FINS Case Study:

Mercury In Shark

Firecrest Publications Pty Ltd

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FINS Case Study -

Mercury in Shark

Prepared by

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on behalf of

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for the

Australian Seafood Industry Council (ASIC)

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1. Non-Technical Summary

This Case Study has implications for the Fishing Industry National Strategy (FINS) plank of Information Flow, and demonstrates the importance of both compiling and providing certain information as a means of protecting the industry from arbitrary and onerous regulation.

The objectives of the Case Study were:

- To research and document the efforts of the seafood industry to raise the accepted level of mercury in shark; and
- To identify reasons for the industry's successes and/or failures and to document the industry's approaches to dealing with these.

The Case Study briefly traces the history of various changes to the food standard relating to mercury in fish and fish products since 1971.

These changes were initially driven by the initiatives of various government departments (including the Attorney General's Department under the Trade Practices Act). These threatened, and in some cases resulted in, significant losses to the seafood industry by excluding many important commercial species from sale, as well as through potential litigation and penalties. Significant among these were shark species (landings of which were severely restricted by size limitations to reduce the incidence of mercury levels exceeding the standard) and large bill fish which resulted in many retailers being heavily fined.

At one stage, it was estimated by the industry peak body (then the Australian Fishing Industry Council) that 36% by weight of the top ten commercial species could be excluded from sale if this standard was rigidly enforced.

The basis on which industry was able to influence the direction of changes to the mercury standard was the provision of information on the two main factors by which the effects of mercury are assessed: - the concentration of the contaminant in particular species; and the rate of consumption of fisheries products by the community.

The seafood industry was eventually able to provide this information by compiling data sets on mercury residues in fish from various sources (eg. state and territory fisheries and health departments), and by reference to consumption data, also from various sources. The most significant of these was the national seafood consumption study initiated by the Fisheries Research & Development Corporation (FRDC) in 1990/91.

Using this information, a report compiled for the fishing industry peak body (then the National Fishing Industry Council) was eventually able to successfully propose to the relevant federal health authorities (the National Health & Medical Research Council and later the National Food Authority) some changes to the mercury standard. The benefits of these rather minor (but difficult to achieve) relaxations of the mercury standard undoubtedly justify the cost of providing the information, and the process has set a valuable precedent for future action by the industry.

The Case Study shows that the task was made more difficult by the lack of initial support, and that seeking information was inhibited by a reluctance on the part of some seafood industry groups and government agencies to provide the data, which they perceived would be better kept confidential.

Preparing the industry proposals for favourable changes to the mercury standard was further inhibited by the lack of dedicated survey design - the national seafood consumption surveys in particular were not developed for the purpose of collecting information specifically for the proposals.

Inconsistent nomenclature between states (and for imported products), an area which has since been addressed to a large extent, also made the task more difficult.

The Case Study demonstrates that the provision of accurate information (whether perceived as either good or bad) is the best defence against arbitrary regulation, and that industry's investment in continued monitoring, compiling and provision of both residue and consumption data is advisable, given that far more challenging circumstances are likely in the future.

The favourable changes to the mercury standard achieved were aided by a general acceptance of low risk to human health by mercury from fish in Australia, by timely changes to the international Codex Alimentarius Commission (Codex) standards, and by inconsistencies in both state legislation and standards in other countries. The low level of mercury in imported fish, and its large contribution to Australian fish consumption, also aided the changes.

However, for a number of reasons the seafood industry was not able to obtain the full array of changes it was seeking.

The Australia New Zealand Food Authority has recently (October 1997) released a policy paper as the first stage in a Review of the Food Standards Code (ANZFA 1997), and it will be important for industry to learn from the previous experiences when making submissions to this Review.

If this is not done, there is not only the chance of the seafood industry not making any headway, but there is a real possibility of losing ground, and of mercury levels (and those of other metals and non metals) being made more restrictive.

Further, the positive factors outlined above might not be so favourable in other circumstances in the future, such as in the case of other residue standards, or standards for micro-biological organisms. Scrutiny by consumer groups and environmental organisations might also demand a high level of (and access to) supporting data for future changes to food standards which apply to seafood.

Based on previous industry experience, we have put forward a number of recommendations for future seafood industry submissions on heavy metal and residue levels in seafood. Many of these recommendations can be equally applied in other areas where the seafood industry is involved in lobbying for improvements or changes to existing constraints on trade, or in responding to pressures from external interest groups.

One of the recommendations is the need for ongoing research to identify those in the community who have very high levels of fish consumption, and would therefore be more likely to have higher ingestion levels of mercury and other heavy metals. Special education campaigns should be targeted at such groups.

Thus the main lessons to be learnt from this case study are the importance of information gathering and dissemination of this information. These strongly support the significance placed by the FINS study on its plank of Information Flow.

2. Background

With an increasingly competitive world trading environment it is essential that the Australian seafood industry identifies and agrees on strategic directions and takes actions in those areas.

The recently completed Fishing Industry National Strategy (FINS) provides a framework for the Australian seafood industry to do this.

2.1 Fishing Industry National Strategy (FINS)

FINS was a project done under the auspices of the Australian Seafood Industry Council (ASIC 1995), and funded by the Fisheries Research and Development Corporation (FRDC). It was a project intended to identify the main areas which the seafood industry needed to address, and to provide the industry with strategies for future development.

The major planks identified in the FINS report were:

- Resource Access
- Industry Profile
- Quality
- Product Identification
- Market Development
- Information Flow

This case study is particularly relevant to one of these planks - Information Flow - and also has some relevance to the Quality plank. The objectives of these planks, as outlined in the FINS study, are:

Information Flow - Foster a more information oriented culture and put in place a structure for the development of efficient information networks.

Quality - Raise the quality of the product, and the efficiency of the process, by ensuring quality standards exist throughout the industry, and to provide industry with the ability and motivation to meet them.

2.2 Sources of Mercury

It has been known for some time that people in frequent contact with mercury in their occupations can suffer a form of mercury poisoning, even at low concentrations.

The most common examples of this in the past were mercury miners, dentists and hatters, who continually worked with mercury. Thus the term "mad hatter", such as found in *Alice's Adventures in Wonderland*, is a reference to the "hatter's shakes" experienced by people making hats out of felt, where mercuric nitrate was used.

However, it is important to keep such problems in perspective. **The fact is there have been no incidents of mercury poisoning from methylmercury in Australia.**

Therefore, it is essential to maintain a realistic appreciation of the situation with mercury ingestion in this country.

Mercury occurs naturally in the environment, concentrated in geographic belts, where it is most commonly found as a mercuric sulphide ore called cinnabar. The east coast of Australia is in a mercuriferous (mercury bearing) zone.

There are also industrial sources of mercury, which include: mining and smelting of mercury; the burning of fossil fuels; the production of steel, cement and phosphate; and the smelting and extraction of metals from their ores (WHO 1976).

There seems little doubt that there are waters adjacent to such industrialised areas which produce mercury products or by-products where fish have higher accumulations of mercury than in other waters.

However, according to WGMF (1980) in Australia mercury in fish is, for the most part, not of industrial origin but from normal accumulation processes. Such accumulation occurs when mercury is transformed in the environment from inorganic to organic forms (OECD 1974). This happens when mercury "finds its way into the food chain due to methylation of inorganic mercury in the sediments of lakes, rivers and other waterways and in the oceans" (WGMF 1980).

There have been some suggestions that there is a relationship between the amount of mercury in the water and the fish that live in those waters. As an example, Gardner (1978) found a linear relationship between mercury concentrations in fish and in the waters adjacent to the UK. There can also be differences in mercury concentrations from one body of water to another, with research suggesting mercury levels in the southern Pacific Ocean may be several times higher than in the northern hemisphere, while those in the Indian Ocean may be quite low (WGMF 1980).

