Chapter 7

International Trade and Seafood Safety

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Summary

Seafood safety, in relation to international trade, is particularly important to the United States for several key reasons. U.S. per capita fish consumption has increased more than 50 percent since 1980 and is projected to continue increasing over the next 20 years (Blisard et al., 2002). Also, imports' share of total U.S. fish consumption now accounts for more than 75 percent of total consumption, compared with less than 50 percent in 1980. Finally, an increasing number of countries are exporting seafood to the United States and some of these countries have poor internal control systems and/or are in tropical areas where toxin and bacteria hazards are intrinsically higher (Ahmed, 1991).

The U.S. Food and Drug Administration (FDA) detains and inspects samples of imported seafood at the port of entry and refuses adulterated shipments. The 2001 FDA import detention data for seafood products indicates that out of 130 countries represented, 80 had violations for adulteration (safety, packaging integrity, or sanitation problems). Detention rates in terms of value were low, with an average of 0.46 detentions per $1 million of imports. Of the 6,405 violations, 84 percent were for adulteration, with *Salmonella* accounting for 34 percent of all adulteration violations. Shrimp, by far the largest import item, accounted for one-quarter of all detentions.

Public and private entities are using measures to ensure safer seafood in addition to end product testing and inspection. Hazard analysis and critical control point (HACCP) systems have been implemented increasingly by private industry for seafood, sometimes voluntarily and sometimes as mandated by Federal governments. Other actions being taken include investment in new technologies and equipment and in identity preservation systems.

As most contamination problems are from *Salmonella* in shrimp and prawns, risk reduction efforts theoretically could be focused on that bacterium. Shrimp is primarily an aquaculture product, so improvements in sanitation and production practices perhaps could make substantial differences in the occurrence and extent of *Salmonella* contamination. However, for the foreseeable future, shrimp will continue to be produced primarily by developing nations and dominate seafood trade moving from developing nations to developed nations (Wessells, 2002). One hurdle is that many less developed countries have difficulty meeting developed countries' quality and safety standards because of a lack of sufficient funds to invest in quality control measures, more adequately trained staff, and expensive equipment (Rahman, 2001).

Continued growth in international seafood markets may increase market segmentation where wealthy countries demand higher valued seafood products with food safety ensured, while less wealthy countries consume lower value species with fewer safety assurances (Wessells, 2002). This means that the degree of food safety could become, to some extent, a source of product differentiation.

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Introduction

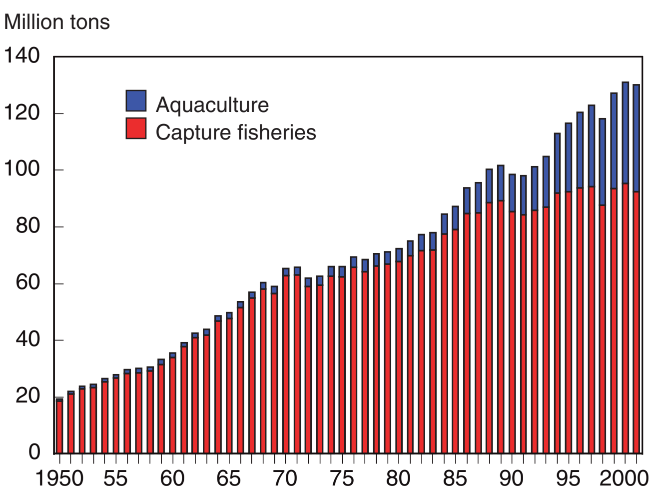
There have been several major developments affecting international seafood trade since the 1970s. Most importantly, during 1976-78, the jurisdiction over coastal waters by coastal nations was expanded to 200 nautical miles offshore. This changed which countries imported or exported particular types of seafood (Wessells and Wallström, 1994). In essence, while most oceans remain a common property resource, nations have limited privatization giving them some control over maintaining fish stocks and determining appropriate levels and procedures for harvest (Wessells and Wallström, 1994). Also, technological advances in fishery operations have increased productivity and in turn altered patterns of trade. These advances have at the same time added pressures on wild fish stocks, which are inherently finite.

Another development is the considerable growth in aquaculture to supplement wild harvests. In the United States alone, aquaculture production increased from 570 million pounds in 1990 to 880 million pounds in 2000 (National Marine Fisheries Service, 2001). Similar growth can be seen in the aquaculture share of world fish and seafood production (fig. 7.1). Aquaculture has caused trade friction in instances where it has led to an oversupply of certain species, resulting in drastically reduced prices and charges of "dumping" of product (e.g., charges by the U.S. International Trade Commission that Norway dumped salmon into the U.S. market in 1989). Meanwhile, governments, particularly in developed countries, are increasingly recognizing the importance of monitoring the state of aquatic ecosystems and managing human interventions (FAO, 2000). Two widely publicized marine resource management examples are import restrictions on tuna harvested with methods that do not minimize dolphin bycatch and shrimp harvested in nets without turtle-excluder devices. Although international disputes for seafood can arise from different stances on jurisdiction, marine resource management, and aquaculture, the focus here is on seafood safety and international trade. In general, countries are increasingly concerned about seafood safety, particularly as trading patterns shift among developed and developing countries.

The United States is one of the world's largest producers, exporters, and importers of fish and fishery products. According to the Food and Agriculture Organization's (FAO) 2000 statistics, the United States ranked fifth in terms of volume of overall fisheries production (aquaculture and wild catch together), fourth in terms of volume of exports, and second in terms of volume of overall imports. Figure 7.2 shows that the total amount of seafood imported into the United States has been increasing over time. At the same time, the level of U.S. seafood exports has been sustained.

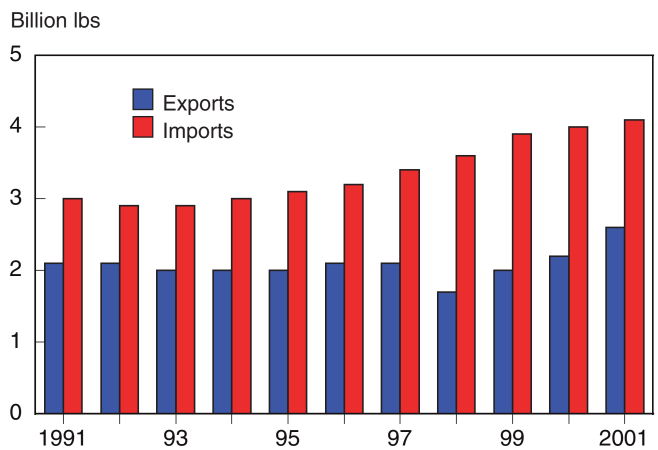
In relation to international trade, seafood safety is particularly important to the United States for several reasons. First, fish consumption has increased over 50 percent since 1980 and a USDA study projects continued increases over the next 20 years (Blisard et al., 2002). Second, the average import share of total U.S. consumption for fish and shellfish is increasing. It was

Figure 7.1
World production from capture fisheries and aquaculture



Note: Aquaculture quantities prior to 1984 are estimates.
Source: FAO, 2000.

