the severity of that effect, consequential to a hazard(s) in food [22]

and recommends that a risk characterisation should provide a:

qualitative and/or quantitative estimation, including attendant uncertainties, of the probability of occurrence and severity of known or potential adverse health effects in a given population based on hazard identification, hazard characterization and exposure assessment [22].

In the case of microbiological hazards, Codex further suggests that such estimates may be validated by comparison with relevant epidemiological data [23]. However, it should be recognised that epidemiological data do not clearly reflect the ‘severity’ component of risk, except to the extent that the severity of illness impacts upon the relative level of reporting.

### **Alternative risk ranking methods**

Many alternative measures are available for, or have been applied to, the task of ranking the public health and safety risks posed by food, including seafood. Several of these are discussed briefly, below. Further information on these approaches may be obtained by reference to the specific literature cited.

#### *Ross and Sumner’s risk ranger*

Risk ranger is a semi-quantitative tool for risk profiling based on deterministic Microsoft Excel spreadsheet functions, designed to help risk managers prioritise hazards for more intensive risk assessment and to inform decisions about the value of investing resources in fully quantitative risk assessments [24,25]. It can also be used to explore the effect of different risk management strategies or the extent of changes needed to bring about a desired reduction in risk.

Users of risk ranger input selections from a prepared list of qualitative statements or provide quantitative data (for example, survey or epidemiological data) to describe the commodity/hazard of interest. Based on these inputs, the tool calculates estimates of the probability and severity of outcomes arising from the level and frequency of exposure. These estimates include:

- probability of illness per day per consumer of interest
- total predicted illnesses per annum in the population of interest
- comparative risk in the population of interest
- a risk ranking.

The risk ranking is a logarithmic scale of risk with outputs ranging from zero (absence of risk) to 100 (certainty of death from each serving of food). Rankings were attributed to broad risk categories of Low: <32; Medium: 32–48; and High: >48.

#### *Ross and Sanderson’s qualitative risk assessment tool*

Ross and Sanderson developed a novel tool to rank the potential impact of food-borne disease from various seafood commodity/hazard combinations, as part of their consultancy report for SafeFood NSW [8]. The scheme takes into account three factors: the severity of the illness (including severity of symptoms, illness duration and likelihood of death, and mode of transmission); the probability of illness (including likelihood of exposure and population susceptibility); and the likely effect of processing and cooking on levels of the hazard.

### *Corlett and Pierson's hazard classification scheme*

Corlett and Pierson developed a two-stage risk assessment tool for food businesses to use in development of HACCP food safety plans [26]. Firstly, the raw materials, ingredients or food, along with the process and the intended consumer, are ranked according to six criteria (Table 1). For every applicable characteristic, the food is assigned a '+'. The higher the number of pluses, the greater the degree of risk attending the particular food.

**Table 1: Hazard classification of Corlett and Pierson**

Hazard	Risk characteristics
A	Special class restricted for at-risk populations, for example, aged, immunocompromised, infants
B	Product contains sensitive ingredients
C	Process has no step which destroys sensitive organisms
D	Product is subject to re-contamination between processing and packaging
E	Potential for abuse by distributor or consumer which could render the product hazardous
F	Product is consumed without further process to kill micro-organisms

### *Risk ranking scheme of Huss et al.*

Huss et al. developed a qualitative scheme for categorising risk from consuming different seafoods using six criteria (Table 2) [27]. Specific seafoods are ranked according to the number of the risk characteristics that apply. A food is considered *high risk* if four or more risk characteristics apply, and *low risk* if less than four apply.

**Table 2: Huss et al. risk ranking scheme**

Hazard	Risk characteristics
I	Epidemiological evidence exists to link the product with food-borne disease
II	The manufacturing process lacks a Critical Control Point (CCP) for at least one hazard associated with the product
III	The product has the potential to become recontaminated after processing
IV	There is potential for abusive handling during distribution or in consumer handling
V	There is potential for growth of pathogens in the product
VI	There is no terminal heat process during meal preparation

### *Center for Food Safety and Applied Nutrition/Food Safety and Inspection Service/Center for Disease Control listeria risk assessment*

The United States Food and Drug Administration's Center for Food Safety and Applied Nutrition, in collaboration with the United States Department of Agriculture's Food Safety and Inspection Service and in consultation with the Department of Health and Human Services' Centers for Disease Control and Prevention, conducted a qualitative assessment of the relative risk to public health from food-borne *L. monocytogenes* in selected ready-to-eat foods [11].

The exercise involved individual semi-quantitative risk assessments being performed for each of 23 food categories considered. The results and models for each food category were obtained and then compared, to establish the relative risk among the food categories, including an evaluation of the uncertainty associated with the risk comparison.

## **Risk ranking model employed**

While each risk ranking approach has its strengths and could be used as a tool for ranking relative risks due to seafood consumption in Australia, none met the requirement of providing a broad three-tier categorisation of seafood industry sectors which could be used in a through-chain assessment of risk. Specifically, a need was identified for a broad comparative method able to take into account a large number of hazards having widely different adverse health consequences. This report uses a method based on consideration of the elements of risk as defined by Codex: the likelihood (probability of occurrence) and severity of adverse health effects (illness).

In deriving estimates of the likelihood of illness due to the presence of a particular hazard in a seafood commodity, available data on seafood consumption and the prevalence and levels of hazards in seafood in Australia were taken into consideration. However, significant data gaps have militated against completion of a formal quantitative exposure assessment for each hazard/commodity pairing considered. In addition, specific characteristics of each hazard, factors along the supply chain that might influence the final risk at point of consumption, and recent epidemiological data were all taken into account. Estimates of the severity of adverse health effects were based on an accepted international scheme, which was adapted to take into account hazards not originally included in that scheme (for example, heavy metals, algal biotoxins, helminthic parasites).

A decision matrix was developed to provide broad qualitative rankings of public health and safety risks due to food safety hazards associated with seafood sectors or commodities. The matrix combines the estimates of severity and likelihood of adverse health effects to arrive at a relative risk ranking. The method used to estimate the severity and likelihood of adverse health effects and to combine these into risk rankings are described below.

### *Severity of adverse health effects*

The estimate of the severity of adverse health effects caused by a food-borne agent is based on the ranking scheme for food-borne pathogens and toxins described by the International Commission on Microbiological Specifications for Foods (ICMSF) [28]. The ICMSF ranking scheme categorises hazards by the severity of the threat they pose to human health, taking into consideration the:

- likely duration of illness
- likelihood of death
- potential for ongoing adverse health effects.

The severity of adverse health effects caused by a hazard is ranked as moderate, serious or severe according to the following definitions:

- moderate severity applies when the hazard is likely to cause an illness of short duration with no ongoing adverse health effects (sequelae)
- a serious hazard would cause an illness of longer duration, with some chance of ongoing chronic and debilitating effects
- a severe hazard would cause illnesses with serious sequelae or significant mortality rates.

Under the ICMSF ranking, severe hazards are further divided into those applying to the general population and those applying to specific sub-populations, that is, susceptible individuals (for example, the very young and old, the immunocompromised, and pregnant women and their unborn children). This takes into account those situations where a hazard considered to be of moderate or serious severity to the general population may cause a severe illness in certain susceptible sub-populations. This is reflected in the severity rankings presented in Table 3.

The ICMSF severity ranking scheme was developed to apply principally to microbiological hazards. In this report, the ICMSF approach has been adapted to rank the severity of threat posed by all microbiological and natural contaminant hazards potentially associated with seafood eaten in Australia. Certain chemical contaminants and microbiological hazards not originally ranked by the ICMSF have been added to Table 3 (entries with asterisks) based on information available on the severity of adverse health effects associated with exposure to them. Justification for severity rankings is in the relevant sections of Appendix 4.

In determining the severity ranking for chemical contaminants, particularly heavy metals, it was noted that adverse health effects tend to become evident after prolonged exposure, and are typically chronic in nature. This is in contrast to the situation applying to most microbiological hazards, where a single exposure can lead to illness.

In determining the severity of the threat to human health, no consideration has been given to the likelihood of exposure to the hazard or the probability of occurrence of any illness caused by that hazard. These considerations are encapsulated in the estimate of likelihood of adverse effects, below.



**Table 3: Ranking of food-borne hazards by severity of adverse health effects**

Severity	Description	Food-borne hazards in seafood	
Moderate	Not usually life threatening; no sequelae; normally short duration; symptoms are self-limiting; can include severe discomfort.	Staphylococcus aureus enterotoxin	Histamine
		Enteropathogenic Escherichia coli	Vibrio parahaemolyticus
		Enterotoxigenic E. coli	Zinc*
		V. cholerae non-O1/non-O139	Wax esters*
		Norwalk-like viruses (noroviruses)	
Serious	Incapacitating but not life threatening; sequelae infrequent; moderate duration.	Non-typhoid Salmonella spp.	Yersinia spp.
		Non-dysenteric Shigella spp.	Listeria monocytogenes
		Aeromonas hydrophila*	V. vulnificus*
		Hepatitis A virus	Helminthic parasites*
		Algal biotoxins* (DSP, NSP)	Mercury*
		Ciguatoxin*	
Severe	Life-threatening or substantial chronic sequelae or long duration.	General population	
		S. Typhi S. Paratyphi	Cadmium*
		Shigella dysenteriae	V. cholerae O1/O139
		Enterohaemorrhagic E. coli	Aflatoxins
		Clostridium botulinum neurotoxin	Arsenic*
		Algal biotoxins* (ASP, PSP)	Lead*
		Cadmium*	
		Susceptible populations	
		L. monocytogenes	V. vulnificus
		Enteropathogenic Escherichia coli and Enterotoxigenic E. coli	Hepatitis A virus
		Mercury	

\* Hazards not originally listed in the International Commission on Microbiological Specifications for Foods severity ranking table.

Key: ASP = amnesic shellfish poison; DSP = diarrhetic shellfish poison; NSP = neurotoxic shellfish poison; PSP = paralytic shellfish poison.

See Appendix 4 for discussion of the different severity rankings amongst the algal biotoxins.

### *Likelihood of adverse health effects*

The estimate of the likelihood of adverse health effects takes into consideration relevant available data and information on:

- the link between the hazard and illness due to consumption of the particular seafood (epidemiological data)
- the prevalence and concentration or level of the hazard in seafood
- patterns of consumption of the specific seafood (that is, frequency of consumption, amount eaten)
- the impact of existing regulatory and non-regulatory risk management systems
- data and information on the following factors related to the properties of the hazard and the effect of production, processing and handling, particularly in terms of how they might influence hazard levels at the point of consumption:
  - the capacity for microbiological pathogens to survive or grow in the commodity
  - any other relevant properties of the hazard (for example, toxigenic or infectious dose)

- the probable effect of production, processing and handling on the presence and level of the hazard
- the likely effect of consumer handling (including cooking and product shelf life) on hazard levels.

### Epidemiological data

Australian and overseas epidemiological evidence of food-borne illness resulting from consumption of a particular seafood commodity demonstrates observed risk, and is accorded the highest weighting in considering the likelihood of adverse health effects. Where available, Australian epidemiological data were considered to be of greater relevance than those from overseas. However, it is important to note the limitations of existing epidemiological data on seafood-borne illness in Australia.

The hazards listed as ‘moderate’ in Table 3 result in self-limiting illnesses of short duration and tend to be poorly reported in all epidemiological datasets. This is emphasised by United States data that shows even quite severe illnesses are significantly under-reported or are not traced back to a particular hazard and/or food source [20]. In cases where an epidemiological link is established, the strength of the linkage is expressed as an odds ratio. The strength of that ratio indicates the likelihood that the linkage is true. It is understood that there is a great deal of uncertainty with this form of data.

### Prevalence and concentration data

Data from monitoring studies of hazards in seafood were used to demonstrate a clear link between particular hazards and certain seafood commodities. For some commodity/hazard combinations (for example, mercury in finfish, *L. monocytogenes* in cooked crustacea), there have been sufficient studies conducted to provide a clear picture of the extent of contamination in products available in Australia. For other combinations there is little Australian prevalence and concentration data to draw on.

Other information used to assess the likelihood of adverse health effects included data on the prevalence and level of hazards in imported seafood (for example, data from the Australian Quarantine and Inspection Service Imported Food Inspection Program testing regime) and a database of Australian food recalls maintained by FSANZ.

Information from these sources was taken as being indicative of the potential for the seafood commodity/hazard combination to cause adverse health effects. This type of data is treated cautiously, however, as food standards are conservatively set to protect public health and safety. Therefore, failures to meet regulatory limits may not necessarily indicate the presence of a hazard at a concentration likely to present an immediate risk to public health. However, while the presence of a hazard does not necessarily imply an immediate threat of illness in a consumer of that product, other factors may apply, leading to a public health and safety risk.

The use of such routine inspection data also has other limitations. Not all testing is random, and sample size is often quite low compared to the total food volume. The data therefore have the potential to be biased and can become insensitive for low incidence pathogens, introducing uncertainty which can affect the validity of conclusions based upon them.

## Consumption data

Data on the level of consumption of specific seafood commodities in Australia were used to adjust the estimates of likelihood of adverse health effects, to take into account relative exposure to hazards in different seafood commodities in the general population.

Consumption figures were derived from the results of the 1995 National Nutrition Survey of Australia, using FSANZ's dietary modelling computer program, DIAMOND. The National Nutrition Survey collected data from 13 858 respondents, using a 24-hour food recall method. Data on consumption of seafood commodities are presented as mean and 95th percentile consumption amounts along with the number and percentage of respondents who ate that seafood commodity in the survey period (Appendix 3). Some limited frequency of consumption data were also collected as part of the National Nutrition Survey, but only covered a few broad food categories and were of limited value to this assessment.

Food-borne illnesses due to microbial hazards are almost always related to single exposure episodes or consumption on a single day. As such, the 24-hour recall data provide critical insights into the reach of the likely exposure over age/gender groups, the extent of the exposure in terms of individuals exposed and the dose of the exposure in terms of the portion eaten. Here, the long-term intake is not an important factor, so absence of frequency of consumption data is not a major limitation to the ranking. In this case, only sample size is a limitation for obtaining precise estimates for relatively rare events.

A limitation of the National Nutrition Survey method is that it tends to over-estimate habitual food consumption amounts for high consumers. In particular, for foods that people tend to consume less than once a week (for example, molluscs and crustacea), consumption figures derived from a 24-hour recall may be higher for most consumers than if consumption amounts were averaged over a longer time frame that better reflects habitual consumption of these foods.

For metals and toxins, the likelihood estimates are based on the dietary modelling conducted by ANZFA for the review of the Code [4,5,7].

Statistics on production, import and export of seafood commodities, such as those available from the Australian Bureau of Statistics – the *Apparent Consumption of Foodstuffs* series – and the Australian Bureau of Agricultural and Resource Economics – the *Australian Fisheries Statistics* series – were also considered, where appropriate. These data sources provide useful information on the gross amount of seafood available for consumption each year in Australia, but do not contain any insight into the frequency, prevalence or levels of consumption of these commodities within the Australian population such as is provided by the National Nutrition Survey data.

## Impact of existing regulatory and non-regulatory risk management systems

The likelihood estimates and resultant risk rankings take into account the effect of the regulatory and non-regulatory mechanisms currently in place to manage seafood safety risks. This approach recognises that the epidemiological data and information on the prevalence and concentration of hazards in seafood are gathered in an environment where those existing risk management mechanisms apply. It also allows some conclusions to be made about the effectiveness of those measures and may point to inadequacies or gaps in the current system.

It is also recognised that changes in management of public health risks associated with seafood have recently taken place, either in response to incremental advances in awareness of food safety issues or in reaction to failures in the previous management systems.

The impact of these changes may not be fully gauged by assessing the burden of food-borne illness. Epidemiological data are an historical record and may not accurately reflect recent changes in the regulatory environment. For example, the effectiveness of the partial, yet ongoing, implementation of a shellfish safety program in New South Wales can only be completely validated over a period of time.

Such ongoing changes in risk management systems introduce a further degree of uncertainty into the final relative risk rankings generated in this report. They also demonstrate the need for risk assessment to be an ongoing, dynamic process, responsive to changes in circumstance and the availability of data.

#### Properties of the hazard and the effect of production, processing and handling

Factors potentially affecting levels of hazards in seafood at the point of consumption were also considered. Production and processing methodologies, consumer food handling habits, product shelf life and the capacity for the seafood to support the survival or growth of pathogens were taken into account. In specific instances, consideration was given to the potential for cross-contamination of seafood commodities during processing and consumer handling, although data on the incidence of contamination is extremely limited.

#### Data limitations

In general, limited access to or availability of data presented considerable difficulties for assessing the likelihood of adverse health effects. Insufficient data on the prevalence and levels of microbiological hazards in seafood available for consumption in Australia prevented the undertaking of a quantitative exposure assessment, so the estimates of likelihood of adverse health effects are largely qualitative, and this impacts on the risk rankings derived from them.

A clear distinction is made, however, between those cases where limited data is available (leading to uncertainty in the conclusions) and those where the available data shows lack of, for example, a specific hazard in a specific commodity (evidence which will tend to reduce the 'likelihood of illness' rating in that case).

Table 4 indicates the way in which the various forms of data and information were used to rank the likelihood of adverse health effects caused by a hazard into categories of unlikely, likely and very likely. Due to the gaps in data and information being unevenly spread across hazard/commodity pairs, it was necessary to employ a degree of expert opinion/judgement in the likelihood of illness ratings, to bridge the gap between what is indicated by the data and what is plausible, given our knowledge of the hazard, the seafood commodity, its regulatory environment, and its production and processing supply chain up to the point of consumption.

**Table 4: Ranking of food-borne hazards by likelihood of adverse health effects**

Likelihood	Factors influencing estimation of likelihood of adverse health effects
Unlikely	<ul style="list-style-type: none"> <li>• Little or no evidence that the hazard has caused food-borne illness in Australia or overseas</li> <li>• Limited consumption of the commodity by the general population, or consumption primarily by selected sub-populations, and/or</li> <li>• Limited or no data demonstrating presence of the hazard in seafood.</li> </ul>
Likely	<ul style="list-style-type: none"> <li>• Limited evidence that the hazard has caused food-borne illness in Australia or overseas</li> <li>• Eaten periodically</li> <li>• Availability of data demonstrating the presence of the hazard in seafood, and/or</li> <li>• Availability of evidence from other data sources, for example, Imported Foods Inspection Program, FSANZ recall database, environmental surveillance, etc.</li> </ul>
Very likely	<ul style="list-style-type: none"> <li>• Evidence that the hazard is associated with reported incidents of food-borne illness in Australia</li> <li>• Widely and/or frequently eaten by the general population</li> <li>• Availability of data demonstrating the presence of the hazard in Australian seafood, and/or</li> <li>• Availability of significant evidence from other data sources, for example, Imported Foods Inspection Program, FSANZ recall database.</li> </ul>

*Risk ranking matrix*

Estimates of the severity of adverse effects caused by the hazards encountered in seafood, and the likelihood of those effects occurring in the general population – defined as the population of generally healthy adults, irrespective of whether or not they consume seafood – are brought together to provide a ranking of the relative risk associated with the particular hazard/commodity combination using the matrix presented in Table 5.

This approach is consistent with the Codex recommendation that a risk characterisation integrate all of the qualitative and quantitative information available into a soundly-based risk estimate, and mirrors the Codex definition of risk as being a function of the probability and the severity of an adverse health effect. Using the matrix, the relative risk assigned to each commodity or group of commodities is qualitatively ranked as high, medium or low. Each broad risk ranking category can arise from three possible combinations of severity and likelihood estimates, as seen in Table 5.

In some susceptible sub-populations (for example, the very young and old, the immunocompromised, and pregnant women and their unborn children), certain hazards may cause illness of greater severity, or illness may occur at a lower infectious or toxigenic dose, leading to a ranking different to that obtained for the general population. In such cases, the relative risk rankings have been explicitly identified for both general and susceptible populations, to guide subsequent development of risk management strategies. However, the overall relative risk ranking for each seafood commodity or group of commodities in this report is a ‘general population’ risk estimate.

**Table 5: A likelihood/severity matrix for ranking food safety risks in seafood**

		likelihood of illness		
		unlikely	likely	very likely
severity of illness	moderate	low	low	medium
	serious	low	medium	high
	severe	medium	high	high

### 3. Risk rankings

A number of food safety hazards are associated with seafood, and the risk to public health and safety posed by each differs according to the characteristics of the particular hazard and of the seafood commodity being considered, and the amount and manner in which it is eaten. A description of these food safety hazards, the evidence for their association with seafood, and evidence linking them with adverse health effects due to consumption of seafood is presented at Appendix 4. A discussion of the interaction of the hazards with the production and processing supply chains for seafood commodities, indicating where the hazards might be introduced or where their level in seafood might be affected, is at Appendix 1.

Information provided in the appendixes is brought together in this section to provide an estimate of the likelihood of an adverse health effect due to each hazard associated with each seafood commodity or group of commodities.

These likelihood estimates are combined with the severity ranking for each hazard (from Table 3) to provide an estimate of the relative public health risk due to each hazard associated with that commodity. An overall relative risk ranking (high, medium or low) is then determined for each seafood commodity or sector, based on the highest risk ranking level pertaining to that commodity.

#### Food safety risks due to molluscan shellfish

##### *Oysters and other bivalves (excluding roe-off scallops)*<sup>64</sup>

The hazards potentially associated with oysters and other bivalves through the production and processing supply chain (Appendix 1) may be grouped as follows:

- Endogenous bacteria that are human pathogens (*Aeromonas hydrophila*, *V. parahaemolyticus*, *V. vulnificus*, *V. cholerae* O1/O139, non-O1/non-O139 *V. cholerae*).
- Pathogens introduced through pollution or post-harvest contamination (*E. coli*, *S. aureus*, *Salmonella* spp., *Campylobacter* spp., *Shigella* spp., *Yersinia* spp., *L. monocytogenes*, hepatitis A virus, Noroviruses).
- Environmental chemical contaminants/toxicants (algal biotoxins, mercury, cadmium, arsenic, zinc).

The severity of illness due to these hazards (Table 3) ranges from moderate (for example, zinc, noroviruses), through serious (for example, *L. monocytogenes*, hepatitis A virus) to severe (for example, amnesic shellfish poison and paralytic shellfish poison algal biotoxins, *V. cholerae* O1/O139). Some of the hazards are considered severe only for certain susceptible populations (for example, *L. monocytogenes*, hepatitis A virus).

---

<sup>64</sup> Specific food safety issues concerning pearl oyster meat have been considered separately, due to the very low volume consumed and the high level of uncertainty regarding tissue distribution of toxins in these species. A brief discussion of these issues is at Appendix 5.

The likelihood of adverse health effects due to this broad range of hazards is diverse, ranging from unlikely through to very likely. Several large outbreaks of food-borne illness in Australia, attributed to oysters harvested from polluted waters that were not subject to the requirements of a comprehensive shellfish safety scheme such as the Australian Shellfish Quality Assurance Program (ASQAP), attest to the potential for significant adverse public health outcomes from the presence of these hazards in bivalve molluscs [19].

Oysters and other bivalves are considered a food group that is occasionally eaten by a significant proportion of the population (Appendix 3; [7,9]) and, on this basis, evidence of the potential for a hazard to be present at an infectious or toxigenic level at the point of consumption is taken as the main determinant of the likelihood of adverse health effects for the general population.

The likelihood of adverse health effects due to each of the hazards identified in Appendix 1 is discussed briefly below.

#### Likelihood of adverse health effects: Unlikely

***Aeromonas hydrophila***: Aeromonads are ubiquitous in most aquatic environments, and there is significant evidence to indicate that at least some strains can cause food-borne illness [29]. *A. hydrophila* has been implicated in food-borne illness due to oyster consumption in the United States and the United Kingdom [29], but there is no epidemiological or other data suggesting a significant likelihood of adverse effects occurring due to pathogenic strains in Australia.

***E. coli*, *S. aureus*, *Salmonella*, *Campylobacter*, *Shigella* and *Yersinia* species**: Pathogenic strains of these bacteria may be present in oysters due to pollution of growing waters or post-harvest contamination. Results from the testing of imported foods (Appendix 1) demonstrate limited contamination of imported molluscan shellfish by these hazards. However, contamination of locally produced bivalves is also considered plausible, and under the provisions of the ASQAP, harvest waters and shellfish meat are tested for faecal or total coliforms, and harvesting bans or a requirement for relaying or depuration are placed on the harvesting area when counts of these indicator organisms exceed specified levels [30]. The combination of ASQAP and adherence to Good Hygienic Practice by shellfish processors and food handlers will tend to reduce the likelihood of adverse health effects from these enteric pathogens.

**Toxigenic *Vibrio cholerae* O1/O139**: Toxigenic strains of *V. cholerae* O1 have been found in fresh water reaches of rivers in Australia but not estuarine or marine environments [31]. There are no epidemiological or concentration data suggesting a significant likelihood of adverse health effects from toxigenic *V. cholerae* O1 in Australia through consumption of oysters and other bivalves.

***L. monocytogenes***: There are limited data indicating the potential for listeriosis due to consumption of molluscan shellfish. The only Australian outbreak, in Tasmania in 1991, was linked to imported smoked mussels eaten beyond their use-by date [9,32]. There are limited concentration data demonstrating the potential for *L. monocytogenes* to be present in molluscan shellfish, with only a low level of failure reported from testing of imported foods and a low number of recalls coordinated by FSANZ in the period 1990–2003 (one for oysters, two for mussels).

**Arsenic, cadmium, mercury, zinc and lead:** ANZFA reviewed the public health risks due to heavy metal contamination in foods (including molluscan shellfish) in 1999 [5,7]. Data on concentrations of heavy metals in foods was used to provide a total-diet estimate of exposure. The results were as follows:

- For **arsenic**, dietary modelling indicated that high consumers of molluscs could receive up to 6 per cent of the provisional tolerable daily intake (PTDI) for inorganic arsenic from molluscs, based on an inorganic arsenic content of seafood of 6 per cent of the total arsenic content.
- For **mercury**, ANZFA concluded that molluscs contribute only 0.17 per cent to total dietary exposure to mercury [7], and that even high consumers were unlikely to approach the provisional tolerable weekly intake (PTWI).
- For **zinc**, ANZFA [7] estimated that high consumers of oysters would approach 38 per cent of the PTDI. However, ANZFA concluded that it was likely that dietary exposures were overestimated and that exposure to zinc at the mean and high dietary exposures posed only a relatively low risk to human health.
- For **lead**, ANZFA [7] estimated that molluscs contribute approximately 0.6 per cent to the total dietary exposure. However, as lead exposure occurs through many exposure routes, a maximum limit for lead in molluscs was established due to the serious nature of lead toxicity and consistent with an overall goal of reducing blood lead levels in the general population.
- For **cadmium**, FSANZ performed a recent dietary exposure assessment in 2000. Dietary exposure to cadmium was estimated to be 52 per cent of the PTDI (calculated as the PTWI divided by 7) at the median daily level of consumption of oysters, and 7.9 per cent of the PTDI at the median daily level of consumption of mussels. However, as oysters and mussels are only occasionally eaten foods, with 94 per cent of the population consuming them less than once per week, this level of exposure would not be expected to occur on a daily basis.

Likelihood of adverse health effects: Likely

**Vibrios (excluding toxigenic *V. cholerae* O1/O139):** *V. parahaemolyticus*, *V. vulnificus*, non-O1/non-O139 *V. cholerae* and non-toxigenic *V. cholerae* O1 are found in estuarine and marine environments in Australia and have been isolated from oysters [31,33,34]. These endogenous pathogens are not efficiently removed by depuration [33–35] and levels do not necessarily always correlate with counts of coliform indicator organisms [9,34]. Monitoring of water quality may not be adequate to control the food safety risks due to these pathogens, and post-harvest measures, such as suitable temperature control to prevent outgrowth, is necessary. Several studies have demonstrated the presence of vibrios in Australian molluscan shellfish and there have been a number of outbreaks and sporadic cases of food-borne illness documented (Appendix 2; [9,19]).

**Algal biotoxins:** Potentially toxic algae are found throughout Australian shellfish growing waters [4]. However, not all isolates of the causative organisms produce toxin, and concentrations of the toxins in shellfish will not necessarily always correlate with levels of algae in the water [4].



Algal biotoxins are not quickly removed by depuration or relaying. Monitoring of water quality may not entirely control the food safety risks due to these hazards. Levels of algal biotoxins are not affected by processing or consumer food handling practices.

There is some evidence of food-borne illness caused by algal biotoxins in molluscan shellfish in Australia, limited to two outbreaks of diarrhoeic shellfish poisoning due to consumption of pipis harvested from waters that were not subject to the requirements of a shellfish safety program, but a significant number of outbreaks occur worldwide [4].

There have been no failures in imported foods tested for domoic acid (amnesic shellfish poison) or paralytic shellfish poison since 1998, and only one FSANZ-coordinated food recall due to domoic acid in the period 1990–2003. Analytical data demonstrate the occasional presence of paralytic shellfish poison, amnesic shellfish poison and neurotoxic shellfish poison in Australian bivalve molluscs [4,16].

Likelihood of adverse health effects: Very likely

**Enteric viruses:** Noroviruses and hepatitis A virus have been implicated in several large outbreaks of food-borne illness due to bivalve mollusc consumption in Australia and worldwide. These viruses persist and remain viable in oysters for long periods of time, and are not efficiently removed by depuration [36,37]. Levels do not necessarily always correlate with counts of faecal indicator organisms, so monitoring of water quality may not entirely control the food safety risks due to these hazards. The infectious dose is presumed to be low [9]. Light cooking does not inactivate noroviruses [38,39], and hepatitis A virus has significant heat stability [40].

Likelihood of adverse health effects for cooked product

Oysters and other bivalves, when not eaten raw, are usually only lightly cooked or steamed before consumption. In this report, it has been assumed that this cooking would normally be sufficient to reduce bacterial hazards to low levels. However, enteric viruses are significantly more heat resistant than bacterial pathogens and infectious doses are assumed to be very low, hence it is considered unlikely that cooking will effectively reduce them to safe levels. Algal biotoxins are also very heat stable [41,42].

***Relative risk ranking for oysters and other bivalves – conclusions***

The severity and likelihood of adverse health effects due to specific hazards associated with oysters and other bivalves are combined in Table 6 to provide relative risk rankings for those hazards. It is concluded that the overall public health risk for this commodity group is relatively high for product harvested in polluted waters and/or waters not subject to a monitoring scheme such as ASQAP, based on the potential presence and adverse health effects of hepatitis A virus and algal biotoxins. The ranking is high due to those algal biotoxins with ‘severe’ adverse health effects (that is, amnesic shellfish poison and paralytic shellfish poison), while it is medium for those rated as having ‘serious’ adverse health effects (that is, diarrhoeic shellfish poison and neurotoxic shellfish poison – these are not included in Table 6). The relative risk ranking is not significantly reduced where these products are cooked prior to consumption.

When the implementation of shellfish safety management schemes, such as ASQAP, is taken into account, the relative risk ranking for oysters and other bivalves is reduced to medium.

The overall relative risk ranking for product eaten raw is also high for people who are susceptible to primary septicaemia from *V. vulnificus* infection (that is, people with liver dysfunction or high serum iron levels).

#### *Abalone and roe-off scallops*

The hazards potentially associated with abalone and roe-off scallops (that is, scallops when the product eaten is only the adductor muscle) through the production and processing supply chain (Appendix 1) may be grouped as follows:

- Endogenous bacteria that are human pathogens (*A. hydrophila*, *V. parahaemolyticus*, *V. vulnificus*, non-O1/non-O139 *V. cholerae*).
- Pathogens introduced through pollution or post-harvest contamination (*E. coli*, *S. aureus*, *Salmonella* spp., *Campylobacter* spp., *Shigella* spp., *Yersinia* spp., *L. monocytogenes*, hepatitis A virus, Noroviruses).
- Environmental chemical contaminants/toxicants (algal biotoxins, mercury).

The severity of illness caused by these hazards (Table 3) ranges from moderate (for example, *V. parahaemolyticus*, noroviruses), through serious (for example, *L. monocytogenes*, hepatitis A virus) to severe (for example, amnesic shellfish poison and paralytic shellfish poison). Some of the hazards are considered severe only for certain susceptible populations (for example, *L. monocytogenes*, hepatitis A virus).

Data from the National Nutrition Survey of 1995 indicate that abalone and scallops (combined) are eaten approximately half as often as oysters and other bivalves, and that serving portions are smaller (Appendix 3). These conclusions are reinforced by recent data on the production, import and export of these seafood commodities, which show that the combined volume of abalone and scallops available for domestic consumption is about half that of oysters, pipis and mussels combined [43]. However, the data do not allow an estimate of the relative consumption of roe-on and roe-off scallops. These data indicate that abalone and roe-off scallops are considered a food group that is occasionally eaten by a small proportion of the population. On this basis, evidence of the potential for a hazard to be present at an infectious or toxigenic level must be balanced by the relatively limited consumption in estimating the likelihood of adverse health effects. In addition, and in contrast to oysters, abalone and roe-off scallops are normally cooked, at least lightly, prior to consumption, which will reduce the likelihood of adverse health effects from bacterial pathogens.

Adverse health effects due to each of the hazards identified in Appendix 1 is considered unlikely, as discussed briefly below.

**Table 6: Relative risk rankings for oysters and other bivalves (excluding roe-off scallops)**

Commodity	Hazard	Severity	Likelihood of adverse health effects	Relative risk Ranking
Raw oysters	A. hydrophila	Serious	Unlikely	Low
	V. parahaemolyticus	Moderate	Likely	Low
	V. vulnificus <sup>1</sup>	Serious	Likely	Medium
	V. cholerae O1/O139	Severe	Unlikely	Medium
	Non-O1/non-O139 V. cholerae	Moderate	Likely	Low
	L. monocytogenes <sup>2</sup>	Serious	Unlikely	Low
	E. coli (non-EHEC)	Moderate	Unlikely	Low
	Staphylococcus aureus	Moderate	Unlikely	Low
	Salmonella (non-typhoid)	Serious	Unlikely	Low
	Campylobacter spp.	Serious	Unlikely	Low
	Shigella spp.	Serious	Unlikely	Low
	Yersinia spp.	Serious	Unlikely	Low
	Noroviruses <sup>4</sup>	Moderate	Very likely	Medium
	Noroviruses <sup>5</sup>	Moderate	Unlikely	Low
	Hepatitis A virus <sup>4</sup>	Serious	Very likely	High
	Hepatitis A virus <sup>5</sup>	Serious	Unlikely	Low
	Algal biotoxins (ASP, PSP) <sup>4</sup>	Severe	Likely	High
	Algal biotoxins (ASP, PSP) <sup>5</sup>	Severe	Unlikely	Medium
	Arsenic	Severe	Unlikely	Medium
	Cadmium	Severe	Unlikely	Medium
	Lead	Severe	Unlikely	Medium
Mercury <sup>3</sup>	Serious	Unlikely	Low	
Zinc	Moderate	Unlikely	Low	
Cooked oysters	A. hydrophila	Serious	Unlikely	Low
	V. parahaemolyticus	Moderate	Unlikely	Low
	V. vulnificus <sup>1</sup>	Serious	Unlikely	Low
	V. cholerae O1/O139	Severe	Unlikely	Medium
	Non-O1/non-O139 V. cholerae	Moderate	Unlikely	Low
	L. monocytogenes <sup>2</sup>	Serious	Unlikely	Low
	E. coli (non-EHEC)	Moderate	Unlikely	Low
	Staphylococcus aureus	Moderate	Unlikely	Low
	Salmonella (non-typhoid)	Serious	Unlikely	Low
	Campylobacter spp.	Serious	Unlikely	Low
	Shigella spp.	Serious	Unlikely	Low
	Yersinia spp.	Serious	Unlikely	Low
	Noroviruses <sup>4</sup>	Moderate	Very likely	Medium
	Noroviruses <sup>5</sup>	Moderate	Unlikely	Low
	Hepatitis A virus <sup>4</sup>	Serious	Very likely	High
	Hepatitis A virus <sup>5</sup>	Serious	Unlikely	Low
	Algal biotoxins (ASP, PSP) <sup>4</sup>	Severe	Likely	High
	Algal biotoxins (ASP, PSP) <sup>5</sup>	Severe	Unlikely	Medium
	Arsenic	Severe	Unlikely	Medium
	Cadmium	Severe	Unlikely	Medium
	Lead	Severe	Unlikely	Medium
Mercury <sup>3</sup>	Serious	Unlikely	Low	
Zinc	Moderate	Unlikely	Low	

1. For susceptible sub-populations (people with liver dysfunction or high serum iron levels) the severity ranking is 'severe', and the relative risk rankings are high and medium for raw and cooked products, respectively.
  2. For susceptible sub-populations (the immunocompromised, pregnant women, the foetus) the relative risk ranking is 'medium' (severe x unlikely).
  3. For susceptible sub-populations (the foetus) the relative risk ranking is 'medium' (severe x unlikely).
  - 4 For product from waters that are subject to pollution and/or do not have an effective management system in place.
  5. For product from pristine waters or from waters that are subject to pollution but where harvesting is controlled under an effective management system.
- Key: ASP = amnesic shellfish poison; EHEC = enterohaemorrhagic Escherichia coli; PSP = paralytic shellfish poison.

Likelihood of adverse health effects: Unlikely

***Aeromonas hydrophila***: *A. hydrophila* has not been implicated in food-borne illness due to consumption of abalone or scallops [29], and there are no epidemiological or presence data suggesting a significant likelihood of adverse health effects from pathogenic strains in Australia. Levels in abalone and roe-off scallops at point of consumption are likely to be significantly reduced by cooking.

***E. coli*, *S. aureus*, *Salmonella*, *Campylobacter*, *Shigella* and *Yersinia* species**: Pathogenic strains of these bacteria may be present in abalone and scallops due to post-harvest contamination, but are unlikely to be introduced through pollution of growing waters. Results from the testing of imported foods (Appendix 1) demonstrate that there is little contamination of imported molluscan shellfish by these hazards. Good hygienic practice by shellfish processors and food handlers will tend to minimise the likelihood of adverse health effects from these hazards. Levels of these pathogens in abalone and roe-off scallops at point of consumption are likely to be significantly reduced by cooking.

***L. monocytogenes***: There are no data indicating the potential for food-borne listeriosis due to consumption of abalone and roe-off scallops. Levels in abalone and roe-off scallops at point of consumption are likely to be significantly reduced by cooking.

**Mercury**: ANZFA recently reviewed the public health risk due to mercury contamination in foods (including molluscan shellfish) [7]. At the time, ANZFA concluded that molluscs contribute only 0.17 per cent of the total dietary exposure to mercury.

**Algal biotoxins**: Potentially toxic algae are found throughout Australian shellfish growing waters [4]. However, not all isolates produce toxin, and the concentration of toxins in shellfish will not necessarily always correlate with levels of algae in the water [4]. There is no evidence of food-borne illness due to algal biotoxins in abalone and roe-off scallops in Australia. These toxins are preferentially concentrated in the viscera of molluscan shellfish.

It is widely believed that scallop and abalone adductor muscle do not accumulate high concentrations of toxins [4], although there is evidence of accumulation of paralytic shellfish poison in the epipodal fringe of the South African abalone *Haliotis midae* [44,45]. There have been no failures in imported abalone and scallops tested for domoic acid or paralytic shellfish poison since 1998, and no FSANZ-coordinated food recalls due to algal biotoxins in these commodities. Available data do, however, demonstrate the occasional presence of paralytic shellfish poison and amnesic shellfish poison in Australian scallops, and neurotoxic shellfish poison has been detected in other shellfish in Australia [4].

**Enteric viruses:** Noroviruses and hepatitis A virus are unlikely to be introduced through pollution of growing waters, and would only be present in abalone and scallops due to post-harvest contamination by a food handler. There are no data suggesting their presence in abalone and scallops in Australia, and no evidence linking food-borne illness in Australia to the consumption of abalone and scallops.

**Vibrios (excluding toxigenic *V. cholerae* O1):** Although *V. parahaemolyticus*, *V. vulnificus*, non-O1/non-O139 *V. cholerae* and non-toxigenic *V. cholerae* O1 are found in estuarine and marine environments in Australia and have been isolated from oysters [31], there is no epidemiological evidence linking them to abalone or scallops in this country. There are limited data [9] showing the presence of *V. parahaemolyticus* in scallops in Australia and none indicating the presence of vibrios in abalone.

**Relative risk ranking for abalone and roe-off scallops – conclusions**

Consideration of the severity of illness and the likelihood of adverse health effects are combined in Table 7, to provide rankings for hazards associated with abalone and roe-off scallops. It is concluded that the relative public health risk ranking for this sector is medium, mainly based on the potential presence and adverse health effects of algal biotoxins (particularly the more severe toxins, amnesic shellfish poison and paralytic shellfish poison).

For populations susceptible to more severe illnesses due to *V. vulnificus*, *L. monocytogenes*, hepatitis A virus or mercury, the relative risk ranking is medium.

**Table 7: Relative risk ranking estimates for abalone and roe-off scallops**

Commodity	Hazard	Severity	Likelihood of adverse health effects	Relative risk Ranking
Cooked	A. hydrophila	Serious	Unlikely	Low
	V. parahaemolyticus	Moderate	Unlikely	Low
	V. vulnificus <sup>1</sup>	Serious	Unlikely	Low
	Non-O1/non-O139 V. cholerae	Moderate	Unlikely	Low
	E. coli (non-EHEC)	Moderate	Unlikely	Low
	Staphylococcus aureus	Moderate	Unlikely	Low
	Salmonella (non-typhoid)	Serious	Unlikely	Low
	Shigella spp.	Serious	Unlikely	Low
	Yersinia spp.	Serious	Unlikely	Low
	L. monocytogenes <sup>1</sup>	Serious	Unlikely	Low
	Noroviruses	Moderate	Unlikely	Low
	Hepatitis A virus <sup>1</sup>	Serious	Unlikely	Low
	Algal biotoxins (ASP and PSP)	Severe	Unlikely	Medium
	Mercury <sup>1</sup>	Serious	Unlikely	Low

1. For susceptible sub-populations the relative risk rankings are medium (severe x unlikely).

Key: ASP = amnesic shellfish poison; EHEC = enterohaemorrhagic Escherichia coli; PSP = paralytic shellfish poison.

**Food safety risks due to cephalopod molluscs**

The hazards associated with cephalopod molluscs through the production and processing supply chain (Appendix 1) may be grouped as follows:

- Endogenous bacteria that are human pathogens (*A. hydrophila*, *V. parahaemolyticus*, *V. vulnificus*, non-toxigenic *V. cholerae* O1, helminthic parasites).
- Pathogens introduced through pollution or post-harvest contamination (*E. coli*, *S. aureus*, *Salmonella* spp., *Campylobacter* spp., *Shigella* spp., *Yersinia* spp., *L. monocytogenes*, hepatitis A virus, Noroviruses).
- Environmental chemical contaminants/toxicants (mercury, cadmium).

The severity of illness caused by these hazards (Table 3) ranges from moderate (for example, *V. parahaemolyticus*, noroviruses), through to serious (for example, *L. monocytogenes*, hepatitis A virus). Some of the hazards are considered severe only for certain susceptible populations (for example, *L. monocytogenes*, hepatitis A virus). However, the relative risk ranking estimates below are determined for the general population, unless otherwise specified.

Data from the National Nutrition Survey of 1995 indicate that squid, octopus and other cephalopods (combined) are eaten about 75 per cent as often as oysters and other bivalves, and that serving portions are of similar size (Appendix 3). Approximately 80 per cent is imported product [43]. Cephalopod molluscs are therefore considered a food group occasionally eaten by a small proportion of the population. On this basis, the limited size of the consuming population must be considered along with evidence of the potential for a hazard to be present at an infectious or toxigenic level in estimating the likelihood of adverse health effects for the general population. In addition, and in contrast to oysters, squid, octopus and cuttlefish are normally cooked, at least lightly, prior to consumption, which will reduce the likelihood of adverse health effects from bacterial hazards.

Adverse health effects due to each of the hazards identified in Appendix 1 is considered unlikely, as discussed briefly below.

#### Likelihood of adverse health effects: Unlikely

***A. hydrophila*:** There are no epidemiological or concentration data suggesting a significant likelihood of adverse health effects from exposure to pathogenic strains of *A. hydrophila* in Australia. Levels in cephalopods at point of consumption are likely to be significantly reduced by cooking.

***E. coli*, *Salmonella*, *Campylobacter*, *Shigella* and *Yersinia* species:** Pathogenic strains of these bacteria may be present in cephalopods due to post-harvest contamination, but are unlikely to be introduced through pollution of the marine environment from which cephalopods are harvested. There are no epidemiological or concentration data suggesting a significant likelihood of adverse effects from pathogenic bacteria in cephalopods. Levels in cephalopods at point of consumption are likely to be significantly reduced by cooking.

***L. monocytogenes*:** There are no data indicating food-borne listeriosis due to consumption of cephalopods. Levels at point of consumption are likely to be significantly reduced by cooking.

**Mercury:** At the time of the review of metal contaminants in food in 1999 [7], ANZFA concluded that molluscs contribute only 0.17 per cent to total dietary exposure to mercury.

**Enteric viruses:** Noroviruses and hepatitis A virus are unlikely to be introduced through pollution of growing waters, and would only be present in cephalopods due to post-harvest contamination by food handlers. There is no epidemiological or concentration data suggesting a significant likelihood of adverse health effects from enteric viruses in Australia through consumption of cephalopods.

**Vibrios (excluding toxigenic *V. cholerae* O1):** Although *V. parahaemolyticus*, *V. vulnificus* and non-toxigenic *V. cholerae* O1 are found in estuarine and marine environments in Australia, there are no data demonstrating their presence in cephalopods in Australia and no epidemiological data indicating food-borne illness from this source.

**Helminthic parasites:** There are no epidemiological or other data suggesting a significant likelihood of adverse health effects from helminthic parasites in cephalopods in Australia. Levels at point of consumption are likely to be significantly reduced by cooking.

### **Relative risk ranking for cephalopod molluscs – conclusions**

Consideration of the severity of illness and the likelihood of adverse effects are combined in Table 8, to provide rankings for the various hazards associated with cephalopod molluscs. It is concluded that the relative public health risk ranking for this sector is low, based on limited consumption by the general population, low potential for presence of hazards, and the tendency for consumers to cook these products before consumption. For populations susceptible to severe illnesses due to *V. vulnificus*, *L. monocytogenes*, hepatitis A virus or mercury, the relative risk ranking is medium.

**Table 8: Relative risk ranking estimates for cephalopod molluscs**

Commodity	Hazard	Severity	Likelihood of adverse health effects	Relative risk Ranking
Cooked	<i>A. hydrophila</i>	Serious	Unlikely	Low
	<i>V. parahaemolyticus</i>	Moderate	Unlikely	Low
	<i>V. vulnificus</i> <sup>1</sup>	Serious	Unlikely	Low
	Non-toxigenic <i>V. cholerae</i> O1	Moderate	Unlikely	Low
	<i>E. coli</i> (non-EHEC)	Moderate	Unlikely	Low
	<i>Staphylococcus aureus</i>	Moderate	Unlikely	Low
	<i>Salmonella</i> (non-typhoid)	Serious	Unlikely	Low
	<i>Campylobacter</i> spp.	Serious	Unlikely	Low
	<i>Shigella</i> spp.	Serious	Unlikely	Low
	<i>Yersinia</i> spp.	Serious	Unlikely	Low
	<i>L. monocytogenes</i> <sup>1</sup>	Serious	Unlikely	Low
	Noroviruses	Moderate	Unlikely	Low
	Hepatitis A virus <sup>1</sup>	Serious	Unlikely	Low
	Mercury <sup>1</sup>	Serious	Unlikely	Low

1. For susceptible sub-populations the relative risk rankings are medium (severe x unlikely).  
Key: EHEC = enterohaemorrhagic *Escherichia coli*.

### **Food safety risks due to crustacea**

The hazards potentially associated with crustacea through the production and processing supply chain (Appendix 1) may be grouped as follows:

- Endogenous bacteria that are human pathogens (*A. hydrophila*, *L. monocytogenes*, *V. parahaemolyticus*, *V. vulnificus*, *V. cholerae* O1/O139, non-O1/non-O139 *V. cholerae*).
- Pathogens introduced through pollution or post-harvest contamination (*E. coli*, *S. aureus*, *Salmonella* spp., *Campylobacter* spp., *Shigella* spp., *Yersinia* spp., *V. cholerae* O1, hepatitis A virus, Noroviruses).
- Environmental chemical contaminants/toxicants (mercury, arsenic).

The environment from which crustacea are harvested influences the range of hazards. Wild-caught crustacea from clean waters are unlikely to contain pathogens of enteric origin, while farmed/estuarine crustacea may be exposed to contamination in the growing environment.

The severity of illness caused by these hazards (Table 3) ranges from moderate (for example, *V. parahaemolyticus*, noroviruses), through serious (for example, *L. monocytogenes*, hepatitis A virus) to severe (for example, *V. cholerae* O1/O139). Some of the hazards are considered severe only for certain susceptible populations (for example, *L. monocytogenes*, hepatitis A virus). However, the relative risk ranking estimates below are determined for the general population, unless otherwise specified.

#### *Prawns – green*

Consumption data indicate that prawns are a food group occasionally eaten by a significant proportion of the population (Appendix 3; [7,9]). On this basis, evidence of the potential for a hazard to be present at an infectious or toxigenic level in this commodity is taken as the main determinant of the likelihood of adverse health effects. Adverse health effects due to each of the hazards identified in Appendix 1 is considered unlikely, as discussed briefly below.

#### Likelihood of adverse health effects: Unlikely

***A. hydrophila*:** *A. hydrophila* has been implicated in food-borne illness due to prawn consumption in the United Kingdom [29], but there are no epidemiological or concentration data suggesting a significant likelihood of adverse health effects from pathogenic strains in Australia. The usual practice of cooking green prawns just before eating should significantly reduce the bacterial load.

***E. coli*, *S. aureus*, *Salmonella*, *Campylobacter*, *Shigella* and *Yersinia* species:** Pathogenic strains of these bacteria may be present in prawns due to pollution of growing waters or post-harvest contamination. Results from testing of imported foods (Appendix 1) demonstrate there is some limited potential for contamination of imported prawns by these hazards. The usual practice of cooking green prawns just before eating should significantly reduce the bacterial load, but will not affect the concentration of staphylococcal enterotoxin, which is thermostable. However, significant time–temperature abuse is usually needed to allow proliferation of *S. aureus* to levels likely to produce sufficient enterotoxin to cause illness [46]. Furthermore, the organism is a poor competitor, and commensal bacteria would hinder its ability to grow and produce toxin.