However, as more mercury accumulates at higher trophic levels, it seems clear that the fish higher up in the food chain, such as sharks and billfish, are more likely to have higher mercury levels (WGMF 1980). This is attributed to biomagnification through the food chain, rather than direct bioconcentration from water (WHO 1990).

There has also been further conjecture about whether the mercury levels in fish might be generally rising. However, Miller *et al.*. (1972) found no significant difference in mercury concentrations between recently caught fish and specimens from museums - specifically, tuna caught 96 years before, and swordfish caught 28 years earlier.

3. Need

The FINS Report is strategic in nature and by itself does not demonstrate its applicability to the wider industry. To engender support at all levels of the industry it is important to demonstrate the relevance of the FINS Report to their particular operations.

A set of case studies was proposed to show how the "planks" identified by FINS are relevant at the "grass roots" level. 3 case studies have been identified to date. Following an assessment of the success of these, a further one or two may be undertaken.

This particular case study illustrates the importance of having an effective and efficient information flow to achieve beneficial outcomes for the industry. It also illustrates the importance of seafood quality from a food safety perspective.

4. Objectives

This case study had two main objectives:

1. To research and document the efforts of the seafood industry to raise the accepted level of mercury in shark.

2. To identify reasons for the industry's successes and/or failures and document the industry's approaches to dealing with these.

5. Results

5.1 History of Changes in Mercury Level

The following is a brief synopsis of the history of various changes at the state, Commonwealth and international level having a bearing on the matter of mercury in fish and fish products in Australia since around 1971.

- Prior to 1971, on the recommendation of the National Health and Medical Research Council (NH&MRC), the states and territories had set the maximum mercury level at 0.03 parts per million (ppm) or mg/kg in all foods.

- The NSW Health Department Food Standards Committee requested that the NH&MRC review its earlier recommendation (which NSW had adopted) that the standard for all food be at 0.03 ppm.

- This request came after the US had prescribed a limit of 0.5 ppm, which seemed to be a sound basis for protection of consumers, based on the available data.

- In 1971 the NH&MRC recommended that state & territory legislation be amended to permit an increased level of mercury in fish ("fish" includes fish, crustaceans, molluscs, the fish content of fish products and the fish content of canned fish) to a maximum of 0.5 ppm. However, the NH&MRC recognised the hazard to human health in seafoods with high levels of mercury and considered the risk of contamination of ocean-inland waters. It therefore recommended monitoring of mercury in inland and ocean waters. It also saw the need to measure residue levels in seafoods and established an *ad hoc* 'Subcommittee on Metallic Contamination of Seafoods'.

  This level was adopted by the Commonwealth Department of Customs & Excise and all states & territories except South Australia which subsequently introduced a 1.0 ppm level (Tasmania also opted for a 1.0 ppm level at a later time).

- Although in 1972 the NH&MRC acknowledged that the recommendation of 0.5 might be too stringent for Australian conditions, it could not recommend otherwise with available data and evidence of mercury poisonings in Japan (refer to Appendix 1) and the serious consequences of mercury poisoning (ie. there is no effective therapy for mercury poisoning, so prevention is the only means of control - see Appendix 1).

  The NH&MRC was also aware that the 0.5 ppm standard was being exceeded with some marine products.

- Although no case of mercury poisoning had been recorded in Australia, the NH&MRC was aware of the potential risks and commented that, until more was known about the effects of methylmercury on human health "...it behoves society to err on the side of caution by ensuring that human exposure is kept minimal, at least within the limits of a reasonable safety" (NH&MRC 1973).

- 1972, September - the Victorian Government imposed a maximum length of 104 cm for school shark to be landed for sale in an attempt to keep mercury levels below the NH&MRC limit of 0.5 ppm.

- 1975, February - the Attorney General's Department prepared a draft regulation for a consumer product safety standard for mercury in fish. It intended to take effect under the Trade Practices Act 1974 setting 0.5 mg/kg or parts per million (ppm) as the maximum limit, with penalties up to $50,000 for companies, $10,000 for individuals or 6 months imprisonment.

- 1975, March - the Australian Fisheries Council (AFC) Co-ordinating Committee on Metals in Fish and Fish Products (CCMFFP) discussed the implications and recommended to the AFC Standing Committee that no action be taken until the matter had been reviewed by the Ministers of Health and Fisheries, and that an examination of heavy metals in fish was undertaken.

  The committee also recommended that the pattern of fish consumption should be examined.

- 1975, June - the Food Committees of the NH&MRC agreed to examine the evidence on mercury put forward by the CCMFFP.

- 1975, October - the AFC endorsed concern at a Regulation enacted under the Trade Practices Act for the purpose of implementing and policing a product safety standard, and agreed that the control of food standards by other than health legislation was inappropriate and undesirable. By that time all states & territories had adopted the 0.5 ppm total mercury standard, except South Australia which had opted for a level of 1.0 ppm.

  The AFC recommended that the rate of fish in Australian diets should be examined and set up a working group of officers from relevant departments (Fisheries, Health, CSIRO) with Dr DA Hancock as Convenor.

  The Working Group on Mercury in Fish and Fish Products (WGMF) reported to the Co-ordinating Committee on Metals in Fish & Fish Products and gave priority to the planning and implementation of an Australia wide survey of fish consumption.

  In the meantime, the AFC recommended that individual states should continue with *ad hoc* mercury analysis of fish until the survey was completed. The AFC agreed finance should be sought from the Fishing Industry Research Trust Account (FIRTA) with the support of the Australian Fishing Industry Council.

- 1975, November - the first meeting of the Working Group was held. A Consumer Survey Steering Committee was set up under the Working Group. Two complementary studies were subsequently funded by FIRTA during 1976/77 financial year: 'Survey of the Pattern of Fish and Shellfish Consumption in Australia' was undertaken by PA Consulting Services Pty Ltd. A 'Dietary Study of Australians Consuming Significant Amounts of Fish Products' was undertaken under the direction of Mrs Ruth English of the Commonwealth Department of Health.

  In addition, relevant data on mercury in fish & fish products in Australia were examined and recommendations for additional analysis needed to complement these studies.

- 1975 - Western Australian Health Department prohibited the sale of any shark exceeding 18 kg dressed weight which, on analysis, contained in excess of 0.5 mg/kg of mercury (WGMF 1980).

- 1976, August - the Victorian Government increased the maximum length for school shark to 77 cm partial length (112 cm total length).

- 1977 - A survey by PA Consulting Services and DPIE indicated the average per capita intake of seafood by Australians in 1976/77 was only 10.07 kg per annum, or 27.59 g per day.

- 1978, May - In the USA the USFDA guideline was raised from 0.5 ppm to 1.0 ppm. Testing was based on a composite of twelve subsamples.

- In the UK, where fish consumption and mercury concentrations in fish are not dissimilar to those of Australia, it was concluded that regulations were not necessary (WGMF 1980).

- In Sweden, despite serious mercury pollution and higher fish consumption, a standard of 1.0 ppm with supplementary controls was considered to provide adequate protection (WGMF 1980).

- 1981 - Research on snapper in Victoria found that 45-52% of the edible flesh had values exceeding 0.5 ppm (Walker 1981).

- 1981 - NH&MRC adopted new standards of a mean mercury level of 0.5 ppm (net weight) in a consignment of fish and a maximum of 1.5 ppm in any individual sample. A new sampling regime was instituted, in which the larger the consignment the more fish or packages were sampled (see Appendix 3).

- The Australian Fishing Industry Council (AFIC) stated that a rigid enforcement of the proposed levels could eliminate 36% by weight of the top ten fish species with serious economic and social consequences for the industry.