Figure 7.2
Volume of U.S. exports and imports of edible seafood, 1991-2001



Source: NMFS, 2002.

56.3 percent in 1990 and 68.3 percent in 2000. Although there is no evidence that imported food, as a whole, poses higher food safety risks than domestically produced food (Zepp et al., 1998), the FDA has less direct access to food safety information on foreign seafood production and processing practices. Third, an increasing number of countries are exporting seafood to the United States and some of these countries have poor internal control systems and/or are in tropical areas where toxin and bacteria hazards are intrinsically higher (Ahmed, 1991). Fourth, FDA import detentions for "fishery/seafood products" accounted for almost 27 percent of the total number of detentions in 2001, second only to the "vegetable/vegetable products" category. Fifth, the large proportion of imported seafood raises concerns about potential food security concerns. Our heavy reliance on imported seafood means that any significant concerns over seafood safety have the potential to disrupt the flow of trade, reduce supplies to consumers, and limit sales for producers. Combined, these factors suggest that ensuring seafood safety is a task that will become more difficult.

FDA detains and inspects samples of imported seafood at the port of entry, refuses adulterated shipments, inspects foreign processors who wish to export to the United States, and inspects seafood importers in the United States. The Federal agency that governs fishery resources is the National Marine Fisheries Service (NMFS) in the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). A brief discussion is presented of some of the implications for policymakers. Seafood trade, in general, is complex because of diverse harvest methods, production areas, and markets, and because fish is not a homogenous commodity (Wessells and Wallström, 1994). Therefore, seafood safety issues are complex.

U.S. Seafood Exports and Imports

In 2000, the U.S. fish and fishery harvest was estimated at 9.1 billion pounds (edible and nonedible), having peaked in 1993 and 1994 at just over 10 billion pounds. The domestic catch is composed of a large number of fish, shellfish, mollusk, and crustacean species, but a handful of species dominate the catch. The total landings (catch) of cod, flounder, menhaden, pollock, salmon, crab, shrimp, and squid accounted for 6.9 billion pounds, or 76 percent of the total catch in 2000.[2] The value of this total harvest was estimated at $3.5 billion (see box 7.1).

The United States is a major producer and exporter of fish and fishery products, on a value basis, but the United States imported roughly $6.8 billion more edible seafood than it exported in 2001: the U.S. imported $9.9 billion (4.1 million pounds) and exported $3.2 billion (2.6 million pounds) (NMFS, 2002) (fig 7.3).[3] Imports and exports are relatively similar to the domestic harvest in that a small number of species dominate the trade picture. Shrimp products made up the largest single import item. Imported shrimp products alone were estimated at 883 million pounds and were estimated to be worth $3.6 billion. The four species next in importance in terms of import values were tuna ($829 million), lobster ($728 million), crab ($368 million), and fresh and frozen salmon ($335 million). This would place the combined values of these products at $5.9 billion, or 60 percent of the value of all U.S. fisheries imports.

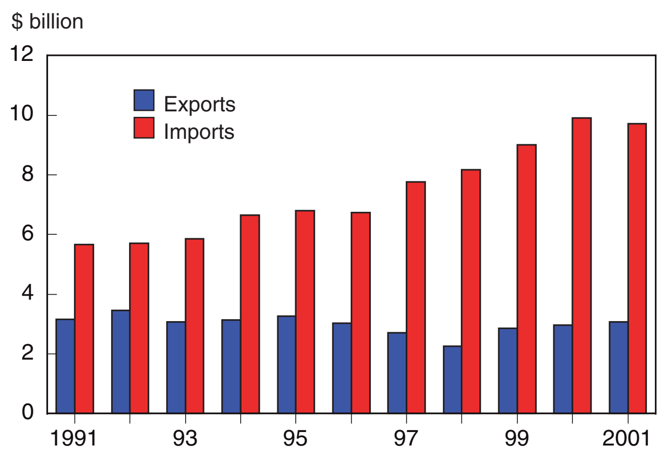
In general, seafood trade with the United States is less restricted than trade for other agricultural products and has no heavy quotas or duties on imports. The vast majority of seafood products are tariff free. Probably the

[2] Menhaden was probably mostly for industrial uses such as to make fish oil and meal for poultry feed.

[3] In 2001, the United States imported a total of roughly $18.5 billion in seafood, of which $8.7 billion was for nonedible seafood, and exported roughly $11.8 billion of seafood, of which $8.6 billion was nonedible.

Figure 7.3

Value of U.S. exports and imports of edible seafood, 1991-2001



Source: NMFS, 2002.

Box 7.1—Measuring the monetary value of seafood

When using monetary values to measure production, imports, and exports, values are not all estimated at the same stage of production. Export value is the "free alongside ship" value, or the value of the product at the port of export, based on the sales price including inland freight, insurance, and other charges incurred prior to exportation. Production values are typically ex-vessel prices, that is, the value of the catch at the dock where the vessel is offloading. Also, export values per pound from the United States are usually significantly lower than import values per pound to the U.S. This is because the mix of species exported is different than the mix of species imported, and because the level of processing varies. Some of the seafood exported from the United States is low value-added or low value, whereas, a large percentage of the seafood imported to the United States is high value-added (e.g., filets) or high-value (e.g., shrimp). In fact, a significant quantity of seafood produced in the United States is exported to countries with significantly lower labor costs for processing and then reimported into the United States for consumption. This is part of the explanation of how the same country could be both a major importer and exporter of seafood. Lower labor costs and manageable transportation costs permit firms to profitably exchange substantial quantities of seafood in international commerce and still provide consumers with high quality seafood at affordable prices.

The other part of the explanation for countries being both importers and exporters of seafood is that harvests of seafood, like that of most agricultural commodities, are seasonal. Seafood producers use their access to international markets to stabilize their revenues. When a given species is in season in one country, some of the catch can be exported to other countries where that same species is out of season.

