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Bureau of Chemical Safety
Food Directorate
Health Products and Food Branch

***Updating the Existing Risk Management
Strategy for Mercury in Retail Fish***



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1.0 PURPOSE

This paper describes the development of risk management options for mercury in fish based on the health risk assessment of mercury in fish. The health risk assessment/benefit document was prepared for consideration by the Bureau of Chemical Safety of Health Canada's Food Directorate and with input from an interdepartmental Science Team, comprised of representatives from various groups within Health Canada, the Canadian Food Inspection Agency, Environment Canada, and Fisheries and Oceans Canada. This risk management document was subsequently considered by an interdepartmental Policy Team, which adopted a recommended option for updating the risk management strategy. The Food Rulings Committee, an interdepartmental Health Canada /Canadian Food Inspection Agency Committee, advising the Director General, Food Directorate, Health Canada, on regulatory matters, has endorsed the option recommended by the Policy Team.

It is important to note that this document pertains to retail fish only. Recreational fishing or "sport fish" usually fall under the jurisdiction of provincial or territorial governments. In certain cases, it may fall under the jurisdiction of certain federal departments; for example, the Department of Fisheries and Oceans (for inland waters that have been created or altered under permission of a Fisheries Act Authorization) or Parks Canada (for waters within federal park boundaries).

2.0 MAIN ISSUES IDENTIFIED IN THE HEALTH RISK ASSESSMENT

It has long been known that, for those who regularly consume fish, fish constitutes the main source of dietary exposure to mercury, which can cause adverse health effects in humans at sufficiently high exposures. A risk management strategy to reduce the risk of unacceptable exposures to mercury from retail fish consumption was first implemented in Canada in the late 1960s, when Health Canada established a standard¹ for mercury in fish. Since this time, the risk management strategy has been periodically revisited, and consumer advice has been issued regarding the consumption of certain types of larger "predatory" types of fish.

The risk management approach at the time this document was prepared comprised:

- A **standard** of 0.5 parts per million (ppm) total mercury² to all commercially-

¹ A "standard" refers to an administrative maximum level that does not appear as a unique regulation in the *Food and Drug Regulations*. Maximum levels that appear in the *Regulations* are called "tolerances." Standards are enforceable by the Canadian Food Inspection Agency as foods that contain contaminants above any established standards are considered not compliant with Part I, Section 4 of the *Food and Drugs Act* which state, in part, that: "no person shall sell an article of food that a) has in or on it any poisonous or harmful substance and b) is unfit for human consumption".

² The standard is applied as "total mercury" rather than methylmercury because it is less costly to analyse total mercury than it is to analyse methylmercury.

sold fish except shark, swordfish, and fresh/frozen tuna, all of which are piscivorous³ fish, and

- a **consumer advisory**, last issued in 2002, for the three fish that are exempted from the standard recommending that the general adult population limit consumption to one meal per week and pregnant women, women of child-bearing age and young children limit consumption to no more than one meal per month.

The standard is enforceable by the Canadian Food Inspection Agency (CFIA). The advisory, issued by Health Canada, is available on the websites of both Health Canada and the CFIA.

A need to revise the risk management⁴ approach for mercury in commercial fish has been identified, based on the most recent review of Canadian data relevant to mercury and fish. In particular, the characterisation of risk (as described in section 5.2 of the health risk assessment/benefit document) indicates that the advisory on the three piscivorous fish is adequately protective provided that the average mercury concentration is equal to or less than 1.0 ppm. However, the most recent data shows that total mercury levels may exceed a concentration of 1.0 ppm total mercury in certain cases (see Appendix II of the health risk assessment/benefit document).

It was also found that regular consumption by young children (12 years of age and younger) of canned albacore tuna could result in an unacceptable exposure to mercury. Canned **albacore** tuna, also known as canned **white** tuna, is not the same as canned light tuna. Cans labelled as “light tuna” tend to be lower in cost relative to albacore tuna and contain other species of tuna such as skipjack, yellowfin, and tongol, which are relatively low in mercury.

Similar reviews of the risk management of mercury in fish have been conducted in other jurisdictions. For example, health authorities in the United States, Australia and New Zealand, the United Kingdom, and Ireland each released updated consumer advisories on the consumption of these fish in 2004 (see Section 5.0). Many of these advisories re-iterated specific consumption advice already in place for “predatory” fish, but also included new advisories regarding the consumption of canned tuna. These updates appeared not long after the establishment by the Joint World Health Organization/Food and Agriculture Organization Expert Committee on Food

³ Piscivorous fish are those that preferably consume, through predation and possibly also by scavenging, other fish for food. Such fish are also commonly referred to as predatory.

⁴ Risk management is a process, distinct from risk assessment, of weighing policy alternatives in consideration of the conclusions of a risk assessment and other factors relevant for the health protection of citizens, and, if needed, selecting appropriate prevention and control options. (Adapted from the Codex Alimentarius Commission Procedural Manual, Fifteenth edition.)

Additives (JECFA)⁵ of a provisional Tolerable Daily Intake (TDI)⁶ of methylmercury based on its neurodevelopmental effects in the developing fetus and young children.

Public reaction to updated consumer advisories in other countries has drawn attention to the importance of recognising the nutritional benefits of fish consumption in risk communication. Fish-consumers should receive balanced information that will allow them to make fish choices that optimise the nutritional benefits and minimise the risks from mercury exposure.

3.0 UPDATING THE RISK MANAGEMENT STRATEGY

3.1 Options

The option of retaining the status quo is not considered acceptable for the reasons stated in the previous section and described in more detail in the health risk assessment/benefit document. The following options for updating the risk management strategy describe possible amendments to the two elements of the current strategy, that is, the standard and the consumer advice.

(a): Two-tiered standard plus consumer advice for specified predatory (piscivorous) fish and for canned albacore tuna.

Under this strategy, all fish would be subject to either of two standards and there would be no exceptions. Retail fish in general would be subject to the 0.5 ppm total mercury standard. A discrete list of specified piscivorous fish, however, would be subject to a newly implemented 1.0 ppm total mercury standard. This discrete list of piscivorous fish would include shark, swordfish, and fresh/frozen tuna. Consideration could be given to expanding the discrete list of piscivorous (or predatory) fish based on certain criteria (discussed further in Section 3.3).

A consumer advisory would be issued for:

- those fish on the discrete list of fish subject to the 1.0 ppm standard, and
- those fish that are subject to the 0.5 ppm standard but that may be consumed in such high quantities that they become an appreciable source of methylmercury to the diet. Based on data currently available, only canned albacore (white) tuna fits this description (light tuna does not fit this description).

With a new standard of 1.0 ppm, the current consumption advisory for fish would be sufficiently protective. Therefore, the maximum recommended consumption limits for fish on the discrete

⁵ JECFA is a committee of scientific experts convened through a joint program of the World Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO).

⁶ The Tolerable Daily Intake (TDI) is the maximum amount of a chemical that can be ingested on a daily basis over a lifetime without increased risk of adverse health effects.

list of predatory fish (at this time, shark, swordfish, and fresh/frozen tuna) could remain as 1 meal per week for the general population and 1 meal per month for women of reproductive age and young children.⁷

Table 3.1 (a): Methylmercury exposure from consuming, to the recommended maximum limits (as described in the current consumer advisory), swordfish, shark, or tuna steak containing a maximum of 1.0 ppm total mercury. The provisional Tolerable Daily Intake (pTDI) for the general population is 0.47 µg/kg bw/day and for women of child-bearing age and young children, 0.20 µg/kg bw/day (see Section 2.0 of the health risk assessment/benefit document).

Group	Recommended Consumption Limit	Meal size (g)	Body weight (kg)	Methylmercury exposure (µg/kg bw/day)	% PTDI
Adults in general	4 meals / month	150	60	0.36	77
Women	1 meal / month	150	60	0.08	40
Children 5-11	1 meal / month	125	26.4	0.16	80
Children 1-4	1 meal / month	75	14.4	0.17	85

The advice for canned albacore tuna can be based on the results shown in Table 3.1 (b). The results shown in the first part of the table are based on average body weights from 1972 and on the assumption that 100% of the mercury in the canned tuna is present as methylmercury. The results shown in the second portion of the table are based on (1) more recent body weights from the Canadian Community Health Survey (cycle 2.2, 2004); and (2) on the assumption that 80% of the total mercury is present as methylmercury. The literature based on Canadian data reports that the percentage can range from 30 to 79% (Forsyth *et al.*, 2004). Based on the conclusion of the Health Risk Assessment, no advice is necessary for canned light tuna.