***Vibrio cholerae* O1/O139:** Toxigenic strains of *V. cholerae* O1 have been found in fresh water reaches of rivers in Australia but not in estuarine or marine environments [31].



There are only limited epidemiological [31] and concentration data suggesting a significant likelihood of adverse health effects from toxigenic *V. cholerae* O1 in Australia through consumption of prawns. Results from testing imported foods (Appendix 1) show no failures due to *V. cholerae* O1/O139 in any seafood commodities. The practice of cooking green prawns just before eating should significantly reduce bacterial levels.

**Vibrios (excluding toxigenic *V. cholerae* O1):** *V. parahaemolyticus*, *V. vulnificus* and non-O1/O139 *V. cholerae* are found in estuarine and marine environments in Australia. There are limited data suggesting a significant likelihood of adverse health effects from vibrios through consumption of prawns. *V. parahaemolyticus* has been isolated from prawns [31] and non-O1/non-O139 *V. cholerae* has been found in imported crustacea. The usual practice of cooking green prawns just before eating should significantly reduce the bacterial load.

***L. monocytogenes*:** There are limited data indicating the potential for food-borne listeriosis due to consumption of prawns. One small outbreak of *Listeria* bacteraemia has been reported, due to shrimp consumption, in the United States [63]. There are only limited data demonstrating the potential for *L. monocytogenes* to be present in uncooked prawns in Australia. Imported crustacea are not tested for *L. monocytogenes* under the Imported Foods Inspection Program, and there were no recalls coordinated by FSANZ in the period 1990–2003 for *L. monocytogenes* in crustacea. The practice of cooking green prawns just before eating should significantly reduce levels of this pathogen.

**Enteric viruses:** There are limited data indicating the potential for adverse health effects caused by exposure to enteric viruses due to consumption of prawns. There has been one outbreak of hepatitis A due to prawn consumption in Australia since 1995 (Appendix 2). Light cooking does not inactivate noroviruses [38,39], and hepatitis A virus has significant heat stability [40], so cooking may not inactivate these hazards.

**Inorganic arsenic and mercury:** ANZFA reviewed the public health risks due to heavy metal contamination in foods (including crustacea) in 1999 [5,7]. Data on concentrations of heavy metals in foods were used to provide an estimate of total dietary exposure. The results were as follows:

- For **inorganic arsenic**, ANZFA determined that prawns contributed up to 52 per cent of the total dietary exposure, and high consumers of crustacea could receive up to 18 per cent of the PTDI for inorganic arsenic, assuming the inorganic arsenic content of seafood is 6 per cent of the total arsenic content.
- For **mercury**, ANZFA concluded that crustacea contribute only 0.34 per cent to total dietary exposure of mercury [7].

#### *Prawns – cooked*

Prawns are often cooked on board the trawler or upon landing. They may also be peeled and possibly deveined, either mechanically or by hand. The cooking process does not significantly alter the concentrations of chemical hazards but should eliminate microbial pathogens if sufficient time is allowed. However, the potential for post-cooking recontamination of a product that is sold as ready-to-eat seafood and thus may undergo no further cooking, and which has a shelf life of several days, must be considered.

Sources of potential contamination of cooked prawns include estuarine or marine water used to cool the prawns, the ice or brine used to chill them, and contamination by food handlers and equipment. Insufficient cooking time and post-process time–temperature abuse may lead to higher counts of microbial pathogens. Hazards of concern are vibrios, *L. monocytogenes* and enteric pathogens including viruses. A significant proportion of outbreaks linked to cooked crustacea have been attributed to enteric bacterial pathogens [47].

The likelihood of adverse health effects due to certain hazards in cooked prawns must, therefore, be considered greater than for green prawns, which will be cooked before consumption. However, there are only limited data to support such a conclusion. One survey of *L. monocytogenes* in cooked prawns [48] detected low counts in 3 per cent of cooked prawns at retail. The samples included peeled and whole, chilled and frozen, local and imported cooked prawns. These data were included in a FSANZ risk assessment which concluded there was a very low risk of contracting listeriosis from cooked prawns in Australia [49]. Epidemiological evidence (Appendix 2; [19]) does provide some support, with recent outbreaks of hepatitis A, *S. Typhi*, *S. Typhimurium* and two outbreaks of *V. parahaemolyticus* being attributed to cooked (imported) prawns (Appendix 2).

Given the limited data, adverse health effects due to these hazards are considered to be unlikely, with the exception of *V. parahaemolyticus*, for which adverse health effects are considered more likely – an assumption supported by the epidemiological evidence.

#### Relative risk ranking for prawns – conclusions

Consideration of the severity and likelihood of adverse health effects are combined in Table 9, to provide rankings for hazards associated with green and cooked prawns. It is concluded that the relative public health risk ranking for green prawns is medium, due to the potential for contamination with *Salmonella* and *Vibrio* species in intensive farming systems or as a consequence of human faecal contamination of estuarine harvest areas.

For cooked prawns, the potential for post-process recontamination by microbial hazards was considered not to significantly increase the overall risk, as the product has a short shelf life, providing insufficient opportunity for outgrowth of pathogens unless subjected to significant time–temperature abuse. Therefore, the overall ranking for cooked prawns is also medium.

For populations susceptible to severe illnesses due to *V. vulnificus*, *L. monocytogenes*, hepatitis A virus or through exposure to mercury, the relative risk ranking is medium.

#### *Lobsters and crabs*

The vast majority of lobsters and crabs eaten in Australia is locally produced [43]. Consumption data indicate that lobsters and crabs are occasionally eaten by a small proportion of the population (Appendix 3; [7,9]). On this basis, the limited size of the consuming population must be considered along with evidence of the potential for a hazard to be present at an infectious or toxigenic level in estimating the likelihood of adverse health effects for the general population. The likelihood of adverse health effects due to each hazard identified in Appendix 1 is discussed briefly below.

## Live/raw product

Hazards associated with eating lobsters and crabs are similar to those for locally produced prawns [47], and a similar unlikely rating for adverse health effects from those hazards is estimated. However, unlike prawns, lobsters and crabs are not produced in intensive aquaculture facilities, and the risk from *V. cholerae* O1 and typhoid-causing *Salmonella* species is considered negligible for these species. There are no epidemiological data indicating an association between food-borne illness and consumption of crab or lobster in Australia, and no data demonstrating the presence of hazards in these seafoods. In the absence of such data, the likelihood of adverse health effects from food-borne hazards through eating crab and lobster is estimated to be low.

**Table 9: Relative risk ranking estimates for prawns – green or cooked**

Commodity	Hazard	Severity	Likelihood of adverse health effects	Relative risk Ranking
Green	<i>A. hydrophila</i>	Serious	Unlikely	Low
	<i>V. parahaemolyticus</i>	Moderate	Unlikely	Low
	<i>V. vulnificus</i> <sup>1</sup>	Serious	Unlikely	Low
	<i>V. cholerae</i> O1 <sup>2</sup>	Severe	Unlikely	Medium
	Non-O1/non-O139 <i>V. cholerae</i>	Moderate	Unlikely	Low
	<i>E. coli</i> (non-EHEC)	Moderate	Unlikely	Low
	<i>Staphylococcus aureus</i>	Moderate	Unlikely	Low
	<i>Salmonella</i> (non-typhoid)	Serious	Unlikely	Low
	<i>Salmonella</i> (typhoid) <sup>2</sup>	Severe	Unlikely	Medium
	<i>Campylobacter</i> spp.	Serious	Unlikely	Low
	<i>Shigella</i> spp.	Serious	Unlikely	Low
	<i>Yersinia</i> spp.	Serious	Unlikely	Low
	<i>L. monocytogenes</i> <sup>1</sup>	Serious	Unlikely	Low
	Noroviruses	Moderate	Unlikely	Low
	Hepatitis A virus <sup>1</sup>	Serious	Unlikely	Low
	Mercury <sup>1</sup>	Serious	Unlikely	Low
Arsenic	Severe	Unlikely	Medium	
Cooked	<i>A. hydrophila</i>	Serious	Unlikely	Low
	<i>V. parahaemolyticus</i>	Moderate	Likely	Low
	<i>V. vulnificus</i> <sup>1</sup>	Serious	Unlikely	Low
	<i>V. cholerae</i> O1 <sup>2</sup>	Severe	Unlikely	Medium
	Non-O1/non-O139 <i>V. cholerae</i>	Moderate	Unlikely	Low
	<i>E. coli</i> (non-EHEC)	Moderate	Unlikely	Low
	<i>Staphylococcus aureus</i>	Moderate	Unlikely	Low
	<i>Salmonella</i> (non-typhoid)	Serious	Unlikely	Low
	<i>Salmonella</i> (typhoid) <sup>2</sup>	Severe	Unlikely	Medium
	<i>Campylobacter</i> spp.	Serious	Unlikely	Low
	<i>Shigella</i> spp.	Serious	Unlikely	Low
	<i>Yersinia</i> spp.	Serious	Unlikely	Low
	<i>L. monocytogenes</i> <sup>1</sup>	Serious	Unlikely	Low
	Noroviruses	Moderate	Unlikely	Low
	Hepatitis A virus <sup>1</sup>	Serious	Unlikely	Low

Mercury <sup>1</sup>	Serious	Unlikely	Low
Arsenic	Severe	Unlikely	Medium

1. For susceptible sub-populations the relative risk rankings are medium (severe x unlikely).
  2. Product from intensive cultivation or estuarine harvest areas subject to human faecal contamination.
- Key: EHEC = enterohaemorrhagic Escherichia coli.

### Cooked product

A large proportion of the catch is sold either live or raw chilled/frozen. However, crab (in particular) may also be sold cooked, with a similar potential for re-contamination as with cooked prawns. As with live/raw product, lack of relevant data leads to the conclusion that adverse health effects due to food-borne hazards from consumption of cooked crab or lobster as ready-to-eat seafood is unlikely.

### *Relative risk ranking for lobsters and crabs – conclusions*

By comparison to the rankings for prawns, it is concluded that the relative public health risk ranking for live/raw crab and lobster is low (Table 10), based on the limited consumption, low potential for presence of hazards, and the tendency for these products to be cooked before consumption. For cooked crab and lobster, the increased potential for post-process recontamination with some microbiological hazards does not affect the overall ranking, which is low.

**Table 10: Relative risk ranking estimates for lobsters and crabs**

Commodity	Hazard	Severity	Likelihood of adverse health effects	Relative risk Ranking
Live/Raw	A. hydrophila	Serious	Unlikely	Low
	V. parahaemolyticus	Moderate	Unlikely	Low
	V. vulnificus <sup>1</sup>	Serious	Unlikely	Low
	Non-O1/non-O139 V. cholerae	Moderate	Unlikely	Low
	E. coli (non-EHEC)	Moderate	Unlikely	Low
	Staphylococcus aureus	Moderate	Unlikely	Low
	Salmonella (non-typhoid)	Serious	Unlikely	Low
	Campylobacter spp.	Serious	Unlikely	Low
	Shigella spp.	Serious	Unlikely	Low
	Yersinia spp.	Serious	Unlikely	Low
	L. monocytogenes <sup>1</sup>	Serious	Unlikely	Low
	Noroviruses	Moderate	Unlikely	Low
	Hepatitis A virus <sup>1</sup>	Serious	Unlikely	Low
	Mercury <sup>1</sup>	Serious	Unlikely	Low
Cooked	A. hydrophila	Serious	Unlikely	Low
	V. parahaemolyticus	Moderate	Likely	Low
	V. vulnificus <sup>1</sup>	Serious	Unlikely	Low
	Non-O1/non-O139 V. cholerae	Moderate	Unlikely	Low
	E. coli (non-EHEC)	Moderate	Unlikely	Low
	Staphylococcus aureus	Moderate	Unlikely	Low
	Salmonella (non-typhoid)	Serious	Unlikely	Low
	Campylobacter spp.	Serious	Unlikely	Low
	Shigella spp.	Serious	Unlikely	Low

Yersinia spp.	Serious	Unlikely	Low
L. monocytogenes <sup>1</sup>	Serious	Unlikely	Low
Noroviruses	Moderate	Unlikely	Low
Hepatitis A virus <sup>1</sup>	Serious	Unlikely	Low
Mercury <sup>1</sup>	Serious	Unlikely	Low

1. For susceptible sub-populations the relative risk rankings are medium (severe x unlikely).

For populations susceptible to severe illnesses due to *V. vulnificus*, *L. monocytogenes*, hepatitis A virus, or mercury ingestion, the relative risk ranking is medium.

#### *Other crustaceans – marron, yabbie, redclaw crayfish and scampi*

These crustacean species are eaten only occasionally by a small proportion of the population in Australia (Appendix 3). These products are usually sold live, then cooked immediately before consumption. There are no data for presence of food safety hazards in these species. Epidemiological evidence of the association of hazards with these crustacea is limited to two recent outbreaks due to *S. Typhimurium* and non-O1/non-O139 *V. cholerae* in redclaw crayfish and one outbreak where scampi was implicated as the vehicle for *S. Typhimurium* (Appendix 2; [19]). In the latter case, the scampi was subject to time–temperature abuse and served with a raw egg mayonnaise, which is a more likely vehicle for the pathogen.

#### *Relative risk ranking for marron, yabbie, redclaw crayfish and scampi – conclusions*

Considering the limited data available, the limited consumption, and the usual practice of selling these species live or as raw/green chilled or frozen product for cooking just before eating, adverse health effects due to food-borne hazards is considered extremely unlikely, similar to that for lobsters and crabs, and the overall relative risk ranking is low.

### **Food safety risks due to finfish**

The hazards potentially associated with finfish and finfish products through the production and processing supply chain (Appendix 1) may be grouped as follows:

- Endogenous bacteria that are human pathogens (*V. parahaemolyticus*, *L. monocytogenes*, *C. botulinum*, helminthic parasites).
- Pathogens introduced through pollution or post-harvest contamination (*E. coli*, *S. aureus*, *Salmonella* spp., *Campylobacter* spp., *Shigella* spp., *Yersinia* spp., *L. monocytogenes*, hepatitis A virus, Noroviruses).
- Environmental chemical contaminants/toxicants (ciguatoxin, histamine, mercury, arsenic).
- Naturally occurring substances (wax esters).

The severity of the illness caused by these hazards (Table 3) ranges from moderate (for example, *V. parahaemolyticus*, noroviruses), through serious (for example, *L. monocytogenes*, hepatitis A virus) to severe (for example, *C. botulinum*). Some of the hazards are considered severe only for certain susceptible populations (for example, *L. monocytogenes*, hepatitis A virus).

However, the relative risk estimates below are determined for the general population, unless otherwise specified.

#### *Chilled/frozen whole fish and fillets (including fish for raw consumption)*

Based on the available consumption data, chilled/frozen whole fish and fillets are considered a food group that is regularly eaten by a significant proportion of the population (Appendix 3; [7,9]). On this basis, evidence of the potential for a hazard to be present at an infectious or toxigenic level is taken as the main determinant of the likelihood of adverse health effects for the general population. The likelihood of adverse health effects due to each of the hazards identified in Appendix 1 is discussed briefly below and listed in Table 11.

Consumption of raw finfish products, such as sashimi and some sushi products, is considered to be rare and mainly limited to certain sub-populations in Australia. There was no reported consumption of these products in the 1995 National Nutrition Survey data. However, changes in national eating habits are leading to increasing availability and consumption [9]. While there may be need to specifically consider these products at some future time, they have not been separately ranked in this report.

#### Likelihood of adverse health effects: Unlikely

**Microbiological hazards:** Fish sold at retail as fillets or whole or gutted fish are typically thoroughly cooked before consumption, reducing the likelihood of exposure to indigenous or introduced microbiological pathogens, including helminthic parasites. *Vibrio* species, for example, are readily inactivated by cooking [47].

There are no epidemiological data indicating food-borne illness due to the presence of helminthic parasites in raw finfish products in Australia. *V. parahaemolyticus* is often associated with food-borne illness due to consumption of raw and minimally processed fish in Japan, but there is no epidemiological link in Australia. Additional hazards potentially present in raw finfish products are enteric pathogens (bacterial and viral) and *L. monocytogenes* due to contamination by food handlers and from the processing environment. One outbreak of food-borne illness due to sushi consumption (Appendix 2) was tentatively ascribed to viral contamination [19].

**Inorganic arsenic:** ANZFA recently reviewed the public health risks due to heavy metal contamination in foods [5,7]. Data on concentrations of heavy metals in foods were used to provide an estimate of total dietary exposure. For inorganic arsenic, fish contributed up to 14 per cent of the total dietary exposure, and high consumers could receive up to 4 per cent of the PTDI for inorganic arsenic, assuming the inorganic arsenic content of seafood is 6 per cent of the total arsenic content.

**Mercury:** At the time of the review of metal contaminants in food [7], ANZFA concluded that median level consumers of fish were unlikely to exceed the PTWI for mercury. However, frequent consumers of fish might exceed the PTWI if all their consumption was of predatory or long-lived fish species. FSANZ has reviewed its risk assessment of mercury due to the Joint FAO/WHO Expert Committee on Food Additives (JECFA's) recent lowering of the PTWI [61], and has issued an updated advisory statement concerning consumption of fish by pregnant women and those considering becoming pregnant.

For the susceptible sub-population (the foetus), the likelihood ranking for mercury is likely if a significant proportion of the mother's fish intake is from large, carnivorous or long-lived fish species (for example, shark, billfish, orange roughy).

#### Likelihood of adverse health effects: Likely

**Wax esters:** Several outbreaks of food-borne illness due to indigestible wax esters present in some fish species (particularly escolar and oilfish) have been reported in Australia in recent times (Appendix 2; [50–53]). It is likely that this usually fairly mild adverse reaction is significantly under-reported in the epidemiological datasets [50]. Instances of escolar food poisoning tend to be sporadic cases or outbreaks involving only a small number of people, as evidenced in reports of up to 88 cases (41 incidents) in South Australia in the period 1997–99 (Delroy, personal communication). Some of these cases involved misnaming of escolar as, for example, rudderfish or butterfish.

**Histamine:** Time–temperature abuse during transport, processing, storage or display will potentially allow formation of histamine. Scombroid species of fish, which have high levels of histidine, are more likely to accumulate high concentrations of histamine under conditions of temperature abuse, but many non-scombroid species have been involved in outbreaks of histamine fish poisoning. Data from testing of samples at retail (Appendix 4) and results from testing of imported fish products (Appendix 1) indicate a low concentration of histamine in whole fish and fillets available in Australia. However, epidemiological data (Appendix 2) show a significant number of outbreaks in commercial and restaurant settings, indicating potential problems in the cold chain (time–temperature abuse). Tuna, blue grenadier and mahi mahi have been identified as species involved in these outbreaks.

**Ciguatoxin:** Ciguatoxins are responsible for many outbreaks of food-borne illness due to fish consumption in Australia. In the period 1995 to June 2002, outbreaks were recorded in all states except South Australia and Tasmania. Queensland and New South Wales accounted for the great majority of the outbreaks, reflecting both the linkage of the disease with fish caught near tropical reefs in Queensland and the role of Sydney as a hub of marketing for seafood on the east coast. A number of fish species were involved, with coral trout, queenfish, Spanish mackerel and cod species predominant.

In contrast to histamine fish poisoning, ciguatera outbreaks have predominantly been in the private residence setting (Appendix 2). This partly reflects the role of recreational fishing around reefs as a risk factor, and may also indicate the effectiveness of voluntary restrictions on marketing of larger specimens of known ciguatoxic fish species. However, epidemiological data reported in the National Risk Validation Project final report [19] indicate that a significant proportion of the outbreaks due to fish eaten in private residences were caused by fish purchased at retail markets.

#### *Canned fish products*

Based on the available consumption data, canned fish products are considered a food group that is regularly eaten by a significant proportion of the population (Appendix 3; [7,9]). On this basis, evidence of the potential for a hazard to be present at an infectious or toxigenic level is taken as the main determinant of the likelihood of adverse health effects for the general population. The likelihood of adverse health effects due to each of the hazards identified in Appendix 1 is discussed briefly below and listed in Table 9.

### Likelihood of adverse health effects: Unlikely

**Microbiological hazards:** Low acid canned fish products undergo a sterilisation process designed to reduce levels of heat-resistant bacterial spores (especially those of *C. botulinum*) to negligible levels, providing that Good Manufacturing Practices and approved thermal processes are applied. This is a well-established practice for production of shelf-stable products. The likelihood of adverse health effects due to bacterial contaminants is thus negligible in a properly controlled canning process. Viral pathogens and helminthic parasites will also be destroyed.

**Inorganic arsenic:** The concentration of inorganic arsenic is not affected by the canning process, and its concentration in the final product will reflect the concentration in the raw materials. As described for chilled/frozen whole fish and fillets above, the likelihood of adverse health effects due to inorganic arsenic is considered low.

**Mercury:** Concentrations of methylmercury are unaffected by canning, although for tuna, different species are used for canning, so canned tuna typically has lower levels of mercury than tuna sold fresh. Other fish species associated with high mercury levels (for example, shark, orange roughy) are not normally canned. Concentrations in the final product will reflect concentrations in the raw materials. At the time of the review of metal contaminants in food [7], ANZFA concluded that median level consumers of fish were unlikely to exceed the PTWI for mercury. However, frequent consumers of fish might exceed the PTWI if all their consumption was of predatory or long-lived fish species. FSANZ has reviewed its risk assessment of mercury due to JECFA's recent lowering of the PTWI [61], and has issued an updated advisory statement concerning consumption of fish by pregnant women and those considering becoming pregnant.

**Staphylococcal enterotoxin:** The enterotoxin produced by *S. aureus* is extremely heat stable, and may survive the heat processes used to sterilise low-acid canned foods [54]. However, production of significant amounts of toxin needs high cell densities (that usually only occur in the late logarithmic or lag phases of growth), and would need significant contamination and time-temperature abuse of the fish prior to canning.

**Histamine:** Time-temperature abuse of fish intended for canning will potentially allow formation of histamine. Histamine (and other biogenic amines) is not destroyed in the canning process. Data from testing of samples at retail (Appendix 4) indicate only a low prevalence of histamine in canned fish. Results from testing of imported fish products (Appendix 1) show few failures for canned tuna (0.2%), but a higher rate (3%) of non-compliance in other canned fish (salmon, mackerel, sardines, anchovies etc.). Epidemiological data (Appendix 2) is inconclusive, but it must be assumed that the outbreaks of histamine fish poisoning reported in a commercial/restaurant setting are unlikely to be due to canned fish products.

### *Ready-to-eat cold-smoked fish products*

Data from the 1995 National Nutrition Survey (Appendix 3) do not distinguish between hot- and cold-smoked finfish, although consumption of hot-smoked seafood is believed to be small relative to cold-smoked seafood (Walsh, personal communication). It has been estimated that some (25%) of Australians eat smoked seafoods a few times a year [9], although the distinction is not made between hot- and cold-smoked products.



Also, smoked cod is a cold-smoked product that remains raw and must be cooked before consumption, and is not included in the definition of cold-smoked fish for the purposes of this section. Approximately 3000 tonnes of cold-smoked salmon and trout are available for consumption in Australia annually (equivalent to 30 million 100 gram serves), compared to approximately 10 000 tonnes of smoked cod needing further cooking (Walsh, personal communication).

It has been assumed, for this report, that ready-to-eat cold-smoked fish products are occasionally eaten by a significant proportion of the population. On this basis, evidence of the potential for a hazard to be present at an infectious or toxigenic level is taken as the main determinant of the likelihood of adverse health effects for the general population. The likelihood of adverse health effects due to each hazard identified in Appendix 1 is discussed briefly below and listed in Table 10.

#### Likelihood of adverse health effects: Unlikely

***C. botulinum***: Spores and vegetative cells are likely to survive the cold-smoking process, but growth is unlikely except in the case of vacuum or modified atmosphere-packed products, as *C. botulinum* is an obligate anaerobe.

Even in the case of vacuum packed and modified atmosphere-packed products, salt concentrations (typically in the order of 5% or higher) are likely to inhibit growth and toxin production by non-proteolytic (Group II and III) types [9,55]. There have been no recorded cases of botulism in Australia in the period 1991–2003 [56].

***V. parahaemolyticus***: Although it is possible that *V. parahaemolyticus* could survive the conditions of salt, water activity and temperature typically encountered in cold-smoked fish, there are only limited data demonstrating its presence in cold-smoked seafood products in Australia and no epidemiological data indicating food-borne illness from this source.

**Enteric pathogens**: There are no data demonstrating the presence of enteric bacterial or viral pathogens in cold-smoked seafood products in Australia and no epidemiological data indicating food-borne illness from this source.

**Helminthic parasites**: Cold smoking does not inactivate anisakids in salmon [57]. Freezing pre- or post-processing will eliminate the larvae. There are, however, no data demonstrating the presence of helminthic parasites in cold-smoked fish products in Australia and no epidemiological data indicating food-borne illness from this source.

**Histamine**: Time–temperature abuse of fish intended for smoking will potentially allow formation of histamine. Histamine and other biogenic amines are not destroyed in the cold-smoking process. Available data indicate that levels of histamine in smoked fish at retail in Australia are low (Appendix 4). Epidemiological data (Appendix 2) do not identify any smoked seafood as vehicles for outbreaks of scombroid fish poisoning.

***L. monocytogenes***: Contamination of cold-smoked fish products by *L. monocytogenes* at levels representing a health risk to the general population is considered unlikely, after consideration of the data demonstrating its presence in cold-smoked seafood products, as indicated in Appendix 1, and by reference to the imported food testing and food recall data.

Listeriosis is primarily a sporadic disease in Australia, with 35–70 cases annually (in the period 1990–2002) from all food sources, primarily amongst susceptible population sub-groups (pregnant women and their foetuses, neonates, immunocompromised individuals and the elderly) [56]. It is often not possible to identify the food source responsible for cases of listeriosis, due primarily to its long incubation time. Worldwide, cold-smoked fish products figure prominently in seafood-related outbreaks of listeriosis (Appendix 4), but there is no known epidemiological association in Australia. There is no listericidal step in the processing of cold-smoked fish, and its control is conditional upon adherence to Good Manufacturing Practices and the inhibitory effects of salt, reduced water activity, low storage temperature, etc.

The likelihood rating is considered to be ‘likely’ where there is insufficient management of the risk through the food supply chain, and for susceptible sub-populations (due to the lower infectious dose). The likelihood rating rises to ‘very likely’ when both conditions apply simultaneously.

#### *Hot-smoked fish products*

Data from the 1995 National Nutrition Survey (Appendix 3) do not distinguish between hot- and cold-smoked finfish, although consumption of hot-smoked seafood is believed to be small relative to cold-smoked seafood (Walsh, personal communication).

It has been estimated that some (25%) of Australians eat smoked seafoods a few times a year [9], although the distinction is not made between hot- and cold-smoked products. It has been assumed, for this report, that hot-smoked fish products are occasionally eaten by a small proportion of the population. On this basis, when estimating the likelihood of adverse health effects, evidence of the potential for a hazard to be present at an infectious or toxigenic level must be balanced by the relatively limited consumption. The likelihood of adverse health effects due to each of the hazards identified in Appendix 1 is discussed briefly below and listed in Table 9.

#### Likelihood of adverse health effects: Unlikely

***V. parahaemolyticus***: Vibrios are relatively heat-sensitive, and will be destroyed by the hot-smoking process. There are no data demonstrating its presence in hot-smoked seafood products in Australia and no epidemiological data indicating food-borne illness from this source.

***C. botulinum***: Spores will survive the hot-smoking process, but growth is unlikely except in the case of vacuum- or modified-atmosphere-packed products, as *C. botulinum* is an obligate anaerobe. Even in the case of vacuum-packed and modified atmosphere-packed products, salt concentrations (typically in the order of 3.5% or higher) and processing to an internal temperature of greater than 63°C for at least 30 minutes are likely to inhibit growth and toxin production by non-proteolytic (Group II and III) types [9,55,64]. Proper storage at temperatures under 5°C inhibits outgrowth and toxin formation by *C. botulinum* in these products [64]. There have been no recorded cases of botulism in Australia in the period 1991–2003 [56].

**Enteric pathogens:** These bacterial and viral contaminants will be destroyed in the hot-smoking process. There are no data demonstrating the presence of enteric bacterial or viral pathogens in hot-smoked seafood products in Australia and no epidemiological data indicating food-borne illness from this source.

**Helminthic parasites:** Hot smoking will inactivate anisakids larvae. There are no data demonstrating the presence of helminthic parasites in hot-smoked fish products in Australia and no epidemiological data indicating food-borne illness from this source.

***L. monocytogenes*:** Temperature encountered during hot-smoking will kill *L. monocytogenes*. There is some low potential for recontamination of hot-smoked fish products with *L. monocytogenes*, but the absence of relevant data showing presence of the hazard indicates this may not be a problem in Australia.

**Histamine:** Time–temperature abuse of fish intended for smoking will potentially allow formation of histamine. Histamine and other biogenic amines are not destroyed in the hot-smoking process. Available data indicate that levels of histamine in smoked fish at retail in Australia are low (Appendix 4). Epidemiological data (Appendix 2) do not identify any smoked seafood as vehicles for outbreaks of scombroid fish poisoning.

#### *Marinated, pickled, brined, dried or fermented fish products*

In general terms, consumption of these classes of seafood is mainly confined to certain ethnic sub-populations. The main hazards identified for these types of products are endogenous (for example, parasites, *C. botulinum*) or arise through mishandling and process contamination (for example, histamine, human enteric pathogens, *L. monocytogenes*) [47]. There is an absence of data indicating these hazards present a significant problem in Australia.

Likelihood of adverse health effects: Unlikely

**Microbiological hazards:** The limited consumption and lack of epidemiological evidence that these types of seafood have caused illness in Australia leads to an overall general conclusion that adverse effects from these hazards is unlikely. The combination of low pH and high salt will usually reduce the likelihood of growth and survival of enteric pathogens and parasites.

Likelihood of adverse health effects: Likely

**Histamine:** The potential for formation of histamine in these products, due to poor quality or time–temperature abuse of raw materials is considered to be significant. Data from testing of imported foods (Appendix 1) supports this contention.

#### *Surimi*

Although not explicitly identified in the data from the 1995 National Nutrition Survey, Surimi products (seafood extender and imitation crab sticks, scallops and calamari rings) are considered to be occasionally eaten by a small proportion of the population.

### Likelihood of adverse health effects: Unlikely

***L. monocytogenes* and *V. parahaemolyticus***: The minced washed fish matrix used in surimi production generally contains higher levels of bacteria than fish fillets, due to the extensive handling and processing involved [47]. However, further processing includes a steaming and/or heating step to set the proteinaceous gel in the formed product. Survival of bacterial pathogens will be minimal, and the attendant adverse health effects will be unlikely. There is potential for post-processing contamination, and the product, especially in the form of ‘seafood extender’, is a ready-to-eat processed finfish product to which the microbiological limits in Standard 1.6.1 of the Code apply.

### *Roe and caviar*

Consumption data indicate limited consumption of roe and caviar by the general population. While the hazards due to caviar and roe consumption are generally similar to those for raw fish consumption, adverse health effects in the general population are considered unlikely.

### Relative risk ranking for fish and fish products – conclusions

Consideration of the severity of adverse health effects and the likelihood of adverse health effects for each fish product type are combined in Table 11, to provide relative risk rankings for the various hazards associated with fish and fish products.

It is concluded that the relative public health risk for ready-to-eat cold-smoked fish is low for the general population when the product meets the microbiological limit for *L. monocytogenes* in Standard 1.6.1 of the Code. The ranking is medium when through-chain hygiene and sanitation is not adequately managed, and high for that sub-group of the population susceptible to invasive listeriosis.

Whole fish or fillets (whether chilled or frozen, for cooking), hot-smoked fish and canned fish are ranked as medium risk, although it is recognised that a maximum level standard exists in the Code to ensure protection of public health and safety from inorganic arsenic in fish, and that ciguatera is largely confined to certain fish species harvested from a limited geographical area (tropical and sub-tropical reefs).

Products such as fish preserved by traditional methods (marinating, pickling, brining, drying or fermenting), surimi, roe and caviar are ranked as low risk, primarily on the basis of the limited consumption of these products by the general population in Australia.

The overall relative risk rankings for whole fish or fillets (whether chilled or frozen, for cooking) and for canned fish are also estimated to be medium for the sub-population susceptible to chronic ongoing effects due to exposure to mercury (that is, the foetus).

**Table 11: Relative risk ranking estimates for fish and fish products**

Commodity	Hazard	Severity	Likelihood of adverse health effects	Relative risk ranking
Chilled/frozen whole fish and fillets* (including fish for raw consumption) *Where fish and fillets are cooked before eating, the risk from non-spore-forming bacteria is significantly reduced.	V. parahaemolyticus	Moderate	Unlikely	Low
	E. coli (non-EHEC)	Moderate	Unlikely	Low
	Staphylococcus aureus	Moderate	Unlikely	Low
	Salmonella (non-typhoid)	Serious	Unlikely	Low
	Campylobacter spp.	Serious	Unlikely	Low
	Shigella spp.	Serious	Unlikely	Low
	Yersinia spp.	Serious	Unlikely	Low
	L. monocytogenes <sup>1</sup>	Serious	Unlikely	Low
	Noroviruses	Moderate	Unlikely	Low
	Hepatitis A virus <sup>1</sup>	Serious	Unlikely	Low
	Helminthic parasites	Serious	Unlikely	Low
	Histamine	Moderate	Likely	Low
	Escolar wax esters <sup>3</sup>	Moderate	Likely	Low
	Ciguatoxin <sup>2</sup>	Serious	Unlikely	Low
	Ciguatoxin/Tropical species <sup>2</sup>	Serious	Likely	Medium
	Mercury <sup>6</sup>	Serious	Unlikely	Low
	Mercury <sup>6</sup>	Serious	Likely	Medium
Arsenic <sup>4</sup>	Severe	Unlikely	Medium	
Canned fish products	C. botulinum <sup>7</sup>	Severe	Unlikely	Medium
	V. parahaemolyticus	Moderate	Unlikely	Low
	E. coli (non-EHEC)	Moderate	Unlikely	Low
	Staphylococcus aureus	Moderate	Unlikely	Low
	Salmonella (non-typhoid)	Serious	Unlikely	Low
	Campylobacter spp.	Serious	Unlikely	Low
	Shigella spp.	Serious	Unlikely	Low
	Yersinia spp.	Serious	Unlikely	Low
	L. monocytogenes <sup>1</sup>	Serious	Unlikely	Low
	Noroviruses	Moderate	Unlikely	Low
	Hepatitis A virus <sup>1</sup>	Serious	Unlikely	Low
	Histamine	Moderate	Unlikely	Low
	Mercury <sup>1</sup>	Serious	Unlikely	Low
	Arsenic <sup>4</sup>	Severe	Unlikely	Medium
Commodity	Hazard	Severity	Likelihood of adverse health effects	Relative risk ranking
Cold-smoked fish products	C. botulinum <sup>7</sup>	Severe	Unlikely	Medium
	V. parahaemolyticus	Moderate	Unlikely	Low
	Helminthic parasites	Serious	Unlikely	Low
	E. coli (non-EHEC)	Moderate	Unlikely	Low
	Staphylococcus aureus	Moderate	Unlikely	Low
	Salmonella (non-typhoid)	Serious	Unlikely	Low
	Campylobacter spp.	Serious	Unlikely	Low
	Shigella spp.	Serious	Unlikely	Low
	Yersinia spp.	Serious	Unlikely	Low
	L. monocytogenes <sup>8</sup>	Serious	Unlikely	Low
	L. monocytogenes <sup>8,10</sup>	Severe	Likely	High
L. monocytogenes <sup>9</sup>	Serious	Likely	Medium	

Cold-smoked fish products (cont.)	L. monocytogenes <sup>9,10</sup>	Severe	Very likely	High
	Noroviruses	Moderate	Unlikely	Low
	Hepatitis A virus <sup>1</sup>	Serious	Unlikely	Low
	Histamine	Moderate	Unlikely	Low
	Mercury <sup>1</sup>	Serious	Unlikely	Low
Surimi	V. parahaemolyticus	Moderate	Unlikely	Low
	L. monocytogenes <sup>1</sup>	Serious	Unlikely	Low
Hot-smoked fish products	V. parahaemolyticus	Moderate	Unlikely	Low
	C. botulinum <sup>7</sup>	Severe	Unlikely	Medium
	Helminthic parasites	Serious	Unlikely	Low
	E. coli (non-EHEC)	Moderate	Unlikely	Low
	Staphylococcus aureus	Moderate	Unlikely	Low
	Salmonella (non-typhoid)	Serious	Unlikely	Low
	Campylobacter spp.	Serious	Unlikely	Low
	Shigella spp.	Serious	Unlikely	Low
	Yersinia spp.	Serious	Unlikely	Low
	L. monocytogenes <sup>1</sup>	Serious	Unlikely	Low
	Noroviruses	Moderate	Unlikely	Low
	Hepatitis A virus <sup>1</sup>	Serious	Unlikely	Low
	Histamine	Moderate	Unlikely	Low
	Mercury <sup>1</sup>	Serious	Unlikely	Low
Marinated, pickled, brined, dried or fermented fish products	Helminthic parasites	Serious	Unlikely	Low
	Histamine	Moderate	Likely	Low
	E. coli (non-EHEC)	Moderate	Unlikely	Low
	Staphylococcus aureus	Moderate	Unlikely	Low
	Salmonella (non-typhoid)	Serious	Unlikely	Low
	Campylobacter spp.	Serious	Unlikely	Low
	Shigella spp.	Serious	Unlikely	Low
	Yersinia spp.	Serious	Unlikely	Low
L. monocytogenes <sup>1</sup>	Serious	Unlikely	Low	
Commodity	Hazard	Severity	Likelihood of adverse health effects	Relative risk ranking
Roe and caviar	V. parahaemolyticus	Moderate	Unlikely	Low
	E. coli (non-EHEC)	Moderate	Unlikely	Low
	Staphylococcus aureus	Moderate	Unlikely	Low
	Salmonella (non-typhoid)	Serious	Unlikely	Low
	Campylobacter spp.	Serious	Unlikely	Low
	Shigella spp.	Serious	Unlikely	Low
	Yersinia spp.	Serious	Unlikely	Low
	L. monocytogenes <sup>1</sup>	Serious	Unlikely	Low
	Noroviruses	Moderate	Unlikely	Low
	Hepatitis A virus <sup>1</sup>	Serious	Unlikely	Low
	Histamine	Moderate	Unlikely	Low
	Ciguatoxin <sup>2</sup>	Serious	Unlikely	Low
Escolar wax esters	Moderate	Unlikely	Low	

1. For susceptible sub-populations the relative risk ranking is medium (severe x unlikely).
2. Ciguatoxin is mainly found in larger members of particular species of tropical and sub-tropical finfish from certain fishing areas.
3. Wax esters are only present in a few fish species (particularly escolar and oilfish).
4. Inorganic arsenic in fish is regulated in the Code, to ensure protection of public health and safety.
5. For susceptible sub-populations the relative risk ranking is high (severe x very likely). For the general population, the risk ranking is high (serious x very likely) when processing and product handling are not managed.
6. Mercury is a problem in large, long-living or predatory fish, such as swordfish, shark/flake and some tuna. These fish tend to accumulate higher levels of methylmercury than other species. The relative risk ranking is medium for the at-risk sub-population (the foetus) when the mother consumes mainly large, predatory or long-lived fish species.
7. Industry adherence to good manufacturing practice, good hygiene practice and appropriate product formulation (for example, pH, levels of salt, preservatives) control this hazard.
8. When correctly managed, the risk ranking is low for the general population, but high for at-risk sub-populations.
9. When not managed, that is, processing, product handling and storage not adequately controlled, the risk ranking is medium for the general population and high for at-risk populations.
10. *L. monocytogenes* is a severe hazard for at-risk populations.

Key: EHEC = enterohaemorrhagic *Escherichia coli*

#### **4. Discussion of relative risk rankings**

The relative risk rankings for those commodity/hazard pairings ranked as medium or high are summarised in Table 12. The factors impacting upon the rankings are discussed below, and a comparison is made with the findings of other relevant risk assessments or ranking exercises.

##### **High relative risk rankings**

###### *Oysters and other bivalve molluscs – polluted and/or unmonitored waters*

Oysters and other bivalve molluscs (except when the consumed product is only the adductor muscle, for example, roe-off scallops) harvested from growing environments likely to be exposed to faecal contamination and/or not under a shellfish safety management scheme were found to present a relatively high risk to public health. The risk is mainly due to the likelihood of illness caused by contamination with the hepatitis A virus and algal biotoxins (particularly amnesic shellfish poison and paralytic shellfish poison). These hazards are introduced in the pre-harvest phase of bivalve production.

The incidence of food-borne illness from eating oysters and other bivalve molluscs in Australia is characterised by a number of small outbreaks and sporadic cases due to *Vibrio* species and a few large outbreaks due to enteric viruses in oysters harvested from polluted and inadequately controlled waters. While adoption of risk management strategies has improved the safety of bivalve shellfish in Australia, residual risks remain. Monitoring of harvest waters for indicators of sewage pollution (for example, faecal or total coliforms) helps manage the risks from enteric pathogens, bacterial and viral, but cannot predict levels of *Vibrio* species in oysters. Monitoring for potentially toxic species of algae only partly reduces the risks due to algal biotoxins, as concentrations of toxin in oysters do not necessarily always correlate with levels of algae in the water.

Based on these considerations, for oysters and bivalves harvested from waters managed by a comprehensive shellfish safety scheme, such as the ASQAP, the relative risk ranking reduces to medium.

The risk ranking for cooked oysters and other bivalves is the same as the ranking for product to be eaten raw, as the hazards leading to the risk ranking are not greatly affected by the light cooking normally applied to these products.

**Table 12: Summary of selected seafood commodities including current risk management\***

Commodity	Hazard/environment or species	Severity	Likelihood	Relative risk ranking <sup>1</sup>	Current risk management
Raw oysters	V. vulnificus	Serious	Likely	Medium	ASQAP/Ch 3 <sup>2</sup>
	V. cholerae O1/O139	Severe	Unlikely	Medium	ASQAP/Ch 3 <sup>2</sup>
	Noroviruses/Uncontrolled <sup>3</sup>	Moderate	Very likely	Medium	
	Noroviruses/Managed <sup>4</sup>	Moderate	Unlikely	Low	ASQAP
	Hepatitis A virus/ Uncontrolled <sup>3</sup>	Serious	Very likely	High	
	Hepatitis A virus/Managed <sup>4</sup>	Serious	Unlikely	Low	ASQAP
	Algal biotoxins/Uncontrolled <sup>3</sup>	Severe	Likely	High	Ch 1
	Algal biotoxins/Managed <sup>4</sup>	Severe	Unlikely	Medium	ASQAP/Ch 1
	Arsenic, Cadmium, Lead	Severe	Unlikely	Medium	ASQAP/Ch 1
Commodity	Hazard/environment or species	Severity	Likelihood	Relative risk ranking <sup>1</sup>	Current risk management
Cooked oysters	V. cholerae O1	Severe	Unlikely	Medium	ASQAP/Ch 3 <sup>2</sup>
	Noroviruses/Uncontrolled <sup>3</sup>	Moderate	Very likely	Medium	Ch 3 <sup>2</sup>
	Noroviruses Managed <sup>4</sup>	Moderate	Unlikely	Low	ASQAP/Ch 3 <sup>2</sup>
	Hepatitis A virus/ Uncontrolled <sup>3</sup>	Serious	Very likely	High	
	Hepatitis A virus/Managed <sup>4</sup>	Serious	Unlikely	Low	ASQAP
	Algal biotoxins//Uncontrolled <sup>3</sup>	Severe	Likely	High	Ch 1
	Algal biotoxins/Managed <sup>4</sup>	Severe	Unlikely	Medium	ASQAP/Ch 1
		Arsenic, Cadmium, Lead	Severe	Unlikely	Medium
Cooked abalone /roe-off scallops	Algal biotoxins	Severe	Unlikely	Medium	Ch 1
Green prawns	V. cholerae O1 <sup>5</sup>	Severe	Unlikely	Medium	Ch 3 <sup>2</sup>
	Salmonella Typhi <sup>5</sup>	Severe	Unlikely	Medium	Ch 1/Ch 3 <sup>2</sup>
	Arsenic	Severe	Unlikely	Medium	Ch 1
Cooked prawns	V. cholerae O1 <sup>5</sup>	Severe	Unlikely	Medium	Ch 3 <sup>2</sup>
	Salmonella Typhi <sup>5</sup>	Severe	Unlikely	Medium	Ch1/Ch 3 <sup>2</sup>
	Arsenic	Severe	Unlikely	Medium	Ch 1
Chilled/ frozen whole fin fish and fillets	Mercury, Ciguatoxin <sup>6</sup>	Serious	Unlikely	Low	Ch 1/Advisory Notes
	Ciguatoxin/Tropical <sup>7</sup>	Serious	Likely	Medium	Advisory Notes
	Mercury/Predatory species <sup>8</sup>	Serious	Likely	Medium	Ch 1/Advisory Notes
	Arsenic	Severe	Unlikely	Medium	Ch 1
Canned fish products	C. botulinum <sup>4, 9</sup>	Severe	Unlikely	Medium	GMP/GHP
	Arsenic	Severe	Unlikely	Medium	Ch 1
Cold-smoked fish products	C. botulinum <sup>4, 9</sup>	Severe	Unlikely	Medium	GMP/GHP
	L. monocytogenes	Serious	Unlikely	Low <sup>10</sup>	Ch 1/Ch 3 <sup>2</sup> /Advisory
	L. monocytogenes	Severe	Likely	High <sup>10, 12</sup>	Ch 1/Ch 3 <sup>2</sup> /Advisory
	L. monocytogenes	Serious	Likely	Medium <sup>11</sup>	
	L. monocytogenes	Severe	Very likely	High <sup>11, 12</sup>	



Hot-smoked fish products	C. botulinum <sup>4,9</sup>	Severe	Unlikely	Medium	GMP/GHP
--------------------------	-----------------------------	--------	----------	--------	---------

\* Relative risk rankings are under constant review to identify emerging significant information.

1. Risk ranking reflects current practice for that commodity/seafood sector. The risk ranking is based on the severity of the hazard and an estimate of the likelihood of illness that takes into account various factors, including current risk management practices.

2. Chapter 3 provisions in the Code apply to the processing sector only.

3. 'Uncontrolled' describes a growing environment not under a shellfish safety management scheme and/or likely to be exposed to faecal contamination. Includes growing waters adjacent to urban areas and rural habitation. In contrast, a growing environment considered pristine is unlikely to be exposed to faecal contamination. Pristine environments would typically include growing waters remote from human habitation and even if uncontrolled, present similar risk to managed waters for enteric pathogens. Algal toxins remain a risk for pristine environments.

4. Where a food safety hazard is controlled under a management system/program, the likelihood of illness is very low.

5. For product from intensive farming systems or estuarine harvest areas subject to human faecal contamination.

6. Majority of finfish present a low risk to consumers (serious x unlikely) due to mercury or ciguatoxin.

7. Ciguatoxin may be found in larger specimens of particular species of tropical and sub-tropical finfish from certain fishing areas. It is predominantly a problem in the recreational fishing sector (Table 4.19).

8. Predatory species – mercury is a problem in large, long-living or predatory fish, such as swordfish, shark/flake and some tuna. These fish tend to accumulate higher levels of methylmercury than other species. The relative risk ranking is medium for the at-risk sub-population (the foetus) when the mother consumes mainly large, predatory or long-lived fish species.

9. Industry adherence to good manufacturing practice, good hygiene practice and appropriate product formulation (for example, pH, levels of salt, preservatives) control this hazard.

10. When correctly managed, the risk ranking is low for the general population (serious x unlikely), but high for at-risk sub populations.

11. When not managed, that is, processing, product handling and storage not adequately controlled, the risk ranking is medium for the general population and high for at-risk populations.

12. L. monocytogenes is a severe hazard for at risk populations.

Key: ASQAP = Australian Shellfish Quality Assurance Program; GMP = good manufacturing practices; GHP = good hygiene practices.

### Findings of other risk assessments

This high relative risk ranking for oysters and other bivalves from polluted and/or unmanaged waters is consistent with the findings of other risk assessments and ranking exercises conducted in Australia on viruses and algal biotoxins in molluscs.

The National Risk Validation Project ranked producers, harvesters, processors and vendors of raw ready-to-eat seafood (including oysters and other bivalves) amongst the five highest risk food industry sectors for food-borne illness in Australia, based on recent epidemiological data [19].

Ross and Sanderson [8] found that consumption of raw shellfish carried a relatively high risk of viral infection compared to other seafoods, whilst recognising that the generally low level of reported illness suggested existing control strategies are effective. They also deduced that the risk of illness due to algal toxins was reduced from medium to low when shellfish were harvested under a quality assurance system. These findings are consistent with the estimates of the likelihood of adverse health effects derived in this report (Table 12).

Sumner [9] ranked the risks from viruses in shellfish from contaminated waters and from algal toxins from uncontrolled waters in an algal event as high (risk rankings of 67 and 72, respectively), with the rankings dropping to low (risk rankings of 31) when harvesting was from approved waters under a quality assurance management system. Again, these are broadly in line with the risk ranking derived in this report (noting that a ranking of 32 is considered 'medium risk' in the Sumner system).

ANZFA [4] concluded that the available data suggested the potential for significant health risk from consumption of shellfish contaminated with algal biotoxins. As a result of that analysis, new end-point maximum level standards were introduced for diarrhoetic and neurotoxic shellfish poisons in bivalve molluscs, and standards were maintained unchanged for amnesic and paralytic shellfish poisons in bivalve molluscs in the Code.

#### *Cold-smoked ready-to-eat finfish*

Ready-to-eat cold-smoked finfish (and other ready-to-eat cold-smoked seafood products) present a higher risk to public health relative to other seafoods due to the possibility of contamination with *Listeria monocytogenes* and the potentially severe illness it causes in at-risk population sub-groups such as pregnant women. *L. monocytogenes* is a ubiquitous organism often found in processing environments, and may also be present in fish at the time of harvest. Cold smoking is not a listericidal process.

Recognition of the risks by both regulators and the industry has resulted in a high level of management of *L. monocytogenes* in Australia and a lower risk of illness to the general population. FSANZ has previously recognised the inherent risk to the general population due to *L. monocytogenes* in cold-smoked seafoods by including a microbiological limit standard for the organism in ‘ready-to-eat processed finfish, other than fully retorted finfish’ in the Code. When the food safety risks are managed, such that cold-smoked seafoods meet this regulatory requirement, the relative risk ranking for the general population is low, although the relative risk ranking for susceptible populations (for example, pregnant women, neonates and the elderly) is high. FSANZ is currently reviewing its dietary advice to these at-risk sub-groups in order to manage their food safety risks due to *L. monocytogenes* from all food sources.

