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An Overview of Seafood Consumption and Supply Sources: Hawai'i Versus U.S.

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Introduction

Since the arrival of the first Polynesian voyagers, seafood has been an important staple in the diets of people in Hawai'i. As the only state in the nation consisting entirely of islands, Hawai'i makes fish the talk of the town whenever New Year's rolls around. In many local households, it is a family tradition to welcome the New Year with sashimi. While Honolulu ranks consistently in the top 10 U.S. ports for commercial fisheries value,¹ its ranking for equivalent fisheries volume is lower, 31st among corresponding ports in 2010.² Seafood is also significant in the U.S. as a whole. The Food and Agriculture Organization (FAO) ranks the U.S. as the third largest consumer of seafood in the world after China and Japan.³ In total, Americans consumed 4.88 billion edible pounds of seafood in 2010, down slightly from 4.91 billion edible pounds in 2009.⁴

While robust seafood data is less readily available for Hawai'i than at the national level, we can nevertheless arrive at a good description of seafood expenditures in Hawai'i and the U.S. by linking various datasets published by various federal and state government agencies. According to the National Oceanic and Atmospheric Administration-National Marine Fisheries Service (NOAA-NMFS, 2011), U.S. consumers collectively spent an estimated \$80.2 billion on seafood products in 2010. An estimated 32.2% of this amount, \$25.8 billion, was spent for home consumption; 67.3%, or \$54 billion, was spent at food service establishments, including restaurants, caterers, and carry-outs; and the remaining 0.5%, or \$432 million, went to industrial fish products.⁵

On a per capita basis, Hawai'i spent \$104.29 on seafood consumption at home, more than twice the comparable U.S. measure of \$45.20 per resident. This spending rate is also higher than the \$53.46 for all consuming units in the U.S. western region. Table 1 shows the per capita seafood expenditure of Hawai'i and U.S. residents for at-home consumption and at food service establishments.⁶ It also shows that Hawai'i residents spent 11.4% of their total food expenditure on seafood, a higher proportion compared to 6% for all U.S. residents.

Apparent Seafood Consumption: Total and Per Capita

The apparent consumption approach mentioned in this analysis is adopted from the FAO's disappearance model, which is defined as seafood production plus imports

Table 1. Hawai'i and U.S. Per Capita Seafood Expenditure by Consumption Site

Consumption Site	Hawai'i	U.S.
At Home	\$104.29	\$45.20
Food Service Establishments	\$226.39	\$98.12
Subtotal	\$330.68	\$143.32
Total Food	\$2,888.93	\$2,372.40
Proportion of Seafood	11.4%	6.0%

Sources: BLS-CES 2004-2005 (2008), BLS-CES 2005 (2008) and NOAA 2005 (2007).

minus exports. Seafood production is further defined as the sum of commercial landings, aquaculture production, and non-commercial catch.⁷ Table 2 presents the estimates of Hawai'i's total and per capita apparent seafood consumption, on average annually, for the 10-year period of 2000–2009. The estimates, measured in edible pounds, are expressed in the various components of seafood production, as well as imports and exports. Excluding non-commercial catch, the total apparent seafood consumption annually on average in Hawai'i is 38.9 million edible pounds. With the inclusion of non-commercial catch, the estimate increases to 50.4 million edible pounds. To estimate apparent consumption per capita, the total estimate is divided by the *de facto* population in Hawai'i, which takes into consideration military personnel stationed in and tourists visiting the state.

The per capita apparent seafood consumption in Hawai'i is 29 edible pounds without including non-commercial catch and 37 edible pounds with the inclusion of non-commercial catch. The eight-pound per capita differential shows the fairly significant contribution of non-commercial catch to Hawai'i's seafood supply chain. The non-commercial catch is 39% of total seafood production in Hawai'i. Furthermore, Table 2 shows that the majority of Hawai'i's seafood is imported. Imports accounted

for 63% of total commercial consumption of seafood in Hawai'i, with almost 57% originating from foreign countries. With the inclusion of non-commercial catch, imports accounted for 49% of total seafood consumption in Hawai'i, with 44% arriving from foreign countries.