- 1986 - The US Food and Drug Administration (USFDA) re-confirmed the current 1.0 ppm regulatory level, which applied to the edible portion of the fish (Tollefson and Cordle 1986).

- 1991, April - The Codex Committee on Food Additives and Contaminants "agreed to seek additional information from governments [of member countries] and the CCFFP [Codex Committee on Fish and Fishery Products] as to other predatory species of fish which were creating problems in international trade" (Codex 1991a).

- 1991, July - At its 19th Session in Rome, the Codex Alimentarius Commission (Codex) adopted two guideline levels for methylmercury in fish, with a level of 1.0 mg/kg for "predatory fish" (such as shark, swordfish, tuna, pike, and others), while retaining 0.5 mg/kg as its standard for non-predatory species. This meant Codex had dual guidelines. Member countries were asked to nominate lists of "predatory fish" species to be included in the Codex guidelines on mercury in fish (Codex 1991b).

- 1992 - The National Seafood Consumption Study indicated that Australian consumption of seafood had increased by just under 20% since the original survey in 1976/77. The average per capita intake for 1990 was 12.06 kg per annum, or 33.04 g per day (PA Consulting Group 1992).

- 1993, February - NFA sought comments on a proposal (P13) to amend Standard A12 to include a single and absolute mercury limit of 1.0 ppm for samples in individual fish or sample units when presented in lots of less than 5 fish or sample units.

- 1993, March - A submission was compiled and submitted by NFIC to the NFA supporting a variation to Standard A12 - Mercury in Fish, to institute a limit of 1.0 ppm mercury in single samples of fish not sampled according to the Standard A12 protocol (see Appendix 3). This submission also recommended a general review of the MPC for mercury in fisheries products.

- 1993, May - The NFA, having assessed proposal P13, prepared a draft variation in line with their original proposal and conducted an inquiry to consider the draft variations.

- 1993, June - The Western Australian Food Monitoring Program released a report on Mercury in shark (a joint project between the Health Department of Western Australia, WA Fisheries and the Department of Minerals and Energy). This recommended that the industry continue with the maximum recommended weight of 18 kg for all species of shark.

- 1993, August- The National Food Authority proposed amendments to Standard A12 under proposal P13.

- 1993, September - In response to these proposed amendments, a further submission was compiled and submitted by NFIC proposing a variation to A12 with a general review of the MPC for mercury in fisheries products. The submission proposed retention of the current sampling protocol and the upper individual reject limit of 1.5 ppm mercury. However, the submission proposed raising the mercury MPC for fish from a mean level of 0.5 ppm to a mean level of 1.0 ppm as the preferred option of those canvassed in the paper. This would be more in line with the Codex Alimentarius Commission standard. It would also enable trade in longer living, larger species which are higher in the food chain, and which can accumulate mean mercury levels exceeding the maximum permissible concentration of a mean of 0.5 ppm. (See Section 4 for the main recommendations in this submission.)

- 1993 - Data from several years of tests of mercury in imported seafood were supplied by the Australian Quarantine Inspection Service (AQIS). These data showed that the mean levels of mercury in all imported species were under the then standard of 0.5 ppm, although some individual fish exceeded the standard.

- 1994, August- In response to industry application A203 the National Food Authority amended Standard A12 for mercury in fish, to encompass dual limits (NFA 1994 - see Section 7 for details).

- 1994 - After full assessment by the NFA, the 1994 meeting of the Codex Alimentarius Commission on Fish and Fishery Products argued that as misunderstanding may arise due to the different limits for predatory and non-predatory fish, only one limit should be set for fish.. This limit should be an average limit of 1.0 ppm (NFA 1994).

5.2 Contributing Factors in Mercury Level Decisions
Variation to Standard A12 - Mercury in Fish

The following factors illustrate the difficulties in making decisions about setting mercury levels for seafood in Australia. Many played an important part in the industry's recommendations to the NFA, and they have all contributed in some way to the NFA decisions on Standard A12 - mercury in fish.

- The lack of uniform administration of the mercury standard between regulatory authorities throughout Australia. This included the inequities caused by having a higher mercury standard of 1.0 ppm, initially in South Australia and subsequently in Tasmania, compared with a mean of 0.5 ppm with a maximum possible concentration in any individual sample unit (individual fish) of 1.5 ppm throughout the rest of Australia.

- Research showing mercury levels in sharks are higher than many other fish, mollusc and crustacean species, eg. Walker (1976); Hancock *et al.* (1977); Lyle (1984); Thomson (1985); and Walker (1988). Sharks are characteristically long-lived with comparatively slow rates of growth, and these factors combined with their position at the top of the food chain probably contribute to their high levels of mercury accumulation (Lyle 1984).

- Resultant restrictions on the capture and sale of shark in some states, with the implementation of maximum size limits in Victoria and New South Wales, and a weight limit in Western Australia.

- Australia has a low level of industrial sources of mercury pollution compared with many overseas countries.

- The low fish consumption rate in Australia compared with overseas countries which have experienced mercury poisoning problems (eg. Japan and Sweden).

- The Working Group on Mercury in Fish (1980) drew to the attention of the Australian Fisheries Council the following points:

  - In Australia mercury in fish is, for the most part, not of anthropogenic origin (not caused by human activities such as industries).

  - In Sweden, despite serious mercury pollution and higher fish consumption, a standard of 1.0 mg/kg with supplementary controls was considered to provide adequate protection.

  - Since a mercury standard is based on calculations of <u>average</u> mercury ingestion, the Australian system of rejecting consignments of imported or domestic fish containing individuals with mercury exceeding the standard is unnecessarily stringent. Other countries, eg. the US, Canada and New Zealand, regulate on the basis of average mercury concentration in a consignment.

- The WGMF (1980) noted there were disadvantages with applying a legal maximum size including: the difficulty of obtaining data on mercury/size composition representative of a species and the area being considered for control, the variability of the data which precludes precision in the choice of a legal maximum size, the costs to industry of sorting and rejecting fish, and the administrative costs of inspection.

- WGMF (1980) pointed out that as recreational fish catches, which form a significant proportion of seafood consumed, would not be subject to regulations covering commercial landings and markets, it would be impracticable to rely on warnings and prohibition of species, sizes and areas in the hope of limiting mercury consumption.

- Mercury concentrations in Australian foods other than fish are relatively very low, generally averaging little more than 0.002 ppm (WGMF 1980).

- The Australian Market Basket Survey has consistently shown that the mean dietary intake of mercury in this country is less than 15% of the provisional tolerable weekly intake (PTWI) established by the Joint WHO/FAO Expert Committee on Food Additives.

- In response to the 1981 adoption by the NH&MRC of new standards of a mean mercury level of 0.5 ppm (wet weight basis) in a consignment of fish and a maximum of 1.5 ppm in any individual sample, the Australian Fishing Industry Council stated that a rigid enforcement of the proposed levels could eliminate 36% by weight of the top ten fish species with serious economic and social consequences for the industry.

- In 1986 the US Food and Drug Administration concluded that "...the current 1.0 ppm regulatory level provides adequate protection for the average fish consumer, for young children, and for a significant number of consumers exceeding the acceptable daily intake" (Tollefson & Cordle 1986).

- In 1991 the Codex Alimentarius Commission (Codex) agreed a guideline mercury level of 1.0 ppm for "predatory fish (such as shark, swordfish, tuna, pike and others)", meaning that Codex had dual limits, retaining 0.5 ppm as its standard for non-predatory species (Codex 1991).

- National Seafood Consumption Studies in 1976/77 and again in 1990/91 indicated the Australian average consumption of seafood had increased by almost 20% between surveys from 193g to 231g per week. Nevertheless this was only little more than half (56%) of the 410 g per week which the Swedish Commission on Evaluating the Toxicity of Fish calculated as the maximum weekly fish consumption for an average man if all the fish were contaminated to 0.5 ppm (WGMF 1980).