The latter calculations were carried out in the interest of determining whether the advice could be provided in terms of Food Guide Servings with no values less than one, thereby avoiding the use of fractions. One Food Guide Serving of fish is defined as 75 g. The results shown in the second portion of Table 3.1 (b) are based on the most up-to-date data reflecting the Canadian context i.e. latest body weights data, and latest estimates of percentage of methylmercury/mercury.

⁷ The recommended maximum frequency of consumption for both women of reproductive age and young children is the same for piscivorous fish because it is on a meal basis. Meal sizes for young children would be smaller than for adult women or teenage girls. Therefore, the potential exposure would in turn be smaller for young children. The advice for canned tuna is on a weight basis rather than meal basis so separate advice is provided for women and for children.

Table 3.1 (b): Recommended Maximum Weekly Intake (RMWI)⁸ of prepackaged albacore tuna, containing an average of 0.37 µg/g total mercury (assumed to be either 100% or 80% methylmercury), for various groups using either 1972 or 2004 average body weights. One 170 g can of tuna actually contains 120 g of meat (after draining). Prepackaged cooked tuna is also available in pouches, typically containing 85 g meat. A Food Guide Serving of fish is equal to 75 g.

<i>Calculations based on 1972 body weights and assumption of 100% methylmercury</i>				
Group	Body weight (kg)	RMWI		
		g per week	170-g cans per week	85-g pouches per week
General Adults	60	533.5	4.4	6.3
Women	60	227	1.9	2.7
Children 5 – 11	26.4	99.9	0.8	1.2
Children 1 – 4	14.4	54.5	0.5	0.6
<i>Calculations based on 2004 body weights and assumption of 80% methylmercury</i>				
Group	Body weight (kg)	RMWI		
		g per week	170-g cans per week	Food Guide Servings
General Adults	66.8	742.5	6.2	9.9
Women	66.8	315.9	2.6	4.2
Children 5 – 11	38.1	180.2	1.5	2.4
Children 1 – 4	15.8	74.7	0.6	1.0

As recommended by the Health Risk and Benefit Assessment, the advice should focus on children and women of reproductive age. The relatively high amounts of canned albacore tuna estimated for the general public and potentially leading to reaching one hundred (100) percent of the TDI for methylmercury, does not warrant a specific advice other than to continuously include fish (whether canned tuna or other species) within a balanced diet, according to the recommendations of Canada's Food Guide. Based on the information in the second section of Table 3.1 (b), the advice for children and women of reproductive age on consumption of canned albacore tuna, would be as follows: Women of reproductive age can consume up to 4 Servings per week, young children aged 5 – 11 can consume up to 2 Servings per week, and very young children aged 1 – 4 can eat up to 1 Food Guide Serving per week. As previously indicated, no advice is necessary for canned light tuna.

⁸ The Recommended Maximum Weekly Intake (RMWI) is the amount of a food (in this case albacore tuna) that would have to be consumed on a weekly basis in order to meet the pTDI, based on average methylmercury levels. The RMWI in general represents a maximum long-term consumption level of a food that would not result in adverse health effects. It is calculated, using appropriate units, as follows: [(pTDI × body weight) / mercury concentration].

The consumption advice should always be provided within the context of Health Canada's recommendations concerning a nutritionally balanced diet (Canada's Food Guide) and concerning the health benefits of fish consumption in general.

The possibility of export selection by other countries of the species currently exempted from the Canadian standard has not been explored as part of this particular review. Nevertheless, the removal of such exemptions would minimize the likelihood of this occurring.

(b): A single 0.5 ppm total mercury standard plus modified consumer advice for specified piscivorous fish that are exempted from the single standard and the addition of advice for canned albacore tuna.

Shark, swordfish, and fresh/frozen tuna would remain exempt from a standard. In the absence of a mechanism to limit total mercury levels in these fish at the retail level, the consumption advisory would need to be modified to provide more stringent advice since the current advisory is protective for fish containing up to 1.0 ppm total mercury. For the consumption of swordfish in particular, the recommended maximum limits for swordfish would have to be halved, based on an average concentration in swordfish of 1.82 ppm total mercury (see Appendix II of the health risk assessment/benefit document). The general public could consume up to 2 meals per month (instead of 1 per week), and women of reproductive age and children 12 years of age and under could consume up to one meal every two months (instead of one meal every month).

The current advice for shark and fresh/frozen tuna does not require modification. Consideration could, however, be given to applying the advice for swordfish to the other types of fish containing somewhat elevated mercury concentrations. This has the advantage of providing less complicated advice to the public but it has the disadvantage of being needlessly restrictive for these other types of fish which contain less mercury than swordfish.

Consideration could also be given to exempting additional piscivorous (predatory) fish and subjecting them to the advisory, based on certain criteria (discussed in Section 3.4).

Consumer advice would be provided for canned albacore (white) tuna (but is not necessary for light tuna), as described in Option (a).

(c): No standards and a reliance solely on consumer advisories for specified predatory fish and for canned albacore tuna.

This strategy puts more responsibility on the consumer for risk mitigation. Its success would rely on very aggressive strategies for consumer education.

3.2 Recommended Option

Strategy (a) as described in Section 3.1 is considered the most appropriate option. Under this strategy, there are no exemptions for any fish. A discrete list of piscivorous fish (shark, swordfish, and fresh/frozen tuna) is subject to the 1.0 ppm standard and is also subject to the advisory, which can retain the same advice with respect to frequency of consumption.

Consideration can be given to adding additional fish to the discrete list of piscivorous fish, based on specific criteria (see Section 3.3).

In comparison, strategy (b) allows for exemptions from a standard. It also requires advice specific to swordfish and separate advice for the remaining fish on the discrete list of piscivorous fish. In the interest of simplifying communications, the stringent advice for swordfish could also be applied to the other fish on the discrete list but this would result in overly restrictive advice in these cases.

Strategy (c) is considered the least favourable option since it places a great deal of responsibility on the consumer and requires a high degree of consumer awareness of not simply the issue in general but of the specific advice.

Strategy (a) is summarised in Table 3.2 (a).

Table 3.2 (a): Recommended option for an updated risk management strategy.

Fish	Standard for total mercury	Consumer advisory
Retail fish in general	0.5 ppm	none except in one case *
Prepackaged albacore tuna	0.5 ppm	yes
Certain piscivorous (predatory) fish (appearing on a discrete list)	1.0 ppm	yes

* Canned albacore tuna is the only type of fish that would be subject to both the 0.5 ppm total mercury standard and a consumer advisory. It is possible that other fish that appear to be slightly elevated, but still within the 0.5 ppm standard, are an important food for certain groups but in the absence of more detailed information on fish consumption, this possibility could not be further assessed.

The advice to consumers could note that if they do consume any of the fish in the consumption advisory to their recommended limits during a particular week or month, then they should only eat non-piscivorous, “low mercury” fish during that week or month that they ate the piscivorous fish. This allows continued benefit from fish consumption.

Alternative advice for those who plan to become pregnant or are pregnant could be to seek out

the low mercury / high **eicosapentaenoic acid** (EPA) - Docosahexaenoic acid (DHA) fish so that they can enjoy the health benefits of regular consumption of fish during their pregnancy.

The standard of 0.5 ppm total mercury which is applied to all other fish is still considered an appropriate and effective part of the risk management strategy for mercury.

3.3 Criteria for adding fish to the discrete list of fish that are subject to the 1.0 ppm standard and to the consumption advisory

It is proposed that shark, swordfish, and fresh/frozen tuna, currently exempt from any standard, be subject to a new standard, set at 1.0 ppm. These would also continue to be subject to the consumption advisory. These fish types tend to contain, on average, greater than 0.5 ppm total mercury. The current exemptions from the 0.5 ppm standard were originally *considered* for these fish because these species would be totally eliminated from the market place if the 0.5 ppm was to be applied. The exemptions were *applied* because it was determined that the availability of these fish were such that consumers who do consume them would likely do so only very occasionally. Hence, these fish would constitute a relatively small source of dietary exposure to mercury, relative to other, more regularly consumed fish.

If a regularly consumed fish were found at the pre-retail level to contain, on average, total mercury in excess of the 0.5 ppm standard, the following criteria would ensure that the more aggressive risk management approach were employed; that is, it would remain subject to the more restrictive 0.5 ppm standard.

Based on the rationale for granting the exemptions for shark, swordfish, and fresh/frozen tuna, it is suggested that the criteria described below as items (a) and (b) be met before accepting an addition to the discrete list of piscivorous fish that is subject to a 1.0 ppm standard and the advisory.

- (a) a relatively high percentage of samples of the fish in question exceed the 0.5 ppm standard such that a large portion of imported or domestically landed fish would not reach the retail level due to compliance activities;
- (b) the type of fish is one of the infrequently consumed varieties such that the average exposure to methylmercury from the variety in question would be small relative to other potential sources.

