Oceana Reveals Mislabeling of America's Favorite Fish: Salmon

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Executive Summary

Americans love salmon. It's our favorite fish, surpassing tuna in per capita consumption in 2013. And yet, it's easy to dig into some salmon cakes or a lox-covered bagel without thinking much about the path that fish took to reach the dinner (or breakfast) plate. It turns out, depending on when and where it is bought, there's a good chance that the fish on our plate is not the fish we expected. This bait and switch can have serious ecological and economic consequences.

Much of the salmon Americans eat travel much farther than one might guess, even those that are caught in the United States. Though fishermen catch enough salmon to satisfy over 80 percent of our domestic demand, on average, 70 percent of that catch is exported instead of staying in the U.S. Some domestic wild-caught salmon likely makes its way back, but only after entering an opaque and poorly regulated global seafood market. During this journey, information about the fish can get lost: which species it is, whether it was farmed or wild, and how and where it was caught. Failing to track this key information throughout the supply chain contributes to high rates of seafood fraud. While seafood fraud encompasses a number of practices meant to mislead consumers about seafood, this report focuses on a very common problem that can be prevented: mislabeling, or species substitution.

Oceana researchers found low rates (7 percent) of mislabeled salmon when samples were collected for the 2013 national seafood fraud report. This may have been because the large majority of samples were collected at the peak of the 2012 salmon fishing season, when wild salmon was plentiful in the market. To find out whether mislabeling would be more common during the off-season in the winter months, Oceana conducted another salmon study during the winter of 2013-2014 in Chicago, New York City, Washington, D.C. and several locations in Virginia.

Key Findings

Oceana researchers determined that the degree of mislabeling is, in fact, dependent on the time of year the salmon are purchased. The analysis of the winter salmon investigation returned the following findings:

- Forty-three percent of the salmon tested were mislabeled.
- The most common form of mislabeling was when farmed Atlantic salmon was being sold as "wild salmon."
- In restaurants, diners were three times more likely to be misled than shoppers in grocery stores. (67 percent of samples vs. 20 percent of samples mislabeled).

When combining the smaller winter survey (82 samples) with the larger national study (384 samples), a more robust picture emerges, showing that the time and place of purchase have a big impact on whether a consumer is likely to be misled. In keeping with what we found in our winter survey, most of the salmon mislabeling in the U.S. at the retail level was found in restaurants when salmon was out-of-season.

New findings which emerged from this nationwide analysis include:

- Consumers have a much higher chance of getting the salmon they pay for in grocery stores, regardless of whether wild salmon are in season.
- Shoppers in small markets are eight times more likely to be misled than shoppers in large grocery chains that are required to give information on species, country of origin and whether salmon is farmed or wild.

Seafood fraud, including mislabeling, can have serious ecological and economic consequences. When a less valuable product like farmed Atlantic salmon is sold as the more valuable Chinook, consumers aren't getting what they think they are paying for. At the same time, responsible fishermen who sell wild Chinook salmon are competing with fraudulent products, usually farmed salmon, and likely receiving less cash than they should be for their hard-won catch.

Imported farmed salmon (which makes up the majority of the salmon consumed in the U.S.) has many negative environmental impacts due to inefficient feeding practices, fish waste, misuse of antibiotics and pesticides, and diseases that can spread to wild populations. Environmentally conscious consumers may wish to opt for more ecologically friendly choices like wild-caught U.S. salmon. Unfortunately, our data show that people who think they are making an ocean-friendly choice by ordering "wild salmon" at a restaurant may very well be having the opposite effect and getting farmed salmon instead.

In contrast to imported farmed salmon, U.S. wild salmon fisheries are among the best managed in the world and yield high-quality, valuable products. Yet we export most of our fresh wild salmon and import mostly farmed salmon. In other words, we send away some of the best salmon in the world, and we import lower-value products of questionable origin. Imported salmon, both farmed and wild-caught, is far more likely to be associated with ecologically harmful practices, economic fraud and even illegal fishing.