Therefore, both seafood producers and consumers have an interest in maintaining open markets for international trade to provide an almost year-round supply of seafood to as many potential customers as possible. If this is to be the case, then issues of seafood safety must be addressed and controlled as they arise.

best example of imports that enter the country with no tariff is frozen shell-on, head-off shrimp. This is the most common product form of imported shrimp and accounted for almost $3 billion in imports in 2001. Imports of fresh or frozen Atlantic salmon, either as whole fish or fillets, also enter with no tariff. The highest tariff rates on seafood imports were for tuna in an airtight container in oil (35 percent) and sturgeon roe/caviar (7.5 percent) (Koplin, 2002). One explanation for the lack of tariffs or very low tariff rates on most seafood is that traditionally imported seafood were products not available from local fishermen or not available in sufficient quantities. Additionally, restrictions may have lessened over time due to General Agreement on Tariffs and Trade (GATT) negotiations.

The United States imports seafood from many countries. The largest suppliers of seafood to the United States tend to be large producers of the top four seafood imports by value (i.e., shrimp, crab, salmon, and tuna). In 2001, Canada and Thailand were by far the largest suppliers, followed by China, Mexico, Chile, Vietnam, and Ecuador. Developing countries supply about half of all seafood exported worldwide (Sun and Caswell, 2002), and Asia is the leading region in seafood exports, with 36.5 percent of the total (Cato, 1998).

U.S. seafood exports are dominated primarily by shipments of salmon products, surimi, lobster, caviar (i.e., sturgeon roe), and other roe. U.S. seafood exports was sold primarily to Japan and Canada. These two countries accounted for almost 55 percent of export value in 2001. In particular, Pacific salmon harvested by the United States and not consumed in the western States is generally exported in large quantities to Japan. Meanwhile, the U.S. imports large amounts of farmed Atlantic salmon from Canada and Chile for consumption on the East Coast. Surimi, a processed seafood product, uses pollock as the major ingredient. The roe exports are a combination of products from herring, salmon, pollock, sea urchin, and other species.

Seafood Safety

Seafood is processed into a wide range of products and is consumed in many forms (e.g., smoked, canned, salted, dried, fresh, frozen, and raw). While thorough cooking destroys most harmful organisms if any are present, raw oysters and clams have been popular in the United States and these products have been linked to illness from *Vibrio vulnificus* and other pathogens.[4] The 1998 FDA Food Safety Survey of U.S. adults found that 12 percent said they ate raw oysters (Fein and Riggins, 1998). Most seafood-associated illness reported by U.S. consumers point to consumption of raw bivalve mollusks and to unspecified and unknown foodborne illnesses with Norwalk-like viral gastroenteritis symptoms (Ahmed, 1991).

A National Academy of Sciences report indicates that most of the seafood sold in the United States is wholesome and unlikely to cause illness (Ahmed, 1991). However, some unknown portion of the estimated 76 million foodborne illnesses that occur each year in the United States (Mead et al., 1999) are attributed to seafood. According to the U.S. Centers for Disease Control and Prevention (CDC), surveillance data for foodborne disease outbreaks indicates that 6.8 percent of the 2,751 outbreaks during 1993-97 were attributed to consumption of shellfish and other fish (Olsen et al., 2000). However, these data do not capture unreported outbreaks or sporadic cases of foodborne illness, and so the true share of foodborne illness due to contaminated seafood is unknown.

On a global scale, the extent of illness from contaminated seafood is high. The World Health Organization (WHO) estimates that 40 million people become infected each year from trematode parasites by consuming raw or inadequately processed shellfish, freshwater fish, and aquatic plants (WHO, 1995). Data are not available on the extent of foodborne illnesses worldwide from all types of seafood hazards, which include:

- ***Bacteria***. A number of different bacteria potentially can be found in seafood. Some examples are *Vibrio parahaemolyticus*, *Listeria*, *Salmonella*, and *Staphylococcus*.
- ***Viruses***. Illnesses from viruses, such as the Norwalk virus, can be associated with the consumption of shellfish, particularly raw shellfish.
- ***Toxins***. Some naturally occurring toxins can accumulate in fish and mollusks. Examples include ciguatera found in some large tropical reef fish; domoic acid found in shellfish and mollusks; saxitoxin, also found in shellfish; and histamine in dolphin (i.e., mahi) and tuna.
- ***Parasites***. A number of fish species are at risk of having parasites such as roundworms. This normally becomes a human health problem only when fish are eaten raw or not fully cooked. The FDA Model Food Code requires freezing to destroy these organisms in fish for raw consumption.
- ***Chemicals***. Chemicals can be a localized problem in freshwater species, but can also affect ocean fish. Chemical contamination can result from local spills or dumping of pesticides, industrial chemicals, heavy metals, and petroleum products.

In general, many kinds of contamination can affect both farm-raised and wild-caught seafood. Different countries allow the use of different vaccines, feed additives, and antibiotics for farm-raised fish and fishery products and therefore, in some cases, residues from these production inputs may cause food safety concerns (FDA, 2001). On the other hand, wild-caught seafood may be more likely affected by other kinds of contamination such as from histamine (FDA, 2001). For the most part, seafood is more perishable than livestock or poultry. The potential for relatively faster decomposition gives seafood a shorter shelf life and makes handling more difficult.

FDA Import Detention Data for Seafood

The Federal Food, Drug and Cosmetic Act (FFDCA) was enacted to protect the health and safety of Americans and to protect them from mislabeled or adulterated domestic or imported food products. In particular, Section 801 directs the FDA to detain any seafood imports that appear to violate the Act. FDA may take a "detention action" based on:

(1) Regular detentions, which include shipments where physical analysis or records show that the food appears to violate the FFDCA and other acts enforced by the FDA, or

(2) Detentions without physical examination (DWPE), which include:

(a) automatic detentions based on past violative history of individual processors, countries, or geographic areas, or

[4] Although *Vibrio vulnificus* causes fewer than 50 foodborne illnesses in the United States each year, it has the highest case fatality rate (39 percent) and second highest hospitalization rate (91 percent) of known foodborne pathogens (Mead et al., 1999). In a case study, Buzby and Frenzen (1999) analyze product liability lawsuits associated with *Vibrio vulnificus* in raw oysters.

(b) detentions based on import alerts, which may cover one or more firms or countries, and arise from new food safety concerns that are identified by U.S. officials and perceived to be a threat to human health.