In contrast, the per capita apparent seafood consumption in the U.S. was 16 edible pounds in 2009.⁸ This means that apparent consumption of seafood per capita in Hawai'i is 1.8 times higher than in the U.S. as a whole when measured in edible weight. With the inclusion of non-commercial catch, the same ratio is 2.3 times higher for Hawai'i. These results are reasonable considering the high propensity to consume seafood amongst the diverse cultural population in Hawai'i.

Apparent Seafood Consumption: Species Grouping

While per capita apparent consumption of seafood in Hawai'i is considerably higher than in the U.S., the next logical question to ask is whether the species and form of seafood consumed are similar. Table 3 lists the top 10 seafood species consumed on a per capita basis in Hawai'i and in the U.S. Notwithstanding that Hawai'i and the U.S. shared seven species in common on the top 10 list; the ranking and quantity consumed of each

Table 2. Hawai'i Total and Per Capita Apparent Seafood Consumption, Edible Pounds, 2000–2009

	Hawai'i Production (1,000 pounds)		+	Imports (1,000 pounds)		-	Exports (1,000 pounds)		=	Consumption	
	Commercial Landings*	Non-Commercial		U.S.	Foreign		U.S.	Foreign		Total (1,000 pounds)	Per Capita (pounds)
Commercial Consumption	18,108		+	2,467	22,075	-	3,128	599	=	38,922	28.5
% Total	46.5%			6.3%	56.7%		-8.0%	-1.5%		100.0%	
Commercial + Non-Commercial Consumption	18,108	11,465	+	2,467	22,075	-	3,128	599	=	50,387	36.9
% Total	35.9%	22.8%		4.9%	43.8%		-6.2%	-1.2%		100%	

Note: *Includes aquaculture production.

Source: Geslani et al. (2012).

species are quite different. Hawai'i has a much higher consumption of fresh tuna (7.4 edible pounds per capita), as compared to the U.S. consumption of canned tuna (2.8 edible pounds per capita). Likewise, the per capita consumption of salmon in Hawai'i (4.2 edible pounds) is twice the amount consumed in the U.S. (2.1 edible pounds). Both of these finfish species are ranked first and second respectively for per capita consumption in Hawai'i.

On the contrary, the consumption of shrimp in the U.S. at 4.1 edible pounds per capita is much higher than Hawai'i's 1.85 edible pounds.⁹ Shrimp and canned tuna are the two top-ranking species for seafood consumption per capita in the U.S. Finfish species—salmon, pollock, catfish, and tilapia—fill the 3rd- to 6th-ranking spots in the U.S. Crab comes in 7th, while cod, clams, and pangasius capture the remaining top 10 spots for the U.S. The consumption of catfish in the U.S. at 0.97 edible pounds per capita is also conspicuously higher than

Hawai'i's 0.46 edible pounds. If we combined catfish with pangasius, the U.S. consumption per capita for “catfish” is almost three times higher than that for Hawai'i. Another category that is significantly higher (3.7 times) for the U.S. as compared to Hawai'i is the consumption of cod/pollock.

Within the Hawai'i top 10 list, it is clear that non-commercial catch contributes significantly to the local seafood supply chain for species such as tuna, mahimahi, billfish,¹⁰ snapper, other pelagic species, reef species, mollusks, crustaceans, and algae. Table 4 shows the contribution of non-commercial catch in Hawai'i by select species as measured by per capita consumption in edible pounds. The non-commercial catch of mahimahi at 1.14 edible pounds per capita contributes to 59% of the total consumption per capita in the state. Tuna, billfish, and snapper trail at 42%, 36%, and 28% respectively on the same measure.

Table 3. Top 10 Hawai'i¹ and U.S.² Per Capita Seafood Consumption by Species, Edible Pounds

Rank	Hawai'i With Non-Commercial Catch	Edible Pounds	Hawai'i Without Non-Commercial Catch	Edible Pounds	U.S.	Edible Pounds
1	Tuna (yellowfin, bigeye, other)	12.72	Tuna (yellowfin, bigeye, other)	7.36	Shrimp	4.08
2	Salmon	4.23	Salmon	4.23	Canned tuna	2.80
3	Mollusks, crustaceans, & aquatic invertebrates	3.92	Mollusks, crustaceans, & aquatic invertebrates	3.92	Salmon	2.12
4	Mahimahi	1.93	Shrimp	1.85	Pollock	1.48
5	Shrimp	1.85	Billfish	1.01	Catfish	0.97
6	Billfish	1.58	Swordfish	0.80	Tilapia	0.93
7	Swordfish	0.80	Mahimahi	0.79	Crab	0.62
8	Cod/pollock	0.53	Cod/pollock	0.53	Cod	0.49
9	Snapper	0.51	Catfish	0.46	Clams	0.45
10	Catfish	0.46	Tilapia	0.37	Pangasius ³	0.38
//	Total Top 10	28.53	Total Top 10	21.32	Total Top 10	14.32
	Total	36.85	Total	28.46	Total	16.14