These problems have solutions. Consistent naming and full-chain traceability would greatly reduce seafood fraud. The Food and Drug Administration's (FDA) guidance on seafood naming is neither clear nor consistent, and it does nothing to effectively eliminate confusion about seafood products in the U.S. In 2014, the White House established the Presidential Task Force on Combating Illegal, Unreported and Unregulated (IUU) Fishing and Seafood Fraud. The Task Force is set to implement measures to prevent IUU fishing and fraud in the coming year, but as this report demonstrates, the new rules need to apply to all seafood entering the U.S. and throughout the entire seafood supply chain to be effective.

Oceana recommends that the Task Force require all seafood sold in the U.S., including salmon, to be required to have catch documentation to show it came from legal sources, and to require traceability that passes key information through the entire supply chain—from the water where the fish is caught or farmed to the dinner plate where it's served. Providing more information to consumers about their seafood will help them make choices based on their preferences for domestic salmon or more environmentally friendly products.

This report is the largest salmon mislabeling study in the U.S. to-date. The results indicate that salmon mislabeling is common, especially in restaurants and especially in the winter. Consumers have a right to know that they will get what they ordered and what they paid for. U.S. fishermen have a right to know that their fish will not have to compete unfairly with fraudulent products, and that they don't have to settle for lower pay when they are delivering a superior product. The U.S. government has a responsibility to ensure a transparent and fair market. Consumers should urge the government to require catch documentation for all seafood, full-chain traceability and to provide more information at the point of sale. Transparency in the seafood supply chain is the only way for consumers to know what fish they are eating, whether it is farmed or wild, and where and how it was caught.

Introduction

In 2013, salmon replaced tuna as the most consumed fish in the United States.[1] Americans may love their salmon, but many are unfamiliar with its story. In this report, Oceana describes the complexities of the global salmon trade and demonstrates that the fillet on the plate may not be the fish the consumer expected, especially when bought out-of-season. Salmon fraud, particularly the substitution of farmed or other less desirable salmon for wild U.S. salmon, is a serious problem, but it could be prevented with proper naming and traceability. Our favorite fish can serve as one of the best examples of why we need to reexamine the way we track and regulate seafood.

Wild salmon undertake remarkable journeys and transformations. They hatch in freshwater streams, spending about one or two years in freshwater before heading out to the open sea. Salmon remain in the ocean for most of their lives, returning to their native waters to spawn after two to seven years. Many salmon undergo dramatic morphological changes during this trip. Some species sprout pronounced humps on their backs or develop hooked jaws. Their bodies change colors, some becoming bright red as they compete for mates.

The climb upstream is exhausting. Foregoing feeding during the swim, their bodies turn on themselves to provide sustenance. The stomach dissolves first, then the muscles and fats, providing just enough energy for their final act. Upon reaching their birth waters, the fish spawn, and then they die.

In a parallel journey, salmon that are caught before returning to their native streams similarly undergo drastic transformations. The product that is landed on the boat can travel thousands of miles, cross many borders, and take many forms and names before ending up on a dinner plate. Currently, there are no rules requiring important information — like where, when and how a fish was caught — to follow the fish from the moment it is caught until the final point of sale. This lack of traceability and the resulting opportunities for fraud has economic and ecological consequences. Without effective regulation, honest fishermen lose market share to dishonest actors, and consumers are unable to make informed decisions based on the environmental impact of their seafood choices.

Salmon: An Overview

“Salmon” is a general name applied to several species of fish in the Salmonidae family that are native to the North Pacific and North Atlantic oceans. Salmon are not unique to the United States or even North America. In fact, both Pacific and Atlantic salmon call the rivers and coastal waters of a combined 23 countries home.[2] Pacific salmon’s native ranges vary by species, but traditionally they extend from Mexico to Alaska in the Eastern Pacific, and Taiwan to Northern Siberia in the Western Pacific.[3] Atlantic salmon may be commercially extinct in much of its U.S. native habitat, but limited wild populations exist in at least 17 countries in Europe and North America.[4] Additionally, farmed Atlantic salmon is raised and harvested globally, with significant production taking place in 17 countries,[5] with Norway and Chile