If the food safety risks are not properly managed, such that cold-smoked seafoods do not meet the microbiological limit standard for *L. monocytogenes*, the relative risk ranking is high for at-risk sub-groups and medium for the general population. This takes account of the relatively long shelf life of the product, the high standards of hygiene and sanitation in processing, and good temperature controls across the food supply chain, up to and including the consumer, that is needed to ensure the safety of the product.

Invasive listeriosis is mainly confined to susceptible sub-populations, such as pregnant woman and their unborn children, neonates, immunocompromised people and the elderly. In addition, there is general susceptibility to a milder gastrointestinal illness due to *L. monocytogenes*.

While cold-smoked seafoods have been linked to outbreaks of listeriosis overseas, there has been no such epidemiological linkage established in Australia. However, there are several factors that might lead to an underestimation of the linkage. Listeriosis is primarily a sporadic disease mainly affecting the susceptible sub-populations and, although it can infect healthy people, the low rate of infection in the general population probably means some outbreaks go undetected [58].

In addition, there are inherent difficulties in determining the food vehicle due to the potentially long incubation time (up to three months) of listeriosis.

## Findings of other risk assessments

Several recent risk assessments and ranking exercises have considered the public health and safety risk of *L. monocytogenes* in cold-smoked seafoods. There are some apparent inconsistencies between the findings of these studies.

Ross and Sanderson qualitatively ranked the risk to New South Wales consumers of listeriosis from consumption of ready-to-eat smoked seafood products to be low, relative to other seafood/hazard combinations. However, application of their quantitative ranking tool led to a higher relative ranking, behind only viruses and algal biotoxins in molluscs, and *C. botulinum* in vacuum-packed seafoods [8]. This higher ranking reflects the greater influence of the severity of outcomes in the ranking tool compared to the qualitative risk ranking. They further estimated that the incidence of listeriosis in the susceptible sub-population in New South Wales would be, at most, a few cases per annum, depending on the degree of adherence to the microbiological limit standard in the Code.

Sumner ranked the public health risk from smoked seafood containing *L. monocytogenes* as medium (risk ranking 39 for the general population, 47 for the foetus – the extremely susceptible sub-population).

However, he concluded that the estimate of 14 cases per annum due to smoked seafood, as generated by the ranking tool, was not supported by the epidemiological data, and that several factors could account for a lower actual case rate [9]. The average annual reported incidence of listeriosis in Australia (from all food sources) in the period 1991–2002 (inclusive) was 59 cases [56].

The quantitative comparative risk ranking of *L. monocytogenes* in ready-to-eat foods conducted jointly in the United States by the Food and Drug Administration, United States Department of Agriculture and Centers for Disease Control and Prevention concluded that smoked seafoods had a relatively high risk ranking on a per-serving basis, but only a moderate relative risk ranking on a per-annum basis (estimated 1.3 cases per annum in the whole population) [11]. However, these rankings are for ‘likelihood of illness’ (specifically, invasive Listeriosis) in the total population, and do not take into account a severity factor because the comparisons were made between risks due to a single hazard (*L. monocytogenes*) in a large number of foods. The report also generated estimates of likelihood of illness in the perinatal and elderly susceptible populations.

FSANZ previously concluded that *L. monocytogenes* in ready-to-eat finfish (such as cold-smoked salmon) poses a significant public health risk, particularly for vulnerable subgroups, recognising that while the incidence of disease is low in the population, the impact (death) for the infected individual is severe [49]. The assessment led to maintenance of the microbiological limit standard for *L. monocytogenes* in smoked seafood.

## **Medium relative risk rankings**

Many of the medium risk rankings reflect hazards that have severe adverse health effects, although the likelihood of illness from these hazards in the seafood commodity is rated as ‘unlikely’. This is the case for abalone and roe-off scallops (amnesic shellfish poison and paralytic shellfish poison); prawns, whether green or cooked (arsenic, *V. cholerae* O1 and *S. Typhi*); canned seafood (arsenic and *C. botulinum*); hot-smoked fish products (*C. botulinum*); and whole or filleted finfish, chilled or frozen, for cooking (arsenic).

The ‘unlikely’ ratings for the likelihood of adverse health effects reflect the effectiveness of existing risk management systems in place for those commodity/hazard combinations.

That many of the medium risk rankings are assigned to hazard/commodity pairs based on severe adverse health effects with unlikely occurrence reflects that the likelihood and severity ratings are not linear and that they are measured on different scales. That reflects the value judgement inherent in the ranking process, and allows inferences to be drawn as to which factors play a more important role in the final risk ranking assigned to each specific commodity group.

#### *Abalone and roe-off scallops*

Abalone and roe-off scallops were ranked in the medium risk category of seafood products due to the potential presence and adverse health effects of algal biotoxins (particularly the more severe toxins, amnesic shellfish poison and paralytic shellfish poison). These are hazards which might be introduced in the pre-harvest phase of primary production. Significantly lower levels of algal biotoxins accumulate in the adductor muscle of scallops and the muscular foot of the abalone [16,44], reducing the likelihood of adverse health effects compared to those molluscs where the viscera is also eaten (for example, oysters). Growth, harvesting and processing of abalone and roe-off scallops are not covered by the requirements of the ASQAP.

#### Findings of other risk assessments

Lehane, in reviewing the public health implications of paralytic shellfish poisons, reported that scallops generally do not pose a public health threat because the adductor muscle does not accumulate toxins [16]. For abalone, Lehane reports the findings of Pitcher et al. [44] that the muscular foot made a low contribution to the total toxin content of abalone harvested during algal bloom events on the west coast of South Africa.

ANZFA [4], Sumner [9] and Ross and Sanderson [8] did not consider the risks due to algal toxins in abalone and roe-off scallop separately from other molluscan shellfish. Sumner noted the low proportion of domestic abalone production available for local consumption, as around 90 per cent is exported, and reported findings that algal toxins had been detected in abalone in Victoria and overseas.

#### *Prawns*

Prawns were ranked in the medium relative risk category due to arsenic, *V. cholerae* O1 and *S. Typhi*. The medium ranking reflects the severe nature of the adverse health effects potentially caused by these hazards and the effectiveness of current risk management strategies in reducing the likelihood of adverse health effects rating to ‘unlikely’.

The bacterial pathogens are hazards which might be present in the growing environment, particularly in aquaculture facilities stocked to high densities, or could be introduced through use of contaminated cooling water for prawns cooked on-board trawlers or at aquaculture sites. Arsenic is an unavoidable contaminant that may be present in the growing environment for prawns. The medium relative risk ranking for these hazards were not significantly affected by consideration of the form in which these crustacea are sold (raw or cooked).

Standard 1.4.1 – Contaminants and Natural Toxicants, of the Code contains a maximum level standard for arsenic in crustacea (2 mg/kg), set in response to the findings of the risk assessment ANZFA conducted as part of Proposal P157 – Contaminants in Foods – Metals [7]. The likelihood of illness due to arsenic in prawns meeting the requirements of Standard 1.4.1 is considered negligible.

Standard 1.6.1 – Microbiological Limits for Food includes microbiological limits for *Salmonella* in both cooked and raw crustacea. In addition, the User Guide to Standard 1.6.1 [59] includes additional non-mandatory guideline criteria for *V. cholerae* in cooked and raw crustacea. (When guideline criteria levels are exceeded it generally indicates a failure in food production or hygiene procedures, and alerts the processor and regulator that action should be taken to identify and remedy the problem.)

#### Findings of other risk assessments

The ongoing FAO/WHO Risk assessment of *Vibrio* spp. in seafood [12] considered the public health risk due to choleraogenic *Vibrio cholerae* O1 and O139 in warm-water shrimps. The qualitative risk assessment showed ‘there was not a public health problem associated with the consumption of imported warm-water shrimp.’

The quantitative risk assessment is yet to be finalised.

Sumner [9] focused on the public health risk from consumption of ready-to-eat prawns from Asia, the primary source of prawns imported into Australia. The resultant rankings were medium (risk rankings of 37) due to:

- *V. cholerae* (for the very susceptible sub-population)
- *Salmonella* (for the general population).

Ross and Sanderson [8] focused their assessment on the risk due to *Vibrio* spp. in raw ready-to-eat shellfish, primarily oysters, but concluded generally that the incidence of severe disease from *V. cholerae* through consumption of bivalve molluscs or crustaceans was low.

The former ANZFA [6] initially proposed microbiological limit standards for *V. cholerae* in raw and cooked crustacea during its review of the Code. However, in response to public submissions and issues raised at a stakeholder forum, ANZFA amended or deleted some proposed microbiological limit standards. As part of these changes, the proposed standards for *V. cholerae* in crustacea were moved into the guideline document. The rationale for this decision was that:

While crustacea obtained from countries where this pathogen [*V. cholerae*] is not endemic will not present a hazard to the consumer, product obtained from those areas where it is endemic could do so. This is supported by epidemiological evidence. However, testing cannot be carried out on product only from countries where *V. cholerae* is endemic. Testing of all imported product would be onerous and unnecessary [62].

#### *Canned seafood*

Canned finfish (and other low-acid canned seafood products) were ranked in the medium relative risk category due to an unlikely rating for severe adverse health effects due to spore survival, outgrowth and toxin formation by *C. botulinum*.

The relative risk due to arsenic was also ranked medium in these products. The medium relative risk rankings primarily reflect the severe nature of the adverse health effects potentially caused by these hazards.

The risk from botulism in low-acid canned foods has been successfully managed for many years through industry adherence to HACCP principles, scientifically based thermal processes, training of retort operators and good hygienic practices, and there have been very few outbreaks attributed to canned seafood either in Australia or other countries over the past 50 years [60].

Standard 1.4.1 – Contaminants and Natural Toxicants – of the Code contains a maximum level standard for arsenic in fish (2 mg/kg), set in response to the findings of the risk assessment ANZFA conducted as part of Proposal P157 – Contaminants in Foods – Metals [7]. The likelihood of illness due to arsenic in canned fish products meeting the requirements of Standard 1.4.1 is considered negligible.

#### Findings of other risk assessments

Sumner [9] ranked the risk of illness due to *C. botulinum* in canned fish as very low (risk ranking 22), based on the demonstrated effectiveness of control mechanisms in place for canning low-acid foods.

Ross and Sanderson [8] focused their assessment on the risk from *C. botulinum* in vacuum-packed ready-to-eat (generally smoked) seafood products, rather than canned seafoods.

FSANZ [6] concluded that the risk of botulism from canned fish was very low due to rigorous control of canning facilities worldwide, while noting that ‘the severity of this disease means that the potential for it to occur must always be allowed for.’

#### *Whole and filleted finfish*

For whole and filleted finfish (chilled or frozen, including fish for raw consumption) the only hazard falling into the medium relative risk ranking category was arsenic. The ranking primarily reflects the severe nature of the adverse health effects potentially caused by arsenic.

#### Findings of other risk assessments

Ross and Sanderson [8] and Sumner [9] did not assess the risks due to arsenic in seafoods. ANZFA concluded [7] that the likelihood of illness due to arsenic in fish and fish products meeting the maximum level standard (2 mg/kg) was negligible.

#### *Whole and filleted finfish – larger reef fish*

Certain species of reef fish prone to accumulating ciguatera were ranked in the medium relative risk ranking category. The epidemiological evidence strongly indicates the risk is greatest in Queensland and New South Wales – the states consuming the greater proportion of potentially ciguateric fish and having fisheries located in proximity to tropical and sub-tropical reefs. However, the interstate trade in fish in Australia leads to the risk being ‘exported’ to other states where the local fish catch is not a source of ciguatera.

### Findings of other risk assessments

Ross and Sanderson considered the risk to New South Wales consumers of ciguatera fish poisoning to be ‘relatively low’ [8]. Sumner [9] ranked the risk of ciguatera in the general population as medium (risk ranking 45), and as high (risk ranking 60) for recreational fishers and their families in known ciguatera ‘hot spots’ in Queensland and the Northern Territory. The different rankings reflect self-regulation by fish marketing bodies, for example, bans on certain known ciguatoxic species and size limits on others, and the perceived need for greater education of recreational fishers.

ANZFA has not previously published a risk assessment of ciguatoxin in fish.

#### *Whole and filleted finfish – large, carnivorous and long-lived fish species*

For the susceptible sub-population (the foetus), the risk of chronic effects caused by exposure to mercury from large, carnivorous or long-lived fish in the maternal diet was also ranked as medium.

Standard 1.4.1 – Contaminants and Natural Toxicants – of the Code contains a maximum level standard for mercury of 1 mg/kg which applies to several identified fish species (including shark and billfish) known to accumulate higher levels of mercury. FSANZ has recently reviewed its risk assessment for mercury, particularly in fish and fish products, and has revised its advice on the consumption of fish by women of childbearing age.

### Findings of other risk assessments

Ross and Sanderson [8] concluded that people consuming above-average levels of fish, particularly of shark and billfish might be exposed to hazardous levels of mercury. Sumner [9] ranked the risk due to mercury in fish as low (risk ranking of 24). Neither explicitly assessed the risk for the foetus, although both indicated that education of pregnant women and consumers of large amounts of larger, predatory fish species was a necessary risk management strategy.

#### *Hot-smoked fish products*

Hot-smoked fish products were ranked in the medium relative risk category due to an ‘unlikely’ rating for severe adverse health effects from spore survival, outgrowth and toxin formation by *C. botulinum*. The medium relative risk ranking primarily reflects the severe nature of the adverse health effects potentially caused by this hazard.

### Findings of other risk assessments

Ross and Sanderson [8] considered that the risk to New South Wales consumers from *C. botulinum* in vacuum-packed ready-to-eat fish products was ‘relatively low’, and would only result from gross temperature abuse. Sumner [9] ranked the risk as ‘negligible’ on the basis of the low levels of spores likely to be in products available in the Australian marketplace and the typical salt levels in these products.

FSANZ has not previously published a risk assessment of *C. botulinum* in hot-smoked fish products.

## Low relative risk rankings

A significant number of seafood commodities were ranked as presenting a low relative risk to the general population. For some of these, limited consumption of the product was the main factor that led to the conclusion that adverse health effects from associated hazards was unlikely. For others, the probable effect of downstream processing and consumer handling on hazard levels was a factor in reducing that likelihood.

## 5. Uncertainty and variability

The relative risk rankings outlined in this document will inform FSANZ's consideration of risk management options. Consequently, it is important to recognise and consider the areas of uncertainty and variability in the ranking. While the rankings are underpinned by available epidemiological data, hazard identification, risk characterisation and detailed evaluations of the seafood supply chain, they remain largely qualitative.

Uncertainties in the risk rankings primarily come from significant data gaps in the information used to derive the 'likelihood of illness' rating. The available surveillance and epidemiological data demonstrating the association between hazards, seafood commodities and food-borne illness are recognised as being limited. Estimates of the amount of food-borne illness due to seafood are therefore wide-ranging, depending upon the assumptions used, and vary from around 4% to up to 25% of the total burden of food-borne illness in developed countries [65-67]. In addition, the gaps in data and information are unevenly spread across hazards and commodities, necessitating employment of a degree of expert opinion/judgement in the likelihood of illness ratings, to bridge the gap between what is indicated by the data and what is plausible given our knowledge of the hazard, the seafood commodity, its regulatory environment, and its production and processing supply chain up to the point of consumption. This has militated against completion of a formal quantitative exposure assessment for each hazard/commodity pairing considered. Qualitative estimates of the likelihood of illness due to the presence of a particular hazard in a seafood commodity were derived, based on available information.

The seafood consumption figures were derived using data from the 1995 National Nutrition Survey of Australia, which was based on selected consumers' recollection of the food they had consumed over a designated 24-hour period. This tends to lead to an over-estimation of habitual food consumption amounts for high consumers and for foods that are only occasionally eaten. Other limitations of the National Nutrition Survey data are that smoked finfish was not identified as being hot- or cold-smoked, or as ready-to-eat or raw (for example, smoked cod); and scallops were not identified as being roe-off or not.

Further uncertainty in the risk rankings arises from the evolving regulatory and non-regulatory risk management environment for seafood in Australia. The impact of such changes on the safety of seafood can only be judged over the course of a number of years, when it might be reflected in the epidemiological, prevalence and concentration data used in generating the risk estimates.

Variability in the risk posed by seafood products can arise from a number of factors, including geographical factors contributing to the risk (for example, risk of ciguatera poisoning is relative to levels of consumption of larger reef fish; risk due to *Salmonella* in cooked prawns is influenced by the method of production – wild-catch versus aquaculture).



Application of international data to the Australian situation may also be a source of variability in risk estimates. For example, differences in the virulence of pathogens, the susceptibility of populations or the levels of hazards in seafood can all affect the overall level of food-borne illness arising from a particular product/hazard combination. However, international data was used in the analysis, particularly in cases where Australian data was lacking or where a significant amount of the seafood commodity was imported.

As significant data gaps are gradually filled by the results of ongoing research and scientific evaluation, the robustness of the risk rankings can be better assessed and the rankings may be further refined. As it stands, the rankings place seafood industry sectors into broad relative risk categories as a basis for considering appropriate risk management strategies.

## 6. Conclusions

The relative risk rankings described in this report demonstrate that, under current risk management practices – both voluntary and mandatory – in Australia, public health and safety risks are low for the majority of seafoods. A small number of industry sectors present a higher public health risk relative to other seafoods.

The report concludes that the following seafood sectors are ranked in the high relative risk category:

- oysters and other bivalve molluscs (except when the consumed product is only the adductor muscle, for example, roe-off scallops) harvested from growing environments likely to be exposed to faecal contamination and/or not under a shellfish safety management scheme
- ready-to-eat cold-smoked finfish (and other ready-to-eat cold-smoked seafood products) when eaten by population sub-groups susceptible to invasive Listeriosis.

Oysters and other bivalves have been the food vehicle in several large and small outbreaks of food-borne illness in Australia over the past 15 years. The food safety hazards involved have included enteric viruses, algal biotoxins and pathogenic bacteria. When harvested from waters managed by a comprehensive shellfish safety scheme, such as the ASQAP, oysters and other bivalves were ranked in the medium relative risk category.

Cold-smoked seafoods have been linked to outbreaks of listeriosis overseas, but there has been no such epidemiological linkage established in Australia. However, there are several factors that might lead to an underestimation of the linkage.

Listeriosis is primarily a sporadic disease affecting susceptible populations (the foetus, pregnant women, neonates, the elderly and the immunocompromised) and, although it can infect healthy people, the low rate of infection in the general population probably means some outbreaks go undetected [58].

The inherent difficulties in determining the food vehicle, due to the long incubation time of the disease, typically militate against identification of the actual food vector.

Of the seafood commodities ranked in the medium relative risk category, prawns and fish (whole or as fillets) have been linked to several outbreaks of food-borne illness in Australia in recent years.

For prawns, the associated food safety hazards have been primarily microbiological hazards, while for fish, ciguatoxin, histamine fish poisoning and escolar wax esters account for the majority of outbreaks.

The conclusions of the risk ranking are subject to uncertainties introduced by significant data gaps and ongoing changes in the risk management environment applying to seafood in Australia. Gaps and uncertainties mean the conclusions must be understood to be based on the current state of knowledge and that they are subject to revision in the light of any new information/data that might become available in the future. So, as the data gaps are filled by the results of ongoing scientific studies and surveys of the prevalence and levels of food safety hazards in seafood in Australia, the rankings may need to be reconsidered and further refined.

## References

- 1 Understanding Risk Analysis: A Short Guide for Health, Safety and Environmental Policy Making. American Chemical Society (1978). Available from: <[http://www.spea.indiana.edu:8000/dhenshel/e311/e311\\_resources.htm](http://www.spea.indiana.edu:8000/dhenshel/e311/e311_resources.htm)>. Accessed 27 November 2003.
- 2 First report on the harmonisation of risk assessment procedures, Report of the Scientific Steering Committee's Working Group on Harmonisation of Risk Assessment Procedures in the Scientific Committees advising the European Commission in the area of human and environmental health, 26–27 October 2000. European Commission Health & Consumer Protection Directorate-General. Available from: <[http://europa.eu.int/comm/food/fs/sc/ssc/out83\\_en.pdf](http://europa.eu.int/comm/food/fs/sc/ssc/out83_en.pdf)>. Accessed 27 November 2003.
- 3 Working Principles for Risk Analysis for Application in the Framework of the Codex Alimentarius, Appendix IV, Alinorm 03/41. Report of the Codex Alimentarius Commission 26th Session (2003).
- 4 Shellfish Toxins in Food: a Toxicological Review and Risk Assessment. ANZFA (1999).
- 5 Review of the Maximum Permitted Concentrations of Cadmium in Food, Full Assessment Report of Proposal P144. ANZFA (1997).
- 6 Microbiological Standards: Risk Analyses for Seafood, Full Assessment Report for Proposal P178. ANZFA (1999).
- 7 Contaminants in Foods – Metals, Full Assessment Report for Proposal P157. ANZFA (1999).
- 8 A Risk Assessment of Selected Seafoods in New South Wales. Ross, T. & Sanderson, K. (2000). A report commissioned by Safe Food Production New South Wales.
- 9 Seafood Food Safety Risk Assessment. Sumner, J. (2001). M&S Food Consultants Pty Ltd for Seafood Services Australia Ltd.
- 10 Consultancy for Researching the Business Profile of the New South Wales Seafood Industry & Food Safety Hazards of Seafood in NSW – Draft Final Report. Walsh, P. & Grant, N. (2000). Commissioned by Safe Food Production, Sydney, New South Wales.
- 11 Quantitative Assessment of the Relative Risk to Public Health from Foodborne *Listeria monocytogenes* among Selected Categories of Ready-to-Eat Foods. Center for Food Safety and Applied Nutrition (Food and Drug Administration), Food Safety and Inspection Service (United States Department of Agriculture) & Centers for Disease Control and Prevention (United States Department of Health and Human Services) (2003). Available from: <<http://www.foodsafety.gov/~dms/lmr2-toc.html>>. Accessed 15 October 2003.

- 12 Risk assessment of *Campylobacter* spp. in broiler chickens and *Vibrio* spp. in seafood. Report of a Joint FAO/WHO Expert Consultation, Bangkok, Thailand, 5–9 August 2002. Available from: <<http://www.who.int/foodsafety/publications/micro/august2002/en/>>. Accessed 15 October 2003.
- 13 Draft Risk Assessment on the Public Health Impact of *Vibrio parahaemolyticus* in Raw Molluscan Shellfish. Center for Food Safety and Applied Nutrition (Food and Drug Administration) and US Department of Health and Human Services (2000).
- 14 Ciguatera Fish Poisoning: A Review in a Risk-Assessment Framework. Lehane, L. (1999). National Office of Animal and Plant Health, Agriculture, Fisheries and Forestry - Australia, Canberra.
- 15 Histamine (Scombroid) Fish Poisoning: A Review in a Risk-Assessment Framework. Lehane, L. & Olley, J. (1999). National Office of Animal and Plant Health, Canberra.
- 16 Paralytic Shellfish Poisoning: A Review. Lehane, L. (2000). National Office of Animal and Plant Health, Agriculture, Fisheries and Forestry - Australia, Canberra.
- 17 Compendium of Fish and Fishery Product Processing Methods, Hazards and Controls. Price, R.J. & Tom, P.D., Food Science & Technology, University of California, Davis, CA. Available from: <<http://seafood.ucdavis.edu/haccp/compendium/compend.htm>>. Accessed 8 October 2003.
- 18 Physical Hazards. Folks, H. & Burson, D. (2003). Available from: <<http://foodsafety.unl.edu/html/physicalhazards.html>>. Accessed 8 October 2003.
- 19 National Risk Validation Project – Final Report. Food Science Australia & Minter Ellison Consulting (2002).
- 20 Food-Related Illness and Death in the United States. Mead, P.S., Slutsker, L., Dietz, V., McCaig, L.F., Bresee, J.S., Shapiro, C., Griffin, P.M. & Tauxe, R.V. (1999). *Emerging Infectious Diseases*, 5:607–25.
- 21 Foodborne disease in Australia: incidence, notifications and outbreaks. Annual report of the OzFoodNet network, 2002. The OzFoodNet Working Group (2003). *Communicable Diseases Intelligence*, 27(2):209–43.
- 22 Procedural Manual, 12th ed. Codex Alimentarius Commission (2001).
- 23 Principles and Guidelines for the Conduct of Microbiological Risk Assessment. Codex Alimentarius Commission. CAC/GL–30 (1999).
- 24 A simple, spreadsheet-based, food safety risk assessment tool. Ross, T. & Sumner, J. (2002). *International Journal of Food Microbiology*, 77(1–2):39–53.
- 25 A semi-quantitative seafood safety risk assessment, Sumner, J. & Ross, T. (2002). *International Journal of Food Microbiology*, 77(1–2):55–59.
- 26 Hazard analysis and assignment of risk categories. Corlett, D.A. & Pierson, M.D. (1992). In Pierson, M.D. & Corlett, D.A. (Eds). *HACCP: principles and applications*. Van Nostrand Reinhold, New York.
- 27 Prevention and control of hazards in seafood, Huss, H.H., Reilly, A. & Karim Ben Embarek, P. (2000). *Food Control*, 11:149–56.
- 28 Micro-organisms in Foods 7: Microbiological Testing in Food Safety Management. International Commission on Microbiological Specifications for Foods. Kluwer Academic/Plenum Publishers, New York (2002). Appendix 8–A, pp. 167–72.
- 29 *Aeromonas*. Kirov, S.M. (1997). In *Foodborne micro-organisms of public health significance*, 5th edn, Australian Institute of Food Science and Technology (NSW Branch) Food Microbiology Group, pp. 473–92.

- 30 Australian Shellfish Quality Assurance Program Operations Manual January 2002 Version 2002–02. Available from: <[http://www.pir.sa.gov.au/pages/aquaculture/quality\\_assur/asqap\\_manual\\_final.pdf](http://www.pir.sa.gov.au/pages/aquaculture/quality_assur/asqap_manual_final.pdf)>. Accessed 14 October 2003.
- 31 Pathogenic vibrios. Desmarchelier, P.M. (1997). In Foodborne Micro-organisms of Public Health Significance, 5th edn. Australian Institute of Food Science and Technology (NSW Branch) Food Microbiology Group, pp. 285–312.
- 32 FAO Expert consultation on the trade impact of Listeria in fish products (FAO Fisheries Report No. 604). Food and Agriculture Organization of the United Nations (1999).
- 33 Microbiology of commercial depuration of the Sydney rock oyster: *Crassostrea commercialis*. Eyles, M.J. & Davey, G.R. (1984). *J. Food Prot.*, 47:703–706.
- 34 *Vibrio cholerae* and enteric bacteria in oyster growing areas of two urban estuaries in Australia. Eyles, M.J. & Davey, G.R. (1988). *Int. J. Food Microbiol.*, 6:207–18.
- 35 Interaction of *Vibrio vulnificus* and the eastern oyster, *Crassostrea virginica*. Groubert, T.N. & Oliver, J.D. (1994). *J. Food Prot.*, 57:224–28.
- 36 Persistence of hepatitis A virus in oysters. Kingsley, D.H. & Richards G.P (2003). *J. Food Prot.*, 66:331–34.
- 37 Distribution of Norwalk virus within shellfish following bioaccumulation and subsequent depuration by using RT-PCR. Schwab, K.J., Neill, F.H., Estes, M.K., Metcalf, T.G. & Atmar, R.L. (1998). *J. Food Prot.*, 61:1674–80.
- 38 Failure of cooking to prevent shellfish-associated viral gastroenteritis. McDonnell, S., Kirkland, K.B., Hlady, W.G., Aristeguieta, C., Hopkins, R.S., Monroe, S.S. & Glass, R.I. (1997). *Arch. Intern. Med.*, 157:111–16.
- 39 Steaming oysters does not prevent Norwalk-like gastroenteritis. Kirkland, K.B., Meriwether, R.A., Leiss, J.K. & MacKenzie, W.R. (1996). *Public Health Rep.*, 111:527–30.
- 40 Heat inactivation of hepatitis A virus in dairy foods. Bidawid, S., Farber, J.M., Sattar, S.A. & Hayward, S. (2003). *J. Food Prot.*, 63:522–28.
- 41 Fish and shellfish poisoning. Hughes, J.M. & Merson, M.H. (1976). *New England J. Medicine*, 295:1117–20.
- 42 Cooked mussels contaminated by *Dinophysis* sp.: a source of okadaic acid. Vernoux, J.P. (1994). *Natural toxins*, 2(4):184–188. In the special issue: Phycotoxin research: a multidisciplinary approach (Part I), J.L.C. Wright (ed.).
- 43 Australian Fisheries Statistics 2002. Australian Bureau of Agricultural and Resource Economics (2003). Canberra.
- 44 Paralytic shellfish poisoning in the abalone *Haliotis midae* on the west coast of South Africa. Pitcher, G.C., Franco, J.M., Doucette, G., Powell, C. & Mouton, A. (2001). *Journal of Shellfish Research*, 20(2):895–904.
- 45 Depuration and transformation of PSP toxins in the South African abalone *Haliotis midae*. Etheridge, S.M., Pitcher, G.P. & Roesler, C. S. (2003 in press). Proceedings of the 10th International Conference on Harmful Algal Blooms, 21–25 October 2002. St. Petes Beach, Florida. Available from: <[http://www.bigelow.org/pi/Etheridge\\_et\\_al\\_XHAB\\_Aba.pdf](http://www.bigelow.org/pi/Etheridge_et_al_XHAB_Aba.pdf)>. Accessed 10 October 2003.
- 46 *Staphylococcus aureus* and staphylococcal enterotoxins. Ash, M. (1997). In Foodborne micro-organisms of public health significance, 5th edn. Australian Institute of Food Science and Technology (NSW Branch) Food Microbiology Group, pp. 313–32.

- 47 Micro-organisms in Foods 6: Microbial Ecology of Food Commodities. International Commission on Microbiological Specifications for Foods (1998). Blackie Academic and Professional, London.
- 48 Survey of *Listeria monocytogenes* in cooked prawns. Marro, N., Hasell, S., Boorman, J. & Crerar, S. (2003). Food Surveillance Newsletter, Spring 2003, Food Standards Australia New Zealand. Available from: <<http://www.foodstandards.gov.au/mediareleasespublications/foodsurveillancenewsletter/spring2003.cfm>>. Accessed 12 November 2003.
- 49 *Listeria* – Risk Assessment & Risk Management Strategy, Final Assessment Report of Proposal P239. ANZFA (2002).
- 50 Editorial: Diarrhoea associated with consumption of escolar (rudderfish). Shadbolt, C., Kirk, M. & Roche, P. (2002). Communicable Disease Intelligence, 26(3):436–38.
- 51 Outbreaks of diarrhoea associated with butterfish in Victoria. Gregory, J. (2002). Communicable Disease Intelligence, 26(3):439–40.
- 52 Illness associated with rudderfish/escolar in South Australia. Givney, R.C. (2002). Communicable Disease Intelligence, 26(3):440.
- 53 An outbreak of gastrointestinal illness associated with the consumption of escolar fish. Yohannes, K., Dalton, C.B., Halliday, L., Unicomb, L.E. & Kirk, M. (2002). Communicable Disease Intelligence, 26(3):441–45.
- 54 Micro-organisms in Foods 5: Characteristics of Microbial Pathogens. International Commission on Microbiological Specifications for Foods (1996). Blackie Academic and Professional, London.
- 55 *Clostridium botulinum*. Szabo, E.A. & Gibson, A.M. (1997). In Foodborne micro-organisms of public health significance, 5th edn. Australian Institute of Food Science and Technology (NSW Branch) Food Microbiology Group, pp. 429–64.
- 56 National Notifiable Diseases Surveillance System, Communicable Diseases of Australia. Australian Government Department of Health and Ageing. Available from: <[www1.health.gov.au/cda/Source/CDA-index.cfm](http://www1.health.gov.au/cda/Source/CDA-index.cfm)>. Accessed 14 October 2003.
- 57 Survival of *Anisakis* in cold smoked salmon. Gardiner, M.A. (1990). Canadian Inst. Food Science Tech. J., 23:143–44.
- 58 *Listeria monocytogenes*. Sutherland, P.S. & Porritt, R.J. (1997). In Foodborne micro-organisms of public health significance, 5th edn. Australian Institute of Food Science and Technology (NSW Branch) Food Microbiology Group, pp. 333–78.
- 59 User guide to Standard 1.6.1 – Microbiological Limits for Food: with additional guideline criteria. Food Standards Australia New Zealand (2001). Available from: <[www.foodstandards.gov.au/assistanceforindustry/userguides/microbiologicallimit1410.cfm](http://www.foodstandards.gov.au/assistanceforindustry/userguides/microbiologicallimit1410.cfm)>. Accessed 15 October 2003.
- 60 HACCP in the fish canning industry. Ababouch, L. (2002). In Safety and quality issues in fish processing, Bremner, H.A. (ed.). Woodhead Publishing, Cambridge, England, pp. 31–53.
- 61 Joint FAO/WHO Expert Committee on Food Additives, Summary and Conclusions. 61st Meeting, Rome, 10–19 June 2003. Available from: <<http://www.who.int/pcs/jecfa/Summary61.pdf>>. Accessed 19 January 2004.
- 62 Microbiological Standards, Inquiry Report for Proposal P178, ANZFA (2000).
- 63 A point-source foodborne listeriosis outbreak: documented incubation period and possible mild illness. Riedo, F.X., Pinner, R.W., Tosca, M.L., Cartter, M.L., Graves, L.M., Reeves, M.W., Weaver, R.E., Plikaytis, B.D. & Broome, C.V. (1994). J. Infect. Dis., 170(3):693–96.
- 64 Control in fishery products. Eklund, M.W. (1993). In *Clostridium botulinum*: Ecology and Control in Foods, (Hauschild, A.H.W & Dodds, K.L., eds). Marcel Dekker, Inc., pp. 209–32.

- 65 Infections related to the ingestion of seafood Part I: Viral and bacterial infections. Butt, A.A., Aldridge, K.E. & Sanders, C.V. (2004). *Lancet Infect. Dis.*, 4(4):201-12.
- 66 Application of modern analytical techniques to ensure seafood safety and authenticity. Martinez, I., James, D. & Loreal, H. A technical paper prepared by the Food and Agricultural Organisation of the United Nations (forthcoming).
- 67 Seafood safety – economics of hazard analysis and critical control point programs. Cato, J.C. (1998). *FAO Fisheries Technical Paper – 381*, Food and Agricultural Organisation of the United Nations.

### Hazards along the seafood production and processing supply chain

The public health risks posed by the consumption of seafood in Australia are affected by the production and processing practices along the entire supply chain of each commodity type.

This appendix summarises, for each broad commodity sector, data indicating the potential presence of food safety hazards and the significant points along the supply chain where there is the possibility of the introduction, increase, reduction or elimination of such hazards. As well as assisting in the evaluation of public health risks due to seafood consumption, the information in this appendix may be useful for the risk manager, helping to define critical points at which risk management strategies may be applied to greatest effect.

#### Molluscan shellfish

Molluscan shellfish, specifically oysters, scallops and pipis, have been implicated in several outbreaks of food-borne illness in Australia in the period 1995 to June 2002 (outbreak data are at Appendix 2). The hazards involved have included viruses (noroviruses and hepatitis A), algal biotoxins (diarrhoeic shellfish poisons in pipis) and bacteria (*Salmonella* serovars).

The Imported Foods Inspection Scheme, coordinated by the Australian Quarantine and Inspection Service, tests a large number of samples of seafood entering Australia each year. In the period 1998 to June 2003 (inclusive), failures were recorded for imported molluscs tested for *E. coli*, the Standard Plate Count (as an indicator of hygienic food preparation and handling), *Salmonella*, *L. monocytogenes* and mercury. No failures were recorded in tests for domoic acid (causes amnesic shellfish poisoning), paralytic shellfish poison, staphylococcal enterotoxin, *V. parahaemolyticus*, cadmium or arsenic (Table 1.1).

**Table 1.1: Significant imported foods testing failures for molluscs, 1998–2003\***

Hazard	Failures per tests (%)	Comments
Mercury	3/302 (1.0%)	
Salmonella	1/218 (0.5%)	
<i>V. cholerae</i>	1/644 (0.2%)	Includes 1/97 (1.0%) in oysters
<i>E. coli</i>	15/623 (2.4%)	Includes 10/207 (4.8%) in oysters
<i>L. monocytogenes</i>	2/238 (0.8%)	
Standard plate count	21/605 (3.5%)	Includes shellfish and cephalopods

\* No failures were recorded for imported molluscs tested for *V. parahaemolyticus*, Staphylococcal enterotoxin, algal biotoxins, cadmium, inorganic arsenic, total arsenic, organophosphates, organochlorines or PCBs.

In the period 1990–2003, FSANZ coordinated four food recalls for oysters (hepatitis A, *L. monocytogenes*, domoic acid and excess lead) and four for mussels (*E. coli*, can defects and two for *L. monocytogenes*).

Factors affecting the presence of these and other potential hazards along the production and processing supply chain for molluscan shellfish have been considered at the point of harvest, during processing and at subsequent points in the distribution chain.

The hazards are broadly summarised in Table 1.2 and discussed at greater length for the main product groups (oysters, scallops, other bivalves and abalone) below.

**Table 1.2: Potential food safety hazards along the molluscan shellfish supply chain**

Supply chain sector	Source of hazards	Examples of hazards
Pre-harvest	Bacterial, viral and chemical contamination by sewage and runoff	<ul style="list-style-type: none"> <li>• Enteric pathogens (E. coli, S. aureus, Salmonella spp., Campylobacter spp., Shigella spp., Yersinia spp., L. monocytogenes, hepatitis A virus, noroviruses)</li> <li>• Agricultural chemical residues</li> </ul>
	Exposure to environmental contaminants	<ul style="list-style-type: none"> <li>• Endogenous bacteria that are human pathogens (A. hydrophila, V. parahaemolyticus, V. vulnificus, V. cholerae O1, non-O1/non-O139 V. cholerae)</li> <li>• Chemical (algal biotoxins, mercury, cadmium, zinc)</li> </ul>
Depuration and shucking	Contamination by shuckers	<ul style="list-style-type: none"> <li>• Microbiological pathogens (E. coli, S. aureus, Salmonella spp., Campylobacter spp., Shigella spp., Yersinia spp., L. monocytogenes, hepatitis A virus, noroviruses)</li> </ul>
	Opportunity for outgrowth	<ul style="list-style-type: none"> <li>• Bacterial pathogens (E. coli, S. aureus, Salmonella spp., Campylobacter spp., Shigella spp., Yersinia spp., L. monocytogenes, A. hydrophila, V. parahaemolyticus, V. vulnificus, V. cholerae O1, non-O1/non-O139 V. cholerae)</li> </ul>
	Reduction in level of hazards due to depuration	<ul style="list-style-type: none"> <li>• Reduced levels of some bacterial pathogens (E. coli, S. aureus, Salmonella spp., Campylobacter spp., Shigella spp., Yersinia spp., L. monocytogenes)</li> </ul>
Transport, marketing, retailing and food service	Contamination by food handlers	<ul style="list-style-type: none"> <li>• Microbiological pathogens (E. coli, S. aureus, Salmonella spp., Campylobacter spp., Shigella spp., Yersinia spp., L. monocytogenes, hepatitis A virus, noroviruses)</li> </ul>
	Opportunity for outgrowth	<ul style="list-style-type: none"> <li>• Bacterial pathogens (E. coli, S. aureus, Salmonella spp., Campylobacter spp., Shigella spp., Yersinia spp., L. monocytogenes, A. hydrophila, V. parahaemolyticus, V. vulnificus, V. cholerae O1, non-O1/non-O139 V. cholerae)</li> </ul>

### *Effects of processing on levels of hazards in molluscan shellfish*

#### Oysters

**Pre-harvest:** Oysters are filter feeders, extracting marine algae, bacteria and nutrients from the surrounding waters. Because of this, they are prone to contamination from the growing environment, and concentrate certain chemical hazards as well as support viability and/or growth of microbiological contaminants. In Australia, oysters are mainly grown on aquaculture leases in estuarine environments, often close to populated or tourist recreational areas.

Some pathogenic bacteria are endogenous to aquatic environments and can survive or grow in oysters, presenting a risk to health if ingested. These include *V. vulnificus*, pathogenic strains of *V. parahaemolyticus* and *V. cholerae*, and *Aeromonas hydrophila*. Typically, levels of these pathogens in the environment will be low, being subject to environmental conditions such as salinity and water temperature.

In Australia, *A. hydrophila*, *V. vulnificus* and pathogenic strains of *V. parahaemolyticus* are present in estuarine environments where oysters are grown commercially. However, only non-toxicogenic strains of *V. cholerae* O1 have been isolated from estuarine environments and oysters [1].



Microbiological hazards may also be introduced into oyster growing waters through pollution from sewage and animal waste. These pathogens typically survive for only short periods of time in the marine environment, but maintain viability for much longer when ingested by oysters. Examples include pathogenic strains of *E. coli* and *Salmonella*, *Campylobacter*, *Yersinia* and *Shigella* species. These organisms can multiply quickly, particularly at higher temperatures, potentially rendering oysters unsafe for consumption.

Pathogenic viruses, particularly hepatitis A and the small round structured viruses (noroviruses of the calciviridae family) may be introduced to oyster growing waters through sewage pollution and can survive for long periods in oysters. While viruses will not replicate in shellstock, they have low infectious doses, and thus present a risk to human health.

Oysters can also extract chemical contaminants from their growing waters, and bioaccumulate them to hazardous concentrations in their flesh. Industrial, agricultural and sewage pollution may introduce various hazardous chemical into waterways where oysters are grown, while natural sources of heavy metals may also be of concern.

Certain species of toxin-producing marine dinoflagellate and diatomic algae present a food safety risk from oyster consumption. The algae and toxins can potentially accumulate to high concentrations in oysters, particularly during periods of algal bloom (for example, red tides) when levels of the algae suddenly increase in response to environmental triggers. The combination of factors triggering bloom events is not fully understood, and toxin concentrations do not necessarily correlate with levels of the algae in the marine environment, making it difficult to predict the degree of food safety risk from these hazards.

**Post-harvest:** Processing of oysters before retail sale is usually minimal. When necessary, algae adhering to the shell are removed by tumbling, a process that can result in some damage to the oyster shells and potentially allow contamination of the meat. Oysters may be purified to some extent by relaying or depuration. These processes are reasonably efficient at reducing the load of enteric bacteria in oysters, but are significantly less effective at reducing the levels of viruses, endogenous marine pathogenic bacteria, chemicals and algal biotoxins.

The main processing of oysters involves shucking and packing in boxes for sale on the half shell or bottling in fresh water, depending on the grade. The shucking process does not kill pathogenic micro-organisms or remove chemical contaminants, but introduces the potential for further contamination by enteric pathogens. In addition, the potential exists during shucking and transportation for temperature abuse, allowing multiplication of bacterial pathogens to levels that might pose a public health risk. Further handling in the distribution chain also carries with it the potential for contamination and temperature abuse.

### Scallops

**Pre-harvest:** Wild-catch southern scallops are harvested by dredging or diving in coastal waters up to 120 metres deep. Saucer scallops are capable of swimming out of the way of dredges, and are primarily caught by trawling (often as by-catch of demersal otter prawn trawling) in shallower waters, up to 75 metres deep.

Scallops filter-feed on plankton and organic detritus from water and sediments in which they settle. As filter feeders, they are subject to the same potential for bioaccumulation of chemical and biological food safety hazards as oysters (see above).

However, the growing environments of wild-caught scallops are less likely to be subjected to significant levels of contamination by human sewage pollution or agricultural run-off. Levels of enteric pathogens and agricultural chemical residues are likely to be low at point of harvest. Endogenous marine pathogens may still present a risk, particularly the *Vibrio* species and also *C. botulinum*, which is found in marine sediments.

Until recently, aquaculture of southern scallops in Australia was limited to rearing wild or hatchery spat to the stage at which they detach from their initial sessile state. Intermediate culture in midwater cages was usually followed by reseeded of the sea floor for grow out to commercial size. More recently, the use of lantern nets or more rigid nets suspended from longlines throughout the ~18 month grow out cycle has been successfully employed. Food safety risks arising from water quality issues in the aquaculture of scallops are obviously related to the choice of site. Shallower coastal sites are preferred, which are closer to land and subject to greater potential for contamination by sewage and agricultural run-offs. The potential for contamination by algal biotoxins would be similar for farmed and wild scallops.

**Post-harvest:** After catching, scallops are sorted and washed on board, and stored live in steel crates or hessian sacks at ambient temperature. The processing of scallops involves removing the gut and shell and retaining the adductor muscle (scallop meat) and the roe (where applicable). After landing, the crates or sacks are opened and the scallops are emptied into hoppers. A knife is inserted to open the shell and the meat and roe are cut out and placed into containers. The freshly shucked scallops are washed and drained before being chilled or frozen. The potential for contamination and temperature abuse during shucking, transport and downstream food handling is similar to that encountered with oysters. Consumption of saucer scallops is usually restricted to the adductor muscle tissue, which tends to accumulate lower levels of food safety hazards than the roe.

#### Other bivalves

Mussels are grown by longline open water aquaculture in Australia. They obtain all their nutrients from the growing environment, filter feeding on plankton and other organic matter, and do not need additional dietary supplementation. All of Australia's mussel production is consumed locally, along with a similar amount of imported mussels (mostly from New Zealand). After reaching marketable size (65–85 mm) the mussels are removed from the long lines and the shells cleaned of external fouling, usually in a washer–tumbler machine in which the mussels are rotated and rub against each other to dislodge small mussels, barnacles and other fouling organisms. The mussels are then cleaned, graded and bagged for sale, live, without further processing. Aside from the potential for shell damage, and consequent contamination of the flesh, the major source of food safety risk is in the quality of the growing waters.

The choice of site determines the potential for contamination by sewage and industrial and agricultural run-off, while the risk from hazardous algal blooms is similar in scope (and unpredictability) to that encountered for scallops. Mussels are usually shipped and sold live. Dead mussels tend to gape, providing a convenient indicator of quality. Good quality mussels have closed shells, minimising the risk of contamination by food handlers.

Small quantities of pipis (also known as Goolwa cockles) are commercially harvested in Australia, mainly in New South Wales and South Australia, with smaller commercial catches in Queensland and Victoria. They are harvested along the waterline, and are usually sold live in the shells, with no processing.

The main hazards likely to be present are endogenous marine pathogens and algal biotoxins, with the potential for temperature abuse after harvest and during transport.

### Abalone

Abalone are gastropod molluscs that feed on drift algae and seagrass leaves. They are found primarily on rocky reefs in waters up to 40 metres deep around the southern coasts of Australia. Although there is increasing interest and investment in aquaculture of abalone, the vast majority (>99%) of Australia's abalone production is wild-caught, usually by diving. The abalone are usually landed live and processed onshore except in South Australia, where a large proportion of the catch is shucked at sea. After shucking, the meat (adductor muscle) is cleaned and graded, before being bulk frozen, parboiled then frozen, or cooked in brine then canned. A small amount is frozen whole on the shell.

As only the adductor muscle is eaten, the potential for accumulation of microbiological hazards and chemical contaminants from the growing environment is similar to that encountered with saucer scallops, as many of these hazards are preferentially concentrated in the viscera, which is discarded. During post-harvest handling, shucking and transport, contamination with microbiological (for example, *S. aureus*) and chemical hazards and temperature abuse are possible. The microbiological hazards will be controlled to some extent by chilling/freezing and canning processes.

In aquaculture of abalone, the potential for contamination by agricultural run-off is greater than for wild-caught abalone, and antibiotic and anaesthetic residues are also a potential hazard, while the hazards potentially introduced during handling are similar to those for wild-caught abalone.

### **Cephalopod molluscs**

Cephalopod molluscs have not been implicated as the vehicle in any outbreaks of food-borne illness in Australia during the period 1995 to June 2002 (Appendix 2 for outbreak data) and were not the subject of any FSANZ-coordinated food recalls in the period 1990–2003.

Under the Imported Foods Inspection Scheme testing regime, failures were recorded for imported squid products for high mercury concentrations (one failure, at 1.6 mg/kg, in 98 tests) and the standard plate count (two failures in 19 tests) in the period 1998 to June 2003 (inclusive). No failures were recorded for enteric pathogens, *Vibrios* or shellfish toxins.

Factors affecting the presence of potential hazards along the production and processing supply chain for cephalopod molluscs have been considered at the point of harvest, during processing and at subsequent points in the distribution chain. The hazards are broadly summarised in Table 1.3 and discussed at greater length below.

#### *Effects of processing on levels of hazards in cephalopod molluscs*

Octopus, squid and other cephalopods eat a diet of crustacea, fish and other molluscs. The marine environments from which they are harvested are largely free of significant levels of pollution. Endogenous hazards which may be present at point of harvest are broadly similar to those associated with other molluscan species, although there is no evidence for the accumulation of algal biotoxins in the cephalopods. Conversely, squid is known to be an intermediate host for anisakid parasites [2].

Squid and octopus are usually landed live and sold as chilled or frozen product. Squid are imported in many forms, including whole dried; dried and shredded; dried shredded and smoked; canned; frozen hoods; and frozen rings. Octopus are imported dried, salted, smoked and marinated.

In Australia, processing of octopus is minimal, involving washing, brining to evert the octopus, removal of teeth and organs, and subsequent chilling or freezing. Squid, calamari and cuttlefish are similarly minimally processed. The internal organs, skeleton and the skin are removed, the product washed, and cleaned tubes and/or bodies are stored chilled or frozen. Post-harvest handling introduces the risk of contamination by pathogenic micro-organisms, and handling and transport introduce the possibility for outgrowth of bacterial pathogens if temperature is not adequately controlled.