Note that these criteria would not necessarily be applicable when considering only whether to subject fish to a consumer advisory, as opposed to both an advisory and a 1.0 ppm standard. For example, based on the available data, it has been recommended that canned albacore (white) tuna, which does not meet the above criteria, be the subject of a consumer advisory.

With respect to (a), this criterion can be assessed based on Canadian Food Inspection Agency data which is pre-compliance, meaning that it represents total mercury levels found in fish at the

premises of the importers or the fish processing plant before it reaches the retail level. As such, it can be used as an indicator of the potential impact on fish availability if a particular standard is applied.

3.4 Consideration of fish for addition to the discrete list of fish subject to a new 1.0 ppm total mercury standard

Fish that were found, in at least one survey, to contain an average of approximately 0.5 ppm or greater total mercury were considered against the two criteria for addition to the list. The rationale for adding, or not adding, each type of fish to the discrete list is provided in the following sections.

3.4.1 *Barracuda*

The Canadian Food Inspection Agency's (CFIA) "List of Canadian Acceptable Common Names for Fish and Seafood" notes that species of genus *Sphyraena* may be sold under the common name "barracuda" (French *bécune*) in Canada. All barracuda available in Canada is imported.

Mercury levels in barracuda species have been analysed in other countries. Barracuda (*Sphyraena* species) from the Fiji Islands were reported to contain an average of 0.26 µg/g total mercury ($N=4$, range 0.18 - 0.38 µg/g) (Kumar 2004). A study conducted in the Seychelles found that Pickhandle Barracuda (*Sphyraena jello*) contained mean total mercury levels of 0.360 µg/g (Robinson 2004). Also, a concentration of 0.39 µg/g total mercury was found in the barracuda *Sphyraena guachancho*.

Samples of barracuda analysed by the CFIA between 1994 and 2004 demonstrate a strong correlation between the source of the barracuda and total mercury levels. A total of eight samples from Oman, Portugal, and New Zealand contained an average of 0.08 ppm total mercury (ranging from 0.02 to 0.18 ppm). Eight samples imported from the U.S. contained an average pre-retail level of 1.0 ppm total mercury (ranging from 0.58 to 1.52 ppm). None of these samples were compliant with the 0.5 ppm standard. The two samples shown in Appendix II of the health risk/benefit document contained an average of 0.77 ppm total mercury.

Data on mercury levels in samples of barracuda from other countries that export barracuda to Canada are not available. For example, import notifications to the CFIA were made in the period 2000 to 2005 for barracuda from Hong Kong, India, Japan, New Zealand, Pakistan, Portugal, Surinam, Thailand, Trinidad and Tobago, and the United States. In each year, only one or two countries accounted for the majority of barracuda imports to Canada. The United States was not one of the major exporter, although the CFIA noted that import weights from the U.S. may actually be higher than what was actually reported by importers.

The limited data on barracuda from the various countries would suggest that barracuda does not meet criterion (a). It is possible that a large proportion of barracuda available in Canada is well below the 0.5 ppm standard. Additional data would be useful for verification.

There is no information available suggesting that barracuda is an important part of the diet of any segment of the Canadian population (criterion b).

3.4.2 *Escolar / Snake Mackerel*

The CFIA's Fish List indicates that fish of the family **Gempylidae** (snake mackerels) may go by the common name escolar or snake mackerel (French escolier). *Lepidocybium flavobrunneum* in particular has the same English common names but the French common name is escolier noire. *Ruvettus pretiosus* may have the common names escolar, snake mackerel, or oilfish (French escolier or rouvet). Escolar is imported to Canada.

For the results shown in Appendix III of the health risk assessment/benefit document, 20 and 16 samples of escolar were analysed in 2002/03 and 2003/04, respectively. Thirty-five percent and 38% of the samples exceeded the 0.5 ppm standard and 5% and 6%, respectively, exceeded 1.0 ppm total mercury. The range of mercury concentrations was very wide.

As for barracuda, there are no data indicating that escolar is an important part of the diet of any segment of the Canadian population. A British Columbia Ministry of Environment publication reports that the flesh and bones of escolar (*L. flavobrunneum* and *R. pretiosus*) contain a strong purgative oil called gempylotoxin. This oil causes the rapid development of diarrhea, but without pain or cramping (B.C. Ministry of Environment, 2001). This may explain the observation that in the case of restaurants noted to serve escolar, the fish was always grilled.

Escolar appears to meet both criterion (a) and (b) in Section 3.3 for addition to the discrete list of fish that are subject to a new 1.0 ppm standard and to the consumer advisory for piscivorous fish.

3.4.3 *Grouper*

The CFIA Fish List indicates that several different species of the family **Serranidae** (Sea Basses and Grouper) may be presented as "grouper": *Epinephelus adscensionis* or rock hind; *Epinephelus guttatus* or red hind; *Epinephelus itajara* synonym *Promicrops itajara* or jewfish or giant grouper.

According to CFIA data, pre-retail grouper levels were variable, ranging from 0.02 to 1.12 ppm. In each of the two fiscal years that these results cover (mean total mercury concentrations of 0.20 ppm and 0.45 ppm respectively), 31% and 14%, respectively, of the samples exceeded the 0.5 ppm standard and 13% and 0%, respectively, exceeded 1.0 ppm total mercury.

The United States Food and Drug Administration (U.S. FDA) found an average of 0.467 ppm total mercury (0.053 - 1.205 ppm) in 41 samples of grouper (mainly red grouper of the genus *Epinephelus* and black grouper of the genus *Mycteroperca*). Of the 41 samples, 27% were above 0.5 ppm.

The results of the two years of CFIA data, in terms of percentages of pre-retail samples that exceeded 0.5 ppm total mercury, are not consistent so it is difficult to assess whether grouper meets criterion (a). There is insufficient Canadian data to allow criterion (b) to be evaluated. However, grouper is described as a popular fish in various areas of the world including the Caribbean and the West Indies (the Nassau grouper or *Epinephelus striatus* in particular), Kuwait, Indonesia, Japan, China, and Mexico (Florida Museum of Natural History, undated; Shakeel, 1996.)

Although grouper is not considered a widely popular fish in Canada, in consideration of its possible popularity in certain diets, it is recommended that it remain subject to the more stringent 0.5 ppm standard.

3.4.4 Marlin

For marlin (included in the CFIA Fish List as blue marlin, *Makaira nigricans*, family **Istiophoridae**, French makaire bleu), 31% and 45% of the samples in each survey year respectively exceeded 0.5 ppm total mercury. Fifty percent exceeded this level in the study conducted by Dabeka et al. 2004. It does not appear that there is a commercial fishery for marlin in Canada.

Based on U.S. FDA data (1990-02 survey), 16 samples of marlin contained a mean of 0.49 ppm total mercury (median = 0.39, range = 0.10 to 0.92 ppm). Forty-four percent of the samples contained greater than 0.5 ppm mercury.

There is no information suggesting that marlin is an important part of the diet of any segment of the Canadian population. Because both criterion (a) and (b) have been met for marlin, it is suggested that it be subject to a new 1.0 ppm standard and that it be subject to the consumer advisory.

3.4.5 Orange Roughy / Slimehead

The species *Leiogaster atlanticus* (synonym *Hoplostethus atlanticus*), of the family **Trachichthyidae**, may be sold in Canada under the common name orange roughy or slimehead (French hoplostète orange or hoplostète rouge). Its distribution includes the western Atlantic Ocean but no information on the possible existence of a commercial fishery in Canada was located.

The CFIA analysed a total of 15 samples of orange roughy in the periods 1998 to 2001 and 2005 to 2006. In each period, 29% of samples exceeded the 0.5 ppm standard. The mean concentrations were 0.47 ppm (range 0.30 to 0.67 ppm) and 0.40 ppm (range 0.22 to 0.72 ppm), respectively. These results are fairly consistent with results generated by the U.S. FDA. The mean concentration in 43 samples of orange roughy analysed between 2002 and 2004 was 0.55

ppm total mercury (median 0.56 ppm, range 0.30 - 0.86 ppm). Of these 43 samples, 61% contained total mercury at levels higher than 0.5 ppm (U.S. FDA, 2004b).

Based on the above data and in the absence of any evidence suggesting that orange roughy is an important part of the diet of any segment of the Canadian population, it is suggested that orange roughy be subjected to a 1.0 ppm standard.

3.4.6 Sablefish / Black Cod

The CFIA Fish List indicates that *Anoplopoma fimbria* of the family **Anoplomatidae** may be sold under the common names, sablefish or black cod (French morue charbonnière). There is a sablefish fishery on the west coast of Canada.