[1] Data from National Marine Fisheries Service (NMFS) as cited in About Seafood.com. Accessed 9/21/15 at https://www.aboutseafood.com/about/about-seafood/top-10-consumed-seafoods
[2] National Oceanic and Atmospheric Adminisitration (NOAA) Fisheries. Marine and Anadromous Fish. Accessed 9/15/15 at http://www.nmfs.noaa.gov/pr/species/fish/
[3] Ibid
[4] Hendry, K. and D. Cragg-Hine (2003). Ecology of the Atlantic Salmon. Conserving Natura 2000 Rivers Ecology Series No 7. English Nature. Accessed 9/15/15 at http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=SMURF_salmon.pdf
[5] United Nations Food and Agriculture Organization (FAO), Fisheries and Aquaculture Department (2015). "Salmo Salar." Retrieved 9/15/15, from http://www.fao.org/fishery/culturedspecies/Salmo_salar/en

producing the bulk.[6] Pacific salmon are also farmed, though to a much lesser extent, with Chinook being farmed in New Zealand, sockeye in Japan and coho in Chile. Wild Pacific salmon have also been introduced, both purposefully and by accident, in New Zealand, Chile, Japan, the Great Lakes and other places.

Chinook

Value: $$$

The **largest and most prized** salmon species in the U.S.

Native range runs from Monterey Bay in California, Northward to Alaska and the Chukchi Sea.

Sockeye

Value: $$

Most popular species of salmon in United States. Coveted for its roe, which is exported primarily to Japan.

Known for their vibrant red color during spawning season.

Coho

Value: $$

Develop aggressively hooked jaws during spawning season and dark red coloration along sides.

Prized by private fisherman as powerful fighters. A staple of recreational fishing economies.

Chum

Value: $

The most widely distributed of all Pacific salmon, found farther north in Arctic seas than its related counterparts.

Known for mild-flavor, lower oil content and pale, pink flesh.

Pink

Value: $

Makes up **half of the total wild salmon catch obtained by U.S. fisheries**.

Famous for their humped backs during spawning season. Predominantly canned, though occasionally it is served fresh and whole or smoked.

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[6] Ibid

Atlantic

Value: $

Most commonly farmed species and makes up the majority of total salmon consumed in the U.S. Most is imported from Chile, Canada and Norway – also farmed in Maine and Washington.

Wiped from their native ranges on the Atlantic coast in the early 1800's as a result of industrialization and dam construction.

Salmon facts and images from NOAA[7]

In the U.S., salmon are caught commercially in Alaska, Washington, Oregon, California and even Michigan (after being introduced to the Great Lakes).[8] The timing of spawning runs is species- and population-specific, and can be highly variable depending on environmental conditions such as snow pack, temperature and rainfall. Although wild salmon may be caught year-round in the ocean, the majority are caught before the major spawning runs, which can start as early as March with Chinook salmon, and continue as late as December with coho salmon.[9] Most salmon are caught in the U.S. between May and November, with peak salmon runs happening mid- to late-summer.[10] This is important because in winter months, when fresh wild salmon should be less abundant, it is suspiciously prevalent on American menus. As this report will show, the "freshness" and "wildness" of much of that winter salmon is questionable.

[7] See NOAA Fish Watch. Accessed 10/1/15 at http://www.fishwatch.gov/seafood_profiles/species/salmon/group_pages/index.html
[8] NMFS, Office of Science and Technology. Commercial Fisheries Statistics. Accessed 9/15/15 at http://www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/index.
[9] California Department Fish and Wildlife. "Chinook Salmon." Accessed 9/15/15 from http://www.dfg.ca.gov/fish/resources/chinook/.
[10] NOAA. Office of Science and Technology. Commercial Fisheries Statistics. Accessed 9/15/15 at http://www.st.nmfs.noaa.gov/pls/webpls/MF_MONTHLY_LANDINGS.RESULTS