Notes: ¹Annual average for 2000–2009. ²Annual average for 2002–2010. ³For Hawai'i, pangasius is included in the catfish species.

Sources: Geslani et al. (2012) and <http://www.aboutseafood.com/about/about-seafood/top-10-consumed-seafoods>.

Apparent Seafood Consumption: Historical Comparison

The first study of Hawai'i's apparent seafood consumption was conducted with the primary objective of determining whether Hawai'i had considerably higher seafood consumption per capita than the U.S. as a whole (Hudgins 1980). That study, covering eight years between 1970 and 1977, found that the apparent seafood consumption per capita in Hawai'i was 1.7 times higher than in the U.S. when measured in edible pounds. From the previous section, we know the equivalent measure from 2000 to 2009 was marginally higher, 1.8 times more than in the U.S. Table 5 presents the historical comparison of Hawai'i and the U.S. After three decades, Hawai'i's apparent seafood consumption per capita increased by 36% compared to 30% for the U.S. as a whole. The Hawai'i:U.S. per capita

seafood consumption ratio increased marginally by 5.9% during the same time period.

Apparent Seafood Consumption: Global Comparison

The NOAA-NMFS publication *Fisheries of the United States, 2010* includes the latest per capita consumption of seafood in live weight (2005–2007) for different countries and the world. Historical figures on this measure are available from the FAO. For Hawai'i, this measure is derived from edible weight by utilizing live-to-edible conversions developed by the FAO (unpublished).¹¹ The per capita seafood consumption in Hawai'i is 55.5 live pounds (excluding non-commercial catch). The equivalent per capita measure for the U.S. is 53.3 live pounds and 37.3 live pounds worldwide. Table 6 presents the per capita seafood consumption for select countries, Hawai'i, U.S., and the world. While Hawai'i and the U.S. consume more seafood than the world in general on a per capita live weight basis, they consume less than select countries with large immigrant descendent populations in Hawai'i.

It is interesting to note that the U.S., South Korea, Portugal, and Samoa experienced higher per capita consumption of seafood (live weight) over time (1977–2007), gaining between 42% and 58%. The Philippines gained a marginal 0.3%, while Japan's seafood consumption actually declined by 9.8% over the three decades reviewed. On the other hand, China's per capita seafood consumption ballooned by 352% in the same period. While the countries in Table 6 are moderate to high consumers of seafood, their per capita consumption largely remains in the shadow of the leading countries. The three countries

Table 4. Non-Commercial Catch in Hawai'i by Species: Per Capita Consumption, Edible Pounds

Fish Species	Edible Pounds	% Total ¹
Tuna (yellowfin, bigeye, other)	5.36	42.2%
Mahimahi	1.14	59.0%
Billfish	0.58	36.7%
Snapper	0.14	27.5%
Total	8.38	22.7%

Note: ¹ Defined as per capita consumption with non-commercial catch.

Table 5. Hawai'i and U.S., 1970s and 2000s: Per Capita Seafood Consumption, Edible Pounds

	1970–1977 ¹			2000–2009/2002–2010 ²		
	Hawai'i	U.S.	Hawai'i : U.S.	Hawai'i	U.S.	Hawai'i : U.S.
Consumption	20.9	12.4	1.7	28.46	16.14	1.8
Change	-	-	-	36.2%	30.2%	5.9%

Notes: ¹ Data sourced from Hudgins (1980). ² Data is average from 2000 to 2009 for Hawai'i per capita consumption and from 2002 to 2010 for U.S. per capita consumption. See Table 3.

with the highest per capita consumption of seafood in the world¹² are the Maldives (313.9 live pounds), Saint Helena (204.4 live pounds), and Iceland (200.5 live pounds).

Seafood Imports by Country of Origin: Hawai'i and U.S.