A high percentage of samples (83%) gathered in 2002-2003 contained greater than 0.5 ppm total mercury. In 2003-2004, only 11% of samples exceeded the standard and the mean concentration of total mercury was 0.20 ppm, as opposed 0.71 ppm in the previous year. The lower concentration is consistent with the level found at the CFIA's Burnaby lab in 2002 (see Appendix II of the health risk assessment/benefit document) and by the U.S. FDA (2004).

This decrease in percentage of samples exceeding the standard was the result of targeted risk management actions by the CFIA and the Department of Fisheries and Oceans after it was discovered that sablefish from a specific fishing zone off the coast of British Columbia contained elevated mercury concentrations relative to sablefish from other zones.

As the cause of the unusually high mercury results in sablefish has already been addressed by other risk management strategies implemented by other federal agencies, and as it is expected that the mean total mercury concentrations in sablefish will be approximately 0.2 to 0.3 ppm, it is recommended that it continue to be subject to the 0.5 ppm standard.

3.4.7 Sea Bass

“Sea bass” is identified in the CFIA Fish List as *Dicentrarchus labrax* (French bar commun). This species, also known as European sea bass in other jurisdictions, is found in the eastern North Atlantic Ocean and the Mediterranean and Black Seas (FAO, 2005).

The “sea bass” samples that were analysed by the CFIA originated in various countries, many of which are outside the reported range of *D. labrax*, including Argentina, Chile, Costa Rica,

France, Hong Kong, Korea, Japan, New Zealand, South Africa, Spain, Tunisia, United States and Uruguay. Therefore, the “sea bass” samples were probably a mixture of species, possibly including European sea bass, black sea bass, and Patagonian toothfish.

“Black sea bass” (*Centropristes striatus*) ranges from southern Nova Scotia and the Bay of Fundy to southern Florida (U.S. Department of Commerce, 1999).

The “Patagonian toothfish” (*Dissostichus eleginoides*) is sometimes referred to as “Chilean sea bass”, although this is not included as an acceptable common name in the CFIA’s Fish List. The Patagonian toothfish’s distribution includes the Indian Ocean and South Atlantic portions of the Southern Ocean⁹, the waters south of New Zealand, Chile, and Argentina (FAO, 2005).

Reference has been found on the internet to Japanese sea bass (*Lateolabrax japonicus*) and Asian sea bass (*Lates calcarifer*) (Yeh *et al.*, undated). The Bureau of Chemical Safety (BCS) does not have information on whether these are being imported to Canada and being sold as “sea bass.”

In each of the three years for which data was provided (see Appendix III of the health risk assessment/benefit document), 58%, 20%, and 7% respectively contained total mercury at levels in excess of 0.5 ppm. The average concentration in each of these years was 0.57 ppm, 0.35 ppm and 0.31 ppm, respectively.

Consultation with the CFIA will be necessary to determine if these results represent a true decrease in the percentage of non-compliant fish entering Canada. With respect to criterion (b), the import data from DFO (see Section 4.1 of the health risk assessment/benefit document) would seem to suggest that “sea bass” is a more popular fish than, for example, marlin. Information found on the internet suggests that sea bass may be a popular fish among certain segments of the Canadian population¹⁰. Because the available information suggests sea bass may not meet criterion (b), it is suggested that at this time, sea bass remain subject to the more stringent 0.5 ppm standard.

3.4.8 *Shark*

There are a variety of different shark species that may be sold as “shark” in Canada. According to the CFIA Fish List, three members of the family **Squalidae** may be presented as shark or dogfish. Acceptable common names for *Centroscyllium fabricii* are shark, dogfish, and black

dogfish (French “aiguillat noir” and “requin”). *Squalus acanthias* may be presented as spiny dogfish, dogfish, shark, greyfish, or northern shark (French aiguillat commun, aiguillat, requin épineux, or requin). And *Squalus blainvillei*’s acceptable common names are dogfish and shark (French aiguillat galludo and requin).

Isurus oxyrinchus (family **Lamnidae**) may be sold as shark, shortfin mako shark, mackerel shark, or mako (French “requin-taupe bleu” or requin).

⁹ The Southern Ocean was delimited by the International Hydrographic Organization in 2002 (IHO, 2004).

¹⁰ Sea bass is described as a popular fish in various Asian countries. It is therefore assumed it may also be popular among Canadians who are also members of the Asian community (Lim, Undated; AAFC, 2003 and 2003a).

Acceptable common names for *Lamna nanus* include shark and porbeagle (French “requin-taupe commun” and “taupe commun”).¹¹

The blue shark, *Prionace glauca* (family **Carcharhinidae**), may also be presented as great blue shark, blue dog, blue pointer shark, blue pointer, and shark (French “requin bleu”, “peau bleue” and requin).

There are Canadian domestic fisheries for many of these sharks. Species of commercial interest include the porbeagle (*L. nasus*), blue (*P. glauca*), shortfin mako (*I. oxyrinchu*), and spiny dogfish (*S. acanthias*). (DFO, 2005c and 2005d)

In general, the data suggests that more than 50% of shark samples (including dogfish) contain greater than 0.5 ppm total mercury. Between 10% and 67% of samples contained greater than 1.0 ppm total mercury. The available information provides no indication that shark is a type of fish that is regularly consumed. Shark is not currently subject to a mercury standard. As both criteria (a) and (b) have been met, it is recommended that shark be subject to a new standard of 1.0 ppm total mercury and that it continue to be the subject of a consumer advisory for piscivorous fish.

3.4.9 *Swordfish*

Swordfish (French “espadon”, *Xiphias gladius*, family **Xiphiidae**), for which there is a domestic fishery (DFO, 2005e), tended to contain more total mercury than the other types of fish analysed. A large percentage (90 to 100%) of samples exceeded 0.5 ppm total mercury and between 30 and 80% of samples contained greater than 1.0 ppm total mercury. The available information provides no indication that swordfish is a type of fish that is regularly consumed. It is recommended that swordfish be subject to the proposed 1.0 ppm standard and that it continue to be subject to the consumer advisory for piscivorous fish.

3.4.10 *Tuna, Fresh and Frozen*

Fresh and frozen tuna are being considered against the two criteria described in Section 3.3 to determine if it should be retained on the list of piscivorous fish that would be subject to a new 1.0 ppm standard. Prepackaged tuna (canned and vacuum-sealed in pouches) will be covered in a separate section since these types of tuna do not contain high enough mercury levels for consideration against the two criteria for piscivorous fish.

¹¹ The CFIA Fish List identifies the porbeagle shark (*Lamna nasus*) as “portbeagle” (*Lama nasus*). In most other references, it is spelled “porbeagle.”

There are a number of different species of fish that go by the common name tuna. Different species of tuna will tend to be directed to different markets depending on the quality of their meat. For example, the quality of bluefin tuna leads to its preferred use raw in Japanese cuisine (sashimi and sushi). Other species may be available as fresh or frozen tuna steaks as well as pre-cooked in packages (cans or pouches).

Species that are available fresh and/or frozen include:

- bluefin tuna, *Thunnus thynnus*, which is among the largest species of tuna.¹² According to the CFIA's Fish List, other acceptable common names are northern bluefin tuna, Atlantic bluefin tuna, and simply tuna (French thon rouge, thon rough de l'atlantique, thon rouge du nord, and thon);
- yellowfin tuna, *Thunnus albacares* synonym *Neothunnus macropterus* (French common name albacore);
- bigeye tuna (*Thunnus obesus* synonym *Parathunnus mebachi*) (French common names thon obèse or thon). Although the U.S. Tuna Foundation notes that bigeye tuna is often used in canned tuna, the CFIA Burnaby laboratory results (2002b) include fresh/frozen bigeye tuna samples;
- skipjack (*Euthynnus pelamis* synonym *Katsuwonus pelamis*);
- albacore tuna (*Thunnus alalunga*, synonym *Thunnus germo*) (French common names germon or thon).

It is important to note that the word "Albacore" is used in the French language to refer to yellowfin tuna.

At the time of last editing this document, the CFIA had generated a special report to clearly identify which of its yellowfin tuna samples and "unspecified species" of tuna were canned and which were fresh/frozen. A report had not yet been generated for the remaining species of tuna analysed by the CFIA between 2002 and 2004.

For those tuna samples identified as fresh or frozen (Appendix III of the Health Risk and Benefit Assessment document), the percentage of samples exceeding the 0.5 ppm standard ranged from 0

to 67% depending on the species. The percentage exceeding a concentration of 1.0 ppm total mercury ranged from 0 to 46%, again depending on the species. It is recommended that fresh/frozen tuna be subject to a new 1.0 ppm total mercury standard and therefore be the continued subject of a consumer advisory for piscivorous fish.