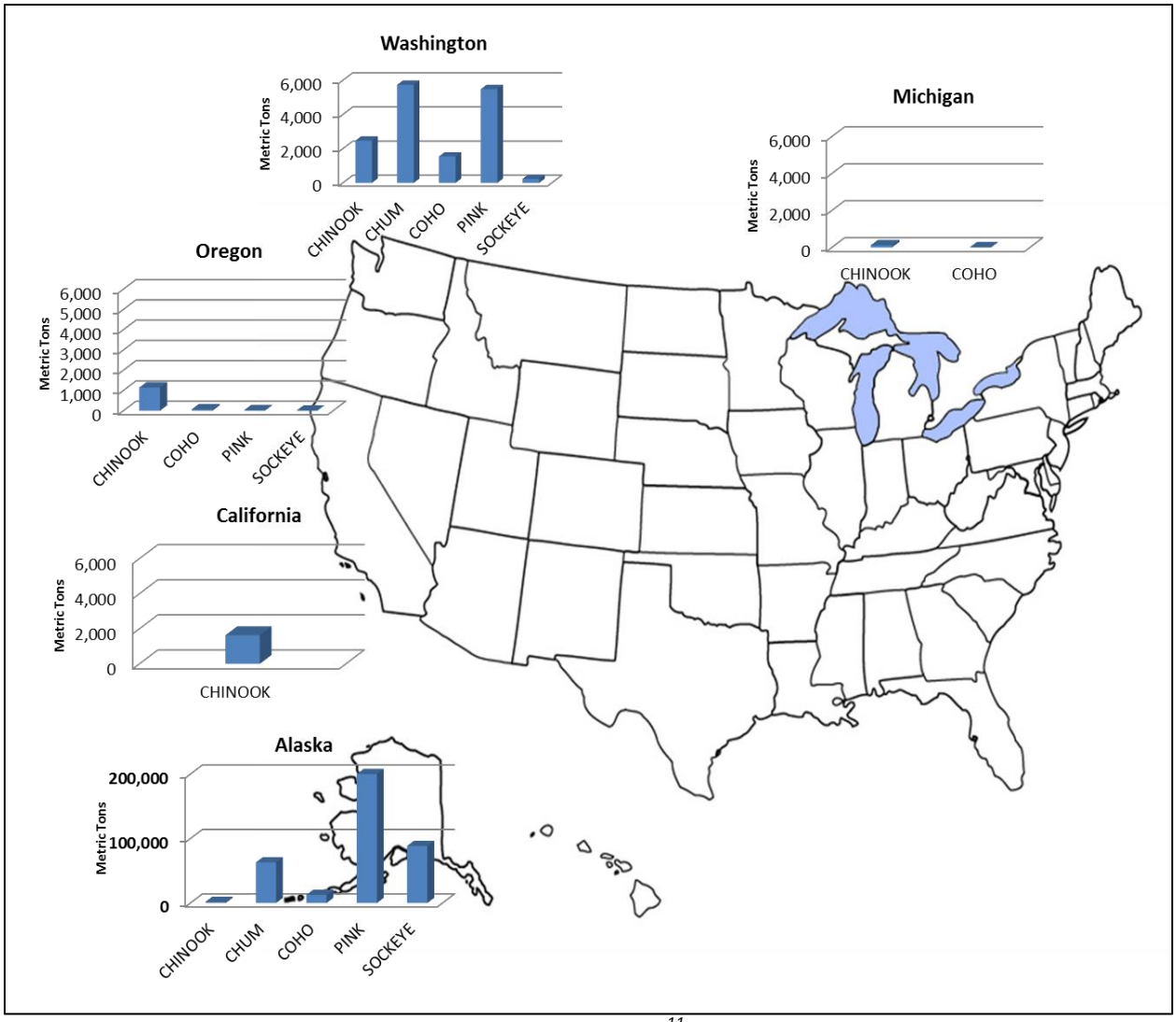

Figure 1: *Average salmon landings in the U.S. (2012-2013).*[11] *Although Alaska catches 95 percent of the salmon in the U.S. (note the different scale used for Alaska), Washington catches the most Chinook.*