- In March and August 1993 two reports were compiled which NFIC submitted to the NFA. The first of these proposed a variation to Standard A12 - Mercury in Fish, to allow a higher mean level of 1.0 ppm to enable trade in longer living, larger species that can accumulate mean mercury levels which exceed the maximum permissible concentration of a mean of 0.5 ppm. It also proposed retention of the current sampling protocol and the upper individual limit of 1.5 ppm mercury. The second submission from NFIC recommended the mercury standard be raised to a mean of 1.0 ppm for <u>all</u> fish.

- In 1993 AQIS data from several years of tests of mercury in imported seafood showed that the mean levels of mercury in all imported species were under the then standard of 0.05 ppm, although some individual fish exceeded the standard.

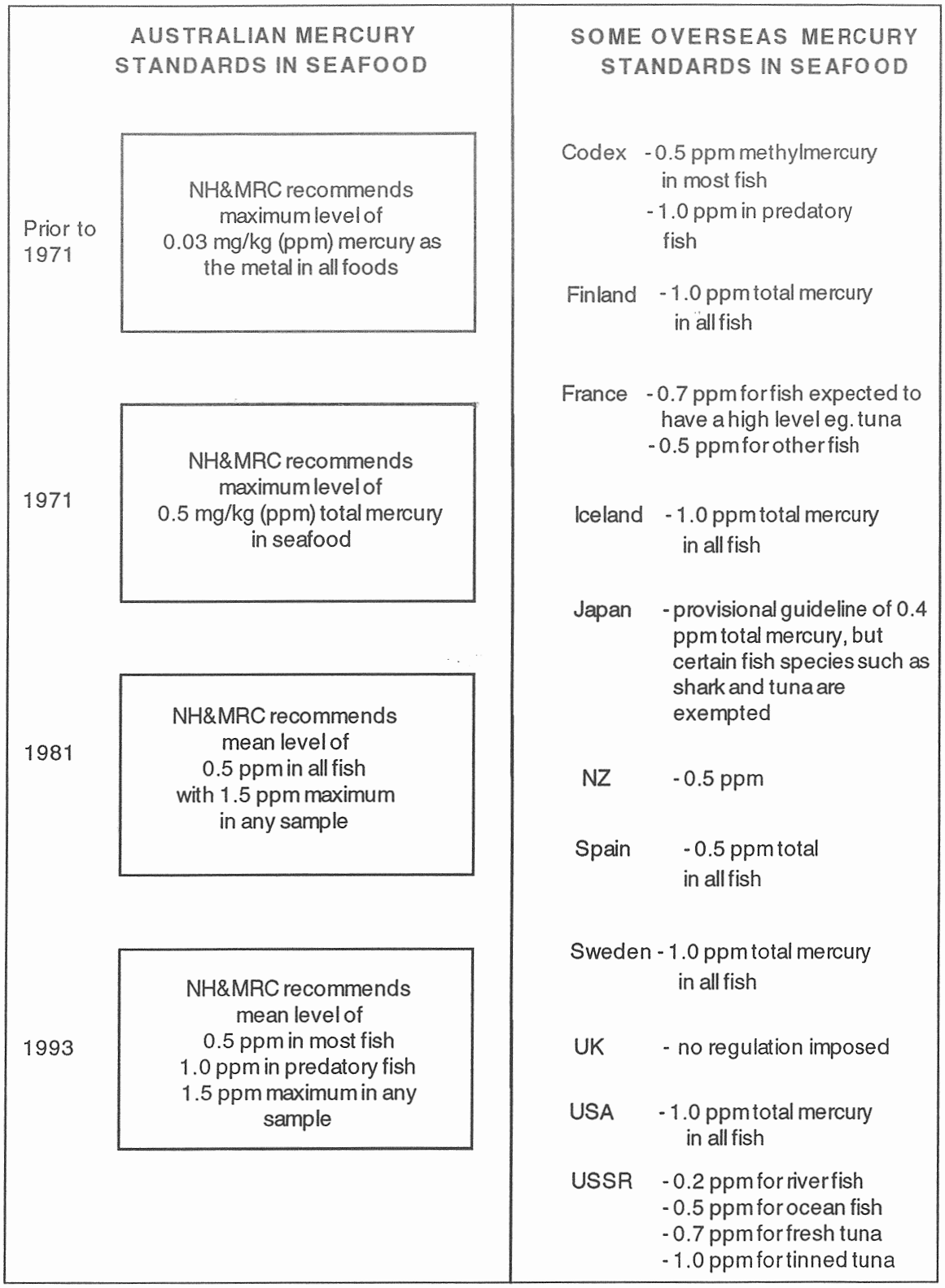

Figure 1. Changes in mercury standards in seafood in Australia, and a comparison with some overseas standards (from WGMF 1980).

5.3 The Industry Submission

In September 1993, in response to the amendments proposed in August 1993 by the NFA, a second submission was compiled and submitted by NFIC proposing a variation to A12 with a general review of the MPC for mercury in fisheries products.

The 1993 industry submissions were compiled by Mr Ian Hamdorf, Liaison Officer to the Fisheries Pollution and Marine Environment Committee (FPMEC) of the Standing Committee on Fisheries and Aquaculture.

The second submission proposed retention of the current sampling protocol and the upper individual reject limit of 1.5 ppm mercury. However, the submission proposed raising the mercury MPC for fish from a mean level of 0.5 ppm to a mean level of 1.0 ppm as the preferred option of those canvassed in the paper. This would be more in line with the Codex Alimentarius Commission standard. It would also enable trade in longer living, larger species which are higher in the food chain, and which can accumulate mean mercury levels exceeding the maximum permissible concentration of a mean of 0.5 ppm.

The submission also pointed out this would achieve a single national standard, as Tasmania and South Australia had exceptions to the current standard, "and other states appear to apply the mercury standard differently within their separate jurisdictions."

The submission from NFIC also suggested "the idea of having 'action lists' or 'exemption lists' for species which may exceed the MPC as in the United States, allowing assessment of the risk to humans from intake of small volumes of fish with these higher levels of mercury."

The submission compiled for NFIC contained 8 main conclusions, as outlined below.

> "The main outcomes of conducting an overview of the mercury concentrations in fish consumed by Australians appear to be:
>
> 1. The overall mean level of mercury in marketed fish appears to be below the current Australian MPC (0.5 mg/kg);
>
> 2. Several species of fish could be unnecessarily restricted in the market if the current MPC were applied strictly;
>
> 3. When compared to other countries' regulatory standards for mercury in fish and the Codex guidelines, there is scope to raise the Australian MPC to 1 mg/kg;
>
> 4. Noting the dietary variability of fish consumers and the highly varied mixture of marketed fish species the probability of adverse effects on human health from mercury is extremely low;
>
> 5. Other means of restricting mercury intake should be attempted for groups of fish consumers likely to have extremely high intakes, for example specific education programs ("advisories") especially designed to target specific groups, such as recreational fishers or ethnic minorities;
>
> 6. A review of the current MPC by the NFA is requested to address the concerns raised in the paper above, and to allow adoption of a uniform standard throughout Australia;
>
> 7. NFIC proposes a revision of this MPC to a mean level of 1.0 mg/kg, retaining the current sampling protocol and upper limit of 1.5 mg/kg; and
>
> 8. NFIC urges the NFA to represent the case for these higher mercury limits or guidelines within international fora such as Codex."

5.4 Cooperation When Preparing Submissions

The 1993 industry submissions were significant in that they drew on expertise from many areas. As mentioned above, the submissions were compiled by the Liaison Officer of FPMEC working within the Bureau of Resource Sciences, following agreement of the committee members of FPMEC to his involvement in the mercury MPC review process.