**Table 1.3: Summary of potential hazards along the cephalopod mollusc supply chain**

Supply chain sector	Source of hazards	Examples of hazards
Pre-harvest	Exposure to environmental contaminants	<ul style="list-style-type: none"> <li>• Endogenous bacteria that are human pathogens (<i>A. hydrophila</i>, <i>V. parahaem-olyticus</i>, <i>V. vulnificus</i>, non-O1/non-O139 <i>V. cholerae</i>)</li> <li>• Helminthic parasites (anisakids)</li> <li>• Chemical (mercury, cadmium)</li> </ul>
Washing, brining, skinning	Contamination by handlers	<ul style="list-style-type: none"> <li>• Microbiological pathogens (<i>E. coli</i>, <i>S. aureus</i>, <i>Salmonella</i> spp., <i>Campylobacter</i> spp., <i>Shigella</i> spp., <i>Yersinia</i> spp., <i>L. monocytogenes</i>, hepatitis A virus, noroviruses)</li> </ul>
	Opportunity for outgrowth	<ul style="list-style-type: none"> <li>• Bacterial pathogens (<i>E. coli</i>, <i>S. aureus</i>, <i>Salmonella</i> spp., <i>Campylobacter</i> spp., <i>Shigella</i> spp., <i>Yersinia</i> spp., <i>L. monocytogenes</i>, <i>A. hydrophila</i>, <i>V. parahaemolyticus</i>, <i>V. vulnificus</i>, non-O1/non-O139 <i>V. cholerae</i>)</li> </ul>
Transport, marketing, retailing and food service	Contamination by handlers	<ul style="list-style-type: none"> <li>• Microbiological pathogens (<i>E. coli</i>, <i>S. aureus</i>, <i>Salmonella</i> spp., <i>Campylobacter</i> spp., <i>Shigella</i> spp., <i>Yersinia</i> spp., <i>L. monocytogenes</i>, hepatitis A virus, noroviruses)</li> </ul>
	Opportunity for outgrowth	<ul style="list-style-type: none"> <li>• Bacterial pathogens (<i>E. coli</i>, <i>S. aureus</i>, <i>Salmonella</i> spp., <i>Campylobacter</i> spp., <i>Shigella</i> spp., <i>Yersinia</i> spp., <i>L. monocytogenes</i>, <i>A. hydrophila</i>, <i>V. parahaemolyticus</i>, <i>V. vulnificus</i>, non-O1/non-O139 <i>V. cholerae</i>)</li> </ul>

## Crustacea

Crustacea, specifically prawns and crayfish, have been implicated in six outbreaks of food-borne illness in Australia in the period 1995 to June 2002 (Appendix 1). The hazards involved have included hepatitis A virus, *S. typhi*, *S. typhimurium*, *V. cholerae* and *C. perfringens*. In the case of the two outbreaks of perfringens food poisoning from consumption of curried prawns, the likely source of contamination is the spices used in the dish [3], as *C. perfringens* is not usually considered a seafood-associated pathogen.

The failures recorded for imported crustacea in Imported Foods Inspection Program testing data for the period January 1998 to June 2003 (inclusive) are listed in Table 1.4.

In the period 1990–2003, FSANZ coordinated three food recalls for crustacea (for unspecified microbiological contamination, *Salmonella* and excess sulphur dioxide).

Further evidence of a public health risk due to crustacea was found in the recent cooked prawns survey coordinated by FSANZ [4]. In this survey, 380 samples of chilled or frozen cooked prawn were tested for the Standard Plate Count and *Listeria monocytogenes*. The retail temperature of the chilled prawns was also determined. The survey covered peeled and unpeeled, imported and domestic prawns.

The contamination rate of *Listeria monocytogenes* in cooked prawns was low (3%) and the levels of those detected were also low (<50 cfu/g). The Standard Plate Counts ranged from negligible (<103 cfu/g) to high (>107 cfu/g), and the temperatures of cooked prawns varied from frozen to 12.8°C. However, there was no correlation between high Standard Plate Counts and high temperatures. Results from the survey were used in the semi qualitative risk assessment FSANZ conducted for '*Listeria monocytogenes* in cooked crustacea' [5].

**Table 1.4: Significant imported foods testing failures for crustacea, 1998–2003\***

Hazard	Failures/Tests (%)	Comments
Sulphur dioxide	3/161 (1.9%)	
Salmonella	11/1383 (0.8%)	
V. cholerae	21/1674 (1.3%)	All failures are non-O1/non-O139 strains
E. coli	13/1432 (0.9%)	8/134 (6.0%) in lobster/crawfish
Staphylococcal enterotoxin	6/1815 (0.3%)	
Standard plate count (SPC)	81/1509 (5.4%)	
Chloramphenicol	4/76 (5.3%)	Frozen farmed prawns
Antibiotics	7/118 (5.9%)	Prawns: streptomycin, oxytetracycline

\* No failures were recorded for crustacean imports tested for coliforms, mercury, cadmium, inorganic arsenic, total arsenic, other metals and heavy metals, organophosphates, organochlorines or PCBs.

### *Effects of processing on levels of hazards in crustacea*

#### Prawns

Prawns are produced through both wildcatch and aquaculture production methods. Prawns are bottom-feeding, opportunistic omnivores, and will consume a wide variety of foods depending on availability. They are subject to a range of hazards through their environment, both chemical and microbiological.

Further hazards can also be introduced during subsequent processing, handling, transport and storage stages (Table 1.5).

**Wildcatch:** A range of prawn species are commercially harvested as wildcatch in Australia, from both estuarine and marine environments. Catch is obtained from a wide range of locations, covering much of the Australian coastline. The primary method of catch is demersal otter trawling. Free-living prawns may encounter a range of hazards in their environment, both chemical and microbiological.

Significant chemical hazards originating from the environment include the metals arsenic and mercury. Both of these are recognised as human toxins, and their presence in crustacea is regulated under the Code. Cadmium has also been identified as a food safety hazard associated particularly with endeavour prawns (*Metapenaeus* spp.) harvested in certain geographical regions [6], but it was concluded that no maximum level standard was necessary in the Code.

Other chemical residues may be present in wild-catch crustacea due to industrial pollution and agricultural run-off. This will be a greater risk in estuarine prawns than those caught in open marine waters.

**Table 1.5: Potential food safety hazards along the crustacean supply chain**

Supply chain sector	Source of hazards	Examples of hazards
Pre-harvest	Bacterial, viral and chemical contamination by sewage and runoff	<ul style="list-style-type: none"> <li>• Enteric pathogens (<i>E. coli</i>, <i>S. aureus</i>, <i>Salmonella</i> spp., <i>Campylobacter</i> spp., <i>Shigella</i> spp., <i>Yersinia</i> spp., <i>L. monocytogenes</i>, hepatitis A virus, noroviruses)</li> <li>• Agricultural and veterinary chemical residues</li> </ul>
	Exposure to environmental contaminants	<ul style="list-style-type: none"> <li>• Endogenous bacteria that are human pathogens (<i>A. hydrophila</i>, <i>V. parahaemolyticus</i>, <i>V. vulnificus</i>, <i>V. cholerae</i> O1, non-O1/non-O139 <i>V. cholerae</i>)</li> <li>• Chemical (arsenic, mercury)</li> </ul>
On-board cooking and cooling	Reduction in level of hazards due to cooking	<ul style="list-style-type: none"> <li>• Reduced levels of bacterial pathogens (<i>E. coli</i>, <i>S. aureus</i>, <i>Salmonella</i> spp., <i>Campylobacter</i> spp., <i>Shigella</i> spp., <i>Yersinia</i> spp., <i>L. monocytogenes</i>)</li> </ul>
	Re-contamination	<ul style="list-style-type: none"> <li>• Microbiological pathogens (<i>E. coli</i>, <i>S. aureus</i>, <i>Salmonella</i> spp., <i>Campylobacter</i> spp., <i>Shigella</i> spp., <i>Yersinia</i> spp., <i>L. monocytogenes</i>, hepatitis A virus, noroviruses)</li> <li>• Chemicals – sulphite</li> </ul>
	Opportunity for outgrowth	<ul style="list-style-type: none"> <li>• Bacterial pathogens (<i>E. coli</i>, <i>S. aureus</i>, <i>Salmonella</i> spp., <i>Campylobacter</i> spp., <i>Shigella</i> spp., <i>Yersinia</i> spp., <i>L. monocytogenes</i>, <i>A. hydrophila</i>, <i>V. parahaemolyticus</i>, <i>V. vulnificus</i>, <i>V. cholerae</i> O1, non-O1/non-O139 <i>V. cholerae</i>)</li> </ul>
Transport, marketing, retailing and food service	Contamination by food handlers	<ul style="list-style-type: none"> <li>• Microbiological pathogens (<i>E. coli</i>, <i>S. aureus</i>, <i>Salmonella</i> spp., <i>Campylobacter</i> spp., <i>Shigella</i> spp., <i>Yersinia</i> spp., <i>L. monocytogenes</i>, hepatitis A virus, noroviruses)</li> </ul>
	Opportunity for outgrowth	<ul style="list-style-type: none"> <li>• Bacterial pathogens (<i>E. coli</i>, <i>S. aureus</i>, <i>Salmonella</i> spp., <i>Campylobacter</i> spp., <i>Shigella</i> spp., <i>Yersinia</i> spp., <i>L. monocytogenes</i>, <i>A. hydrophila</i>, <i>V. parahaemolyticus</i>, <i>V. vulnificus</i>, <i>V. cholerae</i> O1, non-O1/non-O139 <i>V. cholerae</i>)</li> </ul>

Prawns are also potentially exposed to a range of indigenous microbial contaminants from the water environment, including *A. hydrophila*, *V. parahaemolyticus*, *V. vulnificus*, *V. cholerae*, *Salmonella* spp. and *L. monocytogenes* [3,7]. *Vibrios* are known to utilise the chitinous exoskeleton of crustacea as points of attachment and to metabolise it as a carbon/energy source [3,8]. *V. parahaemolyticus*, *V. vulnificus* and *V. cholerae* are considered part of the indigenous microflora of estuarine prawns [9].

*V. cholerae* O1 and O139 and *Salmonella* spp. derived from faecal contamination may become established as environmental contaminants in waters from which prawns are harvested and have the potential to contaminate free-living prawns prior to catch. Noroviruses and hepatitis A may also be present. Prawns inhabiting estuarine environments may be exposed to a greater number of potential sources of microbial or chemical contamination, due to their proximity to shore, land animals, human dwellings, and the introduction of chemical and faecal pollutants [3].

After harvest, prawns caught on commercial vessels can be processed in a variety of ways. While on board, they may be boxed as green (uncooked) product and chilled or frozen on board. In some operations, catch is cooked on board vessels, and subsequently stored in either brine or ice. Dipping of prawns in metabisulphite to inhibit formation of blackspot can present a risk to asthmatics due to formation of sulphur dioxide.

The processing of prawns on board vessels presents considerable potential for further contamination. Raw product may come into contact with chemical or microbial contaminants through contact with water, surfaces or containers. Pathogens of concern include *V. cholerae*, *V. parahaemolyticus*, *E. coli*, *Campylobacter*, *Shigella*, *Yersinia* and *Salmonella* spp. and *L. monocytogenes*. Human handling also introduces potential for contamination by enteric pathogens such as *Salmonella*, *S. aureus*, hepatitis A virus and noroviruses.

Prawns that undergo a cooking step are effectively rendered pathogen free, as any micro-organisms present will be inactivated, assuming that the product is heated at sufficient temperature and time. However, cooking will not remove or inactivate chemical hazards already present in the product, such as arsenic, mercury and other chemical residues. Cross contamination between raw and processed crustaceans during processing, transport and storage, particularly on board vessels, is recognised as an area of particular concern [3,7], potentially reintroducing environmental microbial hazards. Cooling water and brine/ice used for storage of prawns are also recognised as potential sources of recontamination. Cooked crustacea may also be contaminated by food handlers, introducing enteric pathogens.

Use of low temperatures during transport and storage (of both raw and cooked product), as well as during processing, will reduce the opportunities for growth of most microbial contaminants if temperatures are rigorously maintained below 5°C. However, some pathogens are able to proliferate at temperatures close to this: *V. cholerae* will grow at 8°C, *V. parahaemolyticus* can grow at 5°C [1], and *L. monocytogenes* is able to grow at temperatures as low as -0.4°C [19,20,21].

Once frozen, no further microbial growth can occur, and many pathogens will decline in number with prolonged frozen storage [3]. However, survival rates in frozen crustacea are variable. Time/temperature abuse of thawed product can provide opportunity for growth of any bacterial pathogens that have survived freezing.

In some situations, periods of several days may elapse between cooking of prawns and consumption. This time delay provides potential opportunities for outgrowth and further contamination with microbial pathogens, particularly *L. monocytogenes*. Frequently, consumption of pre-cooked prawns does not include another cooking step, or only one of insufficient time and/or temperature to inactivate these microbial contaminants. Cooked crustacea such as prawns are frequently added to cold dishes which receive only warming, and which are then potentially subject to time/temperature abuse. This may allow bacterial growth and toxin production by contaminating *S. aureus*. Toxin production may also be enhanced if the seafood is part of a dish with a starch component [7]. This general pattern of processing and consumption represents an area of primary concern to the health and safety of the prawn-consuming public.

**Aquaculture:** Prawn production through aquaculture has been established for the last fifteen years along the eastern coastline of Australia and in the Northern Territory. Australian prawn farms are restricted to the coastal zone, virtually all drawing their intake water from tidal creeks and estuaries.

In addition, much of Australia's import of prawns is produced in aquaculture ponds.

In Australia, prawn aquaculture is carried out in earthen ponds, close to tidal sources of seawater. The pond bottoms have a clay base for retaining seawater. Most farmers harvest, process and ship product direct to markets. Harvesting and post-harvest treatments are species specific. Currently Australia grows two species of prawns: the black tiger prawn (*Penaeus monodon*) and the Japanese king or kuruma prawn (*P. japonicus*). The black tiger prawn is mostly sold on local Brisbane, Sydney and Melbourne markets, either fresh, frozen or cooked. Typically, black tiger prawns are harvested en-masse with a drain harvest, and then chilled or cooked on site before being shipped to domestic markets. The kuruma prawn is grown exclusively for the live trade to Japan.

Like wild-caught prawns, prawns produced through aquaculture may be exposed to various hazards through their water environment. These potential hazards are largely the same as for wild-caught prawns inhabiting estuarine environments, as described above. In intensive aquaculture systems, *Vibrio* and *Salmonella* species are considered to be inherent contaminants of prawns [3,10].

Water retained in earthen ponds may be come into contact with chemical pollutants or residues from the surrounding soil, depending on previous land use in the local environment. Further, chemicals and feed components may also be added to pond water, to modify the prawns' environment. Typically, these may include antibiotics, to combat any pathogens present, and possibly other chemicals with properties that enhance stock growth and/or health. Residues from these chemicals are likely to remain present in the product at time of harvest. Use of such agricultural chemicals and veterinary medicines in the food supply chain is regulated through an agreement between FSANZ and APVMA.

All animals grown intensively, under artificially high densities and in contained waters, are prone to disease. Crustacean aquaculture is no exception, with bacterial, viral and parasitic diseases having the potential to affect all life history stages and production phases from hatchery to grow-out. Most bacterial and parasitic diseases are easily identified and treated with better hygiene and limited use of veterinary drugs. Good husbandry practices, including ensuring high water-quality standards, lower stocking densities and the screening of spawners and post-larvae will minimise the occurrence and spread of any viral diseases.

Few of these diseases will be of public health and safety concern, being more relevant to the issue of maximising farm production and outputs. However, the use of chemicals and veterinary drugs to control them may present a potential food safety hazard.

Prawns produced by aquaculture are subject to the same potential hazards during processing, transport and storage as described above for wild-caught prawns.

### Lobsters

Lobster fisheries are found in most Australian states (New South Wales, Western Australia, Victoria, South Australia, Tasmania and Queensland), with fisheries for ornate rock lobsters also found in the Torres Strait. The produce is caught mainly using baited pots, though diving and hand spears are also used in some places. A few types of lobster, including Shovel Nosed and Bay Lobsters, are caught mainly as by-product of other fishing operations, such as demersal trawling or dredge netting.



Australian lobsters are both exported and sold on the domestic market. Most of the product is sold or exported live or as raw chilled/frozen tails.

Lobsters inhabit similar marine environments to prawns, and are potentially exposed to the same environmental hazards, both chemical and microbial. Raw and frozen product are also subject to similar processing and similar potential hazards. Endogenous bacteria that are human pathogens (for example, *Vibrios* and *A. hydrophila*) and environmental contaminants (arsenic and mercury) are potential hazards. Post-harvest handling, processing, transport and storage potentially introduce and allow outgrowth of human enteric pathogens (*E. coli*, *S. aureus*, *Campylobacter*, *Shigella*, *Yersinia* and *Salmonella* spp., and noroviruses and hepatitis A virus) and *L. monocytogenes*. However, as lobster is generally sold either as live or raw frozen product, and is generally cooked thoroughly just before eating, concerns regarding microbiological contamination of cooked product prior to consumption are less relevant than for cooked prawns.

### Crabs

Fisheries for two commercial crab species in Australia (Spanner and Blue Swimmer Crabs) are found in Queensland, New South Wales and Western Australia. These are caught in both estuarine and marine waters, using baited tangle nets, or in traps, hoop nets or drag nets. When moving as large aggregations, Spanner crabs are also occasionally caught as a by-product of dermesal otter trawling operations. Cadmium has been identified as a food safety hazard associated particularly with spanner crabs (*Ranina ranina*). Blue Swimmer Crabs can also be caught as a by-product of prawn trawling or of the rock lobster and finfish fisheries.

Wild-caught crabs are generally sold whole, though some are also sold cooked or as crab meat, on either local, interstate or export markets.

In addition to these wild-caught species, production of mud crabs through aquaculture is a developing industry in Australia, as well as south-east Asia. Produce from this new industry is typically snap frozen, though a live crab market is also developing. Product is sold on domestic markets, both locally and interstate, or is exported for sale.

Crabs inhabit similar estuarine and marine environments to prawns, and are potentially exposed to the same environmental hazards, both chemical and microbial. Raw and frozen product are also subject to similar processing and similar potential hazards. Endogenous bacteria that are human pathogens (for example, *Vibrios* and *A. hydrophila*) and environmental contaminants (arsenic and mercury) are potential hazards. Post-harvest handling, processing, transport and storage potentially introduce and allow outgrowth of human enteric pathogens (*E. coli*, *Campylobacter*, *Shigella*, *Yersinia* and *Salmonella* spp., and noroviruses and hepatitis A virus) and *L. monocytogenes*. However, as crab is generally sold either as live or raw frozen product, and is generally cooked thoroughly just before eating, concerns regarding microbiological contamination of cooked product prior to consumption are less relevant than for cooked prawns.

### Other crustaceans – redclaw crayfish, marron, yabbie and scampi

Redclaw crayfish, marron and yabbie are native species of crustaceans that are produced and consumed in Australia. Redclaw are native inhabitants of the rivers of north-western Queensland and the Northern Territory, marron inhabit the river systems of Western Australia, and yabbie are widely distributed throughout central and southern inland Australia.

Commercial ventures for production of these species exist in various states, including New South Wales, Western Australia, Victoria and South Australia for marron and yabbie, and Queensland and the Northern Territory for redclaw.

Redclaw and marron are produced solely through aquaculture, where they are typically cultured in earthen based ponds. Yabbies are also grown in purpose built ponds, though the primary method of procuring this species is via trapping what are essentially wild yabbies from farm dams.

Feed sources for cultured product typically involve a combination of the natural foods found in ponds, and commercial feeds such as crayfish or marron pellets. The primary food source for yabbies is generally crop plants, such as clover, which are grown in the dams they inhabit, though supplementary feed may also be added, and is considered essential to obtain higher than natural yabbie production.

Harvesting of stock may take place using a number of methods. Marron ponds are generally drained to allow collection by hand. Redclaw may be collected from growth ponds in a similar manner, or harvested using bait traps, though the most popular and effective method is thought to be the application of a flow-trap. The primary method of harvesting yabbies from dams involves bait pots or traps, or collection after draining. Drop nets can also be used, however it is generally recognised that harvesting yabbies from dams by seine netting damages the animals and can result in bacterial infection from mud stirred up from the bottom [13].

After collection, the harvested animals undergo cleaning. Harvested stock are gill washed and held in purging tanks for a period between twenty-four and forty-eight hours to prevent mortality due to bacterial infections arising from bottom sediments trapped in the gill chamber, and also to allow purging of the hindgut. Produce are then held in a cool, moist atmosphere, and prior to transport are packed between layers of packaging, generally consisting of foam rubber, or wood shavings, in polystyrene boxes with cool packs or ice bottles. Stock can live for many days out of water, and can be shipped alive if transported in a cool, moist atmosphere.

Redclaw, marron and yabbie are sold primarily as live export product. Some product is retained for domestic consumption; however, there is little retail sale of the raw product. There are typically three steps in the domestic marketing chain: producer, wholesaler and restaurateur. Only a small portion of product undergoes processing, though some cooking and freezing does take place.

The hazards potentially encountered during aquaculture production of redclaw, marron and yabbie are the same as those described for farmed prawns. These include the various chemicals and microbes that may be present in, or added into, the contained water environment. As these three species are predominantly sold live, either on export markets or for domestic consumption through restaurants, minimal processing of the product takes place. Exposure to processing hazards is therefore minimal. However, appropriate conditions (a cool, moist atmosphere) must be maintained during transport and storage of live product to avoid mortality of stock. Dead stock may easily fall prey to contaminating microbes, and cross contamination to live stock packed in close proximity would then be possible.

Scampi are commercially fished in north-western waters of Australia, with some species spreading along the northern coast of Western Australia. They are a demersal species, generally inhabiting burrows, and are caught in demersal trawlers similar to those used for prawns. Scampi are graded, packed and frozen whole on board trawling vessels. They are sold on both the domestic and export markets. Volume of catch has varied in the past two decades between ca. 50–200 tonnes/annum [11,12].

Environmental and on-board processing hazards potentially encountered by scampi are similar to those described for wild-caught prawns from marine environments. Endogenous bacteria that are human pathogens (for example, *Vibrios* and *A. hydrophila*) and environmental contaminants (arsenic and mercury) are potential hazards. Post-harvest handling, processing, transport and storage potentially introduce and allow outgrowth of human enteric pathogens (*E. coli*, *S. aureus*, *Campylobacter*, *Shigella*, *Yersinia* and *Salmonella* spp., and noroviruses and hepatitis A virus) and *L. monocytogenes*.

### **Finfish**

For the purposes of this assessment, finfish includes bony, vertebrate fish and cartilaginous fish such as sharks and rays.

Finfish have been implicated in many outbreaks of food-borne illness in Australia in the period 1995 to June 2002 (Appendix 1). The hazards have mainly been ciguatera, histamine or escolar wax esters. Pathogens implicated include *Salmonella* spp., Norwalk-like virus and *C. perfringens* (in a reef and beef dish). In the case of the outbreak of perfringens food poisoning, the likely source of contamination is the beef, as *C. perfringens* is a common surface contaminant of beef carcasses at slaughter but is not usually considered a seafood-associated pathogen [3].

Many of the outbreaks of ciguatera that occur in Australia are a result of amateur anglers catching fish from affected reefs, but a significant proportion occur in private residences from consumption of fish (whole or fillets) purchased from commercial suppliers (Appendix 2). The outbreaks due to histamine (scombroid) fish poisoning were primarily consumed in a restaurant setting (Appendix 2), implying a failure in the cold chain. Similarly, escolar wax ester illness was mainly reported from a restaurant setting (Appendix 2).

For histamine and escolar wax esters, the mildness of the illness compared to ciguatera probably leads to significant under-reporting of cases that are due to consumption in the home setting.

The failures recorded for imported finfish in the Imported Foods Inspection Program testing data for the period January 1998 to June 2003 (inclusive) are listed in Table 1.6. Of note are the high degree of failure for *L. monocytogenes* and histamine in processed products.

**Table 1.6: Significant imported foods testing failures for finfish, 1998–2003\***

Hazard	Failures/Tests (%)	Comments
Mercury	44/3486 (1.3%)	14/625 (2.2%) dogfish and other shark – fresh, chilled, frozen, dried, salted'
<i>L. monocytogenes</i>	102/674 (15.1%)	99/591 (16.8%) fish – smoked, vacuum packed'
Histamine	90/5613 (1.6%)	43/1447 (3.0%) fish – prepared/preserved' (includes canned, not tuna) 4/1985 (0.2%) tuna – prepared or preserved (includes canned) 37/397 (9.3%) fish/other – dried/salted/brine'
<i>E. coli</i>	3/46 (6.5%)	
Coliforms	6/476 (1.3%)	
Standard plate count (SPC)	3/175 (1.7%)	

\*No failures recorded for finfish imports tested for *V. cholerae*, staphylococcal enterotoxin, Salmonella, cadmium, inorganic arsenic, total arsenic, other metals and heavy metals, organophosphates, organochlorines or PCBs.

In the period 1990–2003, FSANZ coordinated several food recalls for finfish. These included 11 due to *L. monocytogenes* contamination of chilled smoked salmon and salmon dips, mousse, and pate, and four due to *L. monocytogenes* in trout. Hazards potentially associated with finfish along the production and processing supply chain are listed in Table 1.7.

#### *Effects of processing on levels of hazards in finfish*

Fish from salt and freshwater environments, whether farmed or free range, may be sold as whole fish, gutted fish or fillets, chilled or frozen, or may be further processed, for example, hot or cold smoked, salted, dried, pickled, in oil, fermented or canned. This wide variety of processing methods necessitates consideration of a multiplicity of possible effects on hazard levels in finfish in the post-harvest sector.

**Table 1.7: Potential food safety hazards along the finfish supply chain**

Supply chain sector	Source of hazards	Examples of hazards
Pre-harvest	Exposure to environmental contaminants	Endogenous bacteria that are human pathogens ( <i>A. hydrophila</i> , <i>V. parahaemolyticus</i> , <i>V. vulnificus</i> , <i>V. cholerae</i> O1, non-O1/non-O139 <i>V. cholerae</i> , <i>C. botulinum</i> , helminthic parasites) Chemical (ciguatoxin, histamine, arsenic, mercury)
On-board	Contamination	Microbiological pathogens ( <i>E. coli</i> , <i>S. aureus</i> , <i>Salmonella</i> spp., <i>Campylobacter</i> spp., <i>Shigella</i> spp., <i>Yersinia</i> spp., <i>L. monocytogenes</i> , hepatitis A virus, noroviruses) Chemicals – sulphite
	Opportunity for outgrowth	Bacterial pathogens ( <i>E. coli</i> , <i>S. aureus</i> , <i>Salmonella</i> spp., <i>Campylobacter</i> spp., <i>Shigella</i> spp., <i>Yersinia</i> spp., <i>L. monocytogenes</i> , <i>A. hydrophila</i> , <i>V. parahaemolyticus</i> , <i>V. vulnificus</i> , <i>V. cholerae</i> O1, non-O1/non-O139 <i>V. cholerae</i> )
Transport, marketing, retailing and food service	Contamination by food handlers	Microbiological pathogens ( <i>E. coli</i> , <i>S. aureus</i> , <i>Salmonella</i> spp., <i>Campylobacter</i> spp., <i>Shigella</i> spp., <i>Yersinia</i> spp., <i>L. monocytogenes</i> , hepatitis A virus, noroviruses)
	Opportunity for outgrowth	Bacterial pathogens ( <i>E. coli</i> , <i>S. aureus</i> , <i>Salmonella</i> spp., <i>Campylobacter</i> spp., <i>Shigella</i> spp., <i>Yersinia</i> spp., <i>L. monocytogenes</i> , <i>A. hydrophila</i> , <i>V. parahaemolyticus</i> , <i>V. vulnificus</i> , <i>V. cholerae</i> O1, non-O1/non-O139 <i>V. cholerae</i> )

### Capture/harvest, including farmed and wild caught

Finfish are caught by a variety of methods, including longlining, poling, netting and trawling.

At the point of harvest, hazards potentially present in finfish include metals (for example, arsenic, mercury) and indigenous pathogens (for example, *Vibrios*, *C. botulinum*) from the marine or estuarine environment which are naturally present in live fish. Marine toxins such as ciguatoxin may be a hazard in tropical reef fish. Histamine is a hazard in certain species (mainly scombroid, but also some non-scombroid species) of fish, particularly if the fish are harvested from warmer waters, die before landing, or are subject to time/temperature abuse after landing. Both ciguatoxin and histamine are heat-stable.

A number of single cell and multicellular parasites, which may be associated with fish species harvested from particular locations, have been associated with illness in humans after ingestion of raw or undercooked product. The most important of these are nematode species resulting in the disease named anisakiasis, but other fish-borne parasites such as the tapeworm *Diphyllobothrium latum* [14] and *Gnathostoma* spp. may be a problem in some areas. For certain parasites, aquaculture may disrupt the lifecycle, by removing contact between fish and other intermediate or definitive hosts. However, aquaculture may also allow for the presence of parasites not normally found in, for example, marine environments. For aquaculture operations, chemical contaminants and *Salmonellae* may also represent a food safety hazard of concern at point of harvest.

### On-board handling and transport

After harvest/capture, fish may be subject to processes of microbial spoilage and proteolytic hydrolysis. These processes will be more rapid if fish are not gutted or adequately chilled/frozen.

Gutting on board fishing vessels may introduce the possibility of cross-contamination with human/enteric pathogens. Microbial spoilage of fish may, depending on both the species of fish and the bacteria present, result in the production of histamine to hazardous levels. Once formed, histamine remains a hazard during further processing, as it is heat stable and may not necessarily be associated with 'off' flavours or smells in the fish product. Histamine development is accelerated by temperature abuse or lack of chill storage on board.

### Further processing

Following harvest, bacterial growth is potentially rapid because of the high  $a_w$ , high pH and large amounts of non-protein nitrogenous compounds available. Many of the endogenous bacteria are psychrotrophic, that is, capable of growth at refrigerated temperatures, as well as remaining viable for long storage periods. Heat processing reduces these bacterial populations greatly. Traditional preservation techniques, apart from heat treatments such as pasteurisation or canning, are usually bacteriostatic rather than bacteriocidal in nature. Therefore mishandling or temperature abuse of lightly preserved fish may result in spoilage and growth of pathogens.

Parasites may remain viable if the fish is chilled after harvesting, but can be inactivated by appropriate freezing. They will not multiply in the killed fish. Processes such as marinating, pickling and brining will not eliminate parasites, although these processes may reduce parasite numbers.

Brining in 30 per cent solution for at least 10 days would control the hazard associated with the tapeworm, *Diphyllobothrium* spp. and the roundworms, *Anisakis* spp. and *Pseudoterranova* spp. [22]. Parasites will be killed in processes where the internal temperature of the fish reaches 60°C for 1 minute.

In addition to anisakiasis from ingestion of Anisakidae-parasitised fish, allergic reactions after ingestion of safely cooked but parasitised fish have also been reported.

*C. botulinum* (type E non-proteolytic strains), which causes botulism, is commonly associated with the marine environment. In addition, other strains may be present in the processing environment, including processing water. As spores tend to be associated with the gut of the fish, evisceration will reduce the risk of exposure. While illness caused by *C. botulinum* strains associated with seafood in Australia does not appear to be common, the severity of botulism disease means that the potential for it to occur should be addressed.

A significant hazard of concern with ready-to-eat fish products is *Listeria monocytogenes*. While contamination of fish with *L. monocytogenes* at harvest is not usually significant, the potential for contamination to occur post-harvest and during processing is an important factor impacting on the safety of ready-to-eat products.

Where cooked fish has been implicated in food poisonings, the contamination has usually been as a result of poor hygiene during preparation, the addition of contaminated ingredients such as batters or post-cooking contamination.

**Chilled/frozen whole fish and fillets:** The food safety hazards present in fish for sale whole or as fillets are generally the same as present at catch/harvest (including ciguatoxin, parasites, metals and endogenous bacteria that are human pathogens), with the added possibility of contamination during gutting/filleting with endogenous bacteria that are human pathogens from the viscera, human enteric pathogens and viruses, and *L. monocytogenes*.

Whole fish and fillets will normally be stored, transported and displayed chilled or frozen. Histamine formation due to the action of endogenous spoilage bacteria in fish/fillets subject to time/temperature abuse is also a possible hazard [15]. In Japan, *V. parahaemolyticus* outbreaks associated with consumption of fish are not uncommon, but are usually due to consumption of raw or lightly cooked fish meals. Thorough cooking of fish will reduce or eliminate parasites, bacterial pathogens and viruses, but will have no effect on the concentrations of chemical contaminants (toxins and metals).

**Canning:** Sterilising and packaging techniques intended to extend shelf life and which produce anaerobic conditions (for example, cans, gas flushed pouches or packing in oil), can lead to toxin production if *C. botulinum* is present. However, bacterial growth does not occur at temperatures below 3.3°C, salt concentrations above 5 per cent and in marinades below pH 5.0. Various combinations of hurdles may be used to restrict microbial growth. Historically, the major concern would have been the risk of botulism from inadequately processed canned fish, in particular, salmon. However rigorous control of canning facilities worldwide has reduced this risk to very low.

Other hazards potentially present in canned fish include histamine, due to poor quality raw materials, and staphylococcal enterotoxin due to contamination. Both of these hazards may survive the canning process. Concentrations of metal contaminants will not be reduced by the canning process.

**Smoking:** There are two main forms of fish smoking. Hot smoking is a pasteurisation process. The product is cooked during the process, and parasites and bacterial contamination will be destroyed provided a uniform temperature is reached.

The FDA recommends that the internal temperature of the fish must be maintained at or above 63°C throughout the fish for at least 30 minutes during hot smoking [18]. During cold smoking, temperatures do not normally reach levels high enough for pathogen or parasite control.

The most significant hazard of concern with cold-smoked fish products is *L. monocytogenes*. While contamination of fish with *L. monocytogenes* at harvest is not usually significant, extensive contamination may occur post-harvest and during processing. The level of contamination varies between processing sites and may be high. Keeping a processing environment totally free of *L. monocytogenes* is difficult, but levels can be reduced significantly with appropriate management strategies [3].

*L. monocytogenes* present on cold-smoked fish may either be an endogenous environmental contaminant or be introduced by pre- or post-process contamination. Since cold smoking lacks a listericidal step, the product will retain a similar level of contamination. If subject to post-process contamination, hot smoked fish may allow *L. monocytogenes* to increase to high levels, due to the absence of competing micro-organisms [16].

Smoked fish is typically not heated prior to consumption, that is, it is ready-to-eat. Prolonged chilled storage may allow numbers of *L. monocytogenes* to increase to significant levels. While conditions in the processing environment have an impact on the initial levels of *L. monocytogenes* in the product, outgrowth can occur in the post-processing environment.

Cold-smoked fish may be held for considerable periods of time in the retail sector, and there is the potential for time/temperature abuse to occur. In delicatessens, this is exacerbated by the opportunity for further contamination, with *S. aureus* being the main pathogen of concern.

Other hazards in smoked fish products include *V. parahaemolyticus*, *Salmonella* spp., *C. botulinum* and parasites. *V. parahaemolyticus* is a contaminant of raw fish from warmer waters. The level of contamination may increase through post-harvest cross-contamination and by time/temperature abuse. *Salmonella* may be associated with fish due to harvesting from faecally contaminated water bodies, for example, lakes and closed aquaculture systems, or from contamination during processing. *C. botulinum* spores are often found in the gut of fish, and are a potential hazard in product that is not eviscerated prior to smoking. Some packaging technologies for extended shelf-life may also increase the risk of botulism by maintaining a suitable anaerobic environment for growth of vegetative cells and production of toxin. Parasites will normally be killed by hot smoking, but cold-smoked products may contain viable larvae if other control measures are not employed.

**Marinating, pickling, brining, drying or fermenting:** A variety of processes including salting, fermenting and drying that are used traditionally to preserve fish may need specific storage conditions to ensure the safety of the product during the time between production and consumption.

Marinated fish products employ a combination of low pH and moderate salt concentrations to limit the potential for growth of bacterial pathogens. An example of such a product is the Southern American dish 'ceviche', which consists of diced raw fillets marinated in lime juice and spices such as chilli, pepper and mint. Such products may contain several food safety hazards, most notably helminthic parasites, *L. monocytogenes*, and processing contaminants (staphylococci, *Salmonellae*). Suitable control of both pH and salt concentration is necessary to manage these hazards. The parasites, especially anisakids, are acid tolerant and need high salt concentrations for effective control. Freezing prior to pickling will kill the larvae.

Dried fish products can be roughly categorised into fully-dried and partly dried products. The former have been dried until their moisture content is close to uniform and water activity is close to or below 0.75. The shelf life of these products usually ranges between one week and several months under correct packaging and storage conditions. Hazards associated with these products include: histamine fish poisoning (a common condition normally associated with consuming spoiled tuna, mackerel, bonito, or skipjack); microbial growth in caught fish; chemical and bacterial contamination during washing; bacterial contamination during salting; microbial growth during drying and storage.

Partly dried fish products, including Norwegian herring kippers, are typically marinated in concentrated brine solutions for up to two days, then dried, with or without smoking, for up to three days. The products usually have a refrigerated shelf life of up to a week. Hazards are similar to fully dried fish. However, the higher water activity (usually in the range 0.8-0.9) is more conducive to growth of spoilage organisms and some bacterial pathogens (for example, *S. aureus*, *L. monocytogenes*). Conversely, higher salt activity will help to inhibit such growth, and also decreases the viability of helminthic parasites.

Various fermented fish dishes are popular in Europe and Asia. Fish are fermented in salt solutions (with sugar and spices) for anywhere from two weeks to 12 months, with flavour and aroma development due to endogenous enzymic activity and lactic acid bacterial activity.

Products can range from those in which the fish retain their form, to pastes and liquid sauces. In Asian products, rice or cassava is added as a source of fermentable sugars. The fermentation usually results in a rapid drop in pH which, along with the added salt, helps to limit growth of spoilage organisms and pathogens, while allowing the lactic acid bacteria to grow. The food safety hazards presented by such products include parasites, histamine (from poor quality raw materials), *Vibrios* and *C. botulinum* (in specific ethnic foods not expected to be available in Australia).

The United States Food and Drug Administration provides guidance to food businesses producing this broad variety of acidified, fermented, dried and salted products [17,18], aimed at reducing the potential for growth and/or toxin production by pathogens:

The Food and Drug Administration suggests that shelf-stable products must be:

- heated in the final container to destroy spores of *C. botulinum* types A, B, E, and F
- acidified to pH 4.6 or below
- dried to a water activity of 0.85 or below, or
- salted to contain 20 per cent salt or more

and that refrigerated products must be:



- dried sufficient to inhibit the growth of *C. botulinum* type E and non-proteolytic types B and F by drying; and then stored at or below 4.4°C to control the growth of *C. botulinum* type A, and proteolytic types B and F, and other pathogens that may be present in the finished product
- acidified, salted, or dried to control the level of acidity (pH), salt, moisture (water activity), or some combination of these barriers, in the finished product sufficiently to prevent the growth of *C. botulinum* type E and non-proteolytic types B and F by formulation (that is, pH 5 or below; salt 5 per cent or more; or water activity below 0.97); and then stored at or below 4.4°C to control the growth of *C. botulinum* type A and proteolytic types B and F and other pathogens that may be present in the finished product
- stored and distributed at 4.4°C or below.

Torres-Vitela et al. (2000) report that *V. cholerae* O1 will survive during preparation and storage of ceviche, and recommend preheating of the fish to eliminate the pathogen before preparing the food [90].

**Surimi:** Seafood items that look like crab, scallops, etc. but are really mostly white fish fillets, are thought of by most people as some sort of modern high-tech imitation products. They go by such names as ‘sea legs’, imitation crab or imitation shrimp, etc. In reality, this process was developed in Japan several hundred years ago when the Japanese discovered that mincing fish flesh, washing it and then heating it, caused a natural gelling of the flesh. If this was then mixed with other ingredients and steamed, the resulting ‘fish cake’ (*kamaboko*) stayed together as though it were a natural product. As surimi is a minced product, bacterial contamination of the surface of fish, whether through endogenous microflora or contamination, is potentially spread throughout the product. Hazards of particular concern are enteric pathogens, *L. monocytogenes* and *V. parahaemolyticus*.

**Sashimi and sushi:** Sashimi is raw fish. Sushi is a rice based product which may contain sashimi. There are many varieties of sushi which do not contain any raw fish and these are not considered here.

Sashimi is typically made from tuna, although halibut, red snapper, yellowtail and mackerel are also common. Fish for sashimi is usually thinly sliced. Hazards of concern are parasites and *V. parahaemolyticus*. With sushi, the primary concern is related to sushi prepared in advance and then stored for some time without refrigeration. This allows for growth of pathogens as the rice is generally shaped by hand, and the sushi may contain egg, raw vegetables, and a wide variety of other growth media. The potential hazards include parasites and *Vibrios* and contamination by *S. aureus*, *Salmonella*, noroviruses and hepatitis A virus, and *L. monocytogenes*.

**Roe and caviar:** Caviar comes in a variety of shapes and colours the most prolific source country is Russia, from Sturgeon spp. in the Caspian Sea. It may be fresh, pasteurised or pressed. Lumpfish and salmon roe have been long-standing cheaper substitutes for caviar. Sea urchin roe is also a delicacy in some Asian countries. Processing typically involves draining, salting, colouring and pressing into a solid mass. As a raw product, the hazards are similar to those for other raw fish products, including parasites and endogenous and introduced pathogens.

## References in Appendix 1

- 68 Pathogenic vibrios. Desmarchelier, P.M. (1997). in Foodborne micro-organisms of public health significance, 5th edn. Australian Institute of Food Science and Technology (NSW Branch) Food Microbiology Group, pp. 285–312.
- 69 Anisakis simplex larva killed by high-hydrostatic-pressure processing. Molina-Garcia, A.D. & Sanz, P.D. (2002), J. Food Prot. 65:383–88.
- 70 Micro-organisms in Foods 6: Microbial Ecology of Food Commodities, International Commission on Microbiological Specifications for Foods (1998). Blackie Academic and Professional, London.
- 71 Survey of *Listeria monocytogenes* in cooked prawns. Marro, N., Hasell, S., Boorman, J. & Crerar, S. (2003). Food Surveillance Newsletter, Spring 2003. Food Standards Australia New Zealand. Available from:  
<<http://www.foodstandards.gov.au/mediareleasespublications/foodsurveillancenewsletter/spring2003.cfm>>. Accessed 12 November 2003.
- 72 *Listeria* – Risk Assessment and Risk Management Strategy, Final Assessment Report for Proposal P239. FSANZ (2002).
- 73 Review of the Maximum Permitted Concentrations of Cadmium in Food, Full Assessment Report of Proposal P144. ANZFA (1997).
- 74 Microbiological Standards: Risk Analyses for Seafood, Full Assessment Report for Proposal P178. ANZFA (1999).
- 75 *Vibrio cholerae* and other *Vibrios* associated with paddy field cultured prawns. Nair, G.B., Bhadra, R.K., Ramamurthy, T., Ramesh, A. & Pal, S.C. (1991). Food Microbiol. 8:203–208.
- 76 Densities of *Vibrio vulnificus* in the intestines of fish from the United States gulf coast. De Paola, A., Capers, G.M. & Alexander, D. (1994). Appl. Environmental Microbiol., 60:984–88.
- 77 *Salmonella* and *Vibrio cholerae* in brackish water cultured tropical prawns. Reilly, P.J.A. & Twiddy, D.R. (1992). Int. J. Food Microbiol., 16:293–301.
- 78 Fishery Status Reports: Resource Assessments of Australian Commonwealth Fisheries. Caton, A. & McLoughlin, K. (eds). Bureau of Rural Sciences, Agriculture, Fisheries and Forestry – Australia (1999).
- 79 Draft Environmental Assessment Report: Western Trawl Fisheries. Australian Fisheries Management Authority. July 2003.
- 80 The New Rural Industries – A Handbook for Farmers and Investors. Hyde, K. (ed.), Rural Industries Research and Development Corporation, Canberra, Australia (1997). Available from:  
<<http://www.rirdc.gov.au/pub/handbook/contents.html>>. Accessed 16 October 2003.
- 81 Foodborne Parasites. Murrell, K.D. (1995). Int. J. Environmental Health Res., 5:63–85.
- 82 Histamine (Scombroid) Fish Poisoning: A Review in a Risk Assessment Framework. Lehane, L. & Olley, J. (1999). National Office of Animal and Plant Health, Canberra.
- 83 Seafood Food Safety Risk Assessment. M&S Food Consultants Pty Ltd (2001). For Seafood Services Australia Ltd.
- 84 Compendium of Fish and Fishery Product Processing Methods, Hazards and Controls. Price, R.J. & Tom, P.D. Food Science & Technology, University of California, Davis, CA. Available from:  
<<http://seafood.ucdavis.edu/haccp/compendium/compend.htm>>. Accessed 16 October 2003.
- 85 Fish and Fishery Products Hazards and Controls Guidance. US Food & Drug Administration, Center for Food Safety & Applied Nutrition, 3rd edn, June 2001. Available from:  
<<http://www.cfsan.fda.gov/~comm/haccp4.html>>. Accessed 16 October 2003.

- 86 *Listeria monocytogenes*. Sutherland, P.S. & Porritt, R.J. (1997). In Foodborne micro-organisms of public health significance, 5th edn, Australian Institute of Food Science and Technology (New South Wales Branch) Food Microbiology Group, pp. 333–78.
- 87 Growth of *Listeria monocytogenes* and *Aeromonas hydrophila* at chill temperatures. Walker, S.J. & Stringer, M.F. (1987). *J. Appl. Bacteriol.* 63:R20.
- 88 Growth of *Listeria monocytogenes* at refrigeration temperatures. Walker, S.J., Archer, P. & Banks, J.F. (1990). *J. Appl. Bacteriol.*, 68:157–62.
- 89 Code of practice for the preparation of raw, marinated, and partially cooked fin fish. Health and Welfare Canada (1992) (in consultation with Canadian Restaurant and Food Service Association, Fisheries Council of Canada, and Fisheries and Oceans Canada).
- 90 Survival of *Vibrio cholerae* O1 in ceviche and its reduction by heat pretreatment of raw ingredients. Torres-Vitela, M.R., Castillo, A., Ibarra-Velazquez, L.M., Navarro-Hidalgo, V., Rodriguez-Garcia, M.O., Martinez-Gonzales, N.E. & Perez-Montano, J.A. (2000). *J. Food Prot.* 63(4):445-50.

## Epidemiological data

**Table 2.1: Food-borne illness outbreaks due to seafood consumption, Australia, 1995–2000**

Year	Month	State	Setting Pr	Setting Co	Pathname	Cases	Vehicle
1995	Dec	NSW	commercial manufactured food	community	Salmonella typhi	4	seafood – prawns cooked, 1 lab acquired
1995	Jan	NSW	commercial – restaurant	restaurant	scombroid	3	seafood – tuna
1995	Aug	WA	recreational fisherman		Ciguatera	4	coral trout
1996	Aug	Qld/ NSW	contaminated primary produce	community	Norwalk-like virus	97	seafood - oysters
1996	Feb	NSW	contaminated primary produce	private residence	ciguatera	2	fish - frozen rock cod
1996	Jul	NSW	private residence	private residence	Clostridium perfringens	33	seafood - prawns (curried)
1997	May-Jun	NSW	contaminated imported food	restaurant	hepatitis a	17	Seafood – prawns
1997	Dec	NSW	contaminated primary produce	community	dinophysis species	56	seafood – pipis
1997	Nov	Vic.	contaminated primary produce	restaurant	ciguatera	18	fish – 16.2 kg Maori Wrasse
1997	Jan	NSW	contaminated primary produce	private residence	ciguatera	8	Fish (unknown)
1997	Jul	NSW	contaminated primary produce	private residence	ciguatera	6	seafood – coral trout from Fiji
1997	Nov	NSW	contaminated primary produce	private residence	ciguatera	10	seafood – coral trout (Qld)
1997	Jan–Apr	All S&Ts	contaminated primary produce	community	hepatitis a	466*	seafood – oysters
1997	–	NT	contaminated primary produce		ciguatera	20	Fish – Coral Cod
1998	Oct	NT	contaminated primary produce	private residence	ciguatera	7	Fish – barracuda
1998	Nov	NSW	contaminated primary produce	private residence	ciguatera	3	seafood – cod
1998	Aug	NSW	contaminated primary produce	private residence	ciguatera	10	seafood – spotted cod
1998	Jun	Vic.	commercial – restaurant		scombroid	6	seafood – tuna
1998	Sep	Vic.	commercial – restaurant		scombroid	3	seafood – tuna
1998	Oct	Vic.	commercial – restaurant		unknown	9	seafood – cajun fish (RR 5.4)
1998	Dec	Vic.	private residence		ciguatera	5	seafood – reef cod
1998	Dec	Vic.	private residence		ciguatera	3	seafood – reef fish
1998	Dec	Vic.	commercial – restaurant		scombroid	9	seafood – Thai fish cakes (RR 14.3)
1998	Feb	NSW	pipis	community	dinophysis species	22	seafood – pipis

1999	Jan	NSW	private residence	private residence	scombroid	4	seafood – tuna
1999	Nov	NT	commercial – restaurant	restaurant	scombroid	5	seafood – Blue grenadier
1999	March	SA	restaurant	restaurant	wax ester	19	Fish – Escolar
1999	Aug	Qld	contaminated primary produce	private residence	ciguatera	8	Fish – ciguatera toxin/queenfish
1999	Sep	Qld	contaminated primary produce	private residence	ciguatera	2	seafood – ciguatera toxin
1999	Nov	Qld	commercial – restaurant	restaurant	Vibrio cholerae	10	seafood – red claw crayfish
1999	Dec	Qld	commercial – restaurant	restaurant	Norwalk-like virus	14	seafood – sautéed scallops
1999	Jun	NSW	commercial – catered		Clostridium perfringens	43	Shrimp – curried prawns
1999	Jan	Vic.	private residence		ciguatera	4	seafood – Spanish mackerel (35 kg)
1999	Jan	Vic.	commercial – reception centre		Salmonella bareilly	26	seafood – smoked salmon suspected
1999	Oct	Vic.	commercial – restaurant		scombroid	4	seafood – pasta with tuna and chilli
1999	Nov	Vic.	commercial – restaurant		wax ester	14	seafood – butterfish
1999	Dec	Vic.	non-commercial function		Salmonella typhimurium (PT 64)	12	seafood – cooked prawns/crayfish
2000	Sep	WA	commercial – restaurant	restaurant	unknown	27	seafood – sushi
2000	Apr	NSW	private residence		ciguatera	5	seafood – black trevally
2000	Aug	Qld	private residence		ciguatera	9	seafood – coronation trout
2000	Feb	Qld	private residence		ciguatera	33	seafood – queenfish
2000	Feb	Qld	private residence		ciguatera	4	seafood – queenfish
2000	Mar	Qld	private residence		ciguatera	6	seafood – black kingfish
2000	Nov	Qld	private residence		ciguatera	4	seafood – coral trout
2000	Sep	Qld	private residence		ciguatera	5	seafood – spotted mackerel
2000	Mar	Vic.	contaminated primary produce		Salmonella Mississippi	2	seafood – oysters
2000	Dec	Vic.	contaminated primary produce		Ciguatera	3	seafood – coral cod or coral trout

Data provided by Dr C Dalton (Hunter Public Health Unit).