Salmon are very sensitive to environmental changes, both man-made and natural. Pollution, dam construction, overfishing, poorly-managed fish farms, overuse of water resources, climate change, ocean acidification and habitat destruction can all negatively impact salmon populations.[12] Eighteen different populations of salmon are protected under the Endangered Species Act (ESA) in the U.S., including all wild U.S. Atlantic salmon and many in the Pacific Northwest.[13] The U.S. Atlantic salmon were wiped out of

[11] Ibid
[12] e.g. Pacific Marine Environmental Laboratory-Carbon Program. Consumption of Carbonate Ions Impedes Calcification . Accessed 9/15/15 from http://www.pmel.noaa.gov/co2/story/What+is+Ocean+Acidification%3F.
[13] NOAA. (2012). Status of ESA Listings and Critical Habitat Designations for West Coast Atlantic Salmon and Steelhead. Accessed 9/15/15 from http://www.westcoast.fisheries.noaa.gov/publications/protected_species/salmon_steelhead/status_of_esa_salmon_listings_and_ch_designations_map.pdf

their native ranges along the East Coast in the early 1800s because of heavy industrialization and dam building. As such, commercial fishing of Atlantic salmon is now prohibited in the U.S.[14]

The level of protection, conservation status and management scheme associated with salmon may vary species by species, state by state, and in some cases, watershed by watershed. So when buying salmon, consumers need to know the species of fish, and where and how it was caught or farmed. The easiest way to check whether salmon is sustainably sourced is to use the Monterey Bay Aquarium's Seafood Watch as a guide,[15] which takes these factors into account when establishing its ratings. For example, wild salmon caught in Alaska is considered to be a "best choice" by Seafood Watch. Wild salmon in all U.S. fisheries, including Alaska, are mostly caught commercially through the use of one of three primary fishing methods: gillnet, seine and trolling. These methods, due in part to the regions and time of year in which they are employed, lead to relatively little ecosystem damage and fewer problems with bycatch, or the unintentional killing of non-target species.[16] Generally, salmon populations are well-monitored and managed in the United States, with most salmon fisheries evaluated in the U.S. receiving a "best choice" or "good alternative" rating from Seafood Watch.[17]

Aquaculture

Farmed salmon makes up an estimated two-thirds of the salmon consumed in the U.S. each year,[18,19] and the vast majority is imported from Chile, Canada and Europe (See Appendix 2). Salmon farmed in Chile, and certain farms in Canada, Scotland and Norway that use open-water net pens, are rated as "avoid" by Seafood Watch due to their negative impact on the surrounding environment, the potential for disease transfer to wild populations, and the liberal use of antibiotics and pesticides.[20] The feeds used on many farms can be highly inefficient, requiring between 1 and 3 pounds of wild fish to produce enough fish oil for 1 pound of farmed salmon.[21] While the industry today depends on less wild fish and fish oil than in the past, the growth in global aquaculture and associated consumption of fishmeal and fish oil raises concerns regarding pressure placed on wild forage fish species. Many of these species are at risk of being overfished, due in large part to their use as feed.[22]

Global Salmon Trade & "Disappearing" American Salmon

The salmon caught in U.S. waters between 2012 and 2013 could have supplied 82 percent of our domestic salmon demand.[23] However, on average, 70 percent of our wild salmon catch is exported to foreign buyers. The majority of the salmon imported to the U.S. is actually farmed. In the 1990s, the U.S. enjoyed a trade surplus in the salmon market, but the current disparity results in a trade deficit from $1.1