Other expertise was drawn from state and Commonwealth fisheries, health and quarantine departments, as well as from parts of industry.

At the time of preparation of the 1993 submissions from NFIC, a number of industry organisations and government sources were approached to cooperate by providing data and samples for the submission.

Unfortunately, limited numbers of data sets were located and it was difficult to determine which industry groups - particularly companies - had relevant data. There was some apparent reluctance on the part of a few data holders to provide such assistance, both within industry and government sectors. However, according to Ian Hamdorf (pers. comm.) this reluctance was mostly in the general sense of addressing several MPC issues, rather than obtaining information just on mercury.

It seems this reluctance arose from the belief that providing information on metals might be contrary to the industry's interests, so it would be better to keep it confidential. In the case of some government/research organisations, it seemed there were concerns about matters such as the need to publish first, misinterpretation of data, etc.

However, such fears, while at times widespread, are misguided and counter-productive.

In spite of these limitations on access to data, the submissions on mercury on fish went quite smoothly (Ian Hamdorf, pers. comm.).

In fact, the outcomes of the industry submissions, though limited, demonstrate that the provision of accurate information (whether perceived as either good or bad) is the best defence against arbitrary regulation.

Further, it would be in the best interest of industry to invest in continued monitoring, as well as compiling and providing both residue and consumption data, given that similar and perhaps far more challenging circumstances are likely in the future.

5.5 The Review Process

The Australia New Zealand Food Authority (formerly the National Food Authority) is a Commonwealth statutory body which has responsibility for making recommendations on food standards to the Australia New Zealand Food Standards Council (ANZFSC). This Council is made up of the state, territory and New Zealand Health Ministers.

Once ANZFSC has approved the recommendations, they are adopted into state and territory food laws and into the New Zealand food law without amendment (ANZFA 1997).

In developing food standards, ANZFA is legally obliged to take into account all of the objectives set out in section 10 of the *Australia New Zealand Food Authority Act 1991*, in descending order of priority (ANZFA 1997). These are:

(a) the protection of public health and safety;

(b) the provision of adequate information relating to food to enable consumers to make informed choices and to prevent fraud and deception;

(c) the promotion of fair trading in food;

(d) the promotion of trade and commerce in the food industry;

(e) the promotion of consistency between domestic and international food standards where these are at variance.

5.6 The Current Situation

In August 1994 the National Food Authority amended Standard A12 for mercury in fish.

This retained the mean level of 0.5 ppm for most fish sampled as per the sampling protocol (Appendix 2). However, for a number of predatory and long-lived species there was a higher mean level of 1.0 ppm, and where fish were unable to be sampled in this way (generally large predatory species) a maximum level of 1.0 ppm was set in line with NFA Proposal P13.

To a great extent this was consistent with the (then) Codex two-tiered standard.

The reasons given by the NFA for recommending the variation to Standard A12 were outlined in a notice dated August 1994:

"STATEMENT OF REASONS

APPLICATION A203

FOR RECOMMENDING A VARIATION TO STANDARD A12 - METALS AND CONTAMINANTS IN FOODS - TO SPECIFY THE MAXIMUM PERMITTED CONCENTRATION OF MERCURY IN FISH.

The National Food Authority recommends the adoption of the amended draft variation for the following reasons:

- Mercury is a common contaminant of fish and other seafood. A proportion of the mercury in seafood is in the form of the more toxic methyl mercury. Relatively few species of fish have a mercury level above the current standard for mercury of 0.5 mg/kg. Therefore the mercury Maximum Permitted Concentration (MPC) for fish should remain at a mean level of 0.5 mg/kg.

- Certain species of fish could be restricted in the market if an MPC of a mean of 0.5 mg/kg is strictly applied. For these fish, which includes all shark and ray species, marlin (Istiophoridae sp.), gemfish (*Rexea solandri*), orange roughy (*Hoplostethus atlanticus*), and billfish (Xiphiidae sp.) an MPC of a mean of 1.0 mg/kg should apply. A MPC of 1.0 mg/kg for these fish will enable the controlled marketing of these fish while protecting consumers against high mercury levels in fish.

- The majority of fish species have mercury levels well below the current limit of 0.5 mg/kg. Well over 95% of marketed fish have mercury levels below 0.3 mg/kg. Estimates of theoretical maximum mercury intake indicate that there will be no public health risks from excessive dietary mercury.

- The suggested changes are in line with other international limits on the level of mercury in fish. The US limit is a mean level of 1.0 mg/kg of methyl mercury in fish. The EEC has a dual limit of 1.0 mg/kg total mercury in specified species of fish and 0.5 mg/kg in all other species. The New Zealand limit is 0.5 mg/kg of total mercury. The Codex guideline limit for total mercury in fish is 1.0 mg/kg for predatory fish and 0.5 for non-predatory fish.

- Since full assessment, the 1994 meeting of the Codex Alimentarius Commission on Fish and Fishery Products argued that as misunderstanding may arise due to the different limits for predatory and non-predatory fish, only one limit should be set for fish. This limit should be an average limit of 1.0 mg/kg.

The draft variation prepared after full assessment is amended for the following reasons:

- Rays were included in the species allowed an MPC of 1.0 mg/kg because the flesh of both sharks and rays is marketed at flake, is difficult to distinguish in the fillet form and minced fish products may be very difficult. The mercury MPC for these products is a mean of 0.5 mg/kg.

- Section 7 (c) of the Code was modified to take into account the changes in the other sections." has similar mercury levels.

- Barramundi and southern bluefin tuna were included in those species allowed an MPC of a mean of 1.0 mg/kg as increasing the MPC for these fish will have no adverse effect on public health and safety. If required to meet a lower MPC a sizeable proportion of these fish catches could not be legally marketed thus depriving the public of a nutritious protein source.

- A separate entry for minced fish products was included as identification of the species of fish in minced fish products may be very difficult. The mercury MPC for these products is a mean of 0.5 mg/kg.

- Section 7 (c) of the Code was modified to take into account the changes in the other sections.

DRAFT VARIATION AS AMENDED, FOR APPLICATION A203 - MERCURY IN FISH

This drafting is subject to acceptance of drafting for P098 (Carryover levels in Mercury) for which a recommendation has been made to the NFSC.

1. Standard A12 is varied by-

(a) deleting from columns 2 and 3 respectively of the Table in clause (2) in relation to the entry for mercury-

"Fish, which can be sampled in accordance with clause (7), crustaceans and molluscs. A mean level of 0.5*"

and substituting-

"Crustaceans, molluscs and fish which can be sampled in accordance with clause (7), except gemfish, billfish (including marlin), southern bluefish tuna, barramundi, orange roughy, rays and all species of shark. A mean level of 0.5 *"; and

(b) inserting in columns 2 and 3 respectively of the Table in Clause (2) in relation to the entry for mercury-

"Gemfish, billfish (including marlin), southern bluefish tuna, barramundi, orange roughy, rays and all species of shark. A mean level of 1.0*".

"Minced fish products. A mean level of 0.5*".

[Note: where the NFA notice refers to "southern bluefish tuna" this should read "southern bluefin tuna"]

Therefore, in summary, since August 1994 the National Food Authority Standard A12 - Metals and Contaminants in Food - has applied the levels listed below to mercury concentration in seafood.

It is important to remember that these relate to mg/kg (= ppm) of mercury calculated as the metal, not as organic methylmercury.