As is shown in Table 2 previously, the majority of Hawai'i's seafood is imported. While the countries of origin for foreign transshipments via the continental U.S. are not documented, direct imports by country of origin are well recorded. For 2010, the total Hawai'i import volume of edible seafood products was 17.7 million pounds, valued at \$36.3 million.¹³ The five leading direct import sources for Hawai'i's seafood by volume as reported by the USDA Foreign Agricultural Service (FAS), GATS Online Database were Taiwan, Japan, the Philippines, New Zealand, and China. When expressed in dollar value, the top five seafood import sources by country of origin were Japan, New Zealand, China, Canada, and Taiwan. Table 7 lists the top 10 Hawai'i seafood import sources by country of origin in 2010 in terms of live weight and corresponding dollar value.

Imports also account for a high proportion of seafood consumed in the U.S. The total import volume of edible fishery products was 5.2 billion pounds, valued at \$14.6 billion in 2010.¹⁴ The leading sources of seafood imports by volume for the U.S. were China, Thailand, Canada, Vietnam, and Indonesia. These same countries were also the leading sources by dollar value in 2010. Table 8 lists the top 10 U.S. seafood imports by country of origin in 2010 in terms of live weight and corresponding dollar value.

Despite a relatively high proportion of fresh finfish landed, Hawai'i supplements its market demand by importing more finfish directly from foreign countries. Table 9 shows the top 10 Hawai'i seafood imports by volume and related value in 2010. Tuna imports top the list, followed by mollusks, crustaceans, and aquatic invertebrates (octopus, mussels, oysters, scallops, and clams), while salmon, shrimp, and freshwater fish (tilapia and bass) round off the leading five products. When measured in dollar value, the leading import products into Hawai'i were mollusks, crustaceans, and aquatic invertebrates; tuna; shrimp; salmon; and squid. In 2010, imports accounted for 86% of all seafood consumed in

Table 6. Global Comparison of Seafood Consumption Per Capita, Live Pounds

		1977	2005-2007 ¹	% Change
	Hawai'i	N.A.	55.5 ²	N.A.
	U.S.	33.8	53.3	57.7%
	World	25.3	37.3	47.4%
Countries with large immigrant descendent populations in Hawai'i	Japan	143.4	129.3	-9.8%
	South Korea	80.0	126.5	58.1%
	Portugal	83.5	126.2	51.1%
	Samoa	74.2	105.5	42.2%
	Philippines	73.9	74.1	0.3%
	China	12.8	57.9	352.3%

Notes: ¹ Data for worldwide per capita consumption by live weight are from the NOAA-NMFS (2011); 2005–2007 average is the most current available data. Global estimates by edible weight are not available. ² This is the 2007 per capita estimate in live pounds and does not include non-commercial catch, which would raise the 2007 estimate to 66.1 live pounds per capita.

Sources: NOAA-NMFS (2011), FAOSTAT and Geslani et al. (2012).

Table 7. Top 10 Hawai'i Seafood Import Sources by Country of Origin, Volume, and Value, 2010

Rank	Origin	Volume (1,000 pounds)	Value (\$Thousand)
1	Taiwan	4,532	3,380
2	Japan	1,963	4,934
3	Philippines	1,929	2,894
4	New Zealand	1,784	4,198
5	China	1,395	3,711
6	Marshall Islands	1,387	2,227
7	Thailand	1,259	2,446
8	Canada	1,068	3,614
9	Indonesia	633	1,691
10	Micronesia	559	1,291

Source: USDA-FAS, GATS Online Database (HS-10).

Table 8. Top 10 U.S. Seafood Imports by Country of Origin, Volume, and Value, 2010

Rank	Origin	Volume (1,000 pounds)	Value (\$Thousand)
1	China	1,240,873	2,369,395
2	Thailand	916,194	2,272,408
3	Canada	668,831	2,307,733
4	Vietnam	304,077	867,049
5	Indonesia	275,691	990,108
6	Ecuador	243,098	648,394
7	Chile	143,866	592,428
8	Mexico	114,775	372,912
9	Norway	113,328	474,030
10	Philippines	105,829	229,889

Source: USDA-FAS, GATS Online Database (HS-10).