[14] NOAA, Fishwatch: Atlantic Salmon. Accessed 9/15/15 at http://www.fishwatch.gov/seafood_profiles/species/salmon/species_pages/atlantic_salmon.htm
[15] Monterey Bay Aquarium (MBA) Seafood Watch, "Salmon Recommendations" Accessed 8/1/15 at http://www.seafoodwatch.org/seafood-recommendations/groups/salmon?q=Salmon&location=domestic
[16] NOAA, "Fishwatch: U.S. Seafood Facts"
[17] MBA Seafood Watch Accessed 9/15/15 at http://www.seafoodwatch.org/seafood-recommendations/groups/salmon?q=Salmon&location=domestic
[18] See NOAA Fish Watch "The surprising sources of your favorite seafoods." Accessed 9 /15/15 at http://www.fishwatch.gov/features/top10seafoods_and_sources_10_10_12.html.
[19] Knapp, G., Roheim, C. A., & Anderson, J. L. (2007). The Great Salmon Run: Competition Between Wild and Farmed Salmon. Chapter 8: Overview of U.S. Salmon consumption. TRAFFIC North America. Accessed 9/15/15 from http://www.iser.uaa.alaska.edu/people/knapp/personal/pubs/TRAFFIC/The_Great_Salmon_Run.pdf
[20] MBA Seafood Watch. (2014) Farmed Atlantic Salmon Fact Sheet. April 2014.
[21] Ibid
[22] Alder, J., Campbell, B., Karpouzi, V., Kaschner, K., Pauly, D. (2008). Forage fish: From ecosystems to markets. *Annual Review of Environmental Resources* 33:153-166.
[23] See Appendix 1

billion to $1.4 billion annually.[24] In short, most of our wild-caught salmon—some of the healthiest, most sustainable and most valuable fish in the world— is being shipped overseas, and most of what we get back is lower-value farmed salmon.

China is the world's largest importer, exporter and processor of seafood by volume.[25] In fact, in 2013, we exported more of our wild domestic salmon to China than to any other country.[26] While this trade relationship has worked well for U.S. business interests seeking cheaper processing costs overseas, significant issues remain concerning traceability and legality of fish entering China.[27] For instance, according to U.S. government trade data for 2013, the U.S. exported around 85,000 metric tons of wild-caught American salmon to China to be processed.[28] Of that number, only 37,000 metric tons of what is presumed to be U.S. domestic salmon was exported back to the U.S. in its new, processed form (e.g. deboned, frozen, etc.), but only 3 percent was returned labeled as a Pacific species.[29] A 2014 study estimated that up to 70 percent of the wild salmon exported to the U.S. via China is illegally caught Russian salmon.[30] Additional investigations have connected Russian salmon to organized crime, poaching and criminal environmental abuse in Russia, as well as corruption and tax evasion that extend to several trading partner countries in East Asia.[31,32,33]

It's unknown exactly how much the American economy loses each year by allowing illegally caught fish to enter our markets, though the amount is likely significant, as salmon trade between the U.S. and China is valued in the hundreds of millions of dollars annually.[34]

Salmon Naming, Labeling & Traceability

Oceana made the case for properly labeling and tracing fish in its recent report One Name, One Fish.[35] Adopting a species-specific name that would follow a fish throughout the entire supply chain is vital for effective traceability, which in turn is necessary to protect the oceans, public health and seafood consumers.

The FDA's Seafood List provides acceptable market names for seafood sold in the U.S.[36] While some acceptable market names can encompass a group of species (the name "grouper," for example, covers 64 fish that can all be sold as "grouper"), the acceptable market names for salmon are all species-specific names like Chinook salmon or sockeye salmon (Table 1). However, the Seafood List is only provided as guidance and is often not followed when it comes to salmon. Today, if a diner orders "salmon" from a restaurant, he or she could be getting the highly valued and sustainably wild-caught Chinook salmon or a farm-raised Atlantic salmon from a poorly managed, large-scale aquaculture facility in another country.