With respect to the use of the terms "fresh and frozen tuna", this is a generic description that pertains to those species of tuna that tend to contain higher levels of mercury. Also, it could pertain to fresh/frozen tuna that may not necessarily require an advisory. For example, fresh

¹² It appears that although smaller bluefin tuna were once canned, the commercial fishery now focuses on catching large bluefin tuna for the sushi and sashimi market.

yellowfin and albacore tuna tended to contain levels below 0.5 ppm. However, bigeye tuna tended to contain higher levels. This is consistent with data generated by the U.S. FDA in the 1990's that suggests that the skipjack that is directed to the fresh/frozen market contains slightly less mercury than yellowfin and albacore, which in turn, contain less than bigeye (see Table 3.4 (a)). The U.S. FDA results for yellowfin tuna are consistent with CFIA results (see Appendix II of the health risk assessment/benefit document).

While the generic phrase “fresh and frozen tuna” may be too broad, from a communication/risk management viewpoint, “fresh and frozen tuna” is the least complicated means of communicating the advisory. Furthermore, fresh/frozen tuna is often labelled only as “tuna” at retail markets, providing no means for the consumer to determine the species.

Table 3.4 (a): Mercury concentrations in samples of fresh or frozen tuna, as determined by the U.S. FDA between 1992 and 2004 (U.S. FDA, 2004b).

Species	N	Total Mercury Concentration (ppm)				%N > 0.5 ppm	%N > 1.0 ppm
		avg	median	Min	max		
Skipjack	2	0.21	0.21	0.15	0.26	0	0
Yellowfin	68	0.34	0.29	0.05	1.08	19	3
Albacore	25	0.37	0.36	0.04	0.82	12	0
Bigeye	13	0.64	0.56	0.41	1.04	77	8

Notes: * For a number of the samples, methylmercury was specifically analysed rather than total mercury. For this report, the results are reported as though they are all total mercury.
 * Three samples containing “0” ppm total mercury were not included in the above statistics.
 * ND = the analyte was not detected.

3.4.11 Walleye / Yellow Pickerel

The CFIA Fish List indicates that the species *Stizostedion vitreum* may go by the common names walleye, pickerel, walleye pike, and yellow pickerel (French doré jaune). European pike perch (zander)

The average concentration of total mercury in pre-retail walleye samples was close to but did not exceed 0.5 ppm. Results for samples of walleye, which were largely domestic in origin, indicate that roughly a third of the walleye samples taken from the processing plants were above the 0.5

ppm standard (34% and 20% respectively in each of 2002/03 and 2003/04).

Although walleye may meet criterion (a), there is no information to assess criterion (b). It is therefore recommended that it remain subject to the more stringent 0.5 ppm standard.

3.5 The recommended list of piscivorous fish

Based on the above consideration, it is proposed that **shark, swordfish, and fresh/frozen tuna** (exempt from the standard currently in force) and **escolar, marlin, and orange roughy** (subject to the 0.5 ppm standard under the current strategy) comprise a “positive” discrete list of piscivorous fish that should be subject to a new 1.0 ppm total mercury standard. These fish would also be subject to the consumer advisory for piscivorous (predatory) fish.

3.6 Consideration of fish that are subject to the 0.5 ppm standard but that may still require a consumer advisory

It is possible that certain fish that are subject to the 0.5 ppm standard may be consumed in such high quantities that they become an appreciable source of methylmercury to the diet. At this time, only canned albacore (white) tuna has been identified as a fish product that fits this description.

As described in Section 3.4, neither sea bass, grouper, nor walleye were found to meet the criteria for addition to the list of fish subject to a new 1.0 ppm standard. Their total mercury concentrations, on average, appear to be less than 0.5 ppm and are close to those found in canned albacore tuna. In the event that information is found suggesting that certain diets frequently include sea bass, grouper, or walleye then consideration could be given to providing advisories for these fish as well.

3.6.1 *Prepackaged Tuna (Canned or Vacuum-Sealed in Pouches)*

Although prepackaged, pre-cooked tuna is generally described as “canned tuna”, tuna is available prepackaged in cans or vacuum-sealed pouches. Various species of tuna are prepackaged. How they are labelled is governed by the *Fish Inspection Regulations*, which are administered by the

CFIA. These Regulations stipulate that only albacore tuna (species *Thunnus alalunga*, synonym *Thunnus germo*) may be labelled as “white” tuna. The regulatory restrictions with respect to what may be presented as “light” tuna are based not on species but on the tuna meat’s “diffuse luminous reflectance.” Hence, a variety of tuna species are packaged as light tuna including yellowfin¹³ (*Neothunnus macropterus* synonym *Thunnus albacares*), skipjack (*Euthynnus*

¹³ The CFIA website indicate that ALBACORE in French is used for the species *Neothunnus macropterus* and *Thunnus albacares* which in English is the YELLOWFIN TUNA whereas ALBACORE in English is used for the species *Thunnus alalunga* and *Thunnus germo* which are called GERMON in French.

pelamis synonym *Katsuwonus pelamis*), tongol (*Thunnus tongol* synonym *Neothunnus rarus*), bigeye (*Thunnus obesus* synonym *Parathunnus mebachi*), and bonito (*Sarda sarda* or Atlantic bonito and possibly *Sarda chiliensis* synonym *Sarda lineolata* or Pacific bonito).

One regional municipal authority referred to canned bluefin tuna (Region of Waterloo Public Health, 2005). The Bureau of Chemical Safety does not have information to confirm whether pre-cooked bluefin (e.g. canned) is available in Canada.

One sample of canned tongol tuna¹⁴ containing 0.02 ppm total mercury was analysed by the CFIA in fiscal year 2002-2003. Levels between 0.05 and 0.18 ppm total mercury were found in 7 samples of canned tongol tuna by the U.S. FDA in 2003 (U.S. FDA, 2004b).

Bigeye tuna is noted by the U.S. Tuna Foundation to be often used in canned tuna; however, the CFIA data suggests that bigeye is available fresh or frozen only and is not available canned. With respect to the finding that canned tuna generally contains less total mercury than fresh/frozen tuna, the reason often cited is that canned tuna contains species of tuna that are younger or smaller than those sold fresh or frozen. However, yellowfin is reported to be larger than albacore, yet it contains less mercury than albacore. Future communications could incorporate a subtle change in wording by noting that the reason is linked not only to species but also to the size of fish directed toward canning (larger fish tend to be directed toward fresh/frozen markets) (U.S. Tuna Foundation, 2005; Bumble Bee Seafoods, 2003; Atuna, 2004).

As an aside, the Canadian *Food and Drug Regulations* (Department of Justice, 2005) permit the use of the food additive calcium ethylenediamine tetraacetate (EDTA) as a sequestering agent in canned tuna. EDTA is known to bind to certain metals such as lead, iron, and zinc. Scientists in the Bureau of Chemical Safety are not aware, however, of any reports that EDTA effectively binds to mercury and consider that the mercury would remain strongly bound to the proteins in the fish tissue in the presence of EDTA.

4.0 CURRENT REGULATORY OVERSIGHT

The *Food and Drugs Act and Regulations* (Department of Justice, 2005) provide the regulatory oversight for food safety, as well as drug and natural health product approvals and cosmetic safety, in Canada. With respect to food in particular, the *Act* prohibits the manufacture and sale of all dangerous or adulterated food products and the *Regulations* are designed to ensure the safety and nutritional quality of foods sold in Canada.

Fish are subject to Division 21 (Marine and Fresh Water Animal Products) of the *Food and Drug*

¹⁴ According to information on the internet, in the United States, canned tongol tuna is labelled as such and in Europe, it is sometimes labelled "white tuna." In Australia, tongol is permitted to be labelled as Northern Bluefin Tuna. It is described as a smaller species of tuna (average weight 15-20 kg) with a life expectancy thought to be about five years.

Regulations. While mercury in fish is not specifically addressed in the Regulations, Health Canada's authority for conducting human health risk assessment activities related to mercury in fish is derived from the Section 4 of the *Act*. Any necessary risk management activities arising from such assessments may be carried out by either Health Canada or the Canadian Food Inspection Agency, or both, depending on the situation.

The *Fish Inspection Regulations* are relevant to the discussion of prepackaged tuna in particular.

The administration and enforcement of these Regulations are the responsibility of the Canadian Food Inspection Agency (CFIA). The Regulations provide the authority for the Fish Products

Standards and Methods Manual, which contains the "Canned Tuna Standard" (Department of Justice, 2004; CFIA, 2002c).