the U.S.¹⁵ The leading seafood imports by product volume were shrimp, freshwater fish, tuna, salmon, groundfish, crabs, and squid. The vast majority of products on this list were also the leading imports by dollar value. It is clear that the U.S. spent a significantly higher amount of

Table 9. Top 10 Hawai'i Seafood Imports by Volume and Value, 2010

Rank	Product	Volume (1,000 pounds)	Value (\$Thousand)
1	Tuna (fresh & frozen)	1,546	4,323
2	Mollusks, crustaceans, & aquatic invertebrates (fresh, frozen, & processed)	1,398	4,457
3	Salmon (fresh & frozen)	1,285	3,503
4	Shrimp (frozen)	1,213	3,843
5	Freshwater (frozen)	843	625
6	Other pelagic (frozen)	826	827
7	Squid (fresh & frozen)	612	1,582
8	Mahimahi (frozen & chilled)	411	961
9	Snapper (frozen & chilled)	301	1,142
10	Lobster (fresh & frozen)	146	993

Source: USDA-FAS, GATS Online Database (HS-10).

money on shrimp imports (\$4.27 billion) than any other seafood product, 3.7 times more than the next highest import product by value, freshwater fish (\$1.14 billion). Overall, many of the products that made the top 10 imports list are processed seafood, usually fillets, steaks, and canned. Table 10 shows the top 10 U.S. seafood imports by volume and related value in 2010.

Discussion

One notable insight from this study is the significant contribution of non-commercial catch to Hawai'i's seafood consumption. As shown above, non-commercial catch contributes 39% of total seafood production in Hawai'i and further translates into apparent seafood consumption of eight edible pounds per capita. Despite this sizable contribution, almost half (49%) of total seafood consumption (all sources) in Hawai'i is imported. Seafood imports

Table 10. Top 10 U.S. Seafood Imports by Volume and Value, 2010

Rank	Product	Volume (1,000 pounds)	Value (\$Thousand)
1	Shrimp (fresh & frozen)	1,200,000	4,270,000
2	Freshwater (fresh & frozen, fillets & steaks)	558,800	1,140,000
3	Tuna (canned)	442,400	659,600
4	Tuna (fresh & frozen, whole)	426,300	680,200
5	Salmon (fresh & frozen, fillets & steaks)	261,000	1,060,000
6	Salmon (fresh & frozen, whole)	227,900	651,600
7	Groundfish (fresh & frozen, fillets & steaks)	214,800	431,800
8	Crabs (fresh & frozen)	137,800	623,700
9	Squids (fresh & frozen)	128,500	196,849
10	Freshwater (fresh & frozen, whole)	120,400	126,545

Source: NOAA-NMFS, Fish Watch - U.S. Seafood Facts, 2011.

from foreign countries account for 44% of total seafood consumption by edible weight in Hawai'i, while 5% originates from the U.S. mainland (Table 2). Local commercial landings account for 28%, and non-commercial catch rounds up 23% of the total consumption by edible weight. For the entire U.S., dependence on foreign imports is significantly higher than in Hawai'i, accounting for 86% of total seafood consumption by edible weight in 2010 (NOAA-NMFS, 2011).

Now that we have estimated Hawai'i's per capita seafood consumption at 29 edible pounds, or 1.8 times higher than the equivalent U.S. measure of 16 edible pounds, we can proceed to reconcile the per capita seafood consumption of 55.5 live pounds for Hawai'i, which is only 1.04 times higher than the corresponding U.S. measure of 53.3 live pounds. The key to explaining this "quasi-paradox" rests in the different seafood consumption patterns (behaviors) in Hawai'i and the U.S.

In our analysis, we find Hawai'i consumes much more fresh and frozen finfish, led by tuna and salmon (Table 3). Eight of the top 10 species consumed on a per capita basis are fresh or frozen finfish. In contrast, the U.S. in general consumes more shellfish and processed seafood, led by shrimp and canned tuna (Table 3). Only six of the top 10 species consumed are fresh or frozen

finfish. Our analysis also indicates that fresh and frozen products account for 77% and processed products account for 23% of total seafood consumed in Hawai'i by edible weight. In comparison, fresh and frozen products account for 72% and processed products for 28% of total seafood consumed in the U.S.