\* 1 death

**Table 2.2: Food-borne illness outbreaks due to seafood consumption (Australia; January 2001 to June 2002)**

State	Year	Setting	Agent responsible	No. affected	Evidence	Vehicles responsible
NSW	2001	restaurant	unknown	4	D	Seafood sauce
NSW	2001	restaurant	unknown	20	C	Fish 'Lepidocybium flavobrunneum'
Vic.	2001	community	Salmonella Mississippi	6	B	Suspected oysters
Vic.	2001	private residence	Ciguatera poisoning	11	B	Coral trout
Vic.	2001	restaurant	unknown	4	B	Escolar fish
Qld	2001	private residence	Ciguatera poisoning	14	D	Spanish mackerel
Qld	2001	private residence	Ciguatera poisoning	2	D	Spotted mackerel
Qld	2001	restaurant	Scombroid	4	D	Mahi mahi fillets
Qld	2001	private residence	Ciguatera poisoning	3	D	Barracuda fish
Qld	2001	private residence	Ciguatera poisoning	4	D	Coral trout
Qld	2001	private residence	Ciguatera poisoning	9	D	Spanish mackerel
Qld	2002	private residence	Ciguatera poisoning	2	D	Striped Perch
Qld	2002	private residence	Ciguatera poisoning	3	D	Grunter bream
Qld	2002	private residence	Ciguatera poisoning	2	D	Spanish mackerel
Qld	2002	restaurant	Clostridium perfringens	9	A	Reef & beef
WA	2002	restaurant	Norovirus	60	A	Seafood salad; ravioli; grilled chicken

A: statistical evidence from epidemiological investigation

B: compelling supportive evidence

C: laboratory evidence

D: no specific evidence.

Data provided by Janet Li (OzFoodNet 2003).

## Seafood consumption in Australia by gender and age

The following seafood consumption figures were derived using FSANZ’s dietary modelling computer program, DIAMOND. Data from the 1995 National Nutrition Survey of Australia were used to obtain the consumption figures. The National Nutrition Survey used a 24-hour food recall method.

The National Nutrition Survey had 13 858 respondents aged from 2 years and above. The figures below were derived using the whole population 2+ years and sub groups of the population including males and females 2–4 years, 5–12 years, 13–64 years and 65+ years and females of child-bearing age (16–44 years). The figures include where respondents consumed seafood alone or as a part of a mixed food, such as in a marinara sauce.

### Limitations of the dietary modelling

A limitation of estimating dietary exposure over a period of time associated with the dietary modelling is that only 24-hour dietary survey data were available, and these tend to over-estimate habitual food consumption amounts for high consumers.

Molluscs and crustacea are occasionally consumed foods that people tend to consume less than once a week. Therefore, consumption figures derived from a 24-hour recall may be higher for most consumers than if consumption amounts were averaged over a longer time frame that better reflects habitual consumption of these foods. Other limitations of the dietary modelling include:

- smoked finfish was not identified as being hot- or cold-smoked in the National Nutrition Survey
- scallops are not identified as being roe-off or not.

### Molluscan shellfish

**Table 3.1: Consumption of oysters and other bivalves (including clams and mussels) in Australia, by gender and age**

Population group	No. of consumers	% of total respondents	Mean consumer intake (g/day)	95th percentile consumer intake (g/day)
All population (2+ years)	59	0.4	91	270
2–4 years male	–	–	–	–
2–4 years female	1	0.3	20	20
5–12 years male	1	0.1	56	56
5–12 years female	1	0.1	150	150
13–64 years male	25	0.5	98	283
13–64 years female	21	0.4	100	302
65+ years male	4	0.4	46	60
65+ years female	5	0.5	77	180
16–44 years female	11	0.3	118	180

**Table 3.2: Consumption of abalone and scallops in Australia, by gender and age**

Population group	No. of consumers	% of total respondents	Mean consumer intake (g/day)	95th percentile consumer intake (g/day)
All population (2+ years)	24	0.2	40	186
2–4 years male	–	–	–	–
2–4 years female	1	0.3	11	11
5–12 years male	1	0.1	71	71
5–12 years female	–	–	–	–
13–64 years male	4	0.1	34	95
13–64 years female	15	0.3	48	195
65+ years male	2	0.2	9	15
65+ years female	1	0.1	15	15
16–44 years female	11	0.3	42	160

**Cephalopod molluscs****Table 3.3: Consumption of octopus, squid and cuttlefish in Australia, by gender and age**

Population group	No. of consumers	% of total respondents	Mean consumer intake (g/day)	95th percentile consumer intake (g/day)
All population (2+ years)	47	0.3	96	242
2–4 years male	–	–	–	–
2–4 years female	2	0.7	30	40
5–12 years male	1	0.1	79	79
5–12 years female	2	0.2	40	40
13–64 years male	16	0.3	98	245
13–64 years female	24	0.5	98	274
65+ years male	2	0.2	97	120
65+ years female	1	0.1	237	237
16–44 years female	16	0.5	97	212



## Crustacea

**Table 3.4: Consumption of prawns in Australia, by gender and age**

Population group	No. of consumers	% of total respondents	Mean consumer intake (g/day)	95th percentile consumer intake (g/day)
All population (2+ years)	184	1.3	75	248
2–4 years male	–	–	–	–
2–4 years female	3	0.4	42	72
5–12 years male	5	0.6	56	96
5–12 years female	83	1.6	60	198
13–64 years male	71	1.5	89	284
13–64 years female	83	1.6	60	198
65+ years male	11	1.2	103	250
65+ years female	11	1.0	89	250
16–44 years female	52	1.6	50	160

**Table 3.5: Consumption of scampi in Australia, by gender and age**

Population group	No. of consumers	% of total respondents	Mean consumer intake (g/day)	95th percentile consumer intake (g/day)
All population (2+ years)	1	0.0	118	118
2–4 years male	–	–	–	–
2–4 years female	–	–	–	–
5–12 years male	–	–	–	–
5–12 years female	–	–	–	–
13–64 years male	–	–	–	–
13–64 years female	1	0.0	118	118
65+ years male	–	–	–	–
65+ years female	–	–	–	–
16–44 years female	–	–	–	–

**Table 3.6: Consumption of lobsters and bugs in Australia, by gender and age**

Population group	No. of consumers	% of total respondents	Mean consumer intake (g/day)	95th percentile consumer intake (g/day)
All population (2+ years)	14	0.1	78	408
2–4 years male	–	–	–	–
2–4 years female	–	–	–	–
5–12 years male	–	–	–	–
5–12 years female	–	–	–	–
13–64 years male	8	0.2	94	408
13–64 years female	5	0.1	64	204
65+ years male	–	–	–	–
65+ years female	1	0.1	18	18
16–44 years female	2	0.1	140	204

**Table 3.7: Consumption of crabs in Australia, by gender and age**

Population group	No. of consumers	% of total respondents	Mean consumer intake (g/day)	95th percentile consumer intake (g/day)
All population (2+ years)	17	0.1	36	96
2–4 years male	–	–	–	–
2–4 years female	–	–	–	–
5–12 years male	1	0.1	63	63
5–12 years female	8	0.2	41	96
13–64 years male	6	0.1	27	48
13–64 years female	–	–	–	–
65+ years male	1	0.1	63	63
65+ years female	1	0.1	2.5	2.5
16–44 years female	5	0.2	44	96

**Table 3.8: Consumption of crayfish, marron and yabbie in Australia, by gender and age**

Population group	No. of consumers	% of total respondents	Mean consumer intake (g/day)	95th percentile consumer intake (g/day)
All population (2+ years)	7	0.1	100	191
2–4 years male	–	–	–	–
2–4 years female	1	0.3	51	51
5–12 years male	1	0.1	115	115
5–12 years female	–	–	–	–
13–64 years male	3	0.1	89	153
13–64 years female	2	0.0	135	191
65+ years male	–	–	–	–
65+ years female	–	–	–	–
16–44 years female	1	0.0	191	191

**Fish and fish products****Table 3.9: Consumption of finfish (fillets/gutted/whole for cooking) in Australia, by gender and age**

Population group	No. of consumers	% of total respondents	Mean consumer intake (g/day)	95th percentile consumer intake (g/day)
All population (2+ years)	657	4.7	127	314
2–4 years male	9	3.2	78	211
2–4 years female	12	4.0	46	101
5–12 years male	14	1.8	82	167
5–12 years female	30	4.1	72	169
13–64 years male	256	5.5	161	423
13–64 years female	238	4.6	114	288
65+ years male	50	5.5	113	253
65+ years female	48	4.5	103	283
16–44 years female	132	4.2	112	283

**Table 3.10: Consumption of canned finfish in Australia, by gender and age**

Population group	No. of consumers	% of total respondents	Mean consumer intake (g/day)	95th percentile consumer intake (g/day)
All population (2+ years)	538	3.9	72	185
2–4 years male	5	1.8	45	110
2–4 years female	5	1.7	31	70
5–12 years male	19	2.6	72	180
5–12 years female	9	1.2	49	158
13–64 years male	167	3.6	91	239
13–64 years female	224	4.4	67	154
65+ years male	51	5.7	64	122
65+ years female	58	5.5	59	113
16–44 years female	125	3.9	67	154

**Table 3.11: Consumption of smoked finfish in Australia, by gender and age**

Population group	No. of consumers	% of total respondents	Mean consumer intake (g/day)	95th percentile consumer intake (g/day)
All population (2+ years)	85	0.6	72	185
2–4 years male	–	–	–	–
2–4 years female	1	0.3	20	20
5–12 years male	–	–	–	–
5–12 years female	2	0.3	80	95
13–64 years male	29	0.6	133	435
13–64 years female	32	0.6	82	397
65+ years male	13	1.4	116	554
65+ years female	8	0.8	63	198
16–44 years female	15	0.5	67	385

**Table 3.12: Consumption of fish roe in Australia, by gender and age**

Population group	No. of consumers	% of total respondents	Mean consumer intake (g/day)	95th percentile consumer intake (g/day)
All population (2+ years)	6	0.0	16	28
2–4 years male	–	–	–	–
2–4 years female	–	–	–	–
5–12 years male	–	–	–	–
5–12 years female	–	–	–	–
13–64 years male	5	0.1	17	28
13–64 years female	1	0.0	14	14
65+ years male	–	–	–	–
65+ years female	–	–	–	–
16–44 years female	1	0.0	14	14

### Hazard identification/hazard characterisation

This Appendix provides a brief description of the hazards associated with seafood along with information on the nature, severity and duration of adverse health effects resulting from exposure to these hazards. The incidence of illness and hazard levels detected in various seafood are also described.

The information presented in this attachment has largely been extracted from the 'Seafood Food Safety Risk Assessment' conducted by M&S Food Consultants, who were commissioned by Seafood Services Australia in 2001 to undertake a national seafood risk assessment. Other data was derived from FSANZ's 'Shellfish Toxins in Food: Toxicological Review and Risk Assessment', 1999, which was prepared as part of Proposal P158 – review of the maximum permitted concentrations of non-metals in food.

### Bacterial pathogens

The bacterial pathogens discussed here are *Vibrio* spp., *Staphylococcus aureus*, *Salmonella* species, *Listeria monocytogenes*, *Clostridium botulinum*, *Aeromonas hydrophila* and *Escherichia coli*.

#### *Vibrio* spp.

*Vibrio* species are ubiquitous in the aquatic environment, with a small number of species/strains able to cause human disease (Morris 2003). *Vibrios* are described as gram-negative, facultatively anaerobic, halophytic (salt-loving), motile curved rods with a single polar flagellum (ICMSF 1996).

#### *Vibrio cholerae*

**Description:** The temperature range for *V. cholerae* growth is 10–43°C, the minimum  $a_w$  for growth is as low as 0.97 and the pH range for growth is 5.0–9.6. *V. cholerae* can survive in foods for periods up to a month or more as long as the  $a_w$  is sufficiently high (ICMSF 1996). *V. cholerae* is sensitive to acid and dry conditions and so survival under these conditions is generally <12 hours at room temperature.

There are three main serological groupings of *V. cholerae*; namely O1, O139 and non-O1/non-O139. Toxigenic *V. cholerae* O1 and O139 are the causative agents of cholera, a food-borne illness with epidemic and pandemic potential. Non-O1/non-O139 *V. cholerae* do not carry the virulence factors necessary to cause epidemic cholera but have been implicated as causes of diarrhoeal disease, wound infections and, in susceptible populations, septicaemia (Morris 2003).

*V. cholerae* O1 is divided into two serotypes, Indaba and Ogawa, and two biotypes, classic and El Tor (Prescott et al. 1999). The classic biotype, such as the *V. cholerae* strain first isolated by Robert Koch in 1883, was more prevalent in cholera outbreaks before 1960, whereas the El Tor biotype has been more frequently seen since that time (Madigan et al. 1997).

**Pathology of illness:** Illness in humans is initiated by adherence of toxigenic O1 and O139 *V. cholerae* cells to the surface of the small intestine, where they are not invasive but produce cholera enterotoxin, cholera toxin. The action of the toxin on mucosal cells leads to hypersecretion of salts and water.

Loss of water can be as much as 1 L/h and can lead to collapse and death. Initial symptoms include mild diarrhoea, abdominal pain and anorexia and are rapidly followed by severe diarrhoea (classic rice water stools), with rapid loss of body fluids and salts. Without treatment cholera can be fatal, but in otherwise healthy and well-nourished patients, recovery occurs in 1–6 days. *V. cholerae* non-O1 and non-O139, cause milder symptoms (ICMSF 1996).

The incubation period ranges from several hours to 5 days and depends in part on the dose. Onset of illness can be sudden or there may be premonitory symptoms such as anorexia, abdominal discomfort and diarrhoea.

Stomach acidity has a protective effect. Individuals who are achlorhydric (low stomach acidity) because of medication (such as antacids) or other reasons, are more susceptible to infection. Individuals of blood group O are also more susceptible to infection, although the mechanism of this susceptibility is not known (Oliver & Kaper 1997). Individuals with cirrhosis of the liver are susceptible to non-O1 *V. cholerae* bacteraemia (Lin et al. 1996).

**Infectious dose/dose response:** When ingested with food (or after neutralisation of stomach acidity) the infectious dose of *V. cholerae* O1 and O139 in healthy adult volunteers is estimated to be 10<sup>3</sup> – 10<sup>4</sup> cells (Levine et al. 1981; Kothary & Babu 2001). Lower inocula correlated with a longer incubation period and diminished severity of symptoms. Attack rates at these doses were >60 per cent. Analysis of outbreaks suggests *V. cholerae* O1 and O139 may be infectious at doses as low as 10<sup>2</sup> to 10<sup>3</sup> CFU (M&S Food Consultants 2001). *V. cholerae* non-O1/non-O139 strains appear to have a much higher infectious dose of between 10<sup>6</sup> and 10<sup>9</sup> bacteria (Cash et al. 1974; Oliver & Kaper 1997; Kothary & Babu 2001).

**Levels in seafood:** Only *V. cholerae* non-O1/non-O139 and non-toxigenic *V. cholerae* O1 strains have been isolated from brackish and estuarine waters and oysters in Australia (Desmarchelier 1997; Eyles & Davey 1984; 1988).

**Epidemiological data:** Seven pandemics have been recorded worldwide since 1817 (Morris 2003). Cholera remains epidemic in many parts of Central and South America, Asia, and Africa (CDC 1995). In 2001, 58 countries officially reported a total of 184 311 cases and 2728 deaths to the World Health Organisation (WHO 2002). Cholera is generally transmitted via ingestion of faecally contaminated foods and waters (Centre for Disease Control 1995). Outbreaks of cholera have been associated with consumption of seafood including oysters, crabs and shrimp (Oliver & Kaper 1997). For example, a seafood-associated outbreak of cholera in Hong Kong was linked to contaminated seawater in fish tanks used for holding live crustacea (Kam et al. 1995).

The incidence of cholera in Australia is low, with an average of less than 4 reported cases per annum in the period 1991–2002 (inclusive) (Communicable Diseases Australia 2003). The majority of reported cases in Australia are generally acquired overseas (Kraa 1995). An outbreak occurred in Australia in 1999 due to consumption of crayfish contaminated with *V. cholerae* non-O1/non-O139, resulting in 10 cases of illness (Appendix 2).

### *Vibrio parahaemolyticus*

**Description:** *V. parahaemolyticus* is distributed worldwide in inshore marine waters and is mesophilic. The temperature range for growth is 5–43°C, the minimum  $a_w$  for growth is as low as 0.94 and the optimal NaCl concentration for growth is 3 per cent ( $a_w = 0.980$ ). *V. parahaemolyticus* will grow in the pH range of 4.8–11 (ICMSF 1996).

**Pathology of illness:** Illness is caused when the ingested organism attaches itself to an individual's small intestine and secretes a toxin. *V. parahaemolyticus* causes gastroenteritis and symptoms include watery diarrhoea, abdominal cramps, nausea, vomiting, headache, fever and chills. Onset of illness is generally after 4–96 hours with a mean of 15 hours. Illness usually resolves in three days and mortality is normally very low. A more severe dysenteric form of illness that may need hospitalisation has been reported in India, United States (2 cases) and Bangladesh (Twedt 1989). Severe illness is rare and usually occurs in people with weakened immune systems or chronic liver disease. In these cases, infection can lead to septicaemia (Morris 2003).

Not all strains of the organisms are pathogenic. There appears to be a lack of correlation between pathogenicity and serotype of *V. parahaemolyticus* isolates. Virulence correlates with the ability to produce a thermostable direct haemolysin termed the Kanagawa Phenomenon haemolysin. Kanagawa Phenomenon negative strains appear to be non-pathogenic (Twedt 1989; Oliver & Kaper 1997). Kanagawa Phenomenon haemolysin is heat-stable and therefore remains active even after cooking (Twedt 1989).

**Infectious dose/dose response:** Human volunteer studies have established an infectious dose for KP-positive strains between  $2 \times 10^5$  and  $3 \times 10^7$  cfu (Takikawa 1958; Sanyal & Sen 1974). Diarrhoeal illness was not caused by ingestion of up to  $2 \times 10^{10}$  cfu of a KP-negative strain (Centre for Food Safety and Applied Nutrition 2001). However, the level of *V. parahaemolyticus* in oysters from beds implicated in the United States 1997 and 1998 outbreaks was less than 200/g, indicating that human illness can occur at lower levels than currently suspected (Morbidity and Mortality Weekly Reports 1999).

**Levels in seafood:** Studies have demonstrated a seasonal and geographical variation in the concentration of *V. parahaemolyticus* in marine waters, with higher numbers detected in samples collected during the warmer months (DePaola et al. 1990; Cook et al. 2002; Gooch et al. 2002). This is in contrast to many other bacterial pathogens (such as *Salmonella*, pathogenic *E. coli* and *Campylobacter*) where survival is inversely related to temperature (Obiri-Danso & Jones 1999). Therefore, concentrations of *Vibrio* spp. do not always correlate with traditional faecal indicator organism concentration.

Concentrations of *V. parahaemolyticus* have been observed to be >100 times higher in oysters compared with the surrounding coastal water (DePaolo et al. 1990). In a study in the United States, the concentration of *V. parahaemolyticus* in freshly harvested oysters was typically between 200 and 2000 CFU/g, with a prevalence of up to 21% (Kaufman et al. 2003; Nordstrom et al. 2004). The prevalence of *V. parahaemolyticus* is usually lower in crustacea and finfish than in oysters (Table 4.1).

**Table 4.1: Incidence of *V. parahaemolyticus* in seafood**

Country	(% positive, no. of samples)	Level reported	Reference
Australia	Marine fish at market (59%, 39/66)	Not reported	O'Connor 1979
	Wholesale unopened oysters (100%, 16/16)	0.4/g to 2.3 x 10 <sup>4</sup> /g	Eyles et al. 1985
	Retail refrigerated opened oysters (93%, 13/14)	4.3/g to >1.1. x 10 <sup>3</sup> /g	Eyles et al. 1985
	Pacific oysters (69–74%)	Not reported	Kraa & Bird 1992
	Pacific oysters	2.4 x 10 <sup>3</sup> /g	Bird & Kraa 1995
	Scallops, mussels, oysters and fish	25% (20/80) contained 4/g	Gorczyca et al. 1984
UK	Retail cooked prawns and shrimps (0/148)	None detected	Greenwood et al. 1985
	Ready-to-eat molluscs (24%, 64/2311)	58/64 'detected' 6/64 10 <sup>2</sup> -10 <sup>4</sup> /g	Little et al. 1997
India	Crustaceans (79.3%), fish (37.5%)	Not reported	Lall et al. 1979
	Fish (51.26%), shellfish (78.57%), oysters (100%)	Not reported	Sanjeev & Stephen 1993
	Fish and shrimps from coastal waters (60%)	Not reported	Qadri & Zuberi 1977
China	Clam (50%), shrimp (25%) and fish (15%)	Not reported	Shih et al. 1996
NZ	Pacific oysters (57%, 85/149)	<10/g (95%) to >10 <sup>4</sup> /g	Fletcher 1985
	Cockles (0%)	None detected	Nicholson et al. 1989
Brazil	Oysters (77%)	MPN <3-1200/100g	Matte et al. 1994
	Mussels (67–92%)	MPN <3-24 000/100g	
USA	Oysters (33%, 12/36)	MPN 3.6 to 23/g	Tepedino 1982
	Oysters (100% total <i>V. parahaemolyticus</i> ; 22% pathogenic <i>V. parahaemolyticus</i> ; n=156)	<10 – 1.2 × 10 <sup>4</sup> cfu/g	DePaola et al. 2003

Source: M&S Food Consultants 2001.

Key: MPN = most probable number; cfu = colony forming units.

A study by Gooch et al. (2002) investigated the ability of *V. parahaemolyticus* to grow in oysters, post-harvest. After 24 hours storage at 26°C there was a 790-fold increase (2.9 log CFU/g) in concentration, demonstrating *V. parahaemolyticus* can multiply rapidly in unrefrigerated oysters. After 14 days of refrigeration, there was a six-fold decrease (0.8 log CFU/g) of *V. parahaemolyticus*. Others have reported long-term survival of *V. parahaemolyticus* on chilled and frozen fish fillets (Vasudevan et al. 2002).

**Epidemiological data:** There have been a number of large outbreaks of *V. parahaemolyticus* gastroenteritis in Australia (Appendix 2). In 1990 an outbreak affecting more than 100 people, one of whom died, was linked to fresh, cooked prawns from Indonesia. In 1992 there were two outbreaks affecting more than 50 people linked to the same wholesale supplier of cooked prawns (Kraa 1995). One death due to *V. parahaemolyticus* gastroenteritis associated with consumption of oysters was reported in 1992 (Kraa 1995).

In the United States and Europe, most gastroenteritis-related outbreaks have been due to the consumption of raw molluscs (oysters and clams) or cooked crustaceans (shrimp, crab and lobsters). In Japan, South-East Asia, Africa and India, raw fish has been implicated.

### *Vibrio vulnificus*

**Description:** The temperature range for *V. vulnificus* growth is 8–43°C, the minimum  $a_w$  for growth is as low as 0.96 and the optimal NaCl concentration for growth is 2.5 per cent ( $a_w = 0.983$ ). The pH range for growth is 5–10 (ICMSF 1996).

**Pathology of illness:** Disease caused by *V. vulnificus* is characterised by a 24-hour incubation period, followed by signs of sepsis, including fever, chills and nausea (Potasman et al. 2002). Symptoms typical of gastroenteritis, abdominal pain, vomiting and diarrhoeal are less common. *V. vulnificus* is highly invasive and produces a number of virulence factors which may cause tissue damage (including lesions). Again, immunocompromised individuals and those suffering from chronic liver disease are particularly susceptible to *V. vulnificus* infection. *V. vulnificus* can also lead to infection by directly contaminating open wounds during swimming, shellfish cleaning and other marine activities (Centre for Disease Control 1993).

**Infectious dose/dose response:** The infectious dose is not known. It has been suggested that the infectious dose may be very low in susceptible individuals (Oliver & Kaper 1997) and analysis of oysters associated with *V. vulnificus* primary septicaemia indicates that ca.  $10^3$ /g of oyster or higher were associated with infection (Jackson et al. 1997; Tamplin & Jackson 1997).

**Levels in seafood:** Levels reported in seafood range from 15 –  $6 \times 10^4$ /g (Table 4.2; Oliver 1989; Oliver & Kaper 1997). Although human illness has only been associated with consumption of oysters, *V. vulnificus* has been isolated in high numbers ( $>10^6$  cfu/g) from intestinal contents of fish, shrimp and prawns, with low numbers being detected in muscle (DePaola et al. 1994; Hoi et al. 1998; Thampuran & Surendran 1998; Berry et al. 1994; Prasad & Rao 1994).

Numbers of *V. vulnificus* in seawater and seafood vary according to season (Ruple & Cook 1992; DePaola et al. 1994; Motes et al. 1998). In Chesapeake Bay, United States, *V. vulnificus* was not detected in any samples collected during February and March (water temperature  $<8^\circ\text{C}$ ) but was found in 80 per cent of the water samples collected during May, July, September, and December (water temperature  $>8^\circ\text{C}$ ), with concentrations ranging from  $3.0 \times 10^1$  –  $2.1 \times 10^2$ /mL. Isolation from oysters was demonstrable when water temperatures were  $7.6^\circ\text{C}$ , with concentrations ranging from  $1.0 \times 10^3$  –  $4.7 \times 10^4$ /g (Wright et al. 1996). High *V. vulnificus* levels in oysters ( $>10^3$ /g) are also associated with intermediate salinities (5 to 25 ppt), with numbers generally being lower in oysters from water salinities above 28 ppt (Motes et al. 1998).

*V. vulnificus* has been isolated from Australian waters (Myatt and Davis 1989) and cases of wound sepsis have been reported (Maxwell et al. 1991). A 1990 survey in New South Wales found 40 per cent of oysters were contaminated with *V. vulnificus* (McAnulty 1990). However, there is little published data on the levels of *V. vulnificus* in Australian seafoods or seawater. As indicated in Table 4.2, *V. vulnificus* has been found at ‘low levels’ in oysters in Australia (Bird and Kraa 1995).



**Table 4.2: Incidence of *V. vulnificus* in seafood**

Country	(% positive, no. of samples)	Level reported	Reference
Australia	Oysters	'low numbers'	Bird & Kraa 1995
Denmark	Mussels (41%, 7/17)	water (0.8-19/litre)	Hoi et al. 1998
Germany	Seafood (30%, 99/330)	not reported	Janssen 1996
India	Fish	15 - 9 × 10 <sup>2</sup> /g	Thampuran & Surendran 1998
Brazil	Oysters (12%) Mussels (8–17%)	MPN (<3 – 30/100g) MPN (<3 – 3/100g)	Matte et al. 1994
United States of America	Oysters (summer)	1.0x10 <sup>3</sup> – 4.7x10 <sup>4</sup> /g	Wright et al. 1996
	Oysters (summer)	1 × 10 <sup>3</sup> /g	DePaola et al. 1994
	Oysters (summer)	≥1 × 10 <sup>5</sup> /g	Ruple & Cook 1992
	Oysters	MPN 2 × 10 <sup>3</sup> /g; 10/g	Motes et al. 1998
	Oysters (summer and fall)	<0.3/g Jan–Mar; 10 <sup>3</sup> – 10 <sup>4</sup> /g	DePaola et al., 1998
China	Razor Clam (4/4)	< 3.4 log cfu/g	Yano et al. 2004
	Giant Tiger Prawn (7/7)	< 4.9 log cfu/g	
	Mantis Shrimp (5/9)	< 4.9 log cfu/g	

Source: M&S Food Consultants 2001.

Key: MPN = most probable number.

**Epidemiological data:** In the United States between 1988 and 1996, 422 *V. vulnificus* infections from 23 states were reported. Of these reported cases, 45 per cent were wound infections, 43 per cent were primary septicaemia infections, 5 per cent were gastroenteritis infections and 7 per cent of infections were undetermined. Of those with primary septicaemia, 96 per cent had consumed raw oysters. The fatality rate of individuals with primary septicaemia was 61 per cent with underlying liver disease associated with fatal outcome (Shapiro et al. 1998).

An outbreak of *V. vulnificus* infection associated with consumption of raw oysters was documented in 1992. All cases were aged 50–74, suffered from chronic liver disease and presented with primary septicaemia; there were 2 deaths (Kraa 1995). Between 1987–2001, five individual incidents of *V. vulnificus* infection associated with consumption of raw oysters were reported, leading to four deaths, of which were primarily individuals with chronic liver disease (Food Science Australia & Minter Ellison Consulting 2002).

### *Staphylococcus aureus*

*S. aureus* is a gram-positive, non-spore forming spherical bacterium. *S. aureus* is ubiquitous and occurs on mucous membranes and skin of most warm-blooded animals, including all food animals. Up to 50 per cent of humans may carry this organism (FDA 2003).

The temperature range for growth is 7–48°C, the minimum  $a_w$  for growth is as low as 0.85 and the pH range for growth is 4–10. The temperature range for toxin production is 10–48°C, the pH range is 4.5–9.6 and toxin production occurs at an  $a_w$  as low as 0.87 (ICMSF 1996). Toxins are not always totally inactivated by heat treatments used during processing of foods.

Humans and animals are primary reservoirs for *S. aureus*. Staphylococcal food poisoning occurs when enterotoxigenic *S. aureus* is introduced into a food that will support growth of the organism, and that food is stored under conditions allowing the organism to grow and produce sufficient quantities of enterotoxin (Ash 1997).

Foods commonly associated with staphylococcal food poisoning are raw meat and poultry, dairy products, salads, cream-filled bakery products and processed meat (Stewart 2003).

**Pathology of illness:** *S. aureus* is an opportunistic pathogen that typically causes infection via open wounds. *S. aureus* forms a wide range of substances associated with infectivity and illness, including the heat stable enterotoxins that cause food poisoning (Ash 1997). Eleven antigenic types of staphylococcal enterotoxins are currently recognised, with types A and D being involved in most food poisoning outbreaks. The toxins are thought to stimulate neuroreceptors in the intestinal tract which trigger vomiting (Stewart 2003).

Symptoms generally appear around 3 hours after ingestion (range 1–6 hours) and are self-limiting (Ash 1997). Common symptoms are nausea, vomiting, retching, abdominal cramping, and prostration. In more severe cases, headache, muscle cramping and transient changes in blood pressure and pulse rate may occur. Recovery usually takes 1–3 days, but can take longer in severe cases (Ash 1997). All people are susceptible to staphylococcal food poisoning, however the intensity/severity may vary, depending of individual sensitivities. Death from staphylococcal food poisoning is very rare, although it has occurred amongst the elderly (Ash 1997).

**Infectious dose/dose response:** The amount of enterotoxin that must be ingested to cause illness is not known exactly, but it is generally believed to be in the range 0.1–1.0 µg/kg (ICMSF 1996). Toxin levels within this range are typically reached when *S. aureus* populations exceed 100 000/g (Ash 1997).

**Epidemiological data:** Staphylococcal food poisoning associated with seafood consumption has not been reported in Australia (1987–2001). However, a limited number of outbreaks have occurred in other countries such as Canada and the United Kingdom (Sweet et al. 1989; Panisello et al. 2000).

### *Salmonella species*

*Salmonella* is a gram-negative rod-shaped, generally motile, non-spore forming bacterium. It is found worldwide and has widespread occurrence in animals, especially poultry and swine and raw seafoods. The temperature range for growth is 5.2–46.2°C (however, most serotypes fail to grow below 7°C), the pH range is approximately 3.8–9.5 and growth occurs at an  $a_w$  as low as 0.94 (ICMSF 1996).

**Pathology of illness:** Acute symptoms of salmonellosis include nausea, vomiting, abdominal cramps, mild diarrhoea, fever, and headache. Onset of symptoms occur 8–72 hours after ingestion and symptoms generally last 1–2 days (Jay et al. 1997). Symptoms may be prolonged depending on host factors, ingested dose and strain characteristics. Chronic consequences such as arthritic symptoms may follow 3–4 weeks after onset of acute symptoms (FDA 2003).

*S. Typhi* and *S. Paratyphi* are serotypes that cause serious enteric fever (typhoid fever) and are particularly well adapted to invasion and survival in humans (Jay et al. 1997). There are also many other non-typhoid *Salmonella* serovars that cause gastroenteritis in humans. Typhoid fever is quite common in developing countries, whereas non-typhoidal *Salmonella* gastroenteritis is among the leading causes of food-borne morbidity in developed countries.

*Salmonella* causes illness by invading regions of the intestine, leading to an inflammatory reaction. Invasive strains (for example, *S. Typhi*) invade individual cells which can lead to septicaemia. All age groups are susceptible to infection however symptoms may be more severe in the elderly, infants and immunocompromised (Jay et al. 1997).

Salmonellae are found worldwide and are considered to be zoonotic organisms. Several animal reservoirs have been identified and many foods, mostly of animal origin or those subject to sewage pollution, have been responsible for transmission of salmonellae to humans. Food, feeds and water are the primary vehicles, but salmonellae can also become established and multiply in the environment and equipment of food-processing plants. Infected food handlers may also spread infection through poor hygienic practices.

**Infective dose/dose response:** The infective dose is usually generally high at  $>10^5$  cells, but can be lower when the food vehicle is a fatty or buffering substance allowing passage through the acidic environment of the stomach (Jay et al. 1997). As few as 15–20 cells may also cause illness depending upon age and health of host and strain differences (FDA 2003).

**Levels in seafood:** Farmed seafood, or seafood harvested from in-shore waters, estuaries or rivers may be contaminated with *Salmonella* spp. due to faecal pollution of surrounding waters. Fish caught in deep waters are more likely to become contaminated with *Salmonella* spp. after harvesting (Jay et al. 2003), rather than from their growing environment. The prevalence of salmonellae in shrimp has been reported at 8.1 per cent from a survey of 211 samples (Gecan et al. 1994).

**Epidemiological data:** In 2002, 7917 cases of salmonellosis were reported in Australia, which represented a rate of 40.3 cases per 100,000 population (OzFoodNet 2003). During 1995–2002, there were five reported outbreaks associated with consumption of contaminated seafood including oysters, cooked prawns and crayfish (Appendix 2; Food Science Australia & Minter Ellison Consulting 2002).

Outbreaks have also occurred internationally due to the consumption of contaminated seafood. For example, smoked fish (halibut) was implicated in 11 cases of salmonellosis with *S. Paratyphi* in Germany in 1991 (Kuhn et al. 1994), and 19 cases of salmonellosis was due to the consumption of cockles contaminated with *S. Enteritidis* in the United Kingdom (Greenwood et al. 1998).

### *Listeria monocytogenes*

*L. monocytogenes* is a gram positive, non-spore forming rod that may be isolated from a variety of sources including soil, silage, sewage, food-processing environments, raw meats and the faeces of healthy humans and animals (FDA 2003). *L. monocytogenes* grows in the temperature range  $-0.4^{\circ}\text{C}$  to  $45^{\circ}\text{C}$ , over a broad range of pH (4.6–9.2) and to an  $a_w$  as low as 0.90 (glycerol as humectant) or 0.92 (NaCl as humectant) (ICMSF 1996). An important factor in terms of food-borne transmission is that the organism survives well under frozen conditions and has the ability to grow at low temperatures.

**Pathology of illness:** There are two main clinical forms of infection with *L. monocytogenes*, namely listerial gastroenteritis, where usually only mild, flu-like symptoms are reported, and the classic invasive listeriosis, where the bacteria penetrate the gastrointestinal tract and invade normally sterile sites within the body (FDA 2003).

Invasive listeriosis can be very severe, and in some cases, life-threatening. Invasive listeriosis is an opportunistic infection and a relatively rare illness, with a wide range of symptoms including meningoencephalitis and septicaemia. Mild or asymptomatic infections in pregnant women may lead to infection of the foetus (Sutherland & Porritt 1997). The incubation period prior to individuals becoming symptomatic with listeriosis can be long (up to 3 months) but most commonly in the region of several days, and for the gastrointestinal form less than 24 hours (Sutherland & Porritt 1997).

It is estimated that approximately 2–6 per cent of the healthy population harbours *L. monocytogenes* in their intestinal tract, which suggests that people are frequently exposed to *L. monocytogenes* (Rocourt & Bille 1997; Farber & Peterkin 1991). This may also suggest that most people have tolerance to infection by *L. monocytogenes*, and given the relatively low number of reported cases, exposure rarely leads to serious illness (FDA 2003; Marth 1988; Hitchins 1996). However, a number of high-risk groups for listeriosis have been identified, including pregnant women and their foetuses, neonates, elderly, and the immunocompromised (Sutherland & Porritt 1997).

**Infectious dose/dose response:** Epidemiological evidence from investigations where the vehicle of infection has been identified indicates that foods contaminated with less 100 cfu/g of *L. monocytogenes* are unlikely to cause illness in the general population. There is one study that suggests that the level of *L. monocytogenes* needed to cause illness in susceptible groups may be lower (Maijala et al. 2001).

Factors affecting the likelihood of illness developing in an individual consumer may include their immune status, the type of food consumed, the virulence and infectivity of the pathogen, the concentration of the pathogen in the food, and the number of repetitive challenges (National Advisory Committee on Microbiological Criteria for Foods 1991). Thus, even when an outbreak occurs not all people consuming the contaminated foods will develop an infection.

**Levels in seafood:** There are few data describing the prevalence of *L. monocytogenes* in Australian seafood of which a number are not ready-to-eat and will receive a heat treatment prior to consumption, therefore inactivating the organism (Table 4.3). Garland (1995) and Garland and Mellefont (1996) isolated *L. monocytogenes* from only 3/718 smoked salmon samples at a Tasmanian plant. These levels are much lower than those reported for smoked salmon in Europe (M&S Food Consultants 2001). By contrast, the prevalence established in a retail survey in New South Wales during 1993 (Arnold & Coble 1995) is much higher than those determined at the processing plant by Garland and Mellefont, pointing to temperature/time regimes favourable for the growth of the pathogen. Also of concern is the high prevalence of *L. monocytogenes* (29.5–60%) in processed smoked salmon products (Arnold & Coble 1995; Garland & Mellefont 1996).

**Table 4.3: *L. monocytogenes* in Australian seafood**

Product	No. (%) of positive samples	Levels	Reference
Smoked salmon fillets and slices	1/285 (0.4) 2/433 (0.4)	Present in 25g	Garland 1995 Garland & Mellefont 1996
Salmon pate	8/61 (29.5)	Present in 25g	Garland & Mellefont 1996
Smoked fish and mussel products at retail in Canberra	49 (4.1)	4 MPN/g, 460 MPN/g	Rockliff & Millard 1997
Retail survey in Victoria			Dunn, Son & Stone 1998
Marinara mix	13 (31)	Present in 25g	
Smoked fish	9 (10)	Present in 25g	
Seafood salad/cocktail	37 (3)	Present in 25g	
Flake	70 (1.5)	Present in 25g	
NSW retail survey			
Smoked salmon	10/56 (17.9)	<100 MPN/g	Arnold & Coble 1995
Other smoked fish	0/11	Not stated	
Salmon cheese	3/5 (60)	Not stated	
Salmon dip	10/21 (47.6)	Not stated	
Salmon mousse/pate	2/8 (25)	Not stated	
Cooked prawns	12/380	<50 cfu/g	Marro et al. 2003

Source: M&S Food Consultants 2001.

Key: MPN = most probable number; cfu = colony forming units.

**Epidemiological data:** The estimated incidence of listeriosis in European countries is four to eight cases per million of the general population per year. In France, the estimated incidence of listeriosis is sixteen cases per million (general population) per year (Bille 1990). The United States estimates that approximately 8.8 people per million (general population) become seriously ill with listeriosis each year, with a fatality rate of 20 per cent. Of all the food-borne pathogens, *L. monocytogenes* resulted in the highest hospitalisation rate in the United States (FDA 2003).

While the incidence rate is low compared to other food-borne illnesses, such as *Salmonella*, the mortality rate is much higher, ranging between 5 per cent and 33 per cent, and averaging 22 per cent (Rocourt & Brosch 1992). In general, the incidence of listeriosis appears to be decreasing in most countries.

The estimated incidence of invasive listeriosis in New Zealand is five cases per million (average number of cases 17 per annum) of the general population per year (Anon. 1996–2001). The fatality rate in New Zealand since 1995 is approximately 17 per cent.

The number of reported cases of invasive listeriosis in Australia from 1991 to 2002, inclusive, is approximately fifty seven cases per year (Communicable Diseases Australia 2003), which equates to an estimated incidence of invasive listeriosis in Australia of three cases per million of the general population per year (Sutherland & Porritt 1997). In Australia, the exact mortality rate is not known, although the data available would suggest a rate of approximately 23 per cent.

A risk assessment undertaken by the United States Food and Drug Administration (2001) looked at all documented outbreaks of listeriosis internationally, including those listed in Table 4.4, and ranked fish products third behind meat and dairy products in terms of responsibility for outbreaks for which the food linkage has been identified.

**Table 4.4: Cases of food-borne listeriosis associated with seafood**

Location (year)	No. cases	Food	CFU g <sup>-1</sup>	Strain serovar
USA (1989)	2	Shrimp	Not known	4b
Italy (1989)	1	Fish	Not known	4b
Australia (1991)	3	Smoked mussels	1 x 10 <sup>7</sup>	Not known
New Zealand (1992)	2	Smoked mussels	Not known	1/2b
Canada (1996)	2	Imitation crab meat	2 x 10 <sup>9</sup>	1/2b
Sweden (1994/95)	6–9	'Gravad' smoked rainbow trout	>100–2.5 x 10 <sup>6</sup>	4b
Finland (1999–2000)	10	Vacuum packed cold-smoked trout	Not known	1/2a

Source: M&S Food Consultants 2001; after FAO 1999.

### *Clostridium botulinum*

*C. botulinum* is an anaerobic, gram positive, spore-forming rod shaped bacterium that produces a potent neurotoxin. Seven types of *C. botulinum*, (types A-G) are recognised, grouped according to the antigenic specificities of their toxins. *C. botulinum* has also been classified phenotypically into Groups I-IV. This organism is ubiquitous and is found in almost all foods, whether of plant or animal origin. Spores of *C. botulinum*, although usually in low numbers, are widely distributed in soil, the sediments of lakes and coastal waters and in the intestinal tracts of fish and animals.

Both the spores and the toxins are tolerant of freezing. Toxin is destroyed rapidly at temperatures of 75–80°C. Group I (proteolytic) spores are the most heat-resistant of all *C. botulinum* spores and this led to the development of the botulinum cook or '12D process' for low-acid canned foods. Strains of Group I will not grow if the water phase NaCl concentration exceeds 10 per cent ( $a_w = 0.935$ ) while strains of Group II will not grow if the concentration exceeds 5 per cent ( $a_w = 0.97$ ) in the water phase. All strains of *C. botulinum* grow and produce toxin to about pH 5.2 under optimal conditions. Strains of Group II will not grow below pH 5.0, while strains of Group I will not grow below pH 4.6 (ICMSF 1996).

**Pathology of illness:** Illness caused by *C. botulinum* can be of three types: food-borne, infant and wound botulism (FDA 2003). Food-borne botulism is caused by ingestion of preformed toxin. The mortality rate depends on the type of *C. botulinum* toxin ingested. Infant botulism affects infants under the age of 12 months and results from the ingestion of spores that colonise the alimentary tract and produce toxin.

Botulinum neurotoxin causes muscle paralysis, beginning in the upper body and progressing downward, paralysing the chest muscles, eventually leading to asphyxiation and death. Even with treatment, 20–40 per cent of victims die (M&S Food Consultants 2001).

Onset of symptoms in food-borne botulism is usually 18–36 hours after ingestion of the food containing the toxin, although cases have varied from 4 hours to 8 days. Early signs of intoxication consist of marked lassitude, weakness and vertigo, usually followed by double vision and progressive difficulty in speaking and swallowing, difficulty in breathing, weakness of other muscles, abdominal distension, and constipation may also be common symptoms (FDA 2003). All people are believed to be susceptible to the food-borne intoxication.

For seafoods, botulism is most commonly associated with *C. botulinum* type E (Group II). *C. botulinum* type E is capable of growth and toxin production at refrigeration temperatures ( $\geq 3.3^{\circ}\text{C}$ ) but generally needs weeks of growth to produce sufficient amounts of toxin to cause food-borne illness (Lyon & Reddmann 2000). This is significantly greater than the shelf life generally observed for seafood. Botulism is a concern, however, when processes are used to extend the shelf life, such as canning and vacuum packing. If the *C. botulinum* spores survived treatment processes prior to packaging, they have the ability to proliferate and produce toxin, especially if the food is subjected to temperature abuse.

**Infectious dose/dose response:** A very small amount (a few nanograms) of botulinum toxin can cause illness (FDA 2003). As little as 0.1–1.0  $\mu\text{g}$  of type A toxin has been found to cause death in humans (ICMSF 1996).

**Levels in seafood:** The aquatic environment is frequently contaminated with *C. botulinum* spores and therefore fish are often contaminated. A large number of surveys have been conducted, including those for seafoods at retail (Table 4.5). The incidence and level of contamination of prepared fish in Europe and Asia appears to be much lower than that in North America, but fish from Scandinavia and the Caspian Sea appear to be exceptions (Dodds 1993).

Only a limited amount of data are available on the prevalence of *C. botulinum* in Australia. *C. botulinum* types A, B and C have been isolated from soils and waterways and have caused illness in domestic animals (Szabo & Gibson 1997). *C. botulinum* type B was found in two marine muds from Tasmania (Szabo & Gibson 1997). In a study specifically designed to isolate *C. botulinum* type E, Christian (1971) found no evidence from 528 samples of soils, marine muds, fish intestines and potato washings from Tasmania, New South Wales and Queensland. Gibson et al. (1994) examined 368 samples from various Australian coastal marine, harbour and estuarine sediments and found no samples positive for the presence of the organism.

**Table 4.5: Prevalence and level of contamination of seafood products with *C. botulinum* spores**

Product	Origin	% positive	MPN/kg	Types identified
Haddock fillets	Atlantic Coast, N. America	24	170	E
Vacuum packed frozen flounder	Atlantic Coast, N. America	10	70	E
Frozen packaged fish	Canada	<1	–	A,B,E
Smoked fish (28 processors)	Pacific Northwest	5	9	E
Salmon	Alaska	1	–	E
	Washington	8	–	E
	Oregon	6	–	E
	Alaska	100	190	A
Vacuum packed fish	England	0	–	
	England	<1	–	E
	North Sea	0	–	
	Norwegian Sea	44	–	E
Smoked fish	Caspian Sea	0	<68	E
Fish	Indonesia	3	6	A,B,C,D,F
Fish and seafood	Osaka	8	3	C, D
	Viking Bank	42	63	E

Source: M&S Food Consultants 2001; after Dodds 1993.

Key: MPN = most probable number.

**Epidemiological data:** Botulism caused by consumption of commercial foods is rare, with most cases involving non-commercial foods (M&S Food Consultants 2001). Outbreaks are generally associated with improperly canned food (usually home canned) and semi-preserved seafoods including smoked, salted (particularly when uneviscerated) and fermented fish.

Outbreaks of botulism have been reported due to consumption of contaminated mussels in Portugal (Lecour et al. 1988); uneviscerated salted mullet fish (Faseikh) in Egypt, in April 1991 (Weber et al. 1993); hot-smoked Canadian whitefish in 1997 (Korkeala et al. 1998). Ten outbreaks of botulism associated with seafoods have occurred in the United States over the period 1988–98 (Bean et al. 1996; Olsen et al. 2000). Three deaths were reported in New York city from consumption of contaminated seafoods (Wallace et al. 1999); another two deaths reported from botulinum type E toxin associated with eating ‘kapchunka’, a salted ungutted whitefish dish (Badhey et al. 1986) and a further 8 cases occurred in New York and Israel involving the same food (Telzak et al. 1990).

In Canada 61 outbreaks occurred in the period 1971–84, most (113/122) cases involving native peoples eating raw, parboiled or ‘fermented’ meats from marine mammals. A similar pattern of illness occurs in Alaska. Fermented salmon eggs or fish were responsible for 23 per cent of these outbreaks (Hauschild & Gauvreau 1985).

In 1978 (United Kingdom) and 1982 (Belgium) there were two outbreaks of botulism from canned salmon. In the United Kingdom, two people died and two recovered (Murrell 1979) while in Belgium, one died and one recovered (Anon. 1982). There were also a number of outbreaks from smoked, vacuum-packed whitefish in United States in 1963; in all there were 25 cases of botulism and 10 deaths (Anon. 1963).



In New Zealand, there have been two cases of illness (one death) due to botulism type A involving home-bottled fermented mussels and watercress, a traditional Maori food Hauschild (1993).

There have been no reported cases of food-borne botulism in Australia since national notification commenced in 1991 (Blumer et al. 2003). From 1942–83 there were five reported outbreaks of botulism in Australia (Hauschild 1993), of which one (two cases) was linked to consumption of Australian canned tuna (Murrell 1979).

### *Aeromonas hydrophila*

*Aeromonas hydrophila* is a gram-negative, facultatively anaerobic, non-spore forming rod-shaped bacterium that is present in all freshwater environments and in estuarine environments. It is also found in a wide range of foods, including seafood products and shellfish, raw foods of animal origin (for example, poultry, ground meat, raw milk), and raw vegetables (Kirov 2003). *Aeromonas* spp. are ubiquitous and occur worldwide, but are most frequently isolated from treated and untreated water and animals associated with water such as fish and shellfish. Many authors use the name of *A. hydrophila* as a general term to include *A. sobria* and *A. caviae* as well as the main species of *A. hydrophila* (ICMSF 1996). In this document, *A. hydrophila* refers to this species only, unless otherwise indicated.

These bacteria are psychrotrophic and grow rapidly at refrigeration temperatures. Temperature range for growth is 2–45°C with an optimum range between 28°C and 35°C (ICMSF 1996). Growth is optimal in the presence of 1–2 per cent NaCl ( $a_w = 0.991–0.986$ ) and has been found to be inhibited completely at a NaCl concentration of 6.0 per cent ( $a_w = 0.96$ ) or pH 5.5. (ICMSF 1996).

**Pathology of illness:** *Aeromonas* spp. causes a broad spectrum of infections in humans, often in immunocompromised patients, but has not been definitively implicated as a significant cause of food-borne illness. *A. hydrophila* may cause gastroenteritis in healthy individuals or septicaemia in individuals with impaired immune systems or various malignancies. Two distinct types of gastroenteritis have been associated with *A. hydrophila*: a cholera-like illness with a watery (rice water) diarrhoea and a dysenteric illness characterised by loose stools containing blood and mucus.