DWPE have a substantial deterrent effect on the incentive to ship tainted or suspect seafood into the United States, and also illustrate food safety concerns of U.S. officials. DWPE are included in this analysis as they represent the large majority of detentions.

FDA provided us with monthly data on detentions in the form of electronic Import Detention Reports (IDR). Each IDR provides insight into the range and number of possible import violations. Here we analyzed FDA import detention data for "fishery/seafood products" with each record in the IDR representing one detained shipment. Each record generally includes data naming the country, product, product code, product description (e.g., frozen shrimp), manufacturer, city and state of the manufacturer, detention type, sample number, and reasons for detention. Some limitations or caveats of the IDR data for seafood products include:

- Only a small percentage of all seafood imported into the United States is physically inspected, meaning that the detention data likely does not capture all food safety problems. On average, during 1999-2001, less than 1 percent of shipments were detained for any of the above reasons, and even fewer were physically sampled for contamination.[5] However, the sampling strategies by FDA and other agencies are designed to focus enforcement and inspection efforts on areas that have the highest probability of having a problem (Ahmed, 1991).

- The sample of detentions includes many shipments that are found to pose no food safety problems and are released so that trade is resumed. That is, most detained shipments are released with re-examination, new documentation, or new labeling. Other detained shipments are re-exported elsewhere or destroyed. On average, during 1999-2001, 78 percent of detained shipments were released for import into the United States.[6] The large percentage of shipments that are released after being detained reflects the cautious approach that FDA takes in protecting human health.

- The FDA data provided to us did not include the dollar value of detained shipments.

FDA separates the reasons for seafood detentions into two main categories, misbranding and adulteration, and three smaller categories (table 1). Misbranding includes untruthful labeling or lack of labeling whereas adulteration deals with safety, packaging integrity, or sanitation problems (Caswell and Wang, 2001).

In 2001, FDA listed a total of 4,912 detentions for seafood products, which includes 6,405 violations (detentions can be for multiple violations). Of the violations, 83.6 percent were attributed to adulteration, 14.3 percent were for misbranding, and 2 percent for insanitary manufacturing, processing, or packing. Two types of adulteration accounted for slightly more than half of all violations. *Salmonella* was the most common violation (34 percent) for adulteration with seafood coded as "filthy" as the second most common violation (27 percent) (table 7.1).

Of the approximately 130 countries that export seafood products into the United States, 86 had one or more shipments detained in 2001 and 80 had violations for adulteration. Although *Salmonella* was the most common violation, other potential violations occurred in a greater number of countries. *Salmonella* violations occurred in 42 percent of the countries with detentions, whereas over 75 percent of countries had products detained for being "filthy" and 63 percent of countries had products detained for "no process," meaning that the manufacturer had not filed information on its scheduled process.

Because of this chapter's emphasis on food safety, the focus here is on violations for adulteration. The smaller category titled "insanitary manufacturing, processing, or packing" is listed separately in table 7.1, but is combined with adulteration for the remainder of this analysis as it also has implications for food safety.

Table 7.2 breaks down the FDA import detentions for adulteration by exporting country. The number of detentions by country is hard to interpret alone because of the variation in number and magnitude of shipments from a particular country. Therefore, we computed detention rates (i.e., the number of FDA detentions per $1 million imports to the United States)

[5] According to data provided by Mary Snyder of the FDA's Office of Seafood, 11,686 import shipments were detained at the port of entry by FDA out of 1,650,350 line entries during 1999-2001 (or <1 percent).

[6] Of the 11,686 detained shipments during 1999-2001, 9,120 were later released (some with reconditioning).

Table 7.1—FDA violations for detaining fishery/seafood products, 2001

Violation code	No. of violations	% of all violations	Violation description	No. of countries
Total violations	6,405	100.0		86
Adulteration	5,356	83.6		
Salmonella	1,832	28.6	The article appears to contain *Salmonella*, a poisonous and deleterious substance which may render it injurious to health.	36
Filthy	1,460	22.8	The article appears to consist in whole or in part of a filthy, putrid, or decomposed substance or be otherwise unfit for food.	62
No process	683	10.7	It appears that the manufacturer has not filed information on its scheduled process as required.	54
Insanitary	351	5.5	The article appears to have been prepared, packed or held under insanitary conditions whereby it may have been contaminated with filth, or whereby it may have been rendered injurious to health.	25
Needs acid/Needs fce	336	5.2	It appears the manufacturer is not registered as a low acid canned food or acidified food manufacturer.	42
Poisonous	231	3.6	The article appears to contain a poisonous or deleterious substance which may render it injurious to health.	38
Listeria	170	2.7	The article appears to contain *Listeria*, a poisonous and deleterious substance which may render it injurious to health.	11
Histamine	123	1.9	The article appears to contain Histamine, a poisonous and deleterious substance which may render it injurious to health.	11
Imptrhaccp	41	0.6	The food appears to have been prepared, packed or held under insanitary conditions, or may have become injurious to health, due to the failure of the importer to provide verification of compliance.	5
Unsafe col	41	0.6	The article appears to be, or to bear, or contain a color additive which is unsafe.	14
All other violations[1]	88	1.4	Violations includes those for food that—appears to have been prepared or packed under insanitary conditions, contains excessive sulfites, contains or been packed in containers that have poisonous substances, contains unsafe food additives, contains unsafe pesticides, has had inadequate processing, consists of a filthy, putrid or decomposed substance, contains an off odor, or has been held in swollen or leaking containers.	46
Insanitary manufacturing, processing, or packing				
Mfr insan	130	2.0	The article appears to have been manufactured, processed, or packed, under insanitary conditions.	27
Misbranding	914	14.3		
Nutrit lbl	200	3.1	The article appears to be misbranded in that the label fails to bear the required nutrition information.	33
Lacks firm	140	2.2	The food is in package form and appears to not bear a label containing the name and place of business of the manufacturer, packer, or distributor.	32
Usual name	136	2.1	It appears that the label does not bear the common or usual name of the food.	28
List ingre	87	1.4	It appears the food is fabricated from two or more ingredients and the label does not list the common or usual name of each ingredient.	29
Lacks n/c	84	1.3	The food is in package form and appears to not have a label containing an accurate statement of the quantity of the contents in terms of weight, measure, or numerical count and no variations or exemptions have been prescribed.	25
False	70	1.1	The labeling for this article appears to be false or misleading	13
No English	47	0.7	Required label or labeling appears not to be in English.	21
Labeling	46	0.7	The article appears in violation of FPLA because of its placement, form, and/or contentsstatement.	21
Sulfitelbl	40	0.6	The labeling appears false and misleading because it appears to contain sulfites, but thelabel fails to declare the presence of sulfites, a fact material to sulfite-sensitive individuals who must avoid the ingredient.	4
All other violations[1]	64	1.0	Violations include those for food that—appears to be offered for sale under the name of another food, appears to contain an unlabeled chemical preservative, required labeling is not visible enough, purports to be for special dietary uses and its label does not bear required nutritional information, appears to contain additives which are not declared on the label, or appears to be represented as a food for which a standard of identity has been prescribed and does not appear to conform to that definition.	35

Note: Two smaller FDA categories not show here. Complete list of violations are available upon request.