The Standard stipulates that only albacore tuna (species *Thunnus alalunga*, synonym *Thunnus germon*) may be labelled as "white" tuna. Unlike white tuna, "light" tuna is defined not by the species of tuna but by the "diffuse luminous reflectance" of the tuna meat.

5.0 RISK MANAGEMENT OF MERCURY IN FISH - OTHER GROUPS AND JURISDICTIONS

5.1 Australia and New Zealand

The *Australia New Zealand Food Standards Code* prescribes two separate maximum levels for mercury in seafood offered for commercial sale: 1.0 mg mercury/kg¹⁵ for the fish that are known to contain high levels of mercury (such as swordfish, southern bluefin tuna, barramundi, ling, orange roughy, rays and shark) and 0.5 mg/kg for all other species of fish, as well as crustacea and molluscs (FSANZ, Undated).

Food Standards Australia New Zealand (FSANZ, 2004) issued an updated advisory specifically for the Australia population in order to "provide not just advice for pregnant women, and women considering pregnancy, but also for young children and the general population."

FSANZ determined that it is safe for all population groups to eat 2 to 3 "serves" per week of most types of fish. A serve is defined as 150 g (or "two frozen crumbed fish portions") and for children up to 6 years, a serve is 75 g.

FSANZ advises that pregnant women, women planning pregnancy and young children "continue to consume a variety of fish as part of a healthy diet but limit their intake of shark (flake),

¹⁵ The concentration units "mg/kg" are equivalent to "µg/g" and to parts per million (ppm).

broadbill, marlin and swordfish to no more than one serve per fortnight with no other fish to be consumed during that fortnight” (two weeks). The general population can consume 1 serve per week of these fish. For orange roughy (also sold as sea perch in Australia and New Zealand) and

catfish, the advice for pregnant women, women planning pregnancy and young children is to consume no more than one serve per week, with no other fish being consumed during that week.

Information is also provided on the nutritional benefits of fish consumption and on the effects in babies exposed to high levels of mercury in the womb. It is also explained that while very little mercury from fish is transferred to breast milk, breastfeeding mothers may still wish to follow the advice for pregnant women.

5.2 Canada

5.2.1 Health Canada

As described previously, the risk management strategy at the time of preparing this document comprised a standard of 0.5 ppm total mercury in retail fish (with exemptions for shark, swordfish, and fresh/frozen tuna but not canned) and a consumption advisory. The consumption advisory was first posted on Health Canada’s website on May 29, 2001. A revised version was posted on May 29, 2002.

The advisory recommends that Canadians “limit consumption of shark, swordfish and fresh and frozen tuna, to one meal per week. Pregnant women, women of child-bearing age and young children should eat no more than one meal per month.” The advisory does not apply to canned tuna (Health Canada, 2002).

With respect to the history of the consumer advisory in Canada, the first official advisory was issued by the then federal Department of Fisheries and Environment (DFE) in 1979, the year that swordfish was exempted from the Canadian standard of 0.5 ppm total mercury in retail fish tissue. Communication of the advisory was coordinated by DFE as a condition of Health and Welfare Canada agreeing to the exemption. The news release contained advice to limit

consumption of swordfish to one meal per week. This advice was the same for “young children, women of child-bearing age and individuals on special diets.” The recommendation to “follow the advice of Canada’s Food Guide, and eat several meals of fish per week” was also included.

In 1990, shark was also exempted from the mercury standard. A document dated December 3, 1997, and entitled “Communications Plan - Mercury levels in swordfish, shark and tuna”, states that it is not known whether an announcement similar to that made in 1979 was issued for shark in 1990.

In 1997, the exemption of fresh/frozen tuna was accompanied by the release of an information bulletin and direct communication with media and other government organisations. The

previous advice to limit consumption of exempted species to one meal per week was provided but additional advice to limit consumption of exempted species to one meal per month was also included for women of child bearing age and children. This latter advice was provided in response to a re-evaluation of neurodevelopmental effects of methylmercury to the developing fetus and young children.

5.2.2 Municipal Health Authorities

Several municipal health authorities in Ontario have issued consumer advisories relating to mercury and fish. The Region of Waterloo Public Health office issued, in March 2005, its own advice to women who could become pregnant, women who are pregnant, nursing mothers, and young children, with respect to the consumption of retail fish. Their advice, which is very similar to that given by the Wellington-Dufferin-Guelph Health Unit, organises fish into three groups: fish to “enjoy often”; fish to eat “no more than once per month”, and fish “to avoid” (Region of Waterloo Public Health, 2005).

The list of “low in mercury” fish to “enjoy often” includes light canned tuna, canned salmon, cod, crab, halibut, Atlantic mackerel, shrimp, etc.¹⁶ The recommendation is to consume “white” or “albacore” or “bluefin” canned tuna “no more than once per month.” Women who might become pregnant, who are pregnant or nursing, and young children are further recommended to

similarly limit consumption of “bluefin”¹⁷ canned tuna, bluefish¹⁸, grouper, lobster, and orange roughy.

¹⁶ “Bass” (type not specified) was also included, but unlike the other fish in the “enjoy often” list, “sea bass” was found at the importer level (not the retail level) to occasionally exceed the 0.5 ppm standard (CFIA, 2002/03 and 2003/04). On average, it is within the standard (mean 0.31 ppm, max 0.87 ppm total mercury). Relatively low amounts of total mercury were found in the few samples of white bass, striped bass, and rock bass (0.19, 0.06, and 0.03 ppm respectively).

¹⁷ Health Canada is not aware of bluefin being available in a can. The CFIA analysed two samples of Southern Bluefin Tuna (*Thunnus maccoyii*), both of which were frozen samples and which contained mercury at levels comparable to albacore tuna (0.21 and 0.35 ppm total mercury).

¹⁸ With respect to bluefish, the CFIA’s Fish List indicates that this is *Pomatomus saltatrix*, which is distinctive from “Boston Bluefish” or pollock (*Pollachius virens*), which is very low in mercury and is listed in the advisory’s unrestricted list of species that may be eaten often. Health Canada has not seen Canadian data for bluefish. However, it is noted that the U.S. FDA analysed 52 samples of “bluefish” and found 0.34 ppm total mercury (0.14 - 0.63 ppm total mercury).

It is not clear why lobster was included in this list of restricted fish. There are U.S. data from a 1978 report indicating that lobster contained on average 0.31 ppm total mercury (U.S. FDA, 2004). However, more recent CFIA data shows lobster to be very low in mercury ($N=91$, average 0.08 ppm, range non-detected to 0.26 ppm). These results are consistent with U.S. FDA data from 1991 to 2004 for lobster and spiny lobster ($N=25$, average = 0.14 ppm methylmercury or total mercury, median = 0.15 ppm, range = non-detected to 0.31 ppm).

Finally, women who might become pregnant, who are pregnant or nursing, and young children are recommended to avoid fresh or frozen tuna steaks, swordfish, shark, marlin, tilefish, muskelunge (a freshwater fish), and walleye (a freshwater fish).

With respect to tilefish, the CFIA found a concentration of 0.08 ppm total mercury in one sample of tilefish imported from the United States. The CFIA Fish List includes a variety of species whose acceptable name is “tilefish.” Of the 31 samples of “Atlantic tilefish” analysed by the U.S. FDA between 2002 and 2004, two samples (6%) contained more than 0.5 ppm total mercury. The mean was 0.15 ppm (median 0.10 ppm, range 0.04 to 0.53 ppm) (U.S. FDA, 2004b). Tilefish from the Gulf of Mexico was reported in a 1978 document to contain a mean of 1.45 ppm total mercury (U.S. FDA, 2004). However, fish from this source would not be compliant with the Canadian standard of 0.5 ppm total mercury. The result for the one sample of tilefish analysed by the CFIA would suggest that this sample, at least, is not from the Gulf of Mexico. It

was not confirmed whether tilefish was included in the list of “fish to avoid” based on the Gulf of Mexico data.

With respect to muskelunge or muskie (*Esox masquinongyis*), Health Canada has not reviewed any data on this type of fish. Data was not located in the U.S. FDA database. Muskelunge is a freshwater fish that is monitored as a sport fish in Ontario.

5.2.3 Provincial Authorities - Sport Fish

Sport fisheries are handled separately from commercial fisheries. The provinces and territories are responsible for sport fish and may issue consumer advisories at their own discretion. These advisories are generally species specific and water body (lake or river) specific. Environment Canada has consolidated links to fish consumption advisories (both commercial and sport) on one webpage entitled “Mercury and the Environment: Fish Consumption” (EC, 2004).

There are certain situations where federal authorities may issue sport fish consumption advisories. The federal Department of Fisheries and Oceans (DFO) is responsible for recreational fishing in inland waters that have been created or altered by a project that would

have obtained a Fisheries Act Authorization¹⁹ from DFO (the fishing quotas are still set by the province/territory). Such advice in the past has been issued by DFO based on a health risk assessment by Health Canada.