Symptoms associated with *Aeromonas*-related gastroenteritis include diarrhoea, abdominal pain, nausea, chills and headache, dysentery-like illness and colitis. Symptoms usually occur within 24–48 hours of exposure and generally last from one to 7 days (Kirov 2003). On rare occasions the dysentery-like syndrome is severe and may last for several weeks (FDA 2003). All people are believed to be susceptible to gastroenteritis, although it is most frequently observed in very young children. People with impaired immune systems or underlying malignancy are susceptible to the more severe infections (FDA 2003).

Illness caused by *A. hydrophila* is thought to be mediated partly by production of several cytotoxins. Other virulence factors thought to be associated with colonisation of the intestine have not been conclusively identified.

**Infectious dose/dose response:** The infectious does of this organism is unknown. However, it is likely that illness can result from a low dose, as scuba divers who have ingested small amounts of water have become ill, and *A. hydrophila* has been isolated from their stools (FDA 2003).

**Levels in seafood:** *Aeromonas* spp. are ubiquitous throughout the environment (particularly fresh and marine waters) and have been isolated from a variety of foods (Birkenhauer & Oliver 2002).

**Epidemiological data:** Most cases of illness attributed to *A. hydrophila* have been sporadic, rather than associated with large outbreaks. To date, the number of reported food associated outbreaks attributed to *Aeromonas* species is small (Table 4.6).

**Table 4.6: Seafood food-borne illness associated with *Aeromonas* species**

Location	No. of people involved	Suspect food	Reference
Russia	'mass' poisoning	Fish (pre-frozen)	Kalina 1997
United States of America	472	Oysters	Agbonlahor et al. 1982
United States of America	7	Oysters	Abeyta et al. 1986
United States of America	29	unknown (school lunch)	Kobayashi & Ohnaka 1989
Japan	4	Seafood (sashimi)	Kobayashi & Ohnaka 1989
Scotland	>20	Cooked prawns	Todd et al. 1989
England	3	Oysters	Todd et al. 1989
England	14	Cooked prawns	Todd et al. 1989
England	2	Cooked prawns	Todd et al. 1989
Switzerland	1	Shrimp cocktail	Altwegg et al. 1991
Norway	3	Raw fermented fish	Granum et al. 1998
France	10	Dried fish sauce	Hansman et al. 2000

Source: Kirov 2003.

Suspect foods have been principally seafood and oysters, or other foods consumed with little or cooking. In only one case, which was linked to ready to eat shrimp cocktail, has the isolate from the suspect food and diarrhoeal faeces been shown to be the same ribotyping (Kirov 2003). Most recently reported *Aeromonas*-associated outbreaks have occurred in Sweden, Norway and France (Granum et al. 1998; Hansman et al. 2000; Krovacek et al. 1995). They are however, still insufficiently documented to definitively established *Aeromonas* spp. as the causative agents.

### *Escherichia coli*

*E. coli* are members of the family Enterobacteriaceae. The organisms are gram-negative, facultatively anaerobic rod shaped bacteria (Desmarchelier & Fegan 2003). There are currently four main types of pathogenic *E. coli* that have been associated with food-borne diseases: enteropathogenic *E. coli* (EPEC), enterotoxigenic *E. coli* (ETEC), enteroinvasive *E. coli* (EIEC) and enterohaemorrhagic *E. coli* (EHEC).

EPEC have been defined as 'diarrhoeagenic *E. coli* belonging to serogroups epidemiologically incriminated as pathogens but whose pathogenic mechanisms have not been proven to be related either to heat-labile enterotoxins or heat-stable enterotoxins or to *Shigella*-like invasiveness' (Edelman & Levine 1983).

EPEC cause characteristic attaching and effacing lesions in the intestine, similar to those produced by EHEC, but do not produce Shiga toxins. Attachment to the intestinal wall is mediated by a plasmid-encoded outer membrane protein called the EPEC Adherence Factor in type I EPEC. However, pathogenicity is not strictly correlated to the presence of the EPEC Adherence Factor, indicating that other virulence factors are involved (ICMSF 1996).

EPEC that survive passage through the stomach adhere to mucosal cells of the proximal small intestine and produce a heat-labile and/or a heat-stable toxin. The heat-labile are similar in structure and mode of action to cholera toxin (Desmarchelier & Fegan 2003).

EIEC cause a shigellosis-like illness by invading the epithelial cells of the distal ileum and colon. The bacteria multiply within the cytoplasm of the cells, causing cell destruction and ulceration. Pathogenicity is associated with a plasmid-encoded type III secretory apparatus and other plasmid-encoded virulence factors (Desmarchelier & Fegan 2003).

EHEC are a group of *E. coli* organisms producing Shiga toxins and a number of other virulence factors, particularly the adhesion molecule, intimin. The Shiga toxins are closely related or identical to the toxins produced by *Shigella dysenteriae*. Genes of the virulence factors other than Shiga toxins are located in the locus of enterocyte effacement. These virulent factors and Shiga toxins allow the organisms to attach tightly to intestinal epithelial cells, disrupting the cytoskeletal structure and signalling pathways and causing effacing lesions (Ismaili et al. 1998). Many synonyms are used to describe EHEC, including Shiga toxin-producing *E. coli*, Shiga-like toxin-producing *E. coli*, verotoxin-producing *E. coli*, verocytotoxin-producing *E. coli*, as well as *E. coli* O157 and *E. coli* O157:H7.

**Pathology of illness:** EPEC primarily causes illness in infants and young children in developing countries. Symptoms include watery diarrhoea, with fever, vomiting and abdominal pain. The diarrhoea is usually self-limiting and of short duration, but can become chronic (more than 14 days). EPEC is also recognised as a food- and water-borne pathogen in adults, where it causes severe watery diarrhoea (with mucus, but no blood) along with nausea, vomiting, abdominal cramps, fever, headache and chills. Duration of illness is typically less than three days (Doyle & Padhye 1989).

EPEC is another major cause of diarrhoea in infants and children in developing countries, as well as being recognised as the main cause of 'travellers' diarrhoea' (Doyle & Padhye 1989). Symptoms include watery diarrhoea, low-grade fever, abdominal cramps, malaise and nausea. In severe cases, the illness resembles cholera, with severe rice-water diarrhoea and associated dehydration. Duration of illness is from three to 21 days (Doyle & Padhye 1989).

EIEC cause a dysenteric illness similar to shigellosis. Along with profuse diarrhoea, symptoms include chills, fever, headache, muscle pain and abdominal cramps. Onset of symptoms is usually rapid (<24 hours), and may last several weeks (Doyle & Padhye 1989).

EHEC infection normally results in diarrhoea like symptoms. Haemorrhagic colitis, an acute illness caused by EHEC organisms, is characterised by severe abdominal pain and diarrhoea. This diarrhoea is initially watery but becomes grossly bloody. Symptoms such as vomiting and low-grade fever may be experienced. The illness is usually self-limiting and lasts for an average of 8 days. The duration of the excretion of EHEC is about one week or less in adults, but it can be longer in children (ICMSF 1996).

Complications resulting from EHEC infections vary. About 5 per cent of haemorrhagic colitis victims may develop Haemolytic Uraemic Syndrome (European Commission 2000). This involves the rupture of red blood cells (haemolysis), subsequent anaemia, low platelet count and kidney failure. The case-fatality rate of Haemolytic Uraemic Syndrome is 3–5 per cent (WHO 1996). *Shigella* toxins produced by EHEC attack the lining of the blood vessels throughout the body, predominantly affecting the kidney.

However, other organs such as the brain, pancreas, gut, liver and heart are also affected and may result in further complications such as thrombotic thrombocytopenic purpura.

**Infectious dose/dose response:** EPEC: It is thought that only a few EPEC cells are necessary to cause illness in children (FDA 2003). Volunteer studies in adults demonstrated that illness could be caused by ingesting  $10^6$ – $10^{10}$  cells with sodium bicarbonate to neutralise stomach acidity (Doyle & Padhye 1989).

ETEC: Volunteer studies have shown that  $10^8$ – $10^{10}$  cells of ETEC are necessary for illness in adults (DuPont et al. 1971), although the infective dose is probably less for infants (FDA 2003).

EIEC: Volunteer studies have shown that  $10^8$  EIEC cells are necessary to cause illness in adults, with the infectious dose reduced to  $10^6$  when ingested with sodium bicarbonate (DuPont et al. 1971). However, the United States FDA suggest that as few as 10 cells may be needed to cause illness in adults, based on the organisms similarity with *Shigella* (FDA 2003).

EHEC: Investigations of known outbreaks of food-borne illness due to *E. coli* O157:H7 and systematic studies aimed at quantifying the dose–response relationship suggest that as few as 1–700 EHEC organisms can cause illness. The United States FDA suggests that the infective dose is of the order of 10 cells (FDA 2003).

**Incidence and outbreak data:** EIEC stains have been isolated from diarrhoeal cases in both industrialised and less developed countries with low frequency (Nataro & Levine 1994). Outbreaks have occurred in hospitals, on a cruise ship, and from contaminated water (Desmarchelier & Fegan 2003). ETEC stains are a major cause of diarrhoea in infants and young children in developing countries, particularly in the tropics, and are a leading cause of travellers' diarrhoea (Doyle & Padhye 1989; Gross & Rowe 1985; Nataro & Levine 1994). EPEC stains have caused infantile diarrhoea in hospitals and nurseries in the United Kingdom and the United States (Nataro & Levine 1994; Robins-Brown 1987). In developing countries, EPEC stains are still responsible for a high incidence of sporadic infant diarrhoea.

Among different EHEC serotypes, *E. coli* O157:H7 is the single most important EHEC serotype that dominates the number of reported food-borne illnesses caused by EHEC. Mead et al. (1999) reported that *E. coli* O157:H7 caused approximately 73 000 cases of illness each year, and non-O157:H7 EHEC caused approximately 37 000 cases of illness in the United States. During 1999 to 2002, inclusive, Australia recorded 55 cases of HUS (Communicable Diseases Australia 2003).

**Levels in seafood:** The occurrence of strains of EPEC, ETEC and EIEC in foods is typically the result of human faecal contamination, due either to poor hygienic practices by food handlers or raw sewage contamination of waters used in the food production and processing (Desmarchelier & Fegan 2003).

There have been only isolated outbreaks of food-borne illness attributed to seafood containing EIEC and ETEC strains of *E. coli* (Doyle & Padhye 1989). ETEC have been detected in Brazilian seafood harvested from contaminated waters (Teophilo et al. 2002).

EHEC are normally isolated from meat, dairy and plant products (Desmarchelier & Fegan 2003). However, a low level of contamination was detected in one survey of retail fish and shellfish samples in the United States (Samadpour et al. 1994).

## **Viral pathogens**

The viral pathogens discussed here are hepatitis A and noroviruses.

### *Hepatitis A*

Hepatitis A virus is classified within the enterovirus group of the *Picornaviridae* family. Hepatitis A virus has a single molecule of ribonucleic acid (RNA) surrounded by a small (27 nm diameter), non-enveloped, protein capsid (FDA 2003).

Hepatitis A virus is distributed worldwide and is usually transmitted from person-to-person via the faecal-oral route. Hepatitis A virus is excreted in faeces of infected people and can infect susceptible individuals when they consume contaminated water or foods. Water, shellfish, and salads are the most frequent sources.

**Pathology of illness:** The incubation period for hepatitis A virus is generally 2–6 weeks, and with a sudden onset of symptoms including fever, headache, malaise, fatigue, anorexia and nausea, usually followed by vomiting and abdominal pain. When symptoms do occur, they are usually mild and recovery is complete in 1–2 weeks. Many infections do not result in clinical illness especially in children (Grohmann 1997). Less than 0.4 per cent of reported cases in the United States are fatal, usually occurring in the elderly (Sobsey et al. 1991; FDA 2003). Recovery is complete and gives lifelong immunity to further infection. Immunocompromised individuals are more susceptible to infection (Sobsey et al. 1991; FDA 2003).

The mechanisms by which illness is caused are not fully understood, but viral particles are thought to replicate in the gastrointestinal tract and then the liver where they cause cellular damage.

**Infectious dose/dose response:** The infectious dose is unknown (Bidawid et al. 2000) but is presumably similar to other RNA enteroviruses (10–100 particles; FDA 2003).

**Levels in seafood:** Several studies have demonstrated the presence of hepatitis A virus in bivalve molluscs grown in waters subject to human faecal pollution (Table 4.7). The prevalence of contamination is typically higher in shellfish taken from waters closed for harvest, but significant rates of contamination have been demonstrated in areas open for harvest.

**Table 4.7: Reported incidence of hepatitis A virus in seafood**

Food (% positive)	Viruses detected	Reference
Shellfish (21%)	hepatitis A virus	Apaire Marchais et al. 1995
Mussel and cockle (73%)	hepatitis A virus	Crance et al. 1995
Cockles and mussels (67%)	hepatitis A virus	Le Guyader et al. 1993
Cockles and mussels (14%)	hepatitis A virus	Le Guyader et al. 1994
Cockles (84%)	hepatitis A virus	Le Guyader et al. 1995

Source: M&S Food Consultants 2001.

**Epidemiological data:** Shellfish have been associated with food-borne viral infection throughout the world. In 1991 almost 300 000 people in Shanghai contracted hepatitis and nine died after consuming cockles contaminated with hepatitis A virus (Tang et al. 1991).

Hepatitis A virus has also been linked to shellfish-associated gastroenteritis in Australia (Table 4.8). The first reported case of hepatitis A virus from shellfish in Australia was attributed to under-cooked mussels from contaminated waters in Victoria. Seven out of the ten consumers who ate the mussels developed symptoms of hepatitis A (Locarnini & Gust 1978).

The largest outbreak of hepatitis A in Australia occurred during 1996–97 following consumption of oysters harvested from the Wallis Lake region, New South Wales, Australia (Communicable Disease Intelligence 1997) when 444 people were affected and one died.

**Table 4.8: Recent outbreaks of hepatitis shellfish-associated food poisoning in Australia**

Year	Seafood	Growing area	Cases (deaths)
1997	Oysters	Wallis lake, NSW	466 (1)
1997	Prawns	Imported product	17

Source: C Dalton, Hunter Public Health Unit, personal communication.

### *Noroviruses*

Noroviruses (previously termed Norwalk and Norwalk-like viruses) are non-enveloped RNA viruses classified in the Caliciviridae family. The group is described collectively as small round structured viruses.

**Pathology of illness:** Noroviruses cause gastroenteritis in adults and children. The illness is relatively mild and symptoms include nausea, vomiting, diarrhoea, fever and abdominal pain with an incubation period of 1–4 days, usually followed by recovery without complications (Grohmann & Lee 2003). Onset occurs 24–48 hours after infection and the acute phase of the illness generally lasts between 1 and 2 days (ICMSF 1996). Norwalk virus causes illness by invading and damaging the gastrointestinal tract. Infection may not confer long-term immunity.

Human Norovirus may cause epidemic gastroenteritis amongst all age groups and may be the most significant cause of infectious intestinal illness. Attack rates for small round structured virus seafood-associated gastroenteritis in outbreaks are relatively high, with rates of 56 per cent to 89 per cent being reported (Kirkland et al. 1996; Linco & Grohmann 1980).

**Infectious dose/dose response:** The infectious dose is unknown but presumed to be low (FDA 2003).

**Levels in seafood:** Norovirus has been shown to accumulate in bivalve molluscs and is commonly isolated from oysters grown waters impacted by faecal contamination (Formiga-Cruz et al. 2002; LeGuyader et al. 2000). Of particular concern, a study by Schwab et al. (1998) demonstrated that depuration of oysters may result in only a limited reduction of Norovirus concentration (7% reduction following 48 h depuration, compared with 95% reduction of bacteria).

**Epidemiological data:** Norovirus is a major cause of food-borne disease worldwide and is commonly associated with the consumption of faecally contaminated shellfish. This was first evident in 1977, when an outbreak of gastroenteritis in the United Kingdom (> 2000 cases) was linked to oysters harvested from George’s River, Sydney (Fleet et al. 2000).

The oysters had been opened and frozen on the half shell prior to being exported. During 1987–2001, at least 13 outbreaks of gastroenteritis associated with Norovirus contamination of oysters were recorded in Australia (Table 4.9; Food Science Australia & Minter Ellison Consulting 2002). A major contributing factor with these outbreaks was the consumption of raw oysters following heavy rainfall, resulting in increased faecal contamination of shellfish growing areas due to sewage pollution.

**Table 4.9: Recent outbreaks of Norovirus virus associated with seafood consumption in Australia**

Year	Product	Location	Cases
1992	Oysters	Northern Territory	18
1990	Oysters	New South Wales	461
1989	Oysters	Australia	>370
1996	Oysters	New South Wales	97
1999	Scallops	Queensland	14

Source: Adapted from Food Science Australia & Minter Ellison Consulting, 2002.

## Parasites

Parasites are eukaryote organisms that generally belong to either of two major taxonomic groups: protozoa and helminths. Among parasites associated with fish and seafoods, most of those known to cause illness in humans are helminths (parasitic worms) and include nematodes (roundworms), cestodes (tapeworms) and trematodes (flat worms, or flukes). Over 50 species of helminths from fishes, crabs, snails and other molluscs are known to cause human illness. Those of most concern are:

- Nematodes – *Anisakis simplex*, *Pseudoterranova decipiens*, *Eustrongylides* spp. and *Gnathostoma* spp.
- Cestodes – *Diphyllobothrium*.
- Trematodes – *Clonorchis sinensis*, *Opisthorchis* spp., *Heterophyes* spp., *Metagonimus*, *Nanophyetes salminicola* and *Paragonimus*.

Of the protozoa, none have been implicated in food-borne illness due to seafood consumption in Australia and are not further considered in this report. One recent study has demonstrated the recovery of viable infective *Cryptosporidium parvum* oocysts from oysters (Fayer et al. 1998). The same study failed to detect *Giardia* cysts.

*Nematodes (roundworms)*

*Anisakis simplex*, *Pseudoterranova decipiens*, *Eustrongylides* and *Gnathostoma* are anisakid nematodes (roundworms) that have been implicated in human infections.

**Pathology of illness:** Anisakiasis is caused by ingestion of the larval stages of nematodes (Myjak et al. 1994). The illness is characterised by, nausea, vomiting and haematemesis. It is most frequently diagnosed when the affected individual feels a tingling or tickling sensation in the throat and coughs up or manually extracts a nematode. In more severe cases abdominal pain is accompanied by a nauseous feeling. Symptoms occur from as little as an hour to two weeks after consumption of raw or undercooked seafood (FDA 2003). It has also been reported that exposure to material from dead *A. simplex* may result in allergic reactions in some individuals, with symptoms ranging from mild, acute allergic reactions to anaphylaxis and chronic, debilitating conditions (Audicana et al. 2002).

Once ingested, larval nematodes from fish or shellfish usually burrow into the wall of the digestive tract to the level of the muscularis mucosae and can occasionally penetrate the intestinal wall completely and are found in the body cavity. They produce a substance that attracts eosinophils and other host white blood cells to the area. The infiltrating host cells form a granuloma in the tissues surrounding the penetrated worm. In the digestive tract lumen the worm can detach and reattach to other sites on the wall. Anisakids rarely reach full maturity in humans and usually are eliminated spontaneously from the digestive tract lumen within three weeks of infection. Penetrated worms that die in the tissues are eventually removed by the host's phagocytic cells (FDA 2003).

**Infectious dose/dose response:** Ingesting one nematode is believed to be sufficient to cause illness, and is the usual number removed from patients (FDA 2003).

**Prevalence in seafood:** *Anisakis simplex* has been isolated from many species of fish including: rockfish, herring, cod, halibut, mackerel, wild-caught salmon, yellowfin and skipjack tuna, and squid, from many regions of the world (FDA 2003; Hurst 1984). Reports from Japan include mussels, oysters, crawfish, lobster and prawns as sources of anisakid infections (Durborow 1999).

The rates of infection are often high with 10–90 per cent of samples carrying the parasite (Bouree et al. 1997). Multiple larvae in each fish are also commonly recorded. Table 4.10 lists the incidence and prevalence of *A. simplex* and other parasites in fish at retail sale around the world.

In Australia *A. simplex* has been isolated from flathead (*Platycephalus speculator*), mackerel (*Scomberomorus* spp.), mackerel tuna (*Euthynnus alleteratus*), striped trumpeter and farmed salmonids (Ross 2000; Humphrey 1995). It is not known, however, whether the strains isolated were pathogenic to humans.



**Table 4.10: Incidence of *A. simplex* larvae in market fish**

Market	Species	Infection rate (%)	No. of larvae per fish/fillet	Reference
Belgium	Pollock, whiting, catfish, ling, cod, saithe, redfish	4–83	7.8/kg fillet	Piccolo et al. 1999
Kuwait	83 species of fish	13		Sey & Petter 1997
Spain	Horse mackerel	39 26 ( <i>A. simplex</i> )		Adroher et al. 1996
Korea	Anchovies Sea eel	7 58 (not all pathogenic)	1–2	Song et al. 1995 Chai et al. 1992
Paris	13 species including herring, redfish, hake	83–89		Huang 1988
Iran	Tuna Pike perch	75 20		Eslami & Mokhayer 1977
France	Saithe, whiting	'Frequent'		Chord-Auger et al. 1995
USA sashimi restaurants	Salmon, tuna, mackerel, rockfish	~10	max. 3	Adams et al. 1994
Italy	10 species	54 3/4 smoked fish	average > 6	Pacini et al. 1993
Taiwan	13 species	38	average = 14 max 80/fish	Chao 1985

Source: M&S Food Consultants 2001.

**Epidemiological data:** Helminthic parasites are sensitive to freezing and to relatively mild heating (that is, normal cooking temperatures). Consequently, those parasites associated with seafood are generally passed to humans by consumption of raw, minimally processed or inadequately cooked chilled products which are mostly associated with sociocultural and behavioural factors (Adams et al. 1997). Anisakiasis is a relatively common disease in Japan, largely because fish is often eaten raw, lightly cooked or pickled. Infection is also relatively common in northern Europe where cured fish, such as pickled herring, are part of the diet. In Japan the annual incidence of anisakiasis is greater than 1000 cases/annum (Deardorff & Overstreet 1991). In the United States, approximately 10 cases per year are reported but it is considered that many cases go unreported (FDA 2003).

Infections of *A. simplex* have been reported in New Zealand, however, there has been no documented case of foodborne anisakid infection in Australia (Goldsmid & Speare 1997).

#### *Trematodes (flat worms, flukes)*

Fish-borne flatworm (trematode) infections are a public health problem in about 20 countries, particularly in south-east Asia, where freshwater fish are intermediate hosts for *Clonorchis* and *Opisthorchis* and freshwater crustaceans in the case of *Paragonimus*. In terms of human infection, the most important species are from the genera *Clonorchis* and *Opisthorchis* (liver flukes), *Paragonimus* (lung flukes) and to a lesser extent *Heterophyes* and *Echinochasmus* (intestinal flukes). Human susceptibility to infection appears to be universal.

**Pathology of illness:** When eaten by the definitive host, the metacercariae (infective stage) of *C. sinensis* encyst in the duodenum, migrate into the bile duct and grow to adulthood. Symptoms may be slight or absent in light infections, the symptoms resulting from local irritation of the bile ducts by the flukes.

Loss of appetite, diarrhoea and abdominal pressure are early symptoms of infection, which may take up to 30 days to become apparent. Jaundice may result in enlargement and tenderness of the liver, and progressive ascites and oedema followed by cirrhosis, although this is rare. The organisms may live in human host for 25–30 years. Diarrhoea, epigastric pain, and anorexia are common manifestations of acute illness. Adult worms can produce localised tissue damage that may interfere with bile function, leading to secondary bacterial infection. It is usually a mild illness, and often asymptomatic, but is a significant risk factor for the development of carcinoma of the liver (Goldsmid & Speare 1997).

**Levels in seafood:** Reservoir hosts of *Clonorchis sinensis* are wild and domestic mammals. Metacercariae have also been found in crayfish. Metacercariae encyst in fish gills, fins, muscles or under the skin. Adult worms (1.2–2.4 cm long and 0.3–0.5 cm wide) reside in the bile duct. Pancreatitis and cholangiocarcinoma has also been reported (Shin et al. 1996).

Infection by *Paragonimus westermani* (human lung fluke) can occur through eating raw or improperly cooked freshwater crabs or crayfish. Important hosts include freshwater and brackish-water crabs of the genera *Eriocheir*, *Potamon*, and *Sundathelphusa* and the crayfish *Procambarus* (M&S Food Consultants 2001). Direct person to person transmission does not occur (Benenson 1995).

Hosts of the liver fluke include grass carp (*Ctenopharyngodon idellus*) and silver carp (*Hypophthalmichthys molitrix*), common aquaculture species in Asia (Durborow 1999).

**Infective dose/dose response:** No data are available on the infective dose for trematode infection. Infections with as many as 500–1000 worms have been reported (M&S Food Consultants 2001). Severity of symptoms is related to the intensity and duration of infection.

**Incidence and outbreak data:** Fish-borne trematode illness is highly endemic in south-east China but also in other parts of Asia. *Clonorchis sinensis* affects an estimated 7 000 000 people worldwide. It is the most common parasite in Hong Kong, where 30–60 per cent of the population are believed to be infected. Opisthorchiasis (*O. viverrini*) is a major cause of death in north-east Thailand and it is estimated that 7 million people are infected in that country. The infection is very common in Laos (Durborow 1999).

#### *Cestodes (tape worms)*

Cestodes are tapeworms with segmented bodies and a structure that allows them to attach to the intestinal wall of their hosts. *Diphyllobothrium latum* a broad tapeworm is the species of most concern. *D. latum* parasites are distributed worldwide. A similar species is found in the southern latitudes and is associated with seal hosts. Cases have been reported worldwide, including Australia. It is the largest human tapeworm, growing up to 10 metres (FDA 2003).

Fish are intermediate hosts and infective larvae have been found in trout, whitefish, pike and salmon. Cestode larvae found in fish range from a few millimetres to several centimetres in length and are white or grey in colour. *Diphyllobothrium* tapeworms primarily infect freshwater fish, but salmon and related fish can also carry the parasite. *Diphyllobothrium* tapeworms are usually found unencysted and coiled in musculature or encysted in viscera (M&S Food Consultants 2001).

*Diphyllobothrium* spp. have been reported to be present in Australian fish (Humphrey 1995) but there is little detail of the parasite species or species of fish affected.

**Pathology of illness:** Common symptoms are nausea, abdominal pain, diarrhoea and weakness, but infection may also cause pernicious anaemia and vitamin B12 deficiency if the worm attaches to the jejunum. *D. denderiticum* and *Ligula intestinalis* (tapeworms of fish eating birds) and *D. pacificum* (tapeworm of seals) have also been found in humans. The infection is usually mild, or even asymptomatic, and often of long duration. Massive infections may be associated with diarrhoea and obstruction of the intestinal tract, because the mature worm may be up to 10 metres long in the human host (FDA 2003; Goldsmid & Speare 1997).

People are universally susceptible to cestode infection, and there appears to be no induction of immunity (Benenson 1995). People of Scandinavian heritage may be genetically more susceptible to developing severe anaemia due to the tapeworm's great requirement for and absorption of Vitamin B12 (FDA 2003). Victims may harbour more than one worm and multiple worms can amplify the symptoms of infection (M&S Food Consultants 2001).

**Epidemiological data:** Infection is related to dietary and culinary practices. As with nematodes, human infections have been linked to consumption of raw or minimally processed fish. Freezing and cooking temperatures lethal for anisakids will kill the infective stage of *D. latum*.

#### *Acanthocephala* (spiny headed worms)

These burrowing worms are widespread in nature, infecting amphipod crustaceans, freshwater and marine fish, and other, non-aquatic, species. They are intestinal parasites, and may cause an inflammatory response at the site of proboscis attachment, although usually there are no clinical signs. Wild aquatic birds (such as ducks, swans and geese), dogs, pigs and monkeys are the definitive hosts. These worms are considered to pose little risk to humans because they are relatively scarce in the fish eaten by man, and because the worms are usually localised in the viscera of fish, and thus less likely to be eaten (M&S Food Consultants 2001).

### **Chemical contaminants**

The chemical contaminants discussed here are algal biotoxins, histamines, ciguatoxins, escolar wax esters, arsenic, cadmium, lead, mercury and zinc.

#### *Algal biotoxins*

Algae form an important component of the plankton diet of shellfish such as mussels, oysters and scallops. Molluscan shellfish may accumulate toxins produced by toxic algae or other marine micro-organisms, and these may present significant human health risks. Shellfish generally become toxic following a hazardous algal bloom where toxigenic species reach high levels in the water. Of the estimated 2000 living dinoflagellate species, about 30 species produce toxins that can cause human illness from shellfish or fish poisoning. When humans eat seafood contaminated by these toxins, they may suffer a variety of gastrointestinal and neurological illnesses. The most common syndromes are:

- paralytic shellfish poisoning
- diarrhoeic shellfish poisoning
- neurotoxic shellfish poisoning
- amnesic shellfish poisoning.

In addition to these classes of algal biotoxins, azaspiracids (AZAs) are recently identified cytotoxins which have been found in Northern European mussels (specifically in Ireland, United Kingdom and Norway), causing a diarrhoeic shellfish poisoning-like acute toxic response in a small number of outbreaks of food-borne illness. There is no evidence that AZAs are found in Australian or New Zealand shellfish, and although some risk might occur due to imports (for example, mussels from the United Kingdom), these toxins have not been explicitly considered in this report.

### Paralytic shellfish poisons

Potentially toxic dinoflagellates responsible for paralytic shellfish poisoning in Australian waters include *Alexandrium (Gonyaulax) catenella* (Port Phillip Bay, South Australia, New South Wales), *Alexandrium minutum* (Port River, South Australia; Western Australia; Shoalhaven, New South Wales), *Alexandrium tamarense* (presumed toxic strains in Port Phillip Bay), *Gymnodinium catenatum* (Tasmania, Victoria, South Australia, New South Wales) and *Pyrodinium bahamense* var. *compressum* (potential for blooms in the Gulf of Carpentaria) (Hallegraeff 1991, Hallegraeff et al. 1991).

Bivalve molluscs are most at risk of accumulating toxic levels of paralytic shellfish poisons because of their ability to filter and accumulate particles suspended in the water column. Blue mussels, *Mytilus edulis*, can accumulate in excess of 20 000 µg saxitoxin/100 gram tissue (RaLonde 1996). There are about 20 toxins responsible for paralytic shellfish poisoning, all of which are derivatives of saxitoxin. Shellfish species from the same affected area may accumulate different concentrations of toxin.

**Hazard identification and characterisation:** Paralytic shellfish poisoning toxins block the sodium channels of excitable membranes of the nervous system and associated muscles, inhibiting action potentials and nerve transmission impulses (ANZFA 1999a).

Symptoms of poisoning usually occur within 30 minutes to 2 hours after ingestion of shellfish, depending on the amount of toxin consumed. A mild case can cause a tingling sensation or numbness around lips, gradually spreading to face and neck; prickly sensation in fingertips and toes; and headache, dizziness, nausea, vomiting, and diarrhoea. Extreme cases (high doses) can lead to paralysis of the diaphragm, respiratory failure, choking sensation and death (Hallegraeff 2003). Predominant manifestations include paraesthesia of the mouth and extremities, ataxia, dysphagia and muscle paralysis; gastrointestinal symptoms are less common. The prognosis is favourable for patients who survive beyond 12–18 hours. In unusual cases, because of the weak hypotensive action of the toxin, death may occur from cardiovascular collapse despite respiratory support (FDA 2003).

The extreme potency of the paralytic shellfish poisoning toxins has, in the past, resulted in an unusually high mortality rate. In a study of paralytic shellfish poisoning in Alaska between 1973 and 1992, 54 outbreaks involving 117 ill people were examined. Illness was not associated with the shellfish toxin concentration, method of food preparation, dose, race, sex, or age (Gessner & Middaugh 1995).

In humans 120–180 µg paralytic shellfish poisons can produce moderate symptoms, 400–1060 µg PSP can cause death, but 2000–10 000 µg is more likely to constitute a fatal dose (Hallegraeff 2003).

**Incidence of human illness:** Paralytic shellfish poisoning is caused by consumption of contaminated shellfish. Usually by consumption of mussels, clams, cockles and scallops or broth made from cooked shellfish that contain either concentrated saxitoxin, an alkaloid neurotoxin or related compounds (FDA 2003). Globally, paralytic shellfish poisons are responsible for some 2000 cases of human poisoning per year, with around 15 per cent mortality (Hallegraeff 2003).

Lehane (2000) has undertaken a comprehensive review of paralytic shellfish poisons which indicates that, while potentially lethal concentrations of paralytic shellfish poisons have been detected in shellfish, there have been no documented outbreaks in Australia. Table 4.11 lists the number and the annual rates of algal biotoxin-related illness in the United States and Australia for the years 1990–2000.

**Table 4.11: Algal biotoxin related outbreaks of food-borne illness in Australia and the United States, 1990–2000**

Country	Outbreaks	Cases	Cases/outbreak	Annual rate (per 100 000 population)
Australia	3	102	34	0.060
United States	9	125	14	0.005

Source: Extracted from M&S Food Consultants 2001; after Smith de Waal et al. 2000.

**Concentrations in seafood:** The results of monitoring for paralytic shellfish poisons in Port Phillip Bay and Western Port Bay in Victoria are shown in Table 4.12 (ANZFA 1999a).

**Table 4.12: Paralytic shellfish poison results in mussels in Victoria**

Year	No. of samples	No. of positive samples	Average concentration (all samples)(µg/100 g)	Highest concentration (µg/100g)
1987	11	0	0	0
1988	81	17	29.1	480
1989	88	3	2	66
1990	87	3	3.16	121
1991	34	5	15.4	185
1992	46	25	710.4	10009.6
1993	160	41	64.3	4127.7
1994	188	25	26.6	1286.8
1995	165	10	6.6	406.6
1996	161	0	0	0
1997	44	0	0	0

Extensive testing for PSP has also taken place in Tasmania in mussels, oysters and scallops. The results are shown in Table 4.13 (ANZFA 1999a).

**Table 4.13: Paralytic shellfish poison results in Tasmania**

Food	No. of samples	Average concentration (µg/100 g)	Range
Mussels	168	636	35–18429
Oysters	75	123	38–699
Scallops	6	60	56–83

**Current regulations:** A maximum level of 0.8 mg/kg for paralytic shellfish poisons (saxitoxin equivalent) has been established in Standard 1.4.1 – Contaminants and Natural Toxicants – of the Code.

**Ranking of hazard:** PSP is ranked as ‘severe’ in terms of adverse health effects (Section 3, Table 3) because of its potential to be life-threatening or cause chronic sequelae following acute exposure.

#### Diarrhetic shellfish poisons

Diarrhetic shellfish poisoning is caused by a group of high molecular weight polyethers, including okadaic acid, the dinophysins and the pectenotoxins produced by the armoured dinoflagellate algae *Dinophysis fortii* and *D. acuminata*.

In this report, yessotoxins have also been considered as a subset of the diarrhetic shellfish poisons, although this classification is under review due to apparent significant differences in structure and mode of action between yessotoxins and the ‘true’ DSPs, particularly okadaic acid and dinophysins.

Potentially toxic diarrhetic shellfish poisoning plankton dinoflagellates in Australian waters include the planktonic species *Dinophysis acuminata*, *D. caudata*, *D. fortii*, *D. hastata*, *D. mitra*, *D. rotundata*, *D. tripos* and the benthic dinoflagellates *Prorocentrum lima*, *P. elegans*, *P. hoffmannianum* and *P. concavum* (Morton & Tindall 1995). Dense blooms have occurred in Tasmanian and New Zealand waters, and can sometimes be completely non-toxic, but at other times shellfish can become toxic even when only sparse dinoflagellate populations are present (ANZFA 1999a).

**Hazard identification and characterisation:** No human fatalities have been reported due to diarrhetic shellfish poisoning and patients usually recover within three days. Diarrhetic shellfish poisoning is generally a mild gastrointestinal disorder, that is, nausea, vomiting, diarrhoea, and abdominal pain accompanied by chills, headache, and fever. Onset of the disease, depending on the dose of toxin ingested, may be as little as 30 minutes to 2–3 hours, with symptoms of the illness lasting as long as 2–3 days (ANZFA 1999a). Recovery is complete with no after effects and the poisoning is generally not life threatening (FDA 2003). In extreme cases chronic exposure may promote tumour formation in the digestive system (Hallegraeff 2003).

The toxic dose may be as low as 80 µg (Council for Agricultural Science and Technology 1994).

**Incidence of human illness:** Diarrhetic shellfish poisoning is usually caused by the consumption of contaminated mussels, oysters and scallops (FDA 2003).

Pipi shellfish poisoning events occurred in New South Wales (56 patients) in December 1997 and in 1998 (20 patients) circumstantially linked to lipid soluble toxins (Hallegraeff 2003).

**Concentrations in seafood:** Low concentrations of diarrhoeic shellfish poisoning toxins (generally <0.5 mg okadaic acid/gram) have been reported from New Zealand shellfish (Jasperse 1993).

**Current regulations:** A maximum level of 0.2 mg/kg for diarrhetic shellfish poisons (okadaic acid equivalent) has been established in Standard 1.4.1 – Contaminants and Natural Toxicants – of the Code.

**Ranking of hazard:** Diarrhoeic shellfish poison is ranked as ‘serious’ in terms of adverse health effects (Section 3, Table 3) because of its potential to cause incapacitating but not life-threatening illness following acute exposure.

#### Amnesic shellfish poisons

Amnesic shellfish poisoning is caused by domoic acid, produced by chain-forming diatoms. Toxicogenic *Pseudo-nitzschia* blooms also occur in the waters of north-west United States, Japan, New Zealand, Spain and Portugal. In addition to bivalve shellfish, razor clams as well as the hepatopancreas and viscera of Dungeness crab have been found to be contaminated (Hallegraeff 2003).

To date, low concentrations of *P. multiseriis* have been detected in New South Wales estuaries, but its toxicity has not yet been confirmed (Hallegraeff 1994). Blooms of *P. pseudodelicatissima* are common in Tasmanian and Victorian coastal waters, but all cultured strains as well as field samples have proved to be non-toxic (Hallegraeff 2003).

**Hazard identification and characterisation:** The causative compound, domoic acid, is an excitatory amino acid acting as a glutamate antagonist on the kainate receptors of the central nervous system (ANZFA 1999a).

A mild case of amnesic shellfish poisoning is characterised by gastrointestinal disorders (nausea, vomiting, diarrhoea, abdominal pain) and neurological problems (confusion, disorientation, memory loss, seizure, coma). The toxicosis is characterised by the onset of gastrointestinal symptoms within 24 hours, followed by neurological symptoms occurring within 48 hours (FDA 2003).

The toxicosis is particularly serious in elderly patients, and includes symptoms reminiscent of Alzheimer’s disease. All fatalities to date have involved elderly patients (FDA 2003). The neurologic effects can persist for years (Benenson 1995). An extreme case is characterised by decreased reaction to deep pain; dizziness, hallucinations, and confusion; short-term memory loss; and seizures (Hallegraeff 2003).

While the general population is susceptible to this form of shellfish poisoning, the elderly are apparently predisposed to the severe neurological effects of the amnesic shellfish poisoning toxin.

A limited number of human mortalities have also been associated with amnesic shellfish poisoning in Canada, with immunodepressed patients being most at risk. Humans affected had consumed mussels containing 300–1200 µg/g of domoic acid (Hallegraeff 2003).

**Incidence of human illness:** Amnesic shellfish poisoning is usually caused by the consumption of contaminated mussels (FDA 2003). A serious outbreak of shellfish poisoning occurred in eastern Canada in 1987 from Blue Mussels where 22 individuals were hospitalised and three elderly died (FDA 2003).

**Concentrations in seafood:** To date the only positive detection of domoic acid in Australian shellfish refers to scallop viscera from Lakes Entrance, Victoria (August 1993) (one sample 26 µg/g; all others <20 µg/g) but the causative organism was not identified in that case (Sang et al. 1992; Arnott 1998).

Maximum concentrations of domoic acid detected in New Zealand mussels have been up to 187 µg/g (Marlborough Sounds, Dec. 1994) with scallop digestive glands containing up to 600 µg/g (Jasperse 1993; Rhodes et al. 1996).

Extensive routine monitoring has been conducted in Port Phillip Bay (Victoria) since 1987 and no domoic acid has been recorded in bay mussels and scallops. Domoic acid has been detected in scallops in Bass Strait with concentration ranging from 0.12–1.2 µg/g in the edible portion (ANZFA 1999a).

**Current regulations:** A maximum level of 20 mg/kg for amnesic shellfish poisons (domoic acid equivalent) has been established in Standard 1.4.1 – Contaminants and Natural Toxicants – of the Code.

**Ranking of hazard:** Amnesic shellfish poison is ranked as ‘severe’ in terms of adverse health effects (Section 3, Table 3) because of its potential to be life-threatening or cause chronic sequelae following acute exposure.

### Neurotoxic shellfish poisons

Neurotoxic shellfish poisoning is the result of exposure to a group of polyethers called brevetoxins from the unarmoured dinoflagellate *Gymnodinium breve*. Similar dinoflagellates have also been identified in low concentrations in Victorian, South Australian and West Australian waters with recent evidence suggesting that raphidophyte blooms of *Chattonella marina*, and possibly the related genera *Fibrocapsa* and *Heterosigma*, can also produce brevetoxin-like compounds (Hallegraeff 1998).

**Hazard identification and characterisation:** Brevetoxins and their derivatives exert their toxic effect by specific binding to site-5 of voltage-sensitive sodium channels (ANZFA 1999a). The toxins implicated in neurological shellfish poisoning are considered to be primarily ichthyotoxins (fish killing toxins) (Hallegraeff 2003). In humans, the symptoms of a mild case of neurotoxic shellfish poison intoxication include chills, headache, diarrhoea; muscle weakness, muscle and joint pain; nausea and vomiting after a few minutes to 3–6 hours after ingestion (Hallegraeff 2003). Symptoms can last as long as 2–3 days (FDA 2003). An extreme case can cause paraesthesia; altered perception of hot and cold; difficulty in breathing, double vision, trouble in talking and swallowing. No human fatalities from brevetoxin poisoning have ever been reported (Hallegraeff 2003).



Recovery is complete with no after effects and is generally not life threatening.

Respiratory problems in humans occur at about  $10^5$ – $10^6$  cells/litre, while fish mortality occurs at  $>10^6$  cells/litre (Hallegraeff 2003). Toxin concentrations in shellfish during the 1993 New Zealand shellfish poisoning outbreak reached 592 MU/100 g (Hallegraeff 2003).

**Incidence of human illness:** Neurotoxic shellfish poisoning is usually associated with the consumption of contaminated shellfish (FDA 2003). Until recently all reports were endemic to the Gulf of Mexico and the east coast of Florida (Hallegraeff 2003). In 1993 a neurotoxic shellfish poisoning incident involving 180 people was reported in New Zealand. Concentrations of neurotoxic shellfish poisons reached 592 MU/100g (Trusewich et al. 1996).

**Concentrations in seafood:** In January 1994, mussels from Tamboon Inlet on the Gippsland coast of Victoria were found to contain 27.5 MU/100g in association with a *G. breve* type bloom (Arnott 1998). There is no other record of detection of neurotoxic shellfish poisons in Australia (ANZFA 1999a).

**Current regulations:** A maximum level of 200 MU/kg for neurotoxic shellfish poisons has been established in Standard 1.4.1 – Contaminants and Natural Toxicants – of the Code.

**Ranking of hazard:** Neurotoxic shellfish poison is ranked as ‘serious’ in terms of adverse health effects (Section 3, Table 3) because of its potential to cause incapacitating but not life-threatening illness following acute exposure.

### *Histamines*

Scombroid poisoning (histamine poisoning) is associated with the ingestion of foods that contain high concentrations of histamine and possibly other vasoactive amines and compounds.

Histamine is a physiological amine involved in allergic reactions, and is the main toxin involved in histamine fish poisoning. Histamine production in fish is related to the histidine content of the fish, the presence of bacterial histidine decarboxylase, and environmental conditions. Bacterial decarboxylase enzymes acting on free histidine and other amino acids in the fish muscle form histamine and other biogenic amines (Lehane & Olley 1999).

Species in the scombroid group (tuna, mackerel, and sardines) have high histidine levels and are most frequently associated with scombroid poisoning. Non-scombroid species implicated in scombroid poisoning are Australian salmon (*Arripis trutta*), Yellowtail kingfish (*Seriola lalandi*), Mullet (*Mugil cephalus*), Oilfish (*Ruvettus pretiosus*) and Warehou (*Seriola*), known in New Zealand as Kahawai (Fletcher et al. 1998; Lehane & Olley 1999).

**Hazard identification and characterisation:** Initial symptoms include tingling or burning sensation in the mouth, rash on the upper body and drop in blood pressure. Frequently, headaches and itching are encountered. The symptoms may progress to nausea, vomiting and diarrhoea that require hospitalisation, particularly in the case of elderly or impaired patients (FDA 2003).

The onset of intoxication is rapid, ranging from immediate to 30 minutes. The duration of the illness is usually three hours, but may last several days (FDA 2003).

Due to uncertainty about its aetiology it is difficult to determine the susceptible population for scombrototoxicosis. A wide range of histamine concentrations in implicated foods, particularly the increasing number of incidents associated with low histamine concentrations, suggests that some individuals are more susceptible to the toxin than others. Differences may be due to the activity of histamine-degrading enzymes in the stomach. Symptoms can be severe for the elderly (FDA 2003) and for those taking medications such as isoniazid, a potent histaminase inhibitor (Morinaga et al. 1997).

The toxic dose for histamine is not precisely known and scombroid poisoning has occurred at histamine concentrations as low as 50 mg/kg. However most incidents involve fish with histamine concentrations of 200 mg/kg and over (Fletcher et al. 1998).

Clifford and Walker (1992) suggest that neither histamine nor biogenic amines are responsible for scombrototoxicosis. Volunteers fed mackerel with 6000 mg/kg histamine reported only mild tingling around the mouth. Lehane and Olley (1999) speculate that urocanic acid may be the missing factor ('scombroid toxin') in histamine fish poisoning.

**Incidence of human illness:** Histamine fish poisoning is a food-borne chemical intoxication caused by the consumption of fish containing high concentrations of histamine and other biogenic amines.

There is little information on the incidence of scombroid poisoning in Australia, suggesting either that it is rare or that symptoms are not usually severe enough for victims to seek medical attention. Several incidents have been reported and are listed in Table 4.14.

**Table 4.14: Histamine fish poisoning outbreaks in Australia and the United States, 1990–2000**

Country	Outbreaks	Cases	Cases/outbreak	Annual rate (per 100 000 population)
Australia	10	28	3	0.0165
United States of America	103	680	7	0.0272

Source: Extracted from M&S Food Consultants, 2001; after Smith de Waal et al., 2000.

Several cases of histamine poisoning were recorded in New Zealand in the mid-1970s. Nineteen outbreaks were reported from 1990–93 all resulting from the consumption of smoked Warehou (Kahawai) and Mackerel (Mitchell 1993).

Scombroid poisoning results in around 10–15 outbreaks per year in the United States (Centre for Disease Control 1996). Between 40 and 50 scombroid poisoning incidents are reported in England and Wales each year affecting about 100 people.

The annual prevalence of scombrototoxicosis in the United States is approximately 0.03 cases/100 000 population (Table 4.15) and the United Kingdom incidence is approximately 0.07/100 000.

**Table 4.15: Seafood-related outbreaks of histamine poisoning in Australia, 1990–2000**

Date	Location	No. affected (deaths)	Species	Reference
1990	Adelaide	3	Australian Salmon	Smart 1992
1991	Adelaide	4	Australian Salmon	Smart 1992
1993	Brisbane	2	Tuna	Brown 1993
1999	NSW	4	Tuna	Voetsch 2000
1995	WA	>6	Pilchards	Ruello 1999
1997	Sydney	2	Marlin	Ruello 1999
1998	Sydney	>1	Yellow fin tuna	Ruello 1999
1999	Sydney	3	Yellow fin tuna	Ruello 1999
1999	Unknown	2	Yellow fin tuna	Ruello 1999
1999	Victoria	>1	Salmon rissoles	Ruello 1999

Source: Extracted from M&S Food Consultants 2001.

**Concentrations in seafood:** Fish that have been implicated in histamine poisoning include mackerel, tuna, saury, bonito, mahi-mahi, sardines, pilchards, anchovies, herring, marlin and bluefish, however some salmon species have also been implicated (Lehane & Olley 1999). Table 4.16 indicates concentrations of histamine found in a variety of seafood products. In New Zealand, Fletcher et al. (1998) found 8/107 retail samples of smoked fish in Auckland had >50 mg/kg.

Histamine concentrations of >1000 mg/kg were reported from 117/405 incidents of presumptive scombrototoxicosis in United Kingdom between 1987–96 and high concentrations have also been described in tuna steaks imported from Sri Lanka (>7000 mg/kg) and from canned tuna (245 and 3900 mg/kg) (Scoging 1998). Levels of up to 1000 mg/kg were reported in fish sauces made from *Stolephorus* spp., a member of the anchovy family (Brillantes & Samosorn 2001; Brillantes et al. 2002).

Random import sampling reveals a small percentage of samples exceed 100 mg/kg and, of those that do, most are rarely much greater than this concentration. Information from an Australian tuna cannery that each batch of frozen tuna bodies routinely did not exceed 100 mg/kg (Lehane & Olley 1999).

**Current regulations:** A maximum level of 200 mg/kg for histamine has been established in fish and fish products in Standard 2.2.3 – Fish and Fish Products – in the Code.

**Ranking of hazard:** Histamine is ranked as ‘moderate’ in terms of adverse health effects (Section 3, Table 3) because of its potential to be cause short-term self-limiting symptoms following acute exposure.

**Table 4.16: Reported concentrations of histamine in seafood in Australasia**

Country	Histamine concentrations	Reference
Australia retail chilled	10/11 (91%) not detected 1/11 (9%) <100 mg/kg	Rigg 1997
Smoked fish	13/13 (100%) not detected	
Dried fish	1/5 (20%) not detected 3/5 (60%) <100 mg/kg 1/5 (20%) 653 mg/kg 6/7 (85%) not detected	
Canned fish	1/7 (15%) <100 mg/kg	

Australia retail canned tuna	101/104 (98%) <50 mg/kg 3/104 (2%) in 50–100 mg/kg range	Warne 1987
Smoked fish New Zealand	98/107 (92%) not detected 6/107 (6%) in 50–200 mg/kg range 2/107 (2%) >200 mg/kg	Fletcher et al. 1998

Source: Extracted from M&S Food Consultants 2001.