[1]Each individual violation in these groups represent less than 0.5 percent of all violations.

Source: Computed by the authors using FDA Import Detention Reports, January-December, 2001.

using census data on the value of imports obtained from the National Marine Fisheries Service website.[7]

The top three countries in terms of the number of violations in 2001 were Vietnam, Thailand, and Indonesia—all among the top eight exporters of seafood products to the United States. Vietnam had 580 detentions worth $478 million in exports, resulting in a rate of 1.21 detentions per $1 million of exports. This detention rate is almost triple the average for all countries (0.46). Although Thailand had the second highest number of detentions (407), it also had the second highest value of exports and a detention rate below average (0.25). Canada, the number one importer in terms of value, had the lowest detention rate (0.03). Again, two caveats are that only a small percentage of products are inspected, and enforcement/inspection efforts are focused on areas with the highest probability of having a problem.

An earlier study by Sun (2002) computed the detention ratios for fishery products by country over 1997-2000 and found that most ratios remained low. However, the ratios for some countries, including Vietnam, fluctuated wildly.

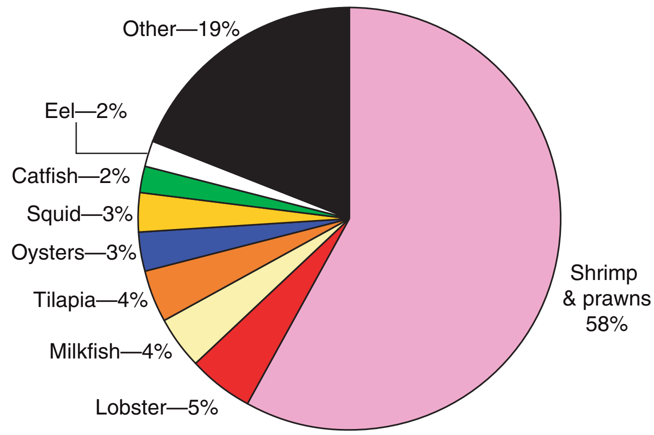
Table 7.3 breaks down the FDA seafood product detentions for adulteration by class and product. Fish was the most implicated class, with 45.3 percent of all detentions. This is not surprising since this category contains more than 60 types of fish and includes high-volume products such as tuna and salmon. However, when looking at individual products, by far, the most implicated product was shrimp and prawns (marine plus aquaculture combined), accounting for more than one-quarter of all detentions. This finding was expected because shrimp was by far the largest single import item, with 40 percent of the value of seafood imports in 2001.

Table 7.4 looks more closely at the number of violations in the 2001 FDA detention data to determine the types of seafood products detained for different reasons. Shrimp and prawns ranked the highest in terms of the number of violations for 6 of the top 11 violation codes for adulteration. In particular, shrimp and prawns accounted for 58 percent of the *Salmonella* violations (fig. 7.4) and 48 percent of the violations for filth.

[7] *www.st.nmfs.gov/st1/trade/trade_prdct_cntry-com.html*, accessed April 2002.

Figure 7.4

U.S. FDA violations for *Salmonella*, by seafood product, 2001



Source: ERS calculations using 2001 FDA Import Detention Reports.

In summary, out of 130 countries represented in FDA import detention data, 86 had one or more violations in 2001 for one or more reasons and 80 of these had violations for adulteration. Detention rates in terms of value were low, with an average of 0.46 detentions per $1 million of imports. Of the 6,405 violations, 83.6 percent were for adulteration, with *Salmonella* accounting for 28.6 percent of the adulteration violations. More than one-quarter of the detentions were for shrimp and prawns (marine plus aquaculture) which was expected because shrimp is by far the largest seafood import item.

Seafood Safety Incidents Affecting International Trade

In general, it appears that seafood safety issues have been less publicized in the media than the food safety issues linked to some of the other agricultural products covered in this report. Nevertheless, international disputes over seafood safety have affected trade opportunities for producers, exporters, and importers.

In 1994, the Spanish government rejected two shipments of squid from the United States. The squid was found to contain copper in excess of 20 parts per million (ppm), which Spain had established as the maximum allowable amount of copper.[8] The 20-ppm level was advantageous to Spanish squid producers because Spanish squid naturally has lower levels of copper than

[8] Copper is an essential trace mineral nutrient.

Table 7.2—FDA import detentions for adulteration of fishery/seafood products versus value of imports, 2001

Country[1]	Detentions		U.S. fishery/ seafood imports		Number of detentions per $1 million imports
	Number	*% of total*	*Mil. dol.*	*% of total*	*Number*
Total[2]	4,431	83.1	9,533.6	93.4	0.46
Vietnam	**580**	**13.1**	**477.9**	**5.0**	**1.21**
Thailand	**407**	**9.2**	**1,607.7**	**16.9**	**0.25**
Indonesia	**366**	**8.3**	**382.1**	**4.0**	**0.96**
Ecuador	321	7.2	392.8	4.1	0.82
India	312	7.0	296.1	3.1	1.05
Taiwan, Republic of China	270	6.1	185.7	1.9	1.45
Philippines	246	5.6	148.1	1.6	1.66
Korea, Republic of (South)	206	4.6	74.1	0.8	2.78
China (Mainland)	150	3.4	659.1	6.9	0.23
Mexico	122	2.8	487.0	5.1	0.25
Japan	114	2.6	120.2	1.3	0.95
Chile	85	1.9	483.4	5.1	0.18
Bangladesh	68	1.5	94.1	1.0	0.72
Brazil	68	1.5	155.4	1.6	0.44
Canada	**64**	**1.4**	**1,945.4**	**20.4**	**0.03**
Norway	52	1.2	115.1	1.2	0.45
Nicaragua	40	0.9	81.6	0.9	0.49
Costa Rica	32	0.7	78.4	0.8	0.41
Honduras	30	0.7	123.1	1.3	0.24
Australia	24	0.5	70.1	0.7	0.34
Panama	24	0.5	104.0	1.1	0.23
Venezuela	21	0.5	118.7	1.2	0.18
Iceland	20	0.5	151.7	1.6	0.13
Argentina	19	0.4	105.1	1.1	0.18
Russia	19	0.4	215.4	2.3	0.09
Guyana	10	0.2	58.4	0.6	0.17
New Zealand	9	0.2	112.2	1.2	0.08
Fiji	5	0.1	57.3	0.6	0.09

[1] Includes only countries with at least 0.5 percent of total imports. Complete list of countries available upon request.
[2] Excludes import detentions from U.S. territories included in tables 7.1, 7.3, and 7.4.