Parks Canada may also issue advisories for sport fishing within federal park boundaries. An advisory was recently issued, based on a health risk assessment conducted by Health Canada, for lakes in Jasper and Banff National Parks.

5.3 Codex Alimentarius Commission

The Codex Alimentarius Commission (CAC), an international organization of which Health Canada is an active member, establishes guidelines and standards for foods that are non-binding on member states but that are considered by the World Trade Organization in any trade disputes between countries.

The CAC has a standard for methylmercury in fish of 1 mg/kg in large predatory fish and 0.5 mg/kg in all other fish (CAC, 2005). For screening purposes, total mercury rather than methylmercury may be determined. For verification purposes, methylmercury should be determined.

The types of fish that can be considered to be “large predatory fish” have not been defined by the CAC. A draft list of fish that would be subject to the 1.0 mg/kg standard was prepared for consideration at the 37th session of the Codex Committee on Food Additives and Contaminants. The draft list was not accepted in view of the additional work required on methylmercury exposure. The draft list comprised the following (the names in brackets are the common names in Canada if different from those used in the EU): alfonsino (red bream), anglerfish

(monkfish/stargazer), Atlantic catfish (wolfish), barracuda, barramundi (barramundi perch), bonito, dogfish, eel, emperor/orange roughy/rosy soldierfish, grenadier, grouper (rock hind or red hind or jewfish), halibut, ling or *Molva* species (which are members of the family **Gadidae** or cod and haddocks), king mackerel (kingfish/Spanish mackerel), marlin, megrim (a type of flatfish in the family **Scophthalmidae** or turbot), mullet or *Mullus* species, pike (northern pike/jackfish), plain bonito or *Oorcynopsis unicolor*, poor cod, Portuguese dogfish, rays, redfish, sail fish, scabbard fish, seabream/pandora (axillary bream), shark (all species), snake mackerel/butterfish/escolar, sturgeon, swordfish/broadbill, tilefish (one of the tilefish species, *Caulolatilus princeps*, is also known as ocean whitefish in Canada), and tuna.

5.4 European Community

¹⁹ A Fisheries Act Authorization (FAA) must be sought by a “project” (e.g. hydroelectric dam) proponent when the project is likely to result in harmful alteration, disruption, or destruction of fish habitat. If the FAA is issued, environmental effects monitoring, etc. are initiated. For example, reservoirs associated with hydroelectric projects are monitored by DFO.

EC Regulation 466/2001, amended by EC regulation 221/2002 sets a limit of 0.5 mg/kg wet weight for mercury in fish and a higher limit of 1.0 mg/kg for a specified list of species of fish that “naturally accumulate mercury” (Commission of the European Communities, 2001 and 2002).

The following fish are subject to the limit of 1.0 mg/kg (the names in brackets are the common names in Canada if it differs from those used in the EU): anglerfish (monkfish/stargazer), Atlantic catfish (wolfish), bass (sea bass), blue ling/*Molva dipterygia* (a member of the family **Gadidae** so a type of codfish), bonito (bonito tuna), eel, emperor or orange roughy, grenadier, halibut, marlin, pike, plain bonito (*Oorcynopsis unicolor*), Portuguese dogfish, rays, redfish, sail fish, scabbard fish, shark (all species), snake mackerel or butterfish (escolar), sturgeon, swordfish, tuna (*Thunnus* species and *Euthynnus* species).

5.5 Ireland

The Food Safety Authority of Ireland (FSAI) issued “precautionary” advice in 2004. It advises that pregnant and breastfeeding women, women of childbearing age and young children not eat swordfish, marlin and shark and to limit their intake of tuna to one fresh tuna steak or two 8 oz cans of tuna per week. They should continue “to consume other fish as part of a balanced diet” (FSAI, 2004).

Consumers other than the above groups are recommended to restrict consumption of shark, swordfish and marlin to not more than one portion per week but it is not necessary to limit consumption of tuna.

The FSAI recommends that “everyone should continue to eat one to two portions of fish per week including one portion of oily fish such as salmon.”

5.6 Japan

The Bureau of Chemical Safety was unable to locate any information on Japanese government websites on regulatory limits for mercury in fish. However, the Canadian Food Inspection Agency webpage on foreign country certification requirements indicates that fish and seafood (except tuna and sturgeon) exported to Japan must meet a standard of 0.4 ppm total mercury and 0.3 ppm methylmercury (CFIA, 2005). A Japanese scientific publication (Yamashita *et al.*, 2005) describes a maximum permitted level of mercury in fish in Japan of 0.4 ppm.

The Japanese Ministry of Health, Labour and Welfare issued advice in June 2003 for pregnant women only (Japanese Ministry of Health, Labour and Welfare, 2003). After noting the nutritional benefits of fish, pregnant women are advised to limit the consumption of the following:

- the meat of Bottlenose Dolphin, to one 60 to 80 gram serving size once every two months or less;
- the meat of Baird's Beaked Whale, Short-finned Pilot Whale, Sperm Whale and "Kinds of Sharks" (muscle meat only), to one 60 to 80 gram serving size once a week or less;
- the meat of Swordfish and Alfonsino, to one 60 to 80 gram serving size twice a week or less.

The advice explains that there is no data suggesting that there may be adverse health effects from fish on the general population nor from fish, other than those described above, on pregnant women.

5.7 Mexico

The Canadian Food Inspection Agency webpage on foreign country certification requirements for Mexico indicates that "fresh-chilled and frozen [seafood] product" must not exceed 1.0 ppm mercury and that canned crustaceans must not exceed 0.5 ppm (as methylmercury) (CFIA, 2003c).

5.8 United Kingdom

It appears that England, Scotland, Northern Ireland, and Wales follow the regulatory limits for mercury in fish that were established by the EC.

The Food Standards Agency (FSA) of the United Kingdom recommends that pregnant women, women intending to become pregnant, and children under 16 should avoid shark, marlin and swordfish. Pregnant women and women intending to become pregnant should not eat more than four medium-sized cans or two fresh tuna steaks per week (no advice on tuna is given for children or other adults) (FSA, undated).

Those over 16 years of age should not eat more than one portion of shark, marlin or swordfish once a week.

The FSA recommends eating "at least two portions of fish a week and one of these should be oily fish." This is in consideration of the evidence indicating that omega-3 essential fatty acids can reduce cholesterol in the blood and can help prevent heart disease (FSA, 2004).

5.9 United States

The United States Food and Drug Administration (U.S. FDA) has an "action level" for methylmercury (as opposed to total mercury) in retail fish of 1.0 ppm.

In 2004, the U.S. FDA and the Environmental Protection Agency (EPA) jointly issued updated consumer advice for women who might become pregnant, women who are pregnant, nursing

mothers, and young children (U.S. FDA and U.S. EPA, 2004). The advisory also includes information on the nutritional importance of fish and shellfish.

The above groups are advised to follow “three recommendations for selecting and eating fish or shellfish” in order to “receive the benefits of eating fish and shellfish and be confident that they have reduced their exposure to the harmful effects of mercury”:

- Do not eat Shark, Swordfish, King Mackerel²⁰, or Tilefish²¹ because they contain high levels of mercury.
- Eat up to 12 ounces (2 average meals) a week of a variety of fish and shellfish that are lower in mercury. Five of the most commonly eaten fish that are low in mercury are shrimp, canned light tuna, salmon, pollock, and catfish.

Another commonly eaten fish, albacore ("white") tuna has more mercury than canned light tuna. So, when choosing your two meals of fish and shellfish, you may eat up to 6 ounces (one average meal) of albacore tuna per week.

- Check local advisories about the safety of fish caught by family and friends in your local lakes, rivers, and coastal areas. If no advice is available, eat up to 6 ounces (one average meal) per week of fish you catch from local waters, but don't consume any other fish during that week.

It is clarified that these same recommendations should be followed for young children, but to serve smaller portions.

6.0 IMPACTS

6.1 Consumer response to the advisory

There have been reports that consumer response to advisories can lead to a drastic reduction in consumption of fish of all types. The advice should also be positioned within the general context

²⁰ Other common names in Canada for king mackerel are kingfish and Spanish mackerel. Thirteen samples of kingfish in Canada were found to contain an average of 0.21 ppm total mercury (median 0.12 ppm, range 0.05 - 0.72 ppm). The U.S. FDA cites a Gulf of Mexico report that found an average of 0.73 ppm mercury in 213 samples of king mackerel (U.S. FDA 2004).