Additionally, finfish and shellfish represent 80% and 20% respectively of total seafood consumed in Hawai'i by edible weight. The comparable proportions for the U.S. are 64% finfish and 36% shellfish respectively. Beyond that, both processed seafood and shellfish have higher edible-to-live conversion factors and translate into higher live weight for any given edible weight. For illustration, the FAO uses a factor of 3.0 in converting the edible weight of canned fish to live weight. Shellfish have conversion factors ranging from 2.8 to 9.1. Furthermore, for a specific species such as salmon, the conversion factor ranges from 1.13 for frozen salmon, to 1.5 for salted salmon, and to 2.0 for fresh or chilled salmon fillets. These differences in the patterns of consumption between Hawai'i and the U.S. help to explain why the former consumes 1.8 times more seafood than the latter in edible weight yet remains so similar when measured in live weight.

Concluding Remarks

In recent years, there has been a rapidly growing interest in the consumption of fresh, healthy, and nutritious local food; alternate food supply channels; food self-sufficiency; and redeveloping a strong regional food system in Hawai'i. While seafood is only one component of total food, it is nonetheless an important part, considering the resource sustainability, cultural connectedness, and social significance of what and how we eat as an island state. While we consume more seafood per person from commercial sources in comparison to the U.S. in general (29 vs. 16 edible pounds) and are less dependent on imports relative to the entire nation, we are nevertheless dependent on imports for a staggering 63% of total commercial consumption, with 6% originating from the U.S. mainland and a startling 57% from foreign countries. Even when we include non-commercial catch in the equation, imports still account for an alarming 49% of total seafood consumption in Hawai'i, with 5% arriving from the U.S. mainland and the remaining 44% from foreign countries.

At the national level, the situation is far more distressing, with foreign imports accounting for 86% of all seafood consumed in the U.S. While seafood imports afford us access to more varieties and greater quantities at more competitive prices, the high level of imports also exposes us to the vulnerability of volatile prices in the international market, as well as to variability in the food safety practices and health standards of exporting countries. With a rapidly growing population and dwindling ocean resources around the world, there is a compelling argument for nurturing our ocean resources and for developing other aquatic resources to produce an increasing supply of seafood to meet increasing consumer demand over time within and outside Hawai'i.

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Endnotes

1. Fish landed in Honolulu are marketed fresh (not frozen), usually sashimi-quality, which is worth more pound for pound than fish landed in most other U.S. ports.

2. Query reports derived from NOAA-NMFS database rank Honolulu as the 9th leading U.S. port in terms of commercial fisheries landings by dollar value and 31st in terms of commercial fisheries landings by poundage in 2010.

3. See NOAA news report “NOAA: U.S. domestic seafood landings and values increase in 2010” (September 7, 2011).

4. Ibid.

5. See *Fish Watch – U.S. Seafood Facts*, published online by NOAA-NMFS (September 13, 2011).

6. While every effort was taken in this publication to present accurate and comparable statistics between Hawai'i and the U.S., not all are identical due to differences in definition, computation, and collection methodology. In some instances, similar statistics are utilized in response to data availability and research expediency. In Table 1, the latest annual consumer expenditure survey (CES) data available for Honolulu, Hawai'i, were last published for 2004–2005 by the BLS. Equivalent U.S. data for 2005 were presented here.

7. Non-commercial catch includes sport and recreational fishing but excludes illegal or unreported fishing.

8. See Fisheries of the United States, 2010, page 74.

9. This significant difference may have arisen due to data definition and specification.

10. Includes swordfish, sailfish, and marlin.

11. It should be noted that due to the composition of different types of seafood consumed by different countries, the live-to-edible-weight ratios can differ significantly. For example, a country that consumes a significant amount of shellfish may show a higher per capita consumption on a live-weight basis than a country that consumes more finfish; however, when measured on an edible-weight basis, the country with high shellfish consumption may exhibit a lower per capita consumption than the country with high finfish consumption.

12. Based on 2005–2007 average published by NOAA-NMFS (2011).

13. These figures from USDA-FAS, GATS Online Database include edible products only and exclude ornamental items such as koi, carp, etc.

14. These figures were sourced from USDA-FAS GATS Online Database and are marginally lower than the 5.5 billion pounds of U.S. imports of edible fisheries products, valued at \$14.8 billion in 2010, reported by NOAA-NMFS.

15. This figure was reported in *Fish Watch – U.S. Seafood Facts*, published by NOAA-NMFS (September 2011).