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[24] Ibid
[25] FAO (2014). World Review of Fisheries and Aquaculture, Accessed 9/15/15 at http://www.fao.org/3/a-i3720e/i3720e01.pdf
[26] See Appendix 2
[27] Clarke, S. (2007)*Trading Tails: Linkages between Russian Salmon Fisheries and East Asian Markets*. Traffic.
[28]See Appendix 2
[29] Ibid and Appendix 2
[30] Pramod, G., K. Nakamura, T. J. Pitcher and L. Delagran. (2014). Estimates of Illegal and Unreported Fish in Seafood Imports to the USA. *Marine Policy* 48: 102-113.
[31] Clarke, S.(2007)
[32] Phelps Bondaroff, T. N. *The Illegal Fishing and Organized Crime Nexus*. The Black Fish: Global Initiative Against Transnational Organized Crime and The Black Fish, 2015
[33] The Wild Salmon Center. (2009).*A Review of IUU Salmon Fishing and Potential Conservation Strategies in the Russian Far East*. The Wild Salmon Center,.
[34] See Appendix 2
[35] Lowell, B., Mustain, P., Ortenzi, K., & Warner, K. (2015). One Name, One Fish: Why Seafood Names Matter. Washington, DC: Oceana.
[36] FDA Seafood List. Accessed 9/15/15 at http://www.accessdata.fda.gov/scripts/fdcc/?set=seafoodlist

Without traceability tracking the fish from farm or fishing vessel to the dinner plate, along with more information provided to consumers like species-specific names, the diner can never be sure.

Table 1: FDA Guidance on Acceptable Market Names for Salmon		
Common Name	**Acceptable Market Name**	**Latin Name**
Chinook Salmon	Salmon, Chinook or King or Spring	*Onorhynchus tshawytscha*
Chum Salmon	Salmon, Chum or Keta	*Oncorhynchus keta*
Coho Salmon	Salmon, Coho or Silver or Medium Red	*Oncorhynchus kisutch*
Pink Salmon	Salmon, Pink or Humpback	*Oncorhynchus gorbuscha*
Sockeye Salmon	Salmon, Sockeye or Red or Blueback	*Oncorhynchus nerka*
Atlantic Salmon	Salmon, Atlantic	*Salmo salar*
Danube Salmon[1]	Salmon, Danube	Hucho hucho
Cherry Salmon[2]	Salmon, Cherry	Oncorhynchus masou

[1] *Danube salmon are found only in the Danube River in Europe and comprise a small percentage (1 percent) of 2013 U.S. salmon imports*
[2] *Cherry salmon are native to Asian and Russian waters and do not appear in 2011-2013 U.S. import records*

Confusion deepens when getting into Country of Origin Labeling (COOL) for seafood. COOL regulations are enforced both by the U.S. Department of Agriculture[37] as well as U.S. Customs and Border Protection,[38] under two different sets of rules. Under both agencies' COOL rules, seafood must be labeled with its country of origin, but not necessarily where it was caught and whether it is farmed or wild, unless it has been "transformed" (Custom's rules), or "processed" (USDA's rules). But even "processed" and "transformed" have different definitions and different sets of rules depending on where an item was purchased, the agency involved and the type of seafood. Therefore, consumers cannot rely on the COOL requirements to find out more about their seafood.

The President's Task Force on Combating Illegal, Unreported and Unregulated Fishing and Seafood Fraud is in a position to correct these shortcomings. The Task Force was formed in 2014 to develop recommendations to prevent IUU fishing and seafood fraud, and the final recommendations and action plan were released in March 2015. The Task Force intends to phase in traceability requirements by first starting with a select number of species at high risk of seafood fraud and illegal fishing. At this point, it is not evident that salmon will be included in the first phase of these requirements. Also, the traceability elements would only be required to follow the fish up to the first point of entry into U.S. commerce in the first phase. It is critical that the Task Force expand the documentation requirements to all seafood and extend traceability to the full supply chain to truly tackle these global problems. The Task Force should require that all seafood have catch documentation as a condition to market access. That information, which verifies that the fish was legally caught, should accompany that fish through the supply chain. The final seafood buyer or consumer should find out more about their seafood—including what specific fish it is, where and how it was caught or farmed—so that they can make informed decisions to ensure their seafood is safe, legally caught and honestly labeled.

[37] Country of Origin Labeling for Fish and Shellfish, 7 C.F.R. § 60.101
[38] 19 C.F.R. § 134.1(b)

Winter Salmon: The Investigation

The most frequently sampled type of fish in Oceana's initial 2013 nationwide investigation into seafood fraud was salmon, comprising