### *Ciguatoxins*

Ciguatoxins are known to originate from several dinoflagellate algae species (predominantly *Gambierdiscus toxicus*) that are common to ciguatera-endemic regions in tropical waters. The ciguatoxins are lipid-soluble toxins. These are relatively inert molecules, and remain toxic after cooking and exposure to mild acidic and basic conditions.

When herbivorous fish are eaten by carnivorous fish dinoflagellate toxin is converted to the more potent ciguatoxin (Durborow 1999). These toxins accumulate through the food chain, from small fish grazing on algae on coral reefs into the organs of larger top-order predators. Toxin is concentrated in the head, liver and viscera of fish (Ting et al. 1998), but concentrations are lower in the muscle, the part more usually eaten. The occurrence of toxic fish is sporadic and not all fish of a given species or from a given locality will be toxic (Benenson 1995). If fish cease ingesting the dinoflagellate the toxin will slowly be purged from the fish.

**Pathology of illness:** Initial signs of poisoning occur within six hours after consumption and include perioral numbness and tingling (paresthesia) which may spread to the extremities, nausea, vomiting, and diarrhoea. Neurological signs include intensified paresthesia, arthralgia, myalgia, headache, temperature sensory reversal and acute sensitivity to temperature extremes, vertigo, and muscular weakness to the point of prostration. Cardiovascular signs include arrhythmia, bradycardia or tachycardia, and reduced blood pressure (FDA 2003).

Ciguatera poisoning is usually self-limiting and signs of poisoning often subside within several days from onset. However, in severe cases the neurological symptoms persist from weeks to months and, in rare cases, for several years. There is a low incidence of death resulting from respiratory and cardiovascular failure (FDA 2003).

All humans are believed to be susceptible to ciguatera toxins. Populations in tropical/subtropical regions are most likely to be affected because of the relatively higher frequency of exposure to toxic fishes (FDA 2003). Repeated ciguatoxin exposures are associated with more severe illness (Glaziou & Martin 1993; Katz et al. 1993).

**Infectious dose/dose response:** Ciguatoxin-1 is the major toxin (on the basis of both quantity and total toxicity) present in fish (Murata et al. 1990; Lewis 1994), except for certain herbivorous species which accumulate mostly gambiertoxins and less polar ciguatoxins. Lehane (1999) estimated the minimum toxic dose to be ~50 ng in an adult of 50 kg weight (that is, ~1 ng/kg body weight), on the basis of outbreak data.

**Mode of transmission:** Ciguatera poisoning is caused by eating subtropical and tropical reef fish that have accumulated naturally occurring toxins produced by marine algae.

**Incidence and outbreak data:** Ciguatera poisoning gives rise to considerable morbidity in 25 000 to 50 000 people worldwide each year (Hahn & Capra 2003).

The epidemiological patterns of ciguatera differ markedly between Australia and the United States (Table 4.17). The annual reported rate of ciguatera poisoning in Australia between 1990–2000 is 0.3182 per 100 000 population compared to the United States which has an annual rate of 0.0131 per 100 000 population (M&S Food Consultants 2001).

**Table 4.17: Seafood-borne outbreaks due to ciguatera poisoning in Australia and the United States, 1990–2000**

Country	Outbreaks	Cases	Cases/outbreak
Australia	3	61	20
United States of America	75	328	4

Source: Extracted from M&S Food Consultants 2001; after Smith de Waal et al. 2000.

In Australia, ciguatera fish poisoning usually occurs as sporadic isolated cases (Fenner et al. 1997; Lucas et al. 1997), although at least two larger outbreaks (>30 cases) have been reported (Table 4.18; Hallegraeff 1998).

**Table 4.18: Ciguatera poisoning related outbreaks of food poisoning in Australia 1990–2000**

Date	Location	No. affected (deaths)	Reference
1991	Darwin	3	Merianos et al. 1991
1994	Sydney	43	Capra 1997
1995	Queensland	15	Harvey 1995
Annual	Queensland	48	Lehane & Lewis 2000

Source: Extracted from M&S Food Consultants 2001.

The incidence of ciguatera in Australia is skewed geographically, with Queensland bearing the major burden. A wide variety of fish species have been implicated in outbreaks in Queensland (Table 4.19).

**Table 4.19: Cases of ciguatoxin illness in Queensland 1965–84**

Scientific name (common name)	No. of cases	No. of outbreaks
<i>Scomberomorus commerson</i> (Spanish mackerel)	226	30
<i>Scomberomorus</i> spp (mackerels, species unknown)	161	62
<i>Sphyræna jello</i> (barracuda)	29	13
<i>Plectropomus</i> spp (coral trout)	27	18
<i>Epinephelus fuscoguttatus</i> (flowery cod & other epinephalids)	27	14
<i>Lutjanus sebae</i> (red emperor) and <i>Lutjanus bohar</i> (red bass)	16	9
<i>Scomberoides commersonianus</i> (giant dart)	8	3
<i>Lethrinus nebulosa</i> (yellow sweetlip)	4	1
<i>Seriola lalande</i> (yellowtail kingfish and other seriolids)	6	1
<i>Caranx</i> sp (trevally, species unknown)	4	2
<i>Cephalopholis miniatus</i> (coral cod)	3	2
<i>Chelinus trilobatus</i> (maori wrasse)	3	3
<i>Choerodon venustus</i> (venus tusk fish)	2	1
<i>Trachinotus</i> sp (dart)	1	1
<i>Paracesio pedlyi</i> (southern fuselier)	1	1

Lates calcarifer (barramundi)	1	1
Other and unknown	14	16

Source: Extracted from M&S Food Consultants 2001; after Gillespie et al. 1986.

In Queensland, several thousand cases were notified to authorities over a 10-year period (Ting et al. 1998) with an estimated 1.8–2.5 per cent of the population in that state affected (Glaziou & Legrand 1994; Lehane 1999). The average incidence in Queensland during the period 1985–90 was 1.6 cases/100 000, although in coastal Queensland the annual prevalence was estimated at 33/100 000 (Capra & Cameron 1988).

Forty-one cases of ciguatera poisoning in New South Wales have been reported for the period 1996–98, although the list was not comprehensive (M&S Food Consultants 2001). Due to under-reporting of this often mild illness, these data represent the minimum prevalence in New South Wales. There have also been several large outbreaks in Sydney at restaurants. In 1987, 63 people became ill after eating Spanish Mackerel (*Scomberomorus commerson*) which had been caught in Hervey Bay, Queensland.

**Concentrations in seafood:** Mackerel and barracuda from mid to north-eastern Australian waters have been reported to be frequently ciguatoxic (Price & Tom 1999).

#### *Escolar wax esters*

Escolar or oilfish (*Lepidocybium flavobrunneum*, *Ruvettus pretiosus*) contain a strong purgative oil, sometimes called gempylotoxin, that may cause diarrhoea when consumed (FDA 2001). Both species are significant bycatches (of the order of 400 tonne/annum) from tuna longlines on the east and west coasts of Australia (Shadbolt et al. 2002).

**Pathology of illness:** The diarrhoea caused by eating the oil contained in the flesh and bones of these fish develops rapidly and is pronounced (Warrington 2001). Symptoms range from mild and rapid passage of oily yellow or orange droplets, to severe diarrhoea with nausea and vomiting (Shadbolt et al. 2002). In reports of up to 88 cases (41 incidents) in South Australia in the period 1997–99 (Delroy, personal communication), 25 per cent of cases reported stomach/abdominal pain or cramping. There is probably a significant under-reporting of illness associated with consumption of these fish as the symptoms can be mild and short-lived. The onset of symptoms occurs with a median of 2.5 hours and a range of 1 to 90 hours after consumption (Shadbolt et al. 2002).

**Infectious dose/dose response:** There are no data on the amount of wax ester likely to cause illness. The question of whether there is general susceptibility to diarrhoea from consumption of the wax esters has not been resolved, and is complicated by the oil content of oilfish species varying between individual fish and across the cross-section of individual fish fillets (Yohannes et al. 2002).

**Levels in seafood:** *Lepidocybium flavobrunneum* (escolar) and *Ruvettus pretiosus* (oilfish) contain approximately 20 per cent (by weight) of indigestible wax ester oil (Nichols et al. 2001).

**Epidemiological data:** There have been several outbreaks of wax ester diarrhoea recorded in Australia in recent years (Shadbolt et al. 2002; Gregory 2002; Givney 2002; Yohannes et al. 2002).

**Ranking of hazard:** Escolar wax esters are ranked as ‘moderate’ in terms of adverse health effects (Section 3, Table 3).

### *Arsenic*

Arsenic is ubiquitous and occurs naturally in both organic and inorganic forms. People are exposed to arsenic through the environment (primarily via the skin and by inhalation), food and water ingestion and through some workplaces.

Inorganic arsenic is the toxic form of arsenic for humans. There is little information on the organic forms of arsenic in terms of their toxicological properties, but it appears that they are much less toxic than the inorganic forms. Limited studies indicate that people who consume large quantities of organic arsenic in fish do not show any ill effects. Drinking water contains largely the inorganic form of arsenic, whereas food contains more than 90 per cent of its arsenic in the organic form.

**Regulation of arsenic in seafood:** FSANZ set maximum levels for arsenic in foods during its review of the Ccode in 1999. Proposal P157 – Contaminants in Food – Metals assessed which foods contributed significantly to dietary exposure to arsenic and set levels accordingly (Table 4.20).

**Table 4.20: Maximum levels for arsenic in seafood in the Code**

Commodity	ML (mg/kg)
Crustacea	2
Fish	2
Molluscs	1

**Hazard identification and characterisation:** The most relevant toxicological data, other than industrial exposure, are derived from studies of human populations exposed to arsenic in drinking water. Skin lesions, including hyperkeratosis and pigmentation, are characteristic and the most sensitive indicators of long-term toxicity of inorganic arsenic. Chronic arsenic exposure is associated with a multiplicity of cancers.

The lowest observed effect level of 0.0029 mg/kg bw/day for inorganic arsenic is based on population studies done in Taiwan, where drinking water exposures for periods of 12 years to whole-of-life were associated with cancers (skin, liver, bladder, lung). This level is effectively a lowest observed effect level for arsenic intake, but has also been shown to be indicative of a ‘threshold’ value, below which increased incidence of skin cancer could not be associated with arsenic exposure. This level, rounded-off to 0.003 mg/kg bw/day was taken to be the provisional tolerable daily intake (PTDI) for inorganic arsenic for the purpose of a previous risk assessment on arsenic in food performed by FSANZ under the review of the Code.

**Recent surveys on arsenic in seafood:** Oysters, smoked fish fillets, seafood sticks and canned red salmon were examined for inorganic arsenic in the 1994 Australian Market Basket Survey. Inorganic arsenic was not detected in the smoked fish fillets, seafood sticks and canned red salmon but low concentrations, ranging from not detected to 0.34 mg/kg with an average of 0.0773 mg/kg, were detected in oysters (Marro 1996).

Inorganic arsenic was also examined in calamari, estuarine fish fillets, battered flake fillets and canned tuna in the 1996 Australian Market Basket Survey. All samples were below the Limit of Reporting (0.05 mg/kg) (Hardy 1998).

Fish fillets, mussels, canned crab and canned red salmon were analysed for inorganic and total arsenic in the 19th Australian Total Diet Survey (FSANZ 2001). All samples were below the Limit of Reporting (0.05 mg/kg) except for the mussels, in which levels of up to 0.56 mg/kg were detected, with a median level of 0.153 mg/kg.

Prawns, fish fillets and portions, and canned tuna were analysed for inorganic and total arsenic in the 20th Australian Total Diet Survey (FSANZ 2003). All samples were below the Limit of Reporting (0.05 mg/kg).

**Dietary exposure to arsenic:** The main seafoods contributing to inorganic arsenic dietary exposure (>5%) from food alone were prawns (52%) and marine fish (14%). Although other seafood such as crabs, mussels and oysters are significant sources of inorganic arsenic per kilogram of food, the relatively small consumption levels of these foods means they do not make a significant contribution to mean inorganic arsenic dietary exposure for the whole population (ANZFA 1999b).

Dietary exposure estimates for high consumers of single food commodity groups indicate that high fish consumers could receive up to 4 per cent of the PTDI for inorganic arsenic, and that high consumers of molluscs and crustacea could receive up to 6 per cent and 18 per cent of the PTDI for inorganic arsenic respectively, assuming that the inorganic content of seafood is 6 per cent of the total arsenic content and assuming that these consumers eat molluscs and crustacea every day over a lifetime (ANZFA 1999b).

**Ranking of hazard:** Arsenic is ranked as 'severe' in terms of adverse health effects (Section 3, Table 3) because of its potential to be life-threatening or cause ongoing illness following chronic exposure.

### *Cadmium*

Cadmium is a metallic element that occurs naturally at low levels in the environment. In Australia and New Zealand, the major source of cadmium in foods is via the soil, with plants playing a central role in the transfer of cadmium from the environment to humans. In the case of seafood, the level of cadmium in the sediment is an important determinant for cadmium levels in the animal.

**Regulation of cadmium in seafood:** The Code currently lists a maximum limit of 2 mg/kg for cadmium in molluscs (excluding dredge/bluff oysters). There is no maximum limit for fish, crustacea or calamari.

**Hazard identification and characterisation:** The most sensitive toxicological concern from cadmium exposure is long-term kidney damage. The provisional tolerable weekly intake (PTWI) of 7 µg/kg bw is based on the most sensitive parameter for kidney damage, namely, an increase in the urinary excretion of low molecular weight protein as a result of reduced re-absorption in the renal tubules. Toxicity is manifested only after many years of slow accumulation of cadmium in the renal cortex and then only if a critical concentration is achieved.



However, the toxicological significance of this observed change with respect to kidney damage is still not established, as it is clear that the excretion of low molecular weight proteins normally increases with age. Food-borne cadmium is recognised as the major source of exposure for the majority of the population.

In June 2003, JECFA maintained the current PTWI based on an evaluation of new data submitted on cadmium in humans. The Committee reaffirmed its previous conclusions that an effect on the kidney (renal tubular dysfunction) is the critical health outcome with regard to cadmium toxicity.

**Recent surveys on cadmium in seafood:** Seafoods analysed in the 1992 Australian Market Basket Survey reported concentrations of cadmium in fish fillets from not detected to 0.04 mg/kg; prawns from not detected to 0.58 mg/kg and canned tuna from not detected to only trace amounts (Stenhouse 1994).

Seafoods analysed in the 1994 Australian Market Basket Survey reported concentrations for cadmium in smoked fish fillets ranging from a minimum of not detected to a maximum of 0.02 mg/kg; oysters ranging from a minimum of 0.16 mg/kg to a maximum 0.91 mg/kg; canned red salmon ranging from a minimum of not detected to only trace amounts; and seafood sticks ranging from a minimum of only trace amounts to 0.06 mg/kg (Marro 1996).

Seafoods analysed in the 1996 Australian Market Basket Survey reported concentrations of cadmium in canned tuna ranging from a minimum of 0.012 mg/kg to a maximum 0.07 mg/kg; for calamari rings concentrations ranged from a minimum of 0.022 mg/kg to a maximum of 0.143 mg/kg; for battered flake fillets concentrations ranged from a minimum of only trace amounts to a maximum of 0.06 mg/kg, and for estuarine fish cadmium was not detected (Hardy 1998).

Canned crab, fish fillets, mussels and canned red salmon were analysed for cadmium in the 19th Australian Total Diet Survey (FSANZ 2001). Levels detected (minimum, maximum, median; units mg/kg) were: canned crab (0.08, 0.39, 0.18); fish fillets (not detected, 0.02, 0.003); mussels (0.26, 0.93, 0.48); and canned red salmon (0.004, 0.006, 0.005).

Prawns, fish fillets and portions, and canned tuna were analysed for cadmium in the 20th Australian Total Diet Survey (FSANZ 2003). Levels detected (minimum, maximum, median; units mg/kg) were: prawns (0.011, 0.500, 0.078); fish fillets (not detected, 0.053, not detected); fish portions (not detected, 0.110, not detected); and canned tuna (0.011, 0.030, 0.018).

**Dietary exposure to cadmium:** A recent dietary exposure assessment was performed in 2000 by FSANZ (unpublished). The mean dietary exposure for the whole population was 13–16 per cent of the PTDI and for high consumers was 34–41 per cent. No high consumers of any single frequently consumed food exceed the PTDI. Fish, molluscs and crustaceans did not make a significant contribution (>5%) to the overall dietary cadmium exposure for Australian consumers (fish 1.4%; crustaceans 3.5; oysters 1.4%).

Dietary exposure to cadmium for the median consumer from oysters (occasionally consumed foods) was 52 per cent of PTDI and for mussels was 7.9 per cent for Australian consumers. High consumers of prawns represented 8.8 per cent of the PTDI.

**Ranking of hazard:** Cadmium is ranked as ‘severe’ in terms of adverse health effects (Section 3, Table 3) because of its potential to be life-threatening or cause ongoing illness following chronic exposure.

### *Lead*

Lead is found widespread in the environment and also in food and drinks as metallic lead, inorganic ions and salts and organometallic compounds. Lead is not easily extracted from the soil by plants and its occurrence in plants is often due to air pollution, leading to contamination of the plant surface. The occurrence of lead in food and drinks is mainly due to many years of use of lead technology and in particular to the use of alkyl-lead compounds as petrol additives. Lead fulfils no essential functions in mammals, but has a number of adverse effects including neurotoxicity at exposure levels that may be reached fairly easily.

Exposure to lead can affect many different organ systems, the most sensitive being the nervous system of children. Humans are exposed to lead via multiple exposure pathways with a significant route via food where lead contaminated soil and dust find its way into the food and water supply.

**Regulation of lead in seafood:** FSANZ set maximum levels for lead in foods during its review of the Code in 1999. Proposal P157 – Contaminants in Food – Metals assessed which foods contributed significantly to dietary exposure to lead and set levels accordingly (Table 4.21).

**Table 4.21: Maximum levels for lead in seafood in the Code**

Commodity	ML (mg/kg)
Fish	0.5
Molluscs	2

**Hazard identification and characterisation:** Studies have shown excessive exposure to lead can affect many different organ systems, and biochemical and physiological processes in both animals and humans, the most sensitive being the nervous system. Lead exposure is cumulative in nature with long half-lives (up to 27 years in various bone compartments).

The available data suggests that the developing brain is more at risk from lead exposure compared to the mature brain. This has been supported by cross-sectional epidemiological studies. Differences between children and adults in several aspects contribute to the greater susceptibility of children to lead toxicity. These include the higher metabolic rates and rapid growth rates compared to adults; immaturity of organ systems (namely the nervous and immune systems); the higher energy requirements for children reflected in their dietary intakes (and hence the intake of contaminants per unit body weight); and the unique behavioural characteristics (for example, heightened hand-to-mouth activity), which may result in significant exposure to lead from non-food sources.

JECFA established a Provisional Tolerable Weekly Intake of 25 µg/kg bw (equivalent to a PTDI of 3.5 µg/kg bw/day) for all age groups (WHO 1987). In 1999, JECFA maintained this PTWI at its 53rd meeting and concluded that the results of a recent risk assessment suggest that concentrations of lead in food would have negligible effects on neurobehavioral development of infants and children (WHO 2000).

**Recent surveys of lead in seafood:** Fish fillets, prawns and canned tuna were examined for lead in the 1992 Australian Market Basket Survey. Concentrations of lead ranging ‘not detected’ to 0.2 mg/kg; were reported for fish fillets, ‘not detected’ to ‘trace’ level for prawns and ‘not detected’ to 0.1 mg/kg for canned tuna (Stenhouse 1994).

Smoked fish fillets, oysters, canned red salmon and seafood sticks were examined for lead in the 1994 Australian Market Basket Survey. Concentrations of lead ranged from ‘not detected’ to ‘trace’ level for smoked fish fillets, canned red salmon, and seafood sticks; and ‘trace’ level to 0.61 mg/kg for oysters (Marro 1996).

Canned tuna, calamari rings, battered flake fillets and estuarine fish were examined for lead in the 1996 Australian Market Basket Survey. Concentrations of lead ranged from ‘trace’ level to 0.018 mg/kg in canned tuna; ‘trace’ level to 0.89 mg/kg for calamari rings; ‘not detected’ to 0.082 mg/kg for battered flake fillets; and ‘not detected’ to a ‘trace’ level for estuarine fish (Hardy 1998).

Canned crab, fish fillets, mussels and canned red salmon were analysed for lead in the 19th Australian Total Diet Survey (FSANZ 2001). Levels detected (minimum, maximum, median; units mg/kg) were: canned crab (0.02, 0.04, 0.03); fish fillets (not detected, 0.007, not detected); mussels (0.05, 1.10, 0.11); and canned red salmon (not detected, 0.006, 0.005).

Prawns, fish fillets and portions, and canned tuna were analysed for lead in the 20th Australian Total Diet Survey (FSANZ 2003). Levels detected (minimum, maximum, median; units mg/kg) were: prawns (not detected, 0.05, not detected); and fish fillets (not detected, 0.02, not detected). There were no levels above the limit of reporting (0.01 mg/kg) for samples of fish portions and canned tuna.

**Dietary exposure to lead:** The mean total dietary exposure to lead for all respondents ranged from 2–6 per cent PTDI, and for high consumers, 6 per cent of the PTDI. For groups considered at risk from lead exposure (namely, 2-year-old children) total dietary exposure to lead was 5–17 per cent PTDI for mean consumers and 15–35 per cent for high consumers (ANZFA 1999b).

**Ranking of hazard:** Lead is ranked as ‘severe’ in terms of adverse health effects (Section 3, Table 3) because of its potential to be life-threatening or cause ongoing illness following chronic exposure.

### *Mercury*

Mercury occurs naturally in the environment as elemental, inorganic and organic mercury. Methylmercury, a form of organic mercury, is the most hazardous form of mercury encountered in food. Fish and other seafood is the main source of exposure to methylmercury for most individuals.

Methylmercury is largely produced from the methylation of inorganic mercury by certain micro-organisms present in marine and freshwater sediments. Once produced, methylmercury is rapidly taken up and concentrated by filter feeding organisms, upon which other fish feed. This process results in the steady accumulation of methylmercury in the aquatic food chain, with all fish containing small amounts of methylmercury in their muscle tissue. Those species at the top of the food chain (for example, predatory fish or marine mammals) tend to accumulate the largest amount of methylmercury.

**Regulation of mercury in seafood:** FSANZ set maximum levels for mercury in foods during its review of the Code in 1999. Proposal P157 (Contaminants in Food – Metals) assessed which foods contributed significantly to dietary exposure to mercury and set levels accordingly (Table 4.22). FSANZ is currently reviewing its risk assessment for mercury due to JECFA’s recent lowering of the PTWI.

**Table 4.22: Maximum limits for mercury in seafood commodities in the Code**

Commodity	ML (mg/kg)
Crustacea	Mean level of 0.5
Fish (as specified in Schedule 4 to Standard 1.4.2) and fish products, excluding gemfish, billfish (including marlin), southern bluefin tuna, barramundi, ling, orange roughy, rays and all species of shark	Mean level of 0.5
Gemfish, billfish (including marlin), southern bluefin tuna, barramundi, ling, orange roughy, rays and all species of shark	Mean level of 1
Fish for which insufficient samples are available to analyse in accordance with clause (6)	1
Molluscs	Mean level of 0.5

**Hazard identification and characterisation:** Methylmercury is readily (>95%) absorbed from the gut following ingestion and is rapidly distributed via blood to the tissues, including the brain where it accumulates and is slowly demethylated to inorganic mercury. The major routes of excretion are through the bile and faeces, with lesser amounts in urine.

The toxic effects of methylmercury, particularly on the nervous system, are well documented and an extensive body of literature is available. Most of what is known about effects in humans has been derived from investigations of large-scale poisoning episodes in Japan and Iraq, although more recently attention has focused on effects following chronic low-dose exposures through fish consumption. The severity of the effects depends largely on the magnitude and duration of the dose, with effects in adults occurring at much higher levels of exposure than those linked to effects in children following in utero exposure. The developing nervous system is thus considered the most sensitive target for toxicity, with the critical exposure period being during in utero development when the foetus is undergoing very rapid neurological development.

In the adult, the first effect observed following exposure to high levels of methylmercury is typically paraesthesia (numbness and tingling in lips, fingers and toes), which frequently appears some months after the exposure first occurred. In severe cases, there is progression to loss of coordination, narrowing of the visual fields, hearing loss and speech impairment, paralysis and death. The lowest observed effect level or threshold dose for neurological effects in adults following short to medium-term exposure to methylmercury is 200 ppb blood mercury (equivalent to 50 ppm hair mercury or an estimated intake of 2.8 µg/kg bw/day) (WHO 1990). The applicability of this level to chronic low-level exposure (for example, from fish consumption) is uncertain.

In the infant, following in utero exposure through maternal fish consumption, the effects observed typically manifest as decreased scores on tests that measure neurocognitive and fine motor function. A level of maternal hair mercury estimated to be without appreciable adverse effects in the offspring of fish eating populations is 14 ppm (equivalent to 56 ppb blood mercury or an intake of 1.5 µg/kg bw/day) (JECFA 2003).

A PTWI for methylmercury of 3.3 µg/kg bw was established by the Joint FAO/WHO Expert Committee on Food Additives (JECFA) in 1988 (WHO 1990). This level was considered protective of the general population, but not the developing foetus. In June 2003, JECFA established a lower level of 1.6 µg/kg bw, to take account of the most sensitive population subgroup (JECFA 2003).

**Recent surveys of mercury in seafood:** Although methylmercury is of primary interest, surveys of contaminants in food typically only measure total mercury. However, about 95 per cent of mercury in fish is in the organic form, principally as methylmercury (Bloom 1989; Swan 1998). Mercury concentrations in most commercially harvested oceanic fish in Australia are <0.5 mg/kg methyl mercury, but larger species, predators and long-lived species tend to accumulate much higher concentrations.

Over the past two decades there have been several surveys of Australian finfish (Table 4.23), all of which have found that most seafood contains low concentrations of mercury (New South Wales Health Commission 1978; Working Group on Mercury in Fish 1979; Western Australian Food Monitoring Program 1993; Bureau of Resource Sciences 1997a and 1997b; White 1999).

In a New South Wales survey, 3/26 shark samples and 3/8 swordfish samples exceeded the 1 mg/kg (White 1999). The maximum concentration of mercury found in shark and swordfish in this survey was 2.3 mg/kg and 1.65 mg/kg, respectively. Several other recent surveys have found fish with mercury concentrations above 1 mg/kg. The 1989–1993 New South Wales health survey found that nearly 3 per cent of 1095 fish samples, all shark and swordfish, exceeded 1 mg/kg.

Canned crab, fish fillets, mussels and canned red salmon were analysed for mercury in the 19th Australian Total Diet Survey (FSANZ 2001). Levels detected (minimum, maximum, median; units mg/kg) were: canned crab (0.03, 0.07, 0.04); fish fillets (0.04, 1.30, 0.18); mussels (0.009, 0.04, 0.02); and canned red salmon (0.03, 0.05, 0.03).

Prawns, fish fillets and portions, and canned tuna were analysed for zinc in the 20th Australian Total Diet Survey (FSANZ 2003). Levels detected (minimum, maximum, median; units mg/kg) were: prawns (0.01, 0.048, 0.016); fish fillets (0.005, 0.05, 0.016); fish portions (0.042, 3.50, 0.25); and canned tuna (0.13, 0.31, 0.16).

**Dietary exposure to mercury:** During its review of metal contaminants in foods, ANZFA concluded that there is potential for consumers to exceed the PTDI set for mercury, especially from eating marine fish, the main contributor to mercury dietary exposure (ANZFA 1999b).

Dietary modelling conducted as part of that risk assessment determined that the exposure to mercury for the general population from a range of foods is well below the PTDI, at up to 23 per cent for mean consumers and up to 89 per cent for 95th percentile consumers. For adults consuming fish at a median level (70 grams fish/day) every day, the PTDI for adult neurological effects is approached (96% PTDI) assuming all fish is predatory, but not if all fish is non-predatory (30% PTDI). However, for high consumers of fish (adults consuming fish alone at the 95th percentile level – 321 grams fish/day) the PTDI for adult neurological effects is exceeded regardless of whether all fish is predatory (438% PTDI) or non-predatory (137% PTDI).

As a result of that review, ANZFA developed an advisory statement for pregnant women informing them about the amounts and types of fish that are safe to consume during pregnancy, as the foetus is the most vulnerable to the effects from mercury. However, several factors have led to FSANZ instigating a review of its mercury risk assessment, particularly with regard to fish consumption.

The lowering of the PTWI by JECFA and the availability of a significant amount of recent data on mercury levels in a far greater number of fish species are allowing a complete and thorough revision of the dietary modelling, and the outcomes of this work are expected to lead to a reconsideration of existing risk management options for mercury in foods.

**Table 4.23: Mercury concentrations in predatory fish in Australia**

	Mean mercury levels (mg/kg) – number of samples in parentheses			
	NSW Health Commission 1978	Working Group on Mercury in Fish 1979	WA Food Monitoring Program 1993	White 1999
Gemfish	–	0.68 (148)	–	–
Tuna, Skipjack	–	0.15 (20)	–	–
Tuna, Southern Bluefin	–	0.22 (219)	–	–
Tuna, Yellow Fin	–	0.38 (20)	–	–
Swordfish	1.98	–	–	0.98 (8)
Marlin, Black	–	7.27 (42)	–	0.57 (3)
Shark	–	–	–	–
Angel	–	0.36 (36)	–	–
Blacktip Whaler	–	1.48 (8)	0.41 (14)	–
Blue Pointer	–	1.93 (2)	0.83 (2)	–
Blue Whaler	–	0.41 (2)	–	–
Bronze Whaler	–	0.72 (159)	0.52 (33)	–
Carpet	–	1.02 (76)	0.69 (12)	–
Gummy	–	0.44 (507)	0.29 (4)	–
'Shark'	–	–	–	0.48 (26)

Source: Extracted from M&S Food Consultants 2001.

**Ranking of hazard:** Mercury, in the form of methylmercury, represents a severe hazard for the developing foetus, which may exhibit adverse effects of long duration at a much lower level of exposure than in the general population. For the general population, mercury is ranked as a serious hazard (Section 3, Table 3). The effects can be debilitating, with the possibility of on going chronic sequelae.

### *Zinc*

Zinc is an essential element that is found in a wide variety of foods at relatively low levels. Diet is the main source of zinc for consumers. Additional sources of exposure may occur from drinking water stored in old galvanised containers and dietary supplements may also add to the daily zinc burden.

**Regulation of zinc in seafood:** There is no maximum limit for zinc in seafood specified in the Code. However, following a review, generally expected levels were established for specific seafood commodities in order to identify the minimum level of contamination that is reasonably achievable, and to provide a trigger for remedial action if a level is exceeded (Table 4.24).

**Table 4.24: Guideline generally expected levels for zinc in seafood**

Commodity	GELs median (mg/kg)	GELs 90th percentile (mg/kg)
Crustacea	25	40
Fish	5	15
Oysters	130	290

GELs = generally expected levels

**Hazard identification and characterisation:** Limited human toxicological data are available for determining the maximum tolerable intake for zinc. Vomiting and fever after acute exposures, and damage to kidneys and pancreas after sub-chronic and chronic exposures in animals have been observed at dietary levels above 1000 mg/day. Copper and iron deficiencies have been documented in animals and in humans exposed to chronically high intake of zinc.

Interaction with other nutrients especially copper, where its absorption and utilisation is influenced at a biochemical level has been observed at intakes as low as 60 mg/day, when zinc was taken as a supplement to the diet. Biochemical changes observed at 60 mg/day were interpreted as the first indicator that the copper-dependent processes were affected.

JECFA established a PTDI of 1 mg/kg bw in 1982. To ensure that very few individuals in a population have an intake of 60 mg/day or higher, a WHO/FAO/IAEA Expert Consultation (1996) recommended that the adult population mean intake should not exceed 45 mg/day, assuming a 20 per cent variation in intake. The PTDI for zinc, for the purposes of a previous risk assessment by FSANZ was set at 1 mg/kg bw, based on a 60 kg adult.

**Recent surveys on zinc in seafood:** Smoked fish fillets, oysters, canned red salmon and seafood sticks were examined for zinc in the 1994 Australian Market Basket Survey. Concentrations of zinc ranged from 3.7 mg/kg to 12 mg/kg for smoked fish fillets; 6.4 mg/kg to 14 mg/kg for canned red salmon; 1.7 mg/kg to 2.6 mg/kg for seafood sticks; and 120 mg/kg to 660 mg/kg for oysters (Marro 1996).

Canned crab, fish fillets, mussels and canned red salmon were analysed for zinc in the 19th Australian Total Diet Survey (FSANZ 2001). Levels detected (minimum, maximum, median; units mg/kg) were: canned crab (22.0, 49.0, 25.0); fish fillets (3.6, 11.0, 6.3); mussels (13.0, 63.0, 26.0); and canned red salmon (5.7, 9.9, 8.1).

Prawns, fish fillets and portions, and canned tuna were analysed for zinc in the 20th Australian Total Diet Survey (FSANZ 2003). Levels detected (minimum, maximum, median; units mg/kg) were: prawns (7.8, 17.0, 12.0); fish fillets (2.9, 5.4, 3.7); fish portions (3.4, 11.0, 5.0); and canned tuna (6.6, 12.0, 8.7).

**Dietary exposure to zinc:** The mean total dietary exposure to zinc for all respondents ranged from 19–20 per cent PTDI. The dietary exposure estimates for high consumers of single food commodity groups indicated that consumers of oysters might receive relatively high levels of zinc from this source compared to any other food. Oysters are considered a food that is ‘occasionally consumed’ and the median consumption level was taken to be a representative level of consumption for a high consumer. Total dietary exposure to zinc for high consumers of oysters, assuming mean exposure from all other foods, is estimated to be 38 per cent of the PTDI (ANZFA 1999b).

**Ranking of hazard:** Zinc is ranked as ‘moderate’ in terms of adverse health effects (Section 3, Table 3). Acute exposure to high levels has an emetic effect of short duration.

#### References in Appendix 4

- Abeyta, C., Kaysner, C.A., Wekell, M.M., Sullivan, J.J. & Stelma, G.N. (1986). Recovery of *Aeromonas hydrophila* from oysters implicated in an outbreak of foodborne illness. *Journal of Food Protection* 49:643–646.
- Adams, A.M., Leja, L.L., Jinneman, K., Beeh, J., Yuen, G.A. & Wekell, M.M. (1994). Anisakid parasites, *Staphylococcus aureus* and *Bacillus cereus* in sushi and sashimi from Seattle area restaurants. *Journal of Food Protection* 57:311–17
- Adams, A.M., Murrell, K.D. and Cross, J.H. (1997). Contamination of animal products: prevention and risks for public health. *Revue Scientifique et Technique Office International des Epizooties* 16:652–60.
- Adroher, F.J., Valero, A., Ruiz-Valero, J. & Iglesias, L. (1996). Larval anisakids (Nematoda: Ascaridoidea) in horse mackerel (*Trachurus trachurus*) from the fish market in Granada (Spain). *Parasitology Research* 82:253–56.
- Agbonlahor, D.E., Shonekan, W. H., Kazak, W.H. & Coker, A.O. (1982). *Aeromonas* food poisoning in Nigeria: a case report. *Cent. Afr. J. Med.* 28:36–38.
- Altwegg, M., Altwegg-Bissis, A., Demarta, A, Peduzzi, R., Reeves, M.W. & Swarminathan, B. (1991). *Aeromonas*-associated gastroenteritis after consumption of contaminated shrimp. *Eur. J. Clin. Microbiol. Infect. Dis.* 10:44–45.
- Anon. (1963). Botulism – Smoked fish products – United States. *Morbidity Mortality Weekly Reports*, 12:378.
- Anon. (1982). Problems with canned Canadian and United States salmon. *Communicable Disease Intelligence Bulletin*, 82(20):5–6.
- Anon. (1996) *Communicable Disease Surveillance Data*, New Zealand Public Health Report, 3(2):14.
- Anon. (1997) *Communicable Disease Surveillance Data*, New Zealand Public Health Report, 3(2):14.
- Anon.(1998) *Communicable Disease Surveillance Data*, New Zealand Public Health Report, 3(2):14.
- Anon. (1999) *Communicable Disease Surveillance Data*, New Zealand Public Health Report, 3(2):14.
- Anon. (2000) *Communicable Disease Surveillance Data*, New Zealand Public Health Report, 3(2):14.
- Anon. (2001) *Communicable Disease Surveillance Data*, New Zealand Public Health Report, 3(2):14.
- ANZFA (1999a), Shellfish toxins in food: a toxicological review and risk assessment (Proposal P158 – review of the maximum permitted concentrations of non-metals in food), Australia New Zealand Food Authority.
- ANZFA (1999b), Contaminants in Foods – Metals; Full Assessment Report for Proposal P157, Australia New Zealand Food Authority.
- Apaire Marchais, V., Le Guyader, F., Besse, B. & Billaudel, S. (1995). Presented at the Shellfish Depuration. Purification des Coquillages. Poggi, R.; Le Gall, J.Y. (eds), Plouzane France Ifremer, Centre de Brest.
- Arnold G. & Coble J. (1995). Incidence of *Listeria* species in foods in New South Wales, *Food Australia*, 47(2):71–75.
- Arnott, G.H. 1998. Toxic marine microalgae: a worldwide problem with major implications for seafood safety. *Advancing Food Safety* 1:24–34.



- Ash, M. (1997). *Staphylococcus aureus* and staphylococcal enterotoxins. In Foodborne micro-organisms of public health significance. (A.D. Hocking, G. Arnold, I. Jenson, K. Newton and P. Sutherland, eds). Australian Institute of Food Science and Technology (New South Wales Branch), Food Microbiology Group. AIFST, Sydney, Australia.
- Audicana, M.T., Ansotegui, I.J. Fernández de Corres, L. & Kennedy, M.W. (2002). *Anisakis simplex*: dangerous – dead and alive? *Trends in parasitology*. 18(1):20–25.
- Badhey, H., Cleri, D.J., D'Amato, R.F., Vernaleo, J.R., Veinni, V. Tessler, J., Wallman, A.A., Mastellone, A.J., Giuliani, M. & Hochstein, L. (1986). Two fatal cases of type E adult botulism with early symptoms and terminal neurologic signs. *Journal of Clinical Microbiology*, 23(3):616–18.
- Bean, N.H., Goulding, J.S., Lao C. & Angulo, F.J. (1996). Surveillance for foodborne-disease outbreaks. United States, 1998–92. *Morbidity and Mortality Weekly. Centre for Disease Control Surveillance Summaries*, 45(SS 5):1–55.
- Benenson, A.S. (1995). (ed.). *Control of the Communicable Diseases of Man* 16th edition. American Public Health Association, Washington, pp. 577.
- Berry, T.M., Park, D.L. & Lightner, D.V. (1994). Comparison of the microbial quality of raw shrimp from China, Ecuador, or Mexico at both wholesale and retail levels. *Journal of Food Protection*, 57(2):150–53.
- Bidawid, S., Farber, J.M. & Sattar, S.A. (2000), Contamination of foods by food handlers: experiments on hepatitis A virus transfer to food and its interruption, *Appl. Environ. Microbiol.* 66(7), 2759–63.
- Bille J. (1990). Epidemiology of human listeriosis in Europe, with special reference to the Swiss outbreak, in Miller, Smith and Somkuti (eds), *Foodborne Listeriosis*, Elsevier Publishers, Amsterdam.
- Bird, P.D. & Kraa, E. (1995). Presented at the Purification des Coquillages. Poggi, R.; Le Gall, J.Y. (eds). *Shellfish Depuration. Purification des Coquillages*. Plouzane France, IFREMER, Centre de Brest.
- Birkenhauer, J.M. & Oliver, J.D. (2002). Effects of refrigeration and alcohol on the load of *Aeromonas hydrophila* in oysters. *Journal of Food Protection*. 65(3):560–62.
- Bloom, N.S. (1989). Determination of picogram levels of methylmercury by aqueous phase ethylation, followed by cryogenic gas chromatography with cold vapor atomic fluorescence detection, *Canadian J. Fish Aquatic Sci.* 46,1131–40.
- Blumer, C., Roche, P., Spencer, J., Lin, M., Milton, A., Bunn, C., Gidding, H., Kaldor, J., Kirk, M., Hall, R., Della-Porta, T., Leader, R. & Wright, P. (2003) Australia's notifiable disease status, 2001. *Communicable Disease Intelligence*. 27(1):1–78.
- Bouree, P., Paugum, A & Petithory, J.C. (1997). *Anisakidosis: report of 25 cases and review of the literature. A Collection of Publications on Nematodes Occurring in Cod Fish, 1997.*
- Brillantes, S. & Samosorn, W. (2001). Determination of histamine in fish sauce from Thailand using a solid-phase extraction and high-performance liquid chromatography. *Fisheries Sci.*, 67(6):1163-8.
- Brillantes, S., Paknoi, S. & Totakien, A. (2002). Histamine formation in fish sauce production. *J. Food Sci.*, 67(6):2090-4.
- Brown, C. (1993). Scombroid poisoning (letter). *Med. J. of Australia*, 158:435–36.
- Bureau of Resource Sciences. (1997a). Report on the National Residue Survey 1995 Results, Bureau of Resource Sciences.
- Bureau of Resource Sciences. (1997b). Report on the National Residue Survey 1996 Results, Bureau of Resource Sciences.

- Capra, M.F. (1997). Ciguatera. In *Foodborne Micro-organisms of Public Health Significance* (A.D. Hocking, G. Arnold, I. Jenson, K. Newton & P. Sutherland, eds). Australian Institute of Food Science and Technology Inc., New South Wales Branch Food Microbiology Group, North Sydney, Australia. pp. 573–82.
- Capra, M.F. & Cameron, J. (1988) Ciguatera poisoning: pharmacology and pathology. Final report, FIRTA grant 83/41. Commonwealth Department of Primary Industry, Canberra, Australia.
- Cash, R.A., Music, S.I., Libonati, J.P., Snyder, M.J., Wenzel, R.P. & Hornick, R.B. (1974), Response of man to infection with *Vibrio cholerae* I: Clinical, serologic, and bacteriologic responses to a known inoculum, *J. Infectious Diseases* 129:45–52.
- Council for Agricultural Science and Technology. (1994). *Foodborne pathogens: risk and consequences*. Council for Agricultural Science and Technology, United States. Task Force Report No. 122. ISSN 01944088.
- Centre for Disease Control. (1993). *Vibrio vulnificus* infections associated with raw oyster consumption – Florida, 1981–1992. *Morbidity and Mortality Weekly Report*. 42(21):405–6.
- Centre for Disease Control. (1995). Update: *Vibrio cholerae* O1 – western hemisphere, 1991–1994, and *V. cholerae* O139 – Asia, 1994. *Morbidity and Mortality Weekly Report*. 44(11):215–19.
- Centre for Disease Control. (1996). Surveillance for foodborne-disease outbreaks – United States, 1988–1992. *Morbidity and Mortality Weekly Report*, 45(SS–5).
- Communicable Disease Intelligence. (1997). Hepatitis A outbreak in New South Wales. *Communicable Disease Intelligence*, 21(4).
- Centre for Food Safety and Applied Nutrition (2001), Draft Risk Assessment on the Public Health Impact of *Vibrio parahaemolyticus* in Raw Molluscan Shellfish. Available from: <<http://www.cfsan.fda.gov/~dms/vprisk.html>>. Accessed 5 November 2003.
- Chai, J.Y., Cho, S.R., Kook, J. & Lee, S.H. (1992). Infection status of the sea eel (*Astroconger myriaster*) purchased from the Noryangjin fish market with anisakid larvae. *Kisaengchunghak Chapchi*, 30:157–62
- Chao, D. (1985). Survey of Anisakis larvae in marine fish of Taiwan. *International Journal of Zoonoses*, 12:233–7.
- Chord-Auger S, Miegerville, M. & Pape, P. (1995). Anisakiasis in the Nantes area. From fishmongers' stalls to medical offices. *Parasite*, 2:395–400.
- Christian, J.H.B. (1971). The ecology of *Clostridium botulinum* type E in the Australian environment. Technical Reporting Service, International Atomic Energy Agency. (cited in Szabo & Gibson, 1997, q.v.)
- Clifford, M.N. & Walker, R. (1992). The aetiology of scombrototoxicosis. *International Journal of Food Science and Technology*, 27:725–26.
- Communicable Diseases Australia (2003). National Notifiable Diseases Surveillance System, Australian Government Department of Health and Ageing. Available from: <[www1.health.gov.au/cda/Source/CDA-index.cfm](http://www1.health.gov.au/cda/Source/CDA-index.cfm)>. Accessed 5 November 2003.
- Cook, D.W., Bowers, J.C. & DePaola, A. (2002). Density of total and pathogenic (tdh+) *Vibrio parahaemolyticus* in Atlantic and Gulf Coast. *Journal of Food Protection*. 35(12):1873–80.
- Crance, J.M., Apaire Marchais, V., Leveque, F., Beril, C., Le Guyader, F., Jouan, A., Schwartzbrod, L. & Billaudel, S. (1995). Detection of hepatitis A virus in wild shellfish. *Marine Pollution Bulletin*, 30(6):372–75.

- Deardorff, T.L. & Overstreet, R.M. (1991). Seafood-transmitted zoonoses in the United States: the fishes, the dishes, and the worms. In Ward, D.R. & Hackney, C. *Microbiology of Marine Food Products*. Van Nostrand Reinhold, New York, pp. 221–65.
- DePaola, A., Capers, G.M. & Alexander, D. (1994). Densities of *Vibrio vulnificus* in the intestines of fish from the United States gulf coast. *Applied and Environmental Microbiology*, 60(3):984–88.
- DePaola, A., Hopkins, L. H., Peeler, J. T., Wentz, B. & McPhearson, R. M. (1990). Incidence of *Vibrio parahaemolyticus* in US coastal waters and oysters. *Applied and Environmental Microbiology*. 56(8):2299–302.
- DePaola, A., Motes, M.L., Chan, A.M. & Suttle, C.A. (1998). Phages infecting *Vibrio vulnificus* are abundant and diverse in oysters (*Crassostrea virginica*) collected from the Gulf of Mexico. *Applied and Environmental Microbiology*, 64(1):346–51.
- DePaola, A., Nordstrom, J.L., Bowers, J.C., Wells, J.G. & Cook., D.W. (2003). Seasonal abundance of total and pathogenic *Vibrio parahaemolyticus* in Alabama oysters. *Applied and Environmental Microbiology*. 69(3):1521–26.
- Desmarchelier, P.M. (1997), Pathogenic Vibrios, in *Foodborne micro-organisms of public health significance*, 5th edn, Australian Institute of Food Science and Technology (New South Wales Branch) Food Microbiology Group, pp. 285–312.
- Desmarchelier, P.M. & Fegan, N. (2003), Enteropathogenic *Escherichia coli*, in *Foodborne micro-organisms of public health significance*, 6th edn, Australian Institute of Food Science and Technology (New South Wales Branch) Food Microbiology Group, pp. 267–310.
- Dodds, K.L. (1993). *Clostridium botulinum* in foods. In *Clostridium botulinum: Ecology and Control in Foods*. A.W. Hauschild and K.L Dodds (eds). Marcel Dekker, Inc., N.Y. pp. 53–68.
- Doyle, M.P. & Padhye, V.V. (1989). *Escherichia coli*. In M.P. Doyle (ed.), *Foodborne Bacterial Pathogens*. Marcel Dekker, Inc., New York. pp 235–81.
- Dunn, Son & Stone. (1998). *Victorian Food Surveillance Annual Report*. North Melbourne, Victoria.
- DuPont, H.L., Formal, S.B., Hornick, R.B., Snyder, M.J., Libonati, J.P., Sheahan, D.G., LaBrec, E.H. & Kalas, J.P. (1971), Pathogenesis of *Escherichia coli* diarrhea, *N. Engl. J. Med.* 285(1):1–9.
- Durborow, R.M. (1999). Health and safety concerns in fisheries and aquaculture. *Occupational Medicine: State of the Art Reviews*, 14:373–406.
- Edelman, R. & Levine, M.M. (1983), From the National Institute of Allergy and Infectious Diseases. Summary of a workshop on enteropathogenic *Escherichia coli*, *J. Infect. Dis.* 147:1108–18.
- Eslami, A. & Mokhayer, B. (1977). Nematode larvae of medical importance found in market fish in Iran. *Pahlavi Medical Journal*, 8:345–48.
- European Commission (2000). Opinion of the scientific committee on veterinary measures relating to public health on Foodborne zoonoses, 12 April 2000, Health and Consumer Protection Directorate-General, European Commission.
- Eyles, M.J. & Davey, G.R. (1984). Microbiology of commercial depuration of the Sydney rock oyster: *Crassostrea commercialis*, *J. Food Prot.* 47:703–706.
- Eyles, M.J., Davey, G.R. & Arnold, G. (1985). Behaviour and incidence of *Vibrio parahaemolyticus* in Sydney Rock oysters (*Crassostrea commercialis*). *International Journal of Food Microbiology*, 1(6):327–34.
- Eyles, M.J. & Davey, G.R. (1988). *Vibrio cholerae* and enteric bacteria in oyster growing areas of two urban estuaries in Australia, *Int. J. Food Microbiol.* 6:207–18.