Source: Computed by the authors using FDA Import Detention Reports, January-December, 2001 and National Marine Fisheries Service, Foreign Trade Information website: *http://www.st.nmfs.gov/st1/trade/trade_prdct_cntry.html*, accessed April 2002.

squid from other countries. After a few months the dispute was resolved and the U.S. went on to export a record $16 million of squid to Spain in 1994 (USDA Foreign Agriculture Service, 1995).

In 1997, the European Commission (EC) banned shrimp imports from Bangladesh because processing plants in Bangladesh did not meet EC standards. The estimated net cost of this August-December 1997 ban after considering shipments diverted to other countries was $14.7 million to the Bangladesh frozen shrimp processing industry (Cato and Lima dos Santos, 1998). As in many other less developed countries (LDCs), many plants in Bangladesh have difficulty meeting the required quality and safety standards because of a lack of sufficient funds to invest in quality control measures, more adequately trained staff, and expensive equipment (Rahman, 2001). The Bangladesh Department of Fisheries, Fish Inspection, and Quality Control has verified and certified compliance of seafood products for only 20 percent of the seafood processing companies that previously were shipping to the European Union (EU) (Cato, 1998). This ban affirms the apprehension of some LDCs that evolving standards under the WTO will become a major market access issue (Rahman, 2001).

Since 1997, Kenya and some other countries surrounding Lake Victoria have faced a series of food safety-related restrictions of their fish exports (Henson et al.,

Table 7.3—FDA import detentions for adulteration of fishery/seafood products, by class and product, 2001

Class and product	Number of detentions	Percent of total detentions	Number of countries
Total	**4,451**	**100.0**	**80**
Fish	**2,016**	**45.3**	**73**
Tuna (Albacore, Yellowfin, Skipjack, etc.)	367	8.2	27
Swordfish	224	5.0	37
Sardines (Brisling, Sprats, Pilchards, etc.)	171	3.8	32
Mahi Mahi	122	2.7	11
Mackerel	104	2.3	26
Salmon (Humpback, Silver, King Sockeye, etc.)	95	2.1	17
Milkfish	94	2.1	3
Other[1]	839	18.8	55
Crustaceans	**1,308**	**29.4**	**41**
Shrimp and prawns	1,043	23.4	35
Crab	126	2.8	14
Lobster	120	2.7	10
Other[2]	19	0.4	7
Aquaculture harvested fishery/seafood products	**413**	**9.3**	**20**
Shrimp and prawns	365	8.2	13
Other[3]	48	1.1	11
Shellfish[4]	**224**	**5.0**	**31**
Other fishery products[5]	**222**	**5.0**	**36**
Other aquatic species[6]	**226**	**5.1**	**18**
Mixed fishery/seafood products[7]	**37**	**0.8**	**13**
Engineered seafood[8]	**5**	**0.1**	**2**

[1] Includes anchovy, barracuda, bass, blue fish, bonito, bream, carp, catfish, cod, corvina, croaker, cusk, dace, eel, escolar, filefish, flounder, gourmay/gourami, groupers, hake, halibut, herring, jack, kingfish, marlin, mud fish, mullet, perch, pike, pickerel, pollack/pollock, pompano, puffer, rockfish, suary, scad, shark, sheatfish, smelt, snake head, snapper, sole, spot fish, tilapia, totoava, trout, turbot, wahoo, white fish, whiting, yellowtail, and other products not classified. [2] Includes crayfish, langostino, and other products not classified. [3] Includes catfish, clams, frogs, mussels, oysters, salmon, tilapia, and other products not classified. [4] Includes abalone, arkshells, clams, cockles, conch, conchmeat, mussels, oysters, scallops, and other products not classified. [5] Includes caviar/roe, fish maw, fish paste, fish sauce, gefilte fish, shark fin, and other products not classified. [6] Includes cuttlefish, frog legs, octopus, sea cucumber, sea urchin, snails, squid, and other products not classified. [7] Includes chowders, stews, bisques, hors d'oeuvres, salads, stuffed pastas, tuna sandwiches, and other products not classified.[8] Includes crab and surimi used for imitation crab and other products not classified.

Source: Computed by the authors using FDA Import Detention Reports, January-December 2001.

2000). *Salmonella* contamination in Nile perch from Kenya in April 1997 led to border testing of all Nile perch consignments. Later, a cholera epidemic in East Africa in December 1997 resulted in a European Commission ban of imports of fresh fish products from Kenya, Mozambique, Tanzania, and Uganda until June 1998. The World Health Organization and Food and Agriculture Organization issued statements that the ban was not scientifically justifiable and the restrictions were lifted in June 1998. For Mozambique alone, the ban resulted in a loss of $60,000 in trade per month while the ban was in place, which means that about 30 tons of fish were not traded to the European Union market (Cato, 1998). Following reports of pesticide poisoning of fish from Lake Victoria, another round of restrictions began in April 1999 that prohibited all fish exports from Lake Victoria to the EU (Henson et al., 2000). As a result of these events, employment in the sector declined and industrial fish processing companies reduced capacity or closed (Henson et al., 2000).