²¹ The CFIA Fish List indicates that several species have the common name “tilefish” although one of these species can also go by the name “ocean whitefish.” One tilefish sample analysed by the CFIA in 2005 contained 0.08 ppm total mercury. U.S. FDA data includes 1978 tilefish data from the Gulf of Mexico showing a mean value of 1.45 ppm.

of adopting a balanced diet, following the recommendations of Canada's Food Guide. It is important that potential heavy consumers of certain fish species be made aware of possible nutritional safety concerns as a result of unusual consumption behaviour, ahead of considerations related to chemical safety in general and over exposure to methylmercury in particular. For those who rely on fish as a main source of protein, this could possibly compromise the quality of their diets. It is important that consumer information provides a balanced message that does not result in restriction of fish consumption beyond what is recommended in the advisory. The advisory should include information on both the benefits of fish consumption and the risk of consuming excessive amounts of certain types of fish.

6.2 Availability of retail fish

The mercury data from the CFIA are for both imported and domestic fish samples. Imported samples were gathered at the premises of importers prior to distribution to retail and domestic samples were gathered at the processing plant. Therefore, Appendix III of the health risk assessment document provides an indication of the impact on each particular fish of the application of the 0.5 ppm standard and the potential application of the proposed 1.0 ppm standard.

Shark, swordfish, and fresh/frozen tuna, which are currently exempt from any standard, would be subject to the 1.0 ppm standard if the recommended risk management strategy is implemented. A certain percentage of samples of each of these fish have been found to contain greater than 1.0 ppm total mercury. The results suggest that the greatest impact would be on swordfish, for which as much as 67% of samples were greater than 1.0 ppm.

The impact of subjecting escolar, marlin, and orange roughy to a 1.0 ppm standard, rather than a 0.5 ppm standard, would be to reduce the proportion of fish that are non-compliant with a standard, while ensuring that Canadian consumers are adequately protected (including the most vulnerable groups).

There would be no impact on the availability of other fish, which would remain subject to the long established 0.5 ppm standard.

6.3 Canadian Food Inspection Agency Compliance Activities

The proposed risk management strategy, if adopted, would require that the Canadian Food Inspection Agency conduct compliance monitoring on swordfish, shark, and fresh/frozen tuna, each of which are currently exempted from the 0.5 ppm total mercury standard. Upon consultation with the Fish Program in the Animal Product Directorate of the Canadian Food Inspection Agency (CFIA), the CFIA has indicated that these activities could be easily included

within the scope of the current Fish Inspection and Monitoring Program.

6.4 The Fishing Industry

The updated risk management strategy, if adopted, would add four new fish to the consumer advisory: escolar (snake mackerel), marlin, orange roughy, and canned albacore tuna. There would possibly be an economic impact on the Canadian fishery for albacore tuna if the domestic catch is directed to canneries. If domestic albacore tuna is sold fresh/frozen, the impact would be minimal since fresh/frozen tuna are already subject to a consumer advisory. There could also be an impact on the fishing industry in general if consumers react negatively to the updated consumer advisory by excluding fish and seafood from their diet. Balanced consumption advice emphasizing the nutritional benefits of fish and seafood, en providing cautionary advice on the potential overexposure to mercury for certain consumers, and associated with certain fish, would permit consumers to make informed choices.

7.0 INTERNATIONAL TRADE AGREEMENTS AND OBLIGATIONS

7.1 North America Free Trade Agreement (NAFTA)

Article 712 of this agreement between Canada, the United States and Mexico states that each Party may “adopt, maintain or apply any sanitary or phytosanitary measure necessary for the protection of human, animal or plant life or health in its territory, including a measure more stringent than an international standard, guideline or recommendation.” These measures must be based on scientific principles and on a risk assessment, “as appropriate to the circumstances.” (North American Free Trade Agreement, 1994).

It notes that the appropriate level of protection should be established in accordance with Article 715: Risk Assessment and Appropriate Level of Protection. Among the criteria for conducting risk assessments are the employment of relevant risk assessment techniques and methodologies developed by international or North American standardizing organizations and the use of relevant scientific evidence.

The risk management strategy for mercury proposed in this document is based on a risk assessment that follows the principles and format for risk assessments accepted by the World Health Organization (WHO, 1999).

7.2 World Trade Organization Agreements

The “Agreement on the Application of Sanitary and Phytosanitary Measures” (SPS Agreement) is a World Trade Organization (WTO) agreement that establishes the right of governments to take sanitary measures. It also clarifies that such measures should be imposed only to the extent necessary to protect life and health (Agreement on the Application of SPS Measures, 1994).

The agreement encourages the use of international standards where they exist but allows higher standards to be introduced if there is scientific justification or if the rules are based on an appropriate risk assessment. The General Agreement on Tariffs and Trade (GATT), the WTO's umbrella treaty for trade in goods, spells out procedures and criteria for the assessment of risk and the determination of appropriate levels of risk management (GATT, 1994).

It is expected that Members will accept the sanitary and health measures of others as equivalent if the exporting country demonstrates to the importing country that its measures achieve the importing country's intended level of protection.

The SPS Agreement also requires prior notification to the World Trade Organization of proposed SPS measures or proposed modifications to existing SPS measures. A period of 60 days is recommended before the measure enters into force in order to allow other countries to comment on the notification (WTO, undated).

A World Trade Organization notification will be required in the event that the 1.0 ppm total mercury standard for specified piscivorous fish is adopted. While slightly more stringent than the Codex Alimentarius position on mercury in fish, none of the proposed risk management strategies are expected to raise a challenge under the auspice of the WTO, since they are not considered unduly restrictive

8.0 POSSIBILITIES FOR COMMUNICATING THE ADVISORY

After the results of the updated health risk assessment and risk management strategy are released, a Risk Communications Team, a sub-group of the interdepartmental Policy Team, will be further investigating methods of disseminating the updated consumer advisory. This will include the development of communications materials and strategies, some possible examples of which are listed below.

- Media releases (newsprint, radio interviews, television interviews).
- Publications (e.g. the current advisory is included in the publication *Nutrition for a Healthy Pregnancy* (1999) which is also on the Health Canada website).
- The Health Canada and the Canadian Food Inspection Agency websites. The current advisory was posted on the Health Canada website in 2001 and again in 2002 when the advisory was reissued. It is also posted to the CFIA's website.
- It will also be important to contact the administrators of other websites that refer to the federal consumption advisory on mercury and retail fish to request that they update the

information and weblinks (a draft list has been generated by the Science Team).

- Dissemination of the advisory to various provincial/territorial and federal health professional associations. A distribution list has been created that includes associations covering a wide range of health workers including pediatricians, obstetricians, gynecologists, dieticians, family doctors, medical doctors in general, nurses, nurse practitioners, midwives, naturopathic doctors, practitioners of Chinese medicine, chief medical officers of health, consumer associations, and food industry associations.
- Developing partnerships with health associations and organisations that have already-established means of effective communication with the public.
- Development of the advisory into poster format.
- Translation of the advisory into other languages, with attention given to common fish names in other languages.

8.3 Consultation

Several groups have contacted Health Canada with an expressed interest in how to effectively communicate consumer advice on fish. These include the Ontario Medical Association, the Waterloo Regional Health Authority, and the Region of Peel Public Health. These groups, as well as the Canadian Medical Association, should be included in the consultation list in order to obtain input and feedback on any draft consumer advisories.

9.0 CONCLUSION

For the currently “exempted” piscivorous fish, it was determined that the consumption advisory for these retail fish would be adequately protective provided that the mercury concentration was equal to or less than 1.0 ppm. It was also determined that excessive consumption of canned

albacore/white tuna (but not light tuna) could lead to an unacceptable level of exposure to mercury for specific segments of the population, considered to be more at risk.

Consequently, the risk management strategy has been updated. The standard of 0.5 ppm total mercury for all retail fish, with certain exceptions, is still considered an appropriate and effective part of the risk management strategy for mercury. However, a 1.0 ppm standard should be imposed on those fish that were previously exempted from the 0.5 ppm standard. The types of retail fish available in Canada were considered against the criteria described previously. Based on selection criteria and data pertaining to the Canadian context, it was determined that discrete limited list of piscivorous fish (escolar, marlin, orange roughy, shark, swordfish, and fresh/frozen tuna) be subject to the 1.0 ppm standard and the consumer advisory. Some advice on canned albacore (white) tuna should also be provided for those who may consume excessive amounts. It was finally concluded that no advice is necessary for canned light tuna (which contains less mercury than canned albacore).

As is always the case, Health Canada will continue to gather data on Canadian exposure to

methylmercury from fish sources and will re-evaluate the potential risk for the health of Canadian and subsequently adjust its recommended risk management strategy on a periodic basis.

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