- FAO (1999). FAO Expert consultation on the trade impact of *Listeria* in fish products (FAO Fisheries Report No. 604), Food and Agriculture Organization of the United Nations.
- Farber J. & Peterkin P. (1991). *Listeria monocytogenes*, a Foodborne Pathogen. *Microbiological Review* 55(3):476–511.
- Fayer, R., Graczyk, T.K., Lewis, E.J., Trout, J.M. & Farley, C.A. (1998). Survival of infectious *Cryptosporidium parvum* oocysts in seawater and eastern oysters (*Crassostrea virginica*) in the Chesapeake Bay. *Applied and Environmental Microbiology* 64(3):1070–74.
- FDA (2001). Natural Toxins, in *Fish and Fishery Products Hazards and Controls Guidance*. 3rd ed. Food and Drug Administration, Center for Food Safety and Applied Nutrition, Office of Seafood, Washington, DC., pp. 73–82.
- FDA. (2003). Bad Bug Book (Foodborne Pathogenic Micro-organisms and Natural Toxins. Available from: <<http://vm.cfsan.fda.gov/~mow/intro.html>>. Accessed 13 November 2003.
- Fenner, P.J., Lewis, R.J., Williamson, J.A. & Williams, M.L. (1997). A Queensland family with ciguatera after eating coral trout. *Medical Journal of Australia*, 166:473–75.
- Fleet, G.H., Heiskanen, P., Reid, I. & Buckle, K.A. (2000). Foodborne viral illness – status in Australia. *International Journal of Food Microbiology* 59:127–36.
- Fletcher, G.C. (1985). The potential food poisoning hazard of *Vibrio parahaemolyticus* in New Zealand pacific oysters. *New Zealand Journal of Marine and Freshwater Research*, 19(4):495–505.
- Fletcher, G.C., Summers, G. & van Veghel, P.W. (1998). Levels of histamine and histamine-producing bacteria in smoked fish from New Zealand markets. *Journal of Food Protection*, 61(8):1064–70.
- Food Science Australia & Minter Ellison Consulting (2002), National Risk Validation Project – Final Report. Available from: <<http://www.health.gov.au/pubhlth/strateg/foodpolicy/pdf/validation.htm>>. Accessed 13 November 2003.
- Formiga-Cruz, M., Tofiño-Quesada, G., Bofill-Mas, S., Lees, D.N., Henshilwood, K., Allard, A.K., Conden-Hansson, A.-C., Hernroth, B.E., Vantarakis, A., Tsibouxi, A., Papapetropoulou, M., Furonos, M.D. & Girones, R. (2002). Distribution of human virus contamination in shellfish from different growing areas in Greece, Spain, Sweden, and the United Kingdom. *Applied and Environmental Microbiology*. 68(12):5990–98.
- Fritz, L., Quilliam, M.A., Wright, J.L.C., Beale, A.M. & Work T.M. (1992). An outbreak of domoic acid poisoning attributed to the pennate diatom *Pseudonitzschia australis*. *J. Phycol.* 28:439–42.
- FSANZ (2001). 19th Australian Total Diet Survey. Available from: <<http://www.foodstandards.gov.au/mediareleasespublications/publications>>. Accessed 13 November 2003.
- FSANZ (2003), 20th Australian Total Diet Survey. Available from: <<http://www.foodstandards.gov.au/mediareleasespublications/publications>>. Accessed 13 November 2003.
- Garland, C.D.G. (1995). Microbiological quality of aquaculture products with special reference to *Listeria monocytogenes* in Atlantic Salmon. *Food Australia*. 47(12):559–63.
- Garland, C.G.D. & Mellefont, L. (1996). Occurrence of *Listeria monocytogenes* in ready-to-eat smoked products of Atlantic salmon farmed in Tasmania, Australia. Proceedings of an international post-harvest seafood symposium Making the most of the catch. Brisbane, July, 1996.
- Gecan, J.S., Bandler, R. & Staruszkiewicz, W.F. (1994). Fresh and frozen shrimp a profile of filth, microbiological contamination, and decomposition. *J. Food. Prot.* 57:154–58, 168.

- Gessner, B.D. & Middaugh, J.P. (1995). Paralytic shellfish poisoning in Alaska: a 20-year retrospective analysis, *American Journal of Epidemiology* 141(8):766–70.
- Gibson, A.M., Eyles, M.J. & Bremner, A. (1994). Presence and persistence of the hazardous micro-organism *Clostridium botulinum* in ballast sediments. Fishing Industry Research and Development Corporation, Project No. CSTIZ, 89/38.
- Gillespie, N.C., Lewis, R.J., Pearn, J.H., Bourke, A.T., Holmes, M.J., Bourke, J.B. & Shields, W.J. (1986). Ciguatera in Australia. Occurrence, clinical features, pathophysiology and management, *Med. J. Aust.* 145(11–12):584–90.
- Givney, R.C. (2002). Illness associated with rudderfish/escolar in South Australia, *Communicable Disease Intelligence* 26(3):440.
- Glaziou, P. & Legrand, A.M. (1994). The epidemiology of ciguatera fish poisoning. *Toxicon*, 32:863–73.
- Glaziou, P. & Martin, P.M.V. (1993). Study of factors that influence the clinical response to Ciguatera fish poisoning. *Toxicon*, 31:1151–54.
- Goldsmid, J.G. & Speare, R. (1997). Parasitology of Foods. In A.D. Hocking, G. Arnold, I. Jenson, K. Newton & P. Sutherland (eds). *Foodborne Micro-organisms of Public Health Significance* 5th Edition. Australian Institute of Food Science and Technology Inc., North Sydney, pp. 585–602.
- Gooch, J.A., DePaola, A., Bowers, J. & Marshall, D.L. (2002), Growth and survival of *Vibrio parahaemolyticus* in post-harvest American oysters, *J. Food Prot.* 65(6):970–74.
- Gorczyca, E. M., Chong, M.P. & Green, J. (1984). The hygiene status of seafood in Melbourne. Spoilage of Tropical Fish and Product Development. Proceedings of a symposium held in conjunction with the 6th session of the Indo Pacific Fishery Commission Working Party on Fish Technology and Marketing, Royal Melbourne Institute of Technology, Melbourne, Australia (317):182–90.
- Granum, P.E., O’Sullivan, K., Tomás, J.M. & Ormen, O. (1998). Possible virulence factors of *Aeromonas* spp. from food and water. *FEMS Immunol. Med. Microbiol.* 21:131–37.
- Greenwood, M., Winnard, G., Bagot, B. (1998). An outbreak of *Salmonella enteritidis* phage type 19 infection associated with cockles. *Communicable Disease and Public Health*, 1:35–37.
- Greenwood, M.H., Coetzee, E.F.C., Ford, B.M., Gill, P., Hooper, W.L., Mathews, S.C.W., Patrick, S., Pether, J.V.S. & Scott, R.J.D. (1985). The bacteriological quality of selected retail, ready-to-eat food products. *Environmental Health*, London, 93:236–39.
- Gregory, J. (2002). Outbreaks of diarrhoea associated with butterfish in Victoria, *Communicable Disease Intelligence* 26(3):439–40.
- Grohmann, G. (1997). Viruses, Food and Environment. In *Foodborne Micro-organisms of Public Health Significance* (A.D. Hocking, G. Arnold, I. Jenson, K. Newton & P. Sutherland, (eds). Australian Institute of Food Science and Technology Inc., Food Microbiology Group, North Sydney, Australia, pp. 605–20.
- Grohmann, G.S. & Lee, A. (2003). Viruses, food and environment, in *Foodborne micro-organisms of public health significance*, 6th edn, Australian Institute of Food Science and Technology (New South Wales Branch) Food Microbiology Group, pp. 615–34.
- Gross, R.J. & Rowe, B. (1985). *Escherichia coli* diarrhoea. *J. Hyg.* 95:531–50.
- Hahn, S. & Capra, M.F. (2003). Fishborne illnesses: scombroid and ciguatera poisoning. In *Foodborne micro-organisms of public health significance*, 6th edn, Australian Institute of Food Science and Technology (New South Wales Branch) Food Microbiology Group, pp. 689–702.

- Hallegraeff, G.M. (1998). Algal toxins in Australian and New Zealand seafood products: review of their occurrence, analytical detection and public health implications. Report for the Australia New Zealand Food Authority (ANZFA).
- Hallegraeff, G.M. (1991). Aquaculturists' Guide to Harmful Australian Microalgae. CSIRO/Fishing Industry Training Board of Tasmania.
- Hallegraeff, G.M. (1994). Species of the diatom genus *Pseudonitzschia* in Australian waters. *Bot. Mar.* 37:397–411.
- Hallegraeff, G.M. (2003). Algal toxins in Australian shellfish. In *Foodborne micro-organisms of public health significance*, 6th edn, Australian Institute of Food Science and Technology (New South Wales Branch) Food Microbiology Group, pp. 675–88.
- Hallegraeff, G.M., Bolch, C.J., Blackburn, S.I. & Oshima, Y. (1991). Species of the toxigenic dinoflagellate genus *Alexandrium* in southeastern Australian waters. *Bot. Mar.* 34:575–87
- Hansman, Y., Harf-Monteil, C., Monteil, H. & Christmann, D. (2000). Collective food toxic-infection due to *Aeromonas caviae*. *Medecine et Maladies Infectieuses* 30:534–35.
- Hardy, B. (1998). The Australian Market Basket Survey 1996. ANZFA, Information Australia, Melbourne.
- Harvey, N.P. (1995). Ciguatera fish poisoning outbreak in Brisbane. *Communicable Diseases Intelligence*, 19:666–68.
- Hauschild, A.H.W. (1993). Epidemiology of human foodborne botulism. In *Clostridium botulinum: Ecology and Control in Foods*, A.H.W. Hauschild & K.L. Dodds (eds), Marcel Dekker, Inc., N.Y., pp. 69–104.
- Hauschild, A.H.W. & Gavreau, L. (1985). Foodborne botulism in Canada, 1971–84. *Canadian Medical Association Journal*, 133(11):1141–46.
- Hitchins, A.D. (1996). Assessment of alimentary exposure to *Listeria monocytogenes*. *International Journal of Food Microbiology*. 30:71–85.
- Hoi, L., Larsen, J.L., Dalsgaard, I. & Dalsgaard, A. (1998). Occurrence of *Vibrio vulnificus* biotypes in Danish marine environments. *Applied and Environmental Microbiology*, 64(1):7–13.
- Huang, W.Y. (1988). Anisakids and human anisakiasis. 2. Investigation of the anisakids of commercial fish in the district of Paris. *Annals of Parasitology and Human Comp*, 63:197–208.
- Humphrey, J.D. (1995). Australian Quarantine Policies and Practices for Aquatic Animals and their Products: a review for the Scientific Working Party on Aquatic Animal Quarantine Part 1 and Annexes. Bureau of Resource Sciences, Canberra.
- Hurst, R.J. (1984). Identification and description of larval *Anisakis simplex* and *Pseudoterranova decipiens* (Anisakidae: Nematoda) from New Zealand waters. *New Zealand Journal of Marine and Freshwater Research*, 18:177–86.
- ICMSF (1996). *Micro-organisms in Foods. 5. Microbiological Specifications of Food Pathogens*. Blackwell Scientific Publications, Oxford.
- Ismaili A., Philpott, D.J., McKay, D.M., Perdue, M.H. & Sherman, P.M. (1998). Epithelial cell responses to Shiga toxin-producing *Escherichia coli* infection. In: *Escherichia coli O157:H7 and other Shiga toxin-producing E. coli strains*. Eds Kaper, JB & O'Brien AO. American society for Microbiology, Washington, pp. 213–25.
- Jackson, J.K., Murphree, R.L. & Tamplin, M.L. (1997). Evidence that mortality from *Vibrio vulnificus* infection results from single strains among heterogeneous populations in shellfish. *Journal of Clinical Microbiology*, 35(8):2098–101.

- Janssen, U. (1996). Investigations on Vibrionaceae in wholesale and retail seafood and their importance for human health. Hannover, Germany.
- Jasperse, J.A. (ed) (1993). Marine toxins and New Zealand shellfish. Proceedings of a workshop on research issues, 10–11 June 1993. The Royal Soc. of New Zealand, Miscellaneous Series 24.
- Jay, L.S., Davos, D., Dundas, M., Frankish, E. & Lightfoot, D. (2003). Salmonella. In Foodborne micro-organisms of public health significance, 6th edn, Australian Institute of Food Science and Technology (New South Wales Branch) Food Microbiology Group, pp. 207–66.
- Jay, L.S., Grau, F.H., Smith, K., Lightfoot, D., Murray, C. & Davey, G.R. (1997). Salmonella. In Foodborne micro-organisms of public health significance. (A.D. Hocking, G. Arnold, I. Jenson, K. Newton & P. Sutherland, eds). Australian Institute of Food Science and Technology (New South Wales Branch), Food Microbiology Group. AIFST, Sydney, Australia.
- JECFA (2003). Summary and Conclusions. 61st meeting of the Joint FAO/WHO Expert Committee on Food Additives, held in Rome, 10–19 June 2003.
- Kalina, G.P. (1997). Aeromonads in food products and their possible role as causative agents of food poisoning. *Gigiena I Sanitariia (Moskva)* 8:97–100.
- Kam, K.M., Leung, T.H., Ho, Y.Y., Ho, N.K. & Saw, T.A. (1995). Outbreak of *Vibrio cholerae* O1 in Hong Kong related to contaminated fish tank water. *Public Health*, 109(5):389–95.
- Katz, A.R., Terrellperica, S. & Sasaki, D.M. (1993). Ciguatera on Kauai – investigation of factors associated with severity of illness. *American Journal of Tropical Medicine & Hygiene*, 49:448–54.
- Kaufman, G.E., Bej, A.K., Bowers, J. & DePaola, A. (2003). Oyster-to-oyster variability in levels of *Vibrio parahaemolyticus*, *J. Food Prot.* 66(1):125–29.
- Kirkland, K.B., Meriwether, R.A., Leiss, J.K. & MacKenzie, W.R. (1996). Steaming oysters does not prevent Norwalk-like gastroenteritis. *Public Health Report*, 3(6):527–30.
- Kirov, S.M. (2003). Aeromonas. In Foodborne micro-organisms of public health significance, 6th edn, Australian Institute of Food Science and Technology (New South Wales Branch) Food Microbiology Group, pp. 553–76.
- Kobayashi, K. & Ohnaka, T. (1989). Food poisoning due to newly recognised pathogens. *Asian Med.* 32:1–12.
- Korkeala, H., Stengal, G., Hyytia, E., Vogelsang, B., Bohl, A., Wihlman, H., Pakkala, P. & Hielm, S. (1998). Type E botulism associated with vacuum-packaged hot-smoked whitefish. *International Journal of Food Microbiology*, 43(1,2):1–5.
- Kothary, M.H. & Babu, US (2001). Infective dose of foodborne pathogens in volunteers: a review. *J. Food Safety* 21(1):49–73.
- Kraa, E. (1995). Surveillance and epidemiology of foodborne illness in New South Wales, Australia. *Food Australia*, 47(9):418–23.
- Kraa, E. & Bird, P. (1992). *Vibrio parahaemolyticus*. *New South Wales Public Health Bulletin*, 3:126–27.
- Krovacek, K., Dumontet, S., Eriksson, E., & Baloda, S.B. (1995). Isolation, and virulence profiles, of *Aeromonas hydrophila* implicated in an outbreak of food poisoning in Sweden. *Microbiol. Immunol.* 39:655–61.
- Kuhn, H., Gericke, B., Klepp, M., Fellmann, G. & Rabsch, W. (1994). Outbreak of *Salmonella* paratyphi B infections in connection with consumption of smoked fish. *Gesundheitswesen*, 56:211–14.

- Lall, R., Sen, D., Saha, M.R., Bose, A.K., De, S.P., Palchowdhury, N.C. & Pal, S.C. (1979). Prevalence of *Vibrio parahaemolyticus* in Port Blair. *Indian Journal of Medical Research*, 69(Feb):217–21.
- LeCour, H., Ramos, M.H., Almeida, B. & Barbosa, R. (1988). Foodborne botulism. A review of 13 outbreaks. *Archives of Internal Medicine*, 148:578–80.
- Le Guyader, F., Apaire Marchais, V., Besse, B. & Billaudel, S. (1995). Presented at the Shellfish Depuration. Purification des Coquillages. Poggi, R., Le Gall, J.Y. (eds), Plouzane France Ifremer, Centre de Brest.
- Le Guyader, F., Apaire Marchais, V., Brillet, J. & Billaudel, S. (1993). Use of genomic probes to detect hepatitis A virus and enterovirus RNAs in wild shellfish and relationship of viral contamination to bacterial contamination. *Applied and Environmental Microbiology*, 59(11):3963–68.
- Le Guyader, F., Dubois, E., Menard, D. & Pommepuy, M. (1994). Detection of hepatitis A virus, rotavirus, and enterovirus in naturally contaminated shellfish and sediment by reverse transcription-seminested PCR. *Applied and Environmental Microbiology*, 60(10):3665–71.
- LeGuyader, F., Haugarreau, L., Miossec, L., Dubois, E. & Pommepuy, M. (2000). Three-year study to assess human enteric viruses in shellfish. *Applied and Environmental Microbiology*. 66(8):3241–48.
- Lehane, L. (1999). Ciguatera Fish Poisoning. A review in a Risk-Assessment Framework. National office of Animal and Plant Health, Agriculture, Fisheries and Forestry Australia.
- Lehane, L. (2000). Paralytic Shellfish Poisoning: a review. National Office of Animal and Plant Health, Agriculture, Fisheries and Forestry - Canberra, Australia.
- Lehane, L. & Lewis, R.J. (2000). Ciguatera: recent advances but the risk remains. *International Journal of Food Microbiology*, 61:91–125.
- Lehane, L. & Olley, J. (1999). Histamine (scombroid) fish poisoning: a review in a risk-assessment framework. National Office of Animal and Plant Health, Canberra.
- Levine, M.M., Black, R.E., Clements, M.L., Nalin, D.R., Cisneros, L. & Finkelstein, R.A. (1981). Volunteer studies in development of vaccines against cholera and enterotoxigenic *Escherichia coli*: a review. In T. Holme, J. Holmgren, M.H. Merson & R. Mollby (eds), *Acute enteric infections in children: new prospects for treatment and prevention*, Elsevier/North-Holland Biomedical Press, Amsterdam, The Netherlands, pp. 443–59.
- Lewis, R.J. (1994). Immunological, biochemical and chemical features of ciguatoxins – Implications for the detection of ciguateric fish, *Memoirs of the Queensland Museum* 34(3):541–48.
- Lin, C.J., Chiu, C.T., Lin, D.Y., Sheen, I.S. & Lien, J.M. (1996). Non-O1 *Vibrio cholerae* bacteraemia in patients with cirrhosis – 5 yr experience from a single medical centre. *American Journal of Gastroenterology*, 91(2):336–40.
- Linco, S.J. & Grohmann, G.S. (1980). The Darwin outbreak of oyster-associated viral gastroenteritis. *Medical Journal of Australia*, 1(5):211–13.
- Little, C.I., Monsey, H.A., Nichols, G.L. & de Louvois, J. (1997). The microbiological quality of cooked, ready-to-eat, out-of-shell molluscs. *PHLS Microbiology Digest*, 14(4):196–201.
- Locarnini, S.A. & Gust, I.D. (1978). Food and hepatitis A. *Food Technology in Australia*, 30:295.
- Lucas, R.E., Lewis, R.J. & Taylor, J.M. (1997). Pacific ciguatoxin-1 associated with a large common-source outbreak of ciguatera in east Arnhem Land, Australia. *Natural Toxins*, 5:136–40.
- Lyon, W.J. & Reddmann, C.S. (2000). Bacteria associated with processed crawfish and potential toxin production by *Clostridium botulinum* type E vacuum-packaged and aerobically packaged crawfish tails. *Journal of Food Protection*. 63(12):1687–96.



- M&S Food Consultants (2001). Seafood Food Safety Risk Assessment, for Seafood Services Australia Ltd.
- Madigan, M.T., Martinko, J.M. & Parker, J. (1997). Brock Biology of Micro-organisms, 8th edn, Prentice-Hall.
- Maijala R., Lyytikainen O., Johansson T., Autio, T., Aalto, T., Haavisto, L. & Hoonkane-Bulzaski, T. (2001). Exposure of *Listeria monocytogenes* within an epidemic caused by butter in Finland, *International Journal of Food Microbiology*, 70:97–109.
- Marro, N (1996). The 1994 Australian Market Basket Survey. The Australian Government Publishing Service, Canberra.
- Marro, N., Hasell, S., Boorman, J. & Crerar, S. (2003). Survey of *Listeria monocytogenes* in cooked prawns, *Food Surveillance Newsletter*, Spring 2003, Food Standards Australia New Zealand. Available from: <<http://www.foodstandards.gov.au/mediareleasespublications/foodsurveillancenewsletter/spring2003.cfm>>. Accessed 12 November 2003.
- Marth, E. (1988). Disease Characteristics of *Listeria monocytogenes*, *Food Technology*, 42(4):165–68.
- Matte, G.R., Matte, M.H., Rivera, I.G. & Martins, M.T. (1994). Distribution of potentially pathogenic *Vibrios* in oysters from a tropical region. *Journal of Food Protection*, 57(10):870–73.
- Maxwell, E.L., Mayall, B.C., Pearson, S.R. & Stanley, P.A. (1991). A case of *Vibrio vulnificus* septicaemia acquired in Victoria. *Medical Journal of Australia*, 154(3):214–15.
- McAnulty, J. (1990). *Vibrio* warning. *New South Wales Public Health Bulletin*, 1:12–13.
- Mead, P.S., Slutsker, L., Dietz, V., McCraig, L.F., Bresee, J.S., Shapiro, C., Griffin, P.M. & Tauxe, R.V. (1999). Food-related illness and death in the United States. *Emerg. Infect. Dis.* 5:607–25.
- Merianos, A., Burrows, J. & Patel, M. (1991). Ciguatera in Darwin following a meal of coral trout. *Communicable Diseases Intelligence*, 15:386–87.
- Mitchell, J.W. (1993). Scombrototoxic fish poisoning. A report prepared for the Ministry of Health. Institute of Environmental Health and Forensic Sciences Ltd., Mt. Albert Science Centre, NZ (cited in Lehane and Olley, 1999, qv.)
- Morbidity and Mortality Weekly Reports (1999). Outbreak of *Vibrio parahaemolyticus* infections associated with eating raw oysters and clams harvested from Long Island Sound – Connecticut, New Jersey and New York, 1998. *Morbidity and Mortality Weekly Reports*, 48(03):48–51.
- Morinaga, S., Kawasaki, A. Hirata, A.H. Suzuki, S. & Mizushima, Y. (1997). Histamine poisoning after ingestion of spoiled raw tuna in a patient taking isoniazid. *Internal Medicine*, 36(3):198–200.
- Morris, J.G. (2003). Cholera and other types of *Vibriosis*: a story of human pandemics and oysters on the half shell. *Clinical Infectious Diseases*. 37:272–80.
- Morton, S.L. & Tindall, D.R. (1995). Morphological and biochemical variability of the toxic dinoflagellate *Prorocentrum lima* isolated from three locations at Heron Island, Australia. *J. Phycol.* 31:914–21.
- Motes, M.L., DePaola, A., Cook, D.W., Veazey, J.E., Hunsucker, J.C., Garthright, W.E., Blodgett, R.J. & Chirtel, S.J. (1998). Influence of water temperature and salinity on *Vibrio vulnificus* in northern Gulf and Atlantic coast oysters (*Crassostrea virginica*). *Applied and Environmental Microbiology*, 64(4):1459–65.

- Murata, M., Legrand, A.M, Ishibashi, Y., Fukui, M. & Yasumoto, T. (1990). Structures and configurations of ciguatoxin from the moray eel *Gymnothorax javanicus* and its likely precursor from the dinoflagellate *Gambierdiscus toxicus*, *Journal of the American Chemical Society* 112(11):4380–86.
- Murrell, W.G. (1979). *Clostridium botulinum*. In Buckle, K.A., Davey, G.R., Eyles, M.J., Fleet, G.H. & Murrell, W.G. (eds). *Foodborne micro-organisms of public health significance*, 3rd edn., AIFST, Sydney, Australia.
- Myatt, D.C., & Davis, G.H. (1989). Isolation of medically significant *Vibrio* species from riverine sources in south east Queensland. *Microbios*, 60(243):111–23.
- Myjak, P., Szostakowska, B., Wojciechowski, J., Pietkiewicz, H. & Rokiki, J. (1994). Anisakid larvae in cod from the southern Baltic Sea. *Archive of Fishery and Marine Research*, 42:149–61.
- Nataro, J.P. & Levine, M.M. (1994). *Escherichia coli* diseases in humans. In C.L. Gyles (ed.), *Escherichia coli in Domestic Animals and Humans*. CAB International, Wallingford, United Kingdom, pp. 285–333.
- National Advisory Committee on Microbiological Criteria for Foods (1991). The Human Infective Dose of *Listeria monocytogenes*, *International Journal of Food Microbiology*, 14:216–19.
- Nicholson, C.M., Lewis, G.D. & Loutit, M.W. (1989). Survey of human pathogenic bacteria and viruses in cockle beds at Otakou, Otago Harbour, New Zealand. *New Zealand Journal of Marine and Freshwater Research*, 23(4):529–32.
- Nichols P., Mooney B., Elliot N. (2001). Unusually high levels of non-saponifiable lipids in the fishes escolar and rudderfish: identification by gas and thin-layer chromatography, *J Chromatography* 936:183–91.
- New South Wales Health Commission (1978). Government to Regulate the Marketing of Shark in New South Wales. Press release from the office of the Minister for Health, Health Commission of New South Wales, 14 April 1978.
- Nordstrom, J.L., Kaysner, C.A., Blackstone, G.M., Vickery, M.C., Bowers, J.C. & De Paola, A. (2004). Effect of intertidal exposure on *Vibrio parahaemolyticus* levels in Pacific Northwest oysters. *J. Food Prot.* 67(10):2178-82.
- Obiri-Danso, K. & Jones, K. (1999). Distribution and seasonality of microbial indicators and thermophilic *Campylobacters* in two freshwater bathing sites on the Rive Lune in northwest England. *Journal of Applied Microbiology*. 87(6):822–32.
- O'Connor, R.F. (1979). *Vibrio alginolyticus* in retail fish. *Medical Journal of Australia*, 1:336.
- Oliver, J.D. (1989). *Vibrio vulnificus*, In M.P. Doyle (ed.), *Foodborne Bacterial Pathogens*. Marcel Dekker, Inc., New York, pp. 569–600.
- Oliver, J.D., & Kaper, J.B. (1997). *Vibrio* Species, In M.P. Doyle, L.R. Beuchat, & T.J. Montville (eds). *Food Microbiology: Fundamentals and Frontiers*. ASM Press, Washington D.C. pp. 228–64.
- Olsen, S.J., MacKinnon, L.C., Goulding, J.S., Bean, N.H. & Slutsker, L. (2000). Surveillance for foodborne disease outbreaks – United States, 1993–97. *Morbidity and Mortality Weekly Review*, Centre for Disease Control Surveillance Summaries 49(SS-1).
- OzFoodNet (2003). Foodborne disease in Australia: incidence, notifications and outbreaks. Annual report of the OzFoodnet network, 2002. *Communicable Disease Intelligence*. 27(2):209–43.
- Pacini, R., Panizzi, L., Galeschi, G., Quagli, E., Galassi, R., Fatighenti, P. & Morganti, R. (1993). The presence of anisakid larvae in fresh and frozen fish products in the market. *Pereira-Bueno* (1992).

- Panisello, P.J., Rooney, R., Quantick, P.C. & Stanwell-Smith, R. (2000). Application of foodborne disease outbreak data in the development and maintenance of HACCP systems. *Int. J. Food Microbiol.* 59(3):221–34.
- Piccolo, G., Manfredi, M.T., Hoste, L. & Vercruyse, J. (1999). Anisakidae larval infection in fish fillets sold in Belgium. *Veterinary Quarterly*, 21:66–67
- Potasman, I., Paz, A. & Odeh, M. (2002). Infectious outbreaks associated with bivalve shellfish consumption: a worldwide perspective. *Clin. Infect. Dis.* 35(8):921–28.
- Prasad, M.M. & Rao, C.C.P. (1994). Pathogenic Vibrios associated with seafoods in and around Kakinada, India. *Fisheries Technology Society, India*, 31(2):185–87.
- Prescott, L.M., Harley, J.P. & Klein D.A. (1999). *Microbiology*, 4th ed. McGraw-Hill.
- Price, R.J., & Tom, P. (1999). *Compendium of Fish and Fishery Product Processes, Hazards and Controls*. Downloaded 3 September 1999 from <<http://seafood.ucdavis.edu/haccp/compendium/compend.htm>>.
- Qadri, R.B. & Zuberi, R. (1977). Survey on the occurrence of *Vibrio parahaemolyticus* and *Vibrio alginolyticus* in fish and shellfish from the Karachi coastal waters. *Pakistan Journal of Scientific and Industrial Research*, 20(3):183–87.
- RaLonde, R. (1996). Paralytic shellfish poisoning: The Alaska problem. *Alaska's Marine Resources*, 8(2):1–7.
- Rhodes, L.L., White, D., Syhre, M. & Atkinson, M. (1996). *Pseudonitzschia* species isolated from New Zealand coastal waters: domoic acid production in vitro and links with shellfish toxicity. In Yasumoto, T., Oshima, Y. & Fukuyo, Y. (eds), *Harmful and Toxic Algal Blooms*, pp. 155–58.
- Rigg, A. (1997). *Biogenic Amines in Fish and Fish Products*. ACT Health Protection Service, <<http://www.health.act.gov.au/hps/foodsurvey/index.html>>.
- Robins-Brown, R.M. (1987). Traditional enteropathogenic *Escherichia coli* of infantile diarrhea. *Rev. Infect. Dis.* 9:28–53.
- Rockliff, S. & Millard, G. (1997). *Microbial Quality of Marinara Mix April – June 1997*. ACTGAL <<http://www.health.act.gov.au/hps/foodsurvey/marinara.html>>.
- Rocourt, J. & Bille, J. (1997). Foodborne listeriosis, *World Health Statistics Quarterly*, 50:67–73.
- Rocourt, J. & Brosch, R. (1992). *Human listeriosis 1990*, WHO Collaborating Centre for Foodborne Listeriosis.
- Ross, T. (2000). *Health risk of parasites in raw fish*. Safe Food New South Wales, Sydney, 2000.
- Ruello, N. (1999). Personal communication cited by Ross, T. (2000). *Seafood risk assessment*, SafeFood Production New South Wales.
- Ruple, A.D. & Cook, D.W. (1992). *Vibrio vulnificus* and indicator bacteria in shellstock and commercially processed oysters from the Gulf Coast. *Journal of Food Protection*, 55(9):667–71.
- Samadpour, M., Ongerth, J.E., Liston, J., Tran, N., Nguyen, D., Whittam, T.S., Wilson, R.A. & Tarr, P.I. (1994). Occurrence of Shiga-like toxin-producing *Escherichia coli* in retail fresh seafood, beef, lamb, pork, and poultry from grocery stores in Seattle, Washington, *Appl. Environ. Microbiol.* 60(3):1038–40.
- Sang, J.P., Wong, C.L. & Kerr, M.G. (1992). *Analysis of shellfish, fish and algae for domoic acid*. State Chemistry Laboratory, Melbourne, Internal Report.

- Sanyal, S.C. & Sen, P.C. (1974). Human volunteer study on the pathogenicity of *Vibrio parahaemolyticus*. In T. Fujino, G. Sakaguchi, R. Sakazaki & Y. Takeda (eds), International Symposium on *Vibrio parahaemolyticus*, Saikon Publishing Company, Tokyo, pp. 227–30.
- Sanjeev, S., & Stephen, J. (1993). Incidence of *Vibrio parahaemolyticus* in fish and shellfish marketed in Cochin. *Indian Journal of Marine Science*, 22(1):70–71.
- Schwab, K.J., Neill, F.H., Estes, M.K., Metcalf, T.G. & Atmar, R.L. (1998). Distribution of Norwalk virus within shellfish following bioaccumulation and subsequent depuration by detection using RT-PCR. *Journal of Food Protection*. 61(12):1674–80.
- Scoging, A. (1998). Scombrototoxic (histamine) fish poisoning in the United Kingdom: 1987–96. *Communicable Disease and Public Health*, 1:204–205.
- Sey, O. & Petter, A.J. (1997). Incidence of ascaridoid larvae in Kuwaiti food fishes. *Southeast Asian Journal of Tropical Medicine and Public Health*, 28 Supp., 1:168–72.
- Shadbolt, C., Kirk, M. & Roche, P. (2002), Editorial: Diarrhoea associated with consumption of escolar (rudderfish), *Communicable Disease Intelligence*, 26(3):436–38.
- Shapiro, R.L., Altekruze, S., Hutwagner, L., Bishop, R., Hammond, R., Wilson, S., Ray, B., Thompson, S., Tauxe, R.V. & Griffin P.M. (1998). The role of Gulf Coast oysters harvested in warmer months in *Vibrio vulnificus* infections in the United States, 1988–1996. *Journal of Infectious Diseases*, 178(3):752–59.
- Shih, D.Y.C., Lai, C.L., Chen, C.R. & Wang, J.Y. (1996). Occurrence of *Vibrio parahaemolyticus* in imported aquatic foods from mainland China. *Journal of Food and Drug Analysis*, 4(3):239–46.
- Shin, H.R., Lee, C.U., Park, H.J., Seol, S.Y., Chung, J.M., Choi, H.C., Ahn, Y.O. & Shigemastu, T. (1996), Hepatitis B and C virus, *Clonorchis sinensis* for the risk of liver cancer: a case-control study in Pusan, Korea, *Int. J. Epidemiol.* 25(5):933–40.
- Smart, D.R. (1992). Scombroid poisoning. A report of seven cases involving the Western Australian salmon, *Arripis truttaceus*. *Medical Journal of Australia*. 157:748–51.
- Smith de Waal, C., Alderton, L. & Jacobsen, M.F. (2000). Closing the gaps in our federal food-safety net. Center for Science in the Public Interest, Washington, D.C.
- Sobsey, M., Cole, M. & Jaykus, L.A. (1991). Human Enteric Pathogenic Viruses. In M.D. Pierson & C.R. Hackney (eds), *Comprehensive Literature Review of Indicators in Shellfish and their Growing Waters*. Pierson Associates, Inc.
- Song, S.B., Lee, S.R., Chung, H.H. & Han, N.S. (1995). Infection status of anisakid larvae in anchovies purchased from local fishery market near southern and eastern sea in Korea. *Korean Journal of Parasitology*, 33:95–99.
- Stenhouse, F (1994). The 1992 Australian Market Basket Survey. Australian Government Publishing Service, Canberra.
- Stewart, C.M. (2003). *Staphylococcus aureus* and staphylococcal enterotoxins. In *Foodborne microorganisms of public health significance*, 6th ed. Australian Institute of Food Science and Technology (New South Wales Branch) Food Microbiology Group, pp. 359–80.
- Sutherland, P. & Porritt, R. (1997). *Listeria monocytogenes*. In Hocking, E. (ed.), *Foodborne Microorganisms of Public Health Significance*, 5th ed. Australian Institute of Food Science and Technology Inc., Sydney.
- Swan, H.B. (1998). Aqueous Phase Ethylation Atomic Emission Spectroscopy for the Determination of Methylmercury in Fish Using Permeated Dimethylmercury Calibration, *Bull. Environ. Contam. Toxicol.* 60:511–18.

- Sweet, L., Blackmore, N. & Haldane, D. (1989). Outbreak of Staphylococcal foodborne illness related to consumption of lobster-Nova Scotia. *Can. Dis Wkly. Rep.* 15(15):81–83.
- Szabo, E.A. & Gibson, A.M. (1997). *Clostridium botulinum*. In A.D. Hocking, G. Arnold, I. Jenson, K. Newton & P. Sutherland (eds). *Foodborne Micro-organisms of Public Health Significance*. Australian Institute of Food Science and Technology Inc., New South Wales Branch Food Microbiology Group, North Sydney, Australia, pp. 429–64.
- Takikawa, I. (1958). Studies on pathogenic halophilic bacteria, *Yokohama Med. Bull.* 9:313–22.
- Tamplin, M.L. & Jackson, J.K. (1997). Assessing the risk of *Vibrio vulnificus* in molluscan shellfish. *Journal of Shellfish Research*, 16(1):321.
- Tang, Y.W., Wang, J.X., Xu, Z.Y., Guo, Y.F., Qian, W.H. & Xu, J.X. (1991). A serologically confirmed, case-control study, of a large outbreak of hepatitis A in China, associated with consumption of clams. *Epidemiology and Infection*, 107(3):651–57.
- Telzak, E.E., Bell, E.P., Kautter, D.A., Crowell, L., Budnick, L.D., Morse, D.L. & Schultz, S. (1990). An international outbreak of type E botulism due to uneviscerated fish. *Journal of Infectious Diseases*, 161(2):340–42.
- Teophilo, G.N., dos Fernandes Vieira, R.H., dos Prazeres Rodrigues, D. & Menezes, F.G. (2002). *Escherichia coli* isolated from seafood: toxicity and plasmid profiles. *Int. Microbiol.* 5(1):11–14.
- Tepedino, A.A. (1982). *Vibrio parahaemolyticus* in Long Island oysters. *Journal of Food Protection*, 45(2):150–51.
- Thampuran, N. & Surendran, P.K. (1998). Occurrence and distribution of *Vibrio vulnificus* in tropical fish and shellfish from Cochin (India). *Letters in Applied Microbiology*, 26(2):110–12.
- Ting, J.Y.S., Brown, A.F.T. & Pearn, J.H. (1998). Ciguatera poisoning – an example of a public health challenge. *Australian and New Zealand Journal of Public Health*, 22:140–42.
- Todd, L.S., Hardy, J.C., Stringer, M.F. & Bartholomew, B.A. (1989). Toxin production by strains of *Aeromonas hydrophila* grown in laboratory media and prawn pure. *Int. J. Food Microbiol.* 9:145–56.
- Trusewich, B., Sim, J., Busby P. & Hughes C. (1996). Management of marine biotoxins in New Zealand. In Yasumoto, T., Oshima, Y. & Fukuyo, Y. (eds), *Harmful and Toxic Algal Blooms*, pp.27–30.
- Twedt, R.M. (1989). *Vibrio parahaemolyticus*. In M.P. Doyle (ed.) *Foodborne Bacterial Pathogens*. Marcel Dekker, Inc., New York, p. 543–68.
- United States Food and Drug Administration (2001). Relative Risk to Public Health from Foodborne *Listeria monocytogenes* among selected categories of ready-to-eat foods, Draft risk assessment, *Federal Register*, 66(13).
- Vasudevan, P., Marek, P., Daigle, S., Hoagland, T. & Venkitanarayanan, K.S. (2002). Effect of shilling and freezing on survival of *Vibrio parahaemolyticus* on fish fillets. *J. Food Safety*, 22(4):209–17.
- Voetsch, D. (2000). Personal communication cited by Ross, T. (2000) *Seafood risk assessment*, SafeFood Production New South Wales.
- Wallace B.J., Guzewich, J.J., Cambridge, M., Altekruise, S. & Morse, D.L. (1999). Seafood associated disease outbreaks in New York. *American Journal of Preventative Medicine*. 17(1):48–54.
- Warne, D. (1987). Histamine content survey in canned tuna. A quick and simple screening method may be called for in response to increasing international scrutiny of histamine levels in canned fish. *Infotish Marketing Digest*, 2:40.

- Warrington, P. (2001). Aquatic pathogens: algae. Available from: <<http://wlapwww.gov.bc.ca/wat/wq/reference/toxicalgae.html>>. Accessed 1 October 2003.
- Weber, J.T., Hibbs, R.G., Darwish, A., Mishu, B., Corwin, A.L., Rakha, M., Hatheway, C.L., el-Sharkawy, S., el-Rahim, S.A. & al-Hamd M.F. (1993). A massive outbreak of type E botulism associated with traditional salted fish in Cairo. *Journal of Infectious Diseases*, 167:451–54.
- Western Australian Food Monitoring Program. (1993). Mercury in Shark. Department of Minerals and Energy Western Australia and Health Department of Western Australia.
- White, K. (1999). Metal Contamination of Major New South Wales Fish Species Available for Human Consumption. New South Wales Health.
- WHO (1987). Evaluation of certain food additives and contaminants – 30th report of the Joint FAO/WHO Expert Committee on Food Additives. WHO Technical Report Series No. 751, World Health Organization, Geneva.
- WHO (1990). Environmental Health Criteria 101: Methylmercury, World Health Organization, Geneva.
- WHO (1996). Information Fact Sheet N125, World Health Organization, Geneva.
- WHO (2000). Evaluation of certain food additives and contaminants – Fifty-third report of the Joint FAO/WHO Expert Committee on Food Additives. WHO Technical Report Series No. 896, World Health Organization, Geneva.
- WHO (2002). Cholera, 2001. *Weekly Epidemiological Record*. 77(31):257–68.
- WHO/FAO/IAEA Expert Consultation (1996). Trace elements in human nutrition and health, World Health Organization, Geneva
- Working Group on Mercury in Fish (1979). Report on Mercury in Fish and Fish Products to the Coordinating Committee on Metals in Fish and Fish Products.
- Wright, A.C., Hill, R.T., Johnson, J.A., Roghman, M.C., Colwell, R.R. & Morris, J.G. Jr. (1996). Distribution of *Vibrio vulnificus* in the Chesapeake Bay. *Applied and Environmental Microbiology*, 62(2):717–24.
- Yano, Y., Yokoyama, M., Satomi, M., Oikawa, H. & Chen, S.S. (2004). Occurrence of *Vibrio vulnificus* in fish and shellfish available from markets in China. *J. Food Prot.* 67(8):1617-23.
- Yohannes, K., Dalton, C.B., Halliday, L., Unicomb, L.E. & Kirk, M. (2002). An outbreak of gastrointestinal illness associated with the consumption of escolar fish, *Communicable Disease Intelligence* 26(3):436–38.

### Pearl oyster meat and offshore scallops

#### Background: Requirements for producers of bivalve molluscs

The draft Standard in the Draft Assessment Report for Proposal P265 (Development of a Primary Production and Processing Standard for Seafood) included a definition for ‘bivalve molluscs’ which specifically excluded ‘*spat, scallops and pearl oysters where the only part of the product consumed is the adductor muscle*’.

The implication of this definition was that producers of roe-off scallops and pearl oyster meat (spat are juvenile molluscs and are not normally eaten) were excluded from having to comply with Division 3 of the Standard, while producers of all other bivalves were required to meet those requirements.

Several submissions to FSANZ did not support excluding pearl meat producers from having to comply with the Division 3 requirements of the draft Standard, and two sought confirmation that there was sufficient scientific justification for the exclusion. Two submissions supported the exclusion.

In addition, the potentially onerous effect of the requirement for classification of harvest waters under Division 3 of the draft Standard on the wild oyster and offshore scallop industries was raised in submissions and in consultations. It is understood that the roe-on component is a small but expanding portion of the offshore scallop industry. The Division 3 requirement would not apply to the roe-off component of the industry.

The supply of pearl oyster meat is likely to increase in future years, as the feasibility of pearl oyster aquaculture in estuarine environments is being investigated in Australia. In NSW, for example, a small industry is being developed in Port Stephens and other estuaries.

If estuarine pearl producers were wishing to market pearl oyster meat as a by-product, the food safety implications would need to be separately considered, as the range of associated food safety hazards might be different. The producers have been advised by the NSW Food Authority that any pearl meat marketed would have to be produced under the requirements of the NSW Shellfish Program.

Consideration is also being given to use of pearl oyster aquaculture as a means of bioremediation of polluted waterways (Gifford *et al.*, 2004), although it must be assumed that the meat would not be marketed from these animals. It should be noted, however, that the considerations below apply only to pearl oyster meat from offshore, remote locations

The global public health and economic impacts of algal biotoxins, the likelihood of those impacts increasing in scale as aquaculture expands, and the vulnerability of the Australian shellfish industry were highlighted in a recent report to the Australian Shellfish Quality Assurance Advisory Committee (Cawthron Institute, 2001).

#### Scientific issues

##### Introduction

The hazards of concern with pearl oyster meat and offshore scallops are algal biotoxins. Hazards derived from faecal pollution and agricultural run-offs, such as enteric bacterial and viral pathogens, are not currently a significant issue because harvesting currently occurs at relatively remote offshore locations. It is generally recognised that very little toxin migrates from the viscera into the adductor muscle in scallops.

### ***Public health data***

There is no evidence of illness from algal biotoxins in scallops or pearl oysters in Australian epidemiological datasets. Unfortunately, outbreak datasets are usually incomplete and capture information on only a fraction of the total food-borne illness in Australia. Furthermore, sporadic cases of food-borne illness (where illness is scattered; occurring singly and not as an outbreak) are not included in these datasets (unless a death results and the food vehicle is identified). Low levels of reporting, even of quite severe food-borne illnesses, are a major data gap and introduce uncertainty into the scientific evaluation. For this reason, FSANZ does not rely solely on outbreak data in evaluating the public health risks due to food safety hazards.

### ***Accumulation of toxins in bivalves***

There are no reports in the scientific literature relating to prevalence, concentration or distribution of algal biotoxins in pearl oysters (*Pinctada* spp.). A proposed study on the accumulation of algal toxins in pearl oyster meat by the pearl oyster industry has yet to get underway.

Given the large inter-species variation in the ability of bivalves to accumulate and detoxify algal biotoxins (see, for example, Bricelj and Shumway, 1998), it is not sound to extrapolate from the findings of low accumulation in scallop adductor to assume a similar low level of accumulation in pearl oyster meat. Assumptions made about toxin uptake being similar between different species might turn out to be incorrect once data is available.

There is evidence that bivalves harvested from areas of fast currents and/or deep waters are still able to accumulate toxins. Paralytic shellfish poisoning (PSP) toxin has been found at high levels in sea scallops (*Placopecten magellanicus*) harvested at a depth of 180 metres in the Gulf of Maine, USA (Cembella *et al.*, 1993), and from areas subject to 14 metre tidal flows in the Bay of Fundy, Canada (Watson-Wright *et al.*, 1990).

Campbell *et al.* (2001) report that in king scallop (*Pecten maximus*) samples taken from a closed harvest area in north west Scotland, the level of algal biotoxin (ASP) accumulating in adductor muscle was very low, and they did not find levels exceeding the regulatory limit. However, while the level of toxin in roe was much lower than in other tissues (except adductor muscle), 22% of individual roe samples still exceeded the regulatory limit (20 mg/kg).

New Zealand applies a scheme of flesh testing of scallops from its commercial scallop fisheries (including offshore-remote fisheries). Roe samples are tested (usually weekly) for the four major classes of algal biotoxins, and 'muscle & roe' samples are tested if the roe toxin level exceeds a trigger level<sup>65</sup>. Combined results from ten years of commercial and non-commercial testing programmes have been recently reviewed (NZFSA, 2003). Some samples of scallop roe and 'muscle & roe' were found to have levels of ASP higher than the maximum limit allowed in the Code.

### ***Summary of scientific issues***

FSANZ concludes that there is significant variability in interspecies accumulation of algal biotoxins such that it is not appropriate to extrapolate from scallops to pearl oysters, given the severity of the health impact of algal biotoxins and the absence of specific data from *Pinctada* species.

Although scallop adductor muscle does not accumulate significant levels of algal biotoxins, available data implies that the roe may accumulate toxins to levels that might pose a significant public health and safety risk following consumption of roe-on scallops sourced from offshore harvest areas.

---

<sup>65</sup> Jim Sim, Principal Advisor (Shellfish), Animal Products Group, New Zealand Food Safety Authority, personal communication, November 2004.



## Applying the Risk Ranking Methodology

In completing the *Risk Ranking of Seafood in Australia*, FSANZ did not apply the ranking matrix to individual species of seafood or to very small fisheries such as pearl oyster meat. The consequences of the very low *per capita* consumption of such products inevitably drives the likelihood rating to ‘*unlikely*’.

Commodity	Hazard/environment	Severity	Likelihood	Relative risk ranking <sup>1</sup>	Current risk management
Pearl oysters meat	Algal biotoxins (ASP, PSP)	Severe	Unlikely	Medium	FSC Ch 1 <sup>2</sup>

1. Risk ranking reflects current practice for that commodity/seafood sector. The risk ranking is based on the severity of the hazard and an estimate of the likelihood of illness that takes into account various factors, including current risk management practices.
2. Current risk management involves maximum level standards for the four major classes of algal toxins in the *Food Standards Code*.

Given the relatively small size of the industry, anecdotally of the order of 5-10 tonnes per year, there is only a very low level of consumption of pearl oyster meat when considered across the whole Australian population. The likelihood of illness rating for the whole population is thus ‘*unlikely*’ and the risk ranking is ‘*Medium*’.

There are a number of sources of uncertainty impacting upon this risk ranking. The critical uncertainty surrounds the fate of any toxin ingested by the oyster. There are no data specific to pearl oysters, and extrapolation from data relating to distantly-related bivalves such as scallops was considered unsound given the large inter-species variation in the ability of bivalves to accumulate and detoxify algal biotoxins. Other sources of uncertainty include the size of the consuming population and the likelihood of toxic algae being present in the harvest waters. These sources of uncertainty affect the ‘likelihood of illness’ rating in the risk ranking.

The risk ranking model is difficult to apply in situations of such high uncertainty. The uncertainty regarding the presence of algal toxin in pearl oyster meat means that if the risk ranking was applied to the subset of the population that consumes the product, the likelihood of illness rating could range from *unlikely* to *likely*, and this would impact on the final risk ranking. Specific data on the bioaccumulation of biotoxins in pearl oysters would resolve the uncertainty in the ranking.

## References

- Bricelj, V.M. and Shumway, S.E. (1998) Paralytic shellfish toxins in bivalve molluscs: occurrence, transfer kinetics, and biotransformation. *Rev. Fisheries Sci.* 6(4): 315-383.
- Campbell, D.A., Kelly, M.S., Busman, M., Bolch, C.J., Wiggins, E., Moeller, P.D.R., Morton, S.L., Hess, P. and Shumway, S.E. (2001) Amnesic shellfish poisoning in the king scallop, *Pecten maximus*, from the west coast of Scotland. *J. Shellfish Res.* 20(1): 75-84.
- Cawthron Institute (2001) Australian biotoxin management plan for shellfish farming. An FRDC-funded project for the Australian Shellfish Quality Assurance Advisory Committee. Cawthron Institute, Nelson, New Zealand.
- Cembella, A.D., Shumway, S. E. and Lewis, N.I. (1993) Anatomical distribution and spatiotemporal variation in paralytic shellfish toxin composition in two bivalve species from the Gulf of Maine. *J. Shellfish Res.* 12: 389-403.
- Gifford, S., Dunstan, R.H., O’Connor, W., Roberts, Y. & Toia, R. (2004) Pearl aquaculture – profitable environmental remediation? *Sci. Total Environ.* 319(1-3): 27-37.
- NZFSA (2003) *Non-commercial marine biotoxin monitoring in New Zealand: risk-based programme enhancement – final report, May 2003*. New Zealand Food Safety Authority. <http://www.nzfsa.govt.nz/animalproducts/publications/reports/biotoxin-report.pdf>. Accessed on 22 November 2004.
- Watson-Wright, W., Richard, D., Belliveau, A., McGuire, A. and Marshall, I. (1990) PSP content of roe cannot be predicted from that in other tissues of Bay of Fundy scallops (*Placopecten magellanicus*) *Toxicon* 28(6): 628. (Conference Abstract: Third Pan. Amer. Symp. on Plant, Animal and Microbial Toxins, Oaxtepec, Mexico, 1989).