In January 2002, the EU suspended shrimp and prawn imports (and other products of animal origin) from China because of residues from a banned antibiotic, chloramphenicol, and because of general deficiencies in the Chinese residue control system (McGovern, 2002). This antibiotic is used in some animal and seafood feed to control disease. It has been linked to fatal leukemia and anemia in humans. The FDA response was to step up surveillance for chloramphenicol residues and residues of other unapproved aquaculture drugs in shrimp and crayfish imports from all countries and to modify its testing methods so as to be able to detect the antibiotic at 0.3 part per billion, equal to that of Canada and the EU. Products with

Table 7.4—FDA violations for adulteration of fishery/seafood products by reason for contravention and main products detained, 2001

Violation code	No. of violations	Main products detained
Total violations	5,486	
Adulteration		
Salmonella	1,832	Shrimp/prawns, 58%; lobster, 5%; milkfish and tilapia, each 4%; oysters and squid, each 3%.
Filthy	1,460	Shrimp/prawns, 48%; tuna, 11%; mahi mahi, 7%; crab 4%, conch/conchmeat, 3% .
No process	683	Sardines, 20%; tuna, 17%; mackerel, 7%; herring, 5%; salmon and shrimp/prawns, each 4%; anchovy, clams, and octopus, each 3%.
Insanitary	351	Shrimp and prawns, 69%; crab, 4%.
Needs acid/Needs fce	336	Tuna, 18%; sardines, 17%; herring, 8%; mackerel, 7%; crab, 6%; anchovy and shrimp/prawns, each 5%; snails, 4%.
Poisonous	231	Swordfish, 87%.
Listeria	170	Salmon, 17%; fish roe/caviar, 14%; crab and shrimp/prawns, each 11%; pollack, 10%.
Histamine	123	Mahi mahi, 53%; tuna, 32.
Imptrhaccp	41	Milkfish, 39%; tuna and groupers, each 17%.
Unsafe col	41	Shrimp/prawns, 29%; seafood salad, 17; fish roe, 12%.
Mfrhaccp	32	Shrimp/prawns, 41%; tuna, 34%.
Other	56	Shrimp/prawns, 34%; swordfish, 9%; anchovy and milkfish, each 5%.
Insanitary manufacturing, processing, or packing		
Mfr insan	130	Anchovy and clams, each 12%; oysters, 12%; mackerel, 7%; mussels and pollack, each 6%.

Note: See table 7.1 for definitions of violation codes.

Source: Computed by the authors using FDA Import Detention Reports, January-December, 2001.

detectable levels of chloramphenicol will be detained and refused entry into the United States (FDA Press Release, 2002.). Also, the U.S. temporarily suspended shrimp imports from China.

Although some of these seafood safety incidents appear to have resulted in relatively limited and short-term interruptions of trade and economic impacts, costs could continue to accrue from continued market diversions (i.e., lost market share), loss of momentum in the sector, decreased prices, and reduced capacity due to temporary or permanent plant closures. The above examples illustrate that food safety restrictions can act as barriers to trade as they can for any type of food. Despite the advantages of some developing countries in terms of preferential trading arrangements, food safety incidents can impose costly requirements on developing countries beyond their ability to afford compliance (Henson et al., 2000).

Public and Private Actions To Ensure Safer Seafood

Federal regulation of seafood imports has tended to focus on end product testing and inspection, except for where memoranda of understanding (MOU) are in place (Ahmed, 1991, p. 15).[9] More recently, HACCP systems have been increasingly implemented by private industry for seafood, sometimes voluntarily and sometimes as mandated by governments. HACCP plans generally follow seven steps: conduct a hazard analysis; identify critical control points (CCP) for physical, biological, and chemical hazards; establish critical limits for preventative measures associated with each CCP; establish CCP monitoring requirements; determine and perform corrective actions; establish recordkeeping systems; and conduct verification procedures. This system has become one of the more common public actions used to ensure safer seafood, particularly in developed countries.

Canada was the first country to establish a mandatory food inspection program for fish and fishery products based on HACCP principles. In 1992, Canada adopted the Quality Management Program (QMP) whereby all federally registered fish processing establishments in Canada must implement a system of procedures,

[9] FDA has had other programs in place for a long time to address food safety issues, such as the low acid canned food regulations to reduce the risk of botulism.

inspections, and records. Meanwhile, importers who wish to be in product compliance with federal regulations may develop a quality management system and provide details through a Quality Management Program for Importers (QMPI) submission to the Canadian Food Inspection Agency (CFIA, 2002).

In 1991 and 1994, the European Commission adopted regulations concerning health conditions for production and marketing of fishery products, and again these were roughly based on HACCP principles (FAO, 2000). In 1995, the FDA promulgated a HACCP program for fish and fishery products stipulating that importers of seafood to the United States must meet the same HACCP standards as U.S seafood processors (*Federal Register*, Dec. 18, 1995). Since then, other developing and developed countries have made similar initiatives. The level of U.S. seafood exports has been sustained despite the U.S. HACCP regulation for fish and fishery products. This means that increased seafood regulation need not have a significant detrimental effect on international seafood trade at the current levels of production. Although higher safety standards raise seafood production costs, the increasing worldwide demand for high-quality seafood has offset these cost increases (Sun and Caswell, 2002).[10]

Inspection protocols and regulatory limits for contaminants vary tremendously across countries (Ahmed, 1991, p. 15), and HACCP systems vary as well. For example, the EU regulations apply to the whole production chain whereas the U.S. seafood HACCP regulations apply only to processors (FAO, 2000). WHO/FAO Codex Alimentarius incorporated HACCP in its general guidelines in 1997, thus creating a starting reference for trade disputes under the WTO Agreement on the Application of Sanitary and Phytosanitary Measures (FAO, 2000).

Meanwhile, private industry may invest in new technologies and equipment that ensure safer food and may take certain measures to reduce food safety risk (which may or may not be part of HACCP systems) such as rapid cooling, irradiation, proper processing, and good temperature control at all stages of the production and distribution chain. Additionally, some companies voluntarily test for *Vibrio*, histamine, or other contaminants. The leading trade association for fish and seafood products in the United States is the National Fisheries Institute, founded in 1945. One component of their mission is food safety education for the seafood industry, which includes scientific and technical information on key issues such as HACCP, irradiation, mandatory recalls, mercury, and voluntary seafood inspection services.