Type	Mercury Level
Crustaceans, molluscs and fish which can be sampled in accordance with clause (7), except gemfish, billfish (including marlin), southern bluefin tuna, barramundi, orange roughy, rays and all species of shark	A mean level of 0.5 *
Fish which cannot be sampled in accordance with clause (7)	1.0 #
Gemfish, billfish (including marlin), southern bluefin tuna, barramundi, orange roughy, rays and all species of shark	A mean level of 1.0 *
Minced fish products	A mean level of 0.5 *
Water	0.001 #
Foods not containing a food otherwise specified	0.03 #

* The mean level of mercury in the prescribed number of sample units as determined by the methods prescribed by clause (7) of Standard A12 (see Appendix 2).

\# The maximum permitted concentration (MPC) in mg/kg.

5.7 Total Versus Organic Mercury

One of the areas where measurement of mercury contamination differs between countries and standards is whether to measure total mercury or organic mercury.

Depending on the methods used, mercury analyses can simply measure total mercury or differentiate the inorganic and organic mercury. It is generally considered that the majority of organic mercury in fish is in the form of methylmercury.

Mercury can be transformed in the environment from inorganic to organic forms by the "methylation of inorganic mercury in the sediments of lakes, rivers and other waterways and in the oceans" (WGMF 1980). The sources of mercury are outlined in Section 2.3.

Of the Australian species tested for organic mercury in the WGMF report (1980), the proportion of total mercury which was organic mercury varied between 77.3% and 96.9%. Some marlin appear to be anomalous in having a very low proportion of organic mercury at around 10% (Edmonds cited in WGMF 1980).

In the USA the conversion factor of 90% is used to estimate methylmercury ingestion in consumption calculations, and this was also used by WGMF (1980).

In Australia, the total mercury level is generally used in analyses of contamination, and the standard specified by the National Food Authority is for total mercury.

However, the WGMF (1980) pointed out that "There is also the need to distinguish accurately the relative proportions of different forms of the contaminant, such as inorganic mercury and methylmercury compounds, in view of their distinctive toxicological implications."

According to WGMF (1980) methylmercury compounds are much more toxic to man than other forms of mercury.

In fact the international standard adopted by the Codex Alimentarius Commission is for methylmercury; that is the equivalent of organic mercury only.

While at present it is more difficult and expensive to test for organic mercury compared with total mercury, based on this international standard it would seem reasonable for Australia to pursue the option of setting a standard based on organic methylmercury as the form of mercury measured in seafood.

5.8 Recent Australian Sampling for Mercury in Fish

Since the proposals to make amendments to standard A12 - Mercury in Fish were first flagged in early 1993, some states have released or undertaken studies on mercury levels in fish, particularly sharks.

1. In June 1993 the Western Australian Food Monitoring Program released a report titled "Mercury in Shark" (a joint project between the Health Department of Western Australia, WA Fisheries and the Department of Minerals and Energy).

The report summarises the results of sampling 193 samples of shark flesh between March 1989 and June 1990. This found that for the two most commonly caught shark species - bronze whaler and whiskery shark - the weighted mean mercury content was 0.48 and 0.50 ppm respectively, reflecting a reduction in the size of shark caught. The report recommended that the industry continue with the maximum recommended weight of 18 kg for all species of shark.

2. The Environmental Health Branch of Queensland Health conducted a survey of heavy metals in shark and ray flesh under the auspices of the Food Surveillance Program (Queensland Health 1993). While this work was undertaken from July 1991 to June 1992, the report was not released until December 1993, when the NFA was undertaking its review of the mercury standard.

By the time this report was released it was clear the NFA proposed raising the standard for all species of sharks and rays to a mean of 1.0 ppm for those sampled according to the standard, and an MPC of 1.0 for those which could not be sampled in this way (see Section 6). In spite of this, the report used the then standard of a mean level of mercury of 0.5 ppm. Further, the results were given on a sample-by-sample basis, and conclusions based on individual samples which were above or below the former standard.

This study therefore concluded that 50% of individual sharks and rays sampled were above the 0.5 ppm standard. However, under the proposed (and now current) standard only 9 of the 54 samples (17%) had mercury levels above 1.0 ppm.

Further, if the mean of the samples were used a different story emerges again. The mean of all samples was 0.66 ppm - well below the current standard. If we look at the mean of the samples for each species a similar picture emerges.

3. A further Queensland study was done on metals in fish, crustaceans and molluscs in Moreton Bay during 1995 (Douglas and Warren 1995). This was based on the current standards, and used means when reaching conclusions. This found that no sample contained a level of mercury in excess of the MPC and all samples were well below MPC values.

4. The NSW Health Department commenced a survey of heavy metals in seafood, specifically in the NSW catch, in mid 1997. This will encompass approximately 500 samples, spread proportionately over the catch, and is due for completion in the first half of 1998 (Edward Kraa, NSW Health, pers. comm.).

6. Discussion

The Australia New Zealand Food Authority (ANZFA, which replaces the National Food Authority) has just begun a review of the whole Food Standards Code, including Standard A12 - Metals and Contaminants in Food, to bring Australian and New Zealand food standards in line with one another (ANZFA 1997).

It will be important for the seafood industry to approach such a review in an open, responsible and professional manner.

The 1993 industry submissions were significant in that they drew on expertise from many areas. In particular, the submissions were compiled by Mr Ian Hamdorf, Liaison Officer * to the Fisheries Pollution and Marine Environment Committee of the Standing Committee on Fisheries and Aquaculture, working within the Bureau of Resource Sciences. Other expertise was drawn from state and Commonwealth fisheries, health and quarantine departments, as well as from parts of industry.

Mr Hamdorf had a lot of dialogue with the NFA and state Health and Fisheries Departments, both prior to and after the submissions were made. He had cooperation and endorsement from the industry through the Fishing Industry Councils and NFIC, as well as support from FPMEC to negotiate technical and practical issues of the mercury MPC modifications (Ian Hamdorf, pers. comm.).

In this way the industry did achieve an increase in mercury levels for predatory and long-lived fish species. However, the industry did not obtain all it was seeking through the NFIC submissions to the NFA. The reasons for this are complex, and include pressure from competing interest groups, lack of support by some industry organisations and government/ research sources, possible errors in strategy, as well as political realities.

It is important for the seafood industry to learn from this experience and to build on it. For example, the submission from NFIC to the NFA inquiry into the proposal to vary standard A12 was basically the only submission from the seafood industry. At the same time, there were many opposing submissions raising concerns about mercury levels from conservation and consumer groups, as well as many individuals (Dr Fay Stenhouse, ANZFA, pers. comm.).

Some industry groups gave the impression they were reluctant to participate in the collection of contentious information, making the preparation of the submission all the more difficult. Further, while the second industry submission was convincing and strong in its recommendations, there was no apparent room for negotiation over the industry position indicated in the submission.

Additionally, neither industry nor the state government fisheries groups followed up on the NFA proposed changes coming out of their review, either with expressions of support or offering other viewpoints. It seems the presumption was that the outcome was a *fait accompli* by that stage (Ian Hamdorf, pers. comm.).

In future submissions it will be important to propose changes that are achievable, and to work closely with the NFA throughout the entire review process.

* Note: The position of Liaison Officer to the Fisheries Pollution and Marine Environment Committee of the Standing Committee on Fisheries and Aquaculture has recently been removed. Therefore it seems likely that the specialised knowledge required to help compile any future submissions to ANZFA will need to be contracted out. The location of where such a contract is based would have a large bearing on gaining access to government and industry data sources.

There are some higher risk groups which have been identified in previous surveys, both in Australia and overseas. These include indigenous groups, some ethnic groups, fishers, and those on fish diets. The foetus is considered to be susceptible to the effects of mercury, therefore pregnant women should be treated as a special group. There is a need to develop specific education programs ("advisories") for the individuals/groups in these higher risk categories.