Identity preservation is another means of ensuring safety, one that is attracting attention in the international trade arena. Under an identity preservation system, information about the origin of a “lot” of food follows that lot from harvest all the way to the consumer. An identity preservation system has been in place since 1925 for molluscan shellfish harvested in the United States. This system is under the auspices of the National Shellfish Sanitation Program (NSSP). The NSSP is a Federal, State, and industry voluntary cooperative program that relies on regulatory controls by State shellfish authorities to ensure safe molluscan shellfish. Among other requirements, the NSSP requires that containers of raw shellfish have identity tags that stay with the shellfish from harvest to sale to the consumer. The tags must include the identity of the shellfish harvester/dealer and the date and location of harvest. Lot identity of the shellfish must be maintained throughout the production and marketing chain. The identity preservation system has been very helpful to authorities in the control of foodborne illness. But it is not a complete solution to the seafood safety problem. Tags may be lost or switched and the existence of tags does not control pathogens and other hazards. Other regulations include certification of domestic and international growing waters for bivalves to be consumed in the United States. Many foodborne illnesses each year are still associated with consumers eating raw molluscan shellfish in the United States.

Regulations for other forms of labeling (e.g., country-of-origin labeling) may be motivated more by concerns other than food safety. For example, as of January 2002, an EC regulation requires seafood and fish products to be labeled with information on the harvest area, harvest water type, commercial species name, and whether the product was cultivated or wild. This regulation will help government officials police

[10] More significant are the differential effects that safety standards have across countries that supply seafood to the U.S. market. Sun and Caswell (2002) indicate both positive and negative effects on volume exported to the U.S. in excess of 30 percent for different seafood exporting nations. Both developed and developing countries experienced sizable negative effects. While large positive effects were mainly experienced by developed nations, smaller positive effects were experienced by some developing nations (Sun and Caswell, 2002).

the Common Fisheries Policy and to help inform consumers (WorldCatch, 2001).[11]

Currently, U.S. Customs requires importers to provide documents that include the country of origin for seafood products. Some specific seafood products additionally are labeled as either farm-raised or wild harvest.[12] In the Farm Security and Rural Investment Act of 2002, Section 10816 contains two new labeling requirements pertaining to seafood. The first requirement is that seafood must have country-of-origin labels.[13] The second requirement is that the labeling has to distinguish between farm-raised and wild harvest seafood products.

Implications for Policymakers

This chapter has three main conclusions, some of which have implications for policymakers.

Point 1: Salmonella is a potential target for risk reduction efforts.

The FDA detention data showed that *Salmonella* was the most common contaminant resulting in adulteration of fish and fishery products. Interestingly, the meat and poultry chapters of this report also found that *Salmonella* was a key food safety concern for those products and the U.S. Centers for Disease Control and Prevention outbreak data show that *Salmonella* was the most common cause for bacterial foodborne disease outbreaks in produce during 1993-97.[14] Therefore, *Salmonella* might be a food safety problem to target for increased risk-reduction efforts in food production, particularly given that *Salmonella* is a leading cause of foodborne illness in the United States and worldwide.

[11] The Common Fisheries Policy is the system of quotas and tariffs that the EU uses to manage fisheries and aquaculture issues from harvest to consumption.

[12] The term “wild harvest” fish means naturally born or hatchery-raised fish or shellfish that are harvested in the wild. The term “wild fish” excludes net-pen aquaculture, primarily salmon, or other farm-raised fish.

[13] To be labeled as a product of the U.S., farm-raised fish have to be hatched, raised, and processed in the U.S. For wild fish to be labeled as a product of the U.S., it must be harvested in U.S. waters or a U.S. territory and it must also be processed in the U.S. or a territory of the U.S.

[14] The caveats about outbreak data apply here as well: the data do not capture unreported outbreaks or sporadic cases of foodborne illness.

Point 2: Most Salmonella contamination detentions are for shrimp.

As most *Salmonella* contamination in fish and fishery products are with shrimp, risk reduction efforts could be focused here. And, as over one-quarter of shrimp production is from aquaculture, improvements in sanitation and production practices could perhaps make substantial differences in the occurrence and extent of *Salmonella* contamination. But this won’t solve all the problems because unlike meat and poultry, where *Salmonella* may be a naturally occurring bacteria in the animals’ digestive tracts, for seafood, *Salmonella* contamination is often due to cross-contamination introduced later during the processing stage.

However, for the foreseeable future, shrimp will continue to be produced primarily by developing nations and dominate seafood trade from developing nations to developed nations (Wessells, 2002). Many less developed countries may have difficulty meeting the required quality and safety standards because of a lack of insufficient funds to invest in quality control measures, more adequately trained staff, and expensive equipment (Rahman, 2001).

Point 3: International seafood markets will continue to expand and become increasingly segmented.

The FAO report *The State of the World Fisheries and Aquaculture* (2000) predicts that international trade of fish and fishery products will grow in two ways. First, fish processing in developing countries will increase due to its attractiveness as an employment-generating opportunity for low-wage workers, particularly in displaced fishing communities, and due to the increased demand for value-added fishery products. Second, developing countries increasingly will become important markets for these products. Fish is becoming a greater source of animal protein around the world—average annual per capita fish consumption has increased from 9 kilograms in the early 1960s to 16 kilograms in 1997 (FAO, 200).

The FAO report (2000) also predicts that by 2030, more than 50 percent of fish supplies will be from aquaculture and that imports will account for an increasing share of consumption in wealthy countries. In the United States, the average import share of fish and shellfish consumption increased from 56.3 percent in 1990 to 68.3 percent in 2000. In general, an increasing share of imports means that wealthy countries will likely want to remove most trade barriers so that these products will become less expensive (FAO, 2000). However, wealthy countries also tend to want higher levels of food safety and tend to be willing to pay more for food safety. In the future, we may see greater evidence of market segmentation where wealthy countries such as the United States, Japan, and EU members demand higher valued seafood products with food safety ensured, while less wealthy countries consume lower value species (e.g., carp) with fewer safety assurances (Wessells, 2002). This means that the degree of food safety could become, to some extent, a source of product differentiation.

Governance over marine resources is complex because of intersecting goals arising out of concerns for food safety, marine resource management, worker safety, and market access.[15] In particular, food safety disputes often require a delicate balancing between the costs of mitigating human health risks and benefits of open trade. Trade for seafood is particularly complex because of the large number of species traded, countries involved, and production processes used.

[15] The most dangerous occupation in the world is fishing at sea (FAO, 2000).

HACCP as an international trade standard for ensuring safe seafood will continue to evolve and be adopted by more governments. And, if countries develop similar HACCP requirements for seafood, this will facilitate trade. Currently, the United States does not have equivalence agreements with other countries for HACCP for seafood products, partly because they are difficult to achieve. Therefore, we have limited reach or control over the actual practices used by seafood importers into the United States, and there will continue to be special challenges that arise from seafood trade between developed and developing countries.

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