While ensuring the special education needs of these higher risk groups are addressed, an overriding reason for pursuing the changes to the mercury standard is to reduce unnecessary regulations which may inhibit trade in seafood in circumstances where there is no danger to public health. This applies equally to all heavy metals and residues in seafood.

Australian Prime Minister John Howard recently (August 1997) emphasised the importance of removing such obstacles to competition when he wrote "The comprehensive review of food regulations we instigated this year is aimed at removing unnecessary regulation that impedes international industry competitiveness."

This view is consistent with the statement in the document on pesticide residues and contaminants which outlines the position of the Codex Alimentarius (1989): "The maximum levels ... represent levels which are not higher than would result from good manufacturing practices and are intended to ensure a free movement of food in international trade."

Therefore, the emphasis with both Codex and the current Federal Government is that there should not be unnecessary restrictions on international trade. Naturally, it is important to remember that this should apply as long as contamination levels are safe.

Overall, the main lessons to be learnt from this case study are the importance of information gathering and dissemination of this information. These strongly support the significance placed by the Fishing Industry National Strategy (FINS) in its plank of Information Flow.

7. Further Development/Recommendations

1. In the ANZFA review of the Food Standards Code - including Standard A12, relating to mercury in fish - it will be important for the seafood industry to propose changes that are achievable.

2. The seafood industry should work closely with the ANZFA throughout the review process.

3. In future submissions on mercury in fish, the emphasis should be on measurements of methylmercury (organic mercury) rather than the present total mercury level, which includes organic and inorganic mercury. This would be consistent with the Codex Guideline Levels for Methylmercury in Fish which were adopted by the Codex Commission in 1991.

4. As noted in the NFA notice of August 1994, the 1994 meeting of the Codex Alimentarius Commission on Fish and Fishery Products argued that as misunderstanding may arise due to the different limits for predatory and non-predatory fish, only one limit should be set for fish, and this limit should be an average limit of 1.0 mg/kg (see Section 7). Industry should pursue the logic and consistency of this Codex Standard in the present ANZFA review of the Food Standards Code.

5. When pursuing an issue on behalf of the industry, there needs to be a single coordinating organisation to oversee preparation of submissions, at a national level if this is appropriate. It is essential that this organisation has the confidence of both government and reserach agencies.

6. In preparing submissions, the industry needs to draw on a wide range of expertise, including specialised expertise wherever required, and as much information as is readily available on the subject.

7. The seafood industry must ensure there are many responses to future ANZFA proposals from the various industry sectors, state peak bodies, groups and individuals. This is very important, as there will inevitably be many (often uninformed) submissions from other interest groups, and no matter how strong the industry submission may be, a single submission will almost certainly be 'swamped' by the sheer numbers of other submissions. Naturally, it will be important for the industry submissions to be consistent in the messages they convey, supporting one other.

8. It is imperative for industry to be heavily involved in providing accurate information (whether perceived as either good or bad), as this is the best defence against arbitrary regulation.

9. Industry members or groups must not refuse to cooperate in the fear that the truth might harm their interests. On the contrary, the industry must be 'up front' about any problems or concerns, and should make efforts to address such concerns.

10. With this in mind, it will be important for those doing any research to convince those individuals and groups providing survey information that their confidentiality will be assured. It will be important to emphasise that the data collected will be used for their benefit, and will not be used against them. This will generally require extensive communication early in any research project with those at the 'grass roots' level providing the information.

11. Industry's investment in continued monitoring, compiling and provision of both residue and consumption data is advisable, given that more challenging circumstances are likely in the future.

12. There is a need to ensure that future designs of surveys - in particular consumption surveys - must be developed to ensure the data collected can be used for the purposes of assessing matters such as metal standards. For example, an important aspect of this would be the need to be able to identify consumption by species.

13. Future consumption surveys should identify those consumers who eat fish in large quantities (ie. higher risk categories). Then there should be follow-up work to find out what species of fish these people are eating.

14. There are some higher risk groups which have been identified in previous surveys, both in Australia and overseas. These include indigenous groups, some ethnic groups, fishers, and those on fish diets. The foetus is considered to be susceptible to the effects of mercury, therefore pregnant women should be treated as a special group. There is a need to develop specific education programs ("advisories") for the individuals/groups in these higher risk categories.

15. There needs to be a public education program on the low level of risk associated with eating food with heavy metals and other residues, if the level of consumption is anything other than extremely frequent.

16. There is a need for consistent names to be applied to fish in all states and regions, as well as for imported products. This has been addressed to a large extent, but more work is necessary.

17. The lessons from this case study can be applied in circumstances involving other heavy metals and residues in seafood.

18. The experience from this case study can also be used as a model in other industry sectors, eg. where there is contamination in shellfish.

8. References

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Appendix 1 - Intellectual Property

The FRDC's proportion of ownership of the project intellectual property, based on Part C of the application for this project, will be 100%.

Appendix 2 - Australian Seafood Consumption

The average amount of seafood eaten per person from the 1977 survey was 10.07 kg per annum, or 27.59 g per day (PA Consulting 1978).

The average amount of seafood eaten per person from the 1990/91 study was 12.06 kg per annum, or 33.04 g per day (FRDC 1992).

This represents an 19.8% increase in seafood consumption by Australians over the 13 years between these surveys.

The later study showed a number of other trends in seafood consumption in Australia, including:

- 94.6% of individuals living in Australian households had eaten seafood in the previous year.
- In-home consumption of fresh and frozen forms of seafood had increased from 2.90 kg per person in 1977 to 4.26 kg in 1990/91.
- In-home consumption of fresh, frozen, frozen packaged and canned forms of seafood had declined from 1.01 per person kg in 1977 to 0.79 kg in 1990/91.
- Out-of-home consumption of fish had trebled from 0.74 kg per person in 1977 (excluding fish purchased from takeaways), to 2.23 kg in 1990/91, plus 0.15 kg was purchased from takeaways.
- Out-of-home consumption of other seafood had more than doubled from 0.70 kg per person in 1977 (excluding other seafood purchased from takeaways), to 1.47 kg in 1990/91, plus 0.17 kg purchased from takeaways.

Appendix 3 - Standard A12 Sampling Protocols

The following extracts are taken from the ANZFA "Standard A12 - Metals and Contaminants in Food", and include those parts which relate to mercury in fish.

"(1) For the purposes of this Standard and save where the contrary intention appears -
(a) 'metal' includes compounds of metal;
(b) where food contains a metal and any compound or compounds of that metal, that metal and compound or compounds shall be expressed as the metal;
(c) antimony, arsenic and selenium are deemed to be metals;
(d) maximum permitted concentration shall be determined on the edible content of the food that is ordinarily consumed and, in the case of food in a dried, dehydrated or concentrated form, shall be calculated with respect to the mass of the food after dilution or reconstitution;
(da) maximum permitted concentration for seaweed (edible kelp) whether dried, dehydrated, concentrated or not shall be calculated with respect to the mass of the seaweed at 85% hydration; and
(e) 'beverages and other liquid foods' include fruit juices and beverages with a fruit juice content, milk, alcoholic beverages and frozen liquid foods, but do not include thick gels or other semi-solid foods."

"(7) **Methods of sampling and analysis.** The methods specified in this clause are the prescribed methods for the sampling for analysis of mercury in fish and fish products.

(a) Preliminary.

(i) For the purposes of this sampling plan, a sample shall consist of a prescribed number of sample units, and a sample unit shall consist of a quantity, taken from the edible portions of fish including sharks, rays and scale fish, crustaceans or molluscs, sufficient for the purposes of analysis.

(ii) Where the lot under investigation is fish, not packaged, the number of random sample units of the same species shall be as detailed in subparagraph (b)(i) of this clause (7) and each sample unit shall be homogenised separately.

(iii) Where the lot under investigation is crustaceans or molluscs, not packaged, the number of random sample units of the same species shall be as detailed in subparagraph (b)(ii) of this clause (7) and each sample unit shall be homogenised separately.

(iv) Where the lot under investigation is fish including sharks, rays and scale fish, fish products (for example fillets, deep frozen products, fish preserves), crustaceans or molluscs, that are packaged, the number of random sample units to be taken at the factories, or establishments of production, or at the time of importation, or at the point of sale, shall be in proportion to the weight of the lot as prescribed in clause (7)(b)(i) or clause (7)(b)(ii) of this Standard.

(v) In the case of samplings at the retail level where the prescribed number of sample units cannot be taken, 5 sample units shall be taken.

(b) The number of random sample units to be taken for the purposes of analysis is as follows -

(i) Fish, including packaged fish:

(A) lots of up to and including 5 tonnes ... sample units from 10 fish, or 10 packages;
(B) lots over 5 tonnes, up to 10 tonnes ... sample units from 15 fish, or 15 packages;
(C) lots over 10 tonnes, up to 30 tonnes ... sample units from 20 fish, or 20 packages;
(D) lots over 30 tonnes, up to 100 tonnes ... sample units from 25 fish, or 25 packages;
(E) lots over 100 tonnes, up to 200 tonnes ... sample units from 30 fish, or 30 packages;
(F) lots over 200 tonnes ... sample units from 40 fish, or 40 packages.

(ii) Crustaceans and molluscs, including packaged crustaceans and molluscs:

(A) lots up to and including 1 tonne ... 10 sample units, or 10 packages;
(B) lots over 1 tonne, up to 5 tonnes ... 15 sample units, or 15 packages;
(C) lots over 5 tonnes, up to 30 tonnes ... 20 sample units, or 20 packages;
(D) lots over 30 tonnes, up to 100 tonnes ... 25 sample units, or 25 packages;
(E) lots over 100 tonnes ... 30 sample units, or 30 packages.

(b) Preparation, Analysis and Interpretation of the Sample.

(i) Samples with 10 or more sample units -

(A) the sample shall be randomly sorted into sub-groups, each of 5 sample units;
(B) relative to each sub-group, a composite homogenate is prepared by thoroughly mixing portions, equal to the nearest 0.01 g, of the respective sample unit homogenates, reserving the remainder of each sample unit homogenate for later analysis, if required;
(C) analyse each composite homogenate for mercury;
(D) if the concentration of mercury in each composite homogenate is less than or equal to 1.0 mg/kg in the case of gemfish, billfish (including marlin), southern bluefin tuna, barramundi, orange roughy, rays and all species of shark, or is less than or equal to 0.5 mg/kg in the case of crustaceans, molluscs, other fish which can be sampled in accordance with this clause and minced fish products, the lot shall be reported as complying with the standard;
(E) if the concentration of mercury in any of the composite homogenates is greater than 1.0 mg/kg in the case of gemfish, billfish (including marlin), southern bluefin tuna, barramundi, orange roughy, rays and all species of shark, or is greater than 0.5 mg/kg in the case of crustaceans, molluscs, other fish which can be sampled in accordance with this clause and minced fish products, the overall mean of the composites is examined;

(EA) if the overall mean of the lot is greater than 1.0 mg/kg in the case of gemfish, billfish (including marlin), southern bluefin tuna, barramundi, orange roughy, rays and all species of shark, or is greater than 0.5 mg/kg in the case of crustaceans, molluscs, other fish which can be sampled in accordance with this clause and minced fish products, the lot shall be reported as not complying with the standard;

(EB) if the overall mean of the lot is less than or equal to 1.0 mg/kg in the case of gemfish, billfish (including marlin), southern bluefin tuna, barramundi, orange roughy, rays and all species of shark, or is less than or equal to 0.5 mg/kg in the case of crustaceans, molluscs, other fish which can be sampled in accordance with this clause and minced fish products, then the reserved homogenates from the sample units shall be submitted for individual mercury analysis;

(F) if no individual sample unit exceeds 1.5 mg/kg of mercury, the lot shall be reported as complying with the standard;

(G) if any individual sample unit has a mercury concentration exceeding 1.5 mg/kg, the lot shall be reported as not complying with the standard.

(ii) Samples with 5 sample units -

(A) a composite homogenate is prepared by thoroughly mixing portions, equal to the nearest 0.01 g, of each of the sample unit homogenates;

(B) the composite homogenate is analysed for mercury;

(C) if the concentration of mercury in this composite homogenate is less than or equal to 1.0 mg/kg in the case of gemfish, billfish (including marlin), southern bluefin tuna, barramundi, orange roughy, rays and all species of shark, or is less than or equal to 0.5 mg/kg in the case of crustaceans, molluscs, other fish which can be sampled in accordance with this clause and minced fish products, the lot shall be reported as complying with the standard;

(D) if the concentration of mercury in this composite homogenate is greater than 1.0 mg/kg in the case of gemfish, billfish (including marlin), southern bluefin tuna, barramundi, orange roughy, rays and all species of shark, or is greater than 0.5 mg/kg in the case of crustaceans, molluscs, other fish which can be sampled in accordance with this clause and minced fish products, the lot shall be reported as not complying with the standard.

(iii) Dried or partially dried fish:

the mercury content of dried or partially dried fish shall be calculated on an 80% moisture basis.

Appendix 4 - List of Acronyms and Abbreviations

AFC	Australian Fisheries Council
AFIC	Australian Fishing Industry Council
ANZFA	Australia New Zealand Food Authority
ANZFSC	Australia New Zealand Food Standards Council
AQIS	Australian Quarantine Inspection Service
ASIC	Australian Seafood Industry Council (formerly NFIC)
BRS	Bureau of Resource Sciences
CCFFP	Codex Committee on Fish and Fishery Products
CCMFFP	Co-ordinating Committee on Metals in Fish & Fish Products
Codex	Codex Alimentarius Commission of the United Nations
CSIRO	Commonwealth Scientific & Industrial Research Organisation
DPIE	Department of Primary Industries and Energy
FAO	Food and Agricultural Organisation of the United Nations
FINS	Fishing Industry National Strategy
FIRTA	Fishing Industry Research Trust Account
FPMEC	Fisheries Pollution and Marine Environment Committee
FRDC	Fisheries Research & Development Corporation
MPC	Maximum permitted concentration
NFA	National Food Authority (subsequently changed to ANZFA)
NFIC	National Fishing Industry Council (formerly AFIC)
NFSC	National Food Standards Council (subsequently changed to ANZFSC)
NH&MRC	National Health & Medical Research Council of the Commonwealth Health Department
NRS	National Residue Survey
OECD	Organisation for Economic Co-operation and Development
PTWI	Provisional tolerable weekly intake
SCFA	Standing Committee on Fishing and Aquaculture
USFDA	United States Food and Drug Authority
WGMF	Working Group on Mercury in Fish and Fish Products
WHO	World Health Organisation

Appendix 4 - List of Acronyms and Abbreviations

AFC	Australian Fisheries Council
AFIC	Australian Fishing Industry Council
ANZFA	Australia New Zealand Food Authority
ANZFSC	Australia New Zealand Food Standards Council
AQIS	Australian Quarantine Inspection Service
ASIC	Australian Seafood Industry Council (formerly NFIC)
BRS	Bureau of Resource Sciences
CCFFP	Codex Committee on Fish and Fishery Products
CCMFFP	Co-ordinating Committee on Metals in Fish & Fish Products
Codex	Codex Alimentarius Commission of the United Nations
CSIRO	Commonwealth Scientific & Industrial Research Organisation
DPIE	Department of Primary Industries and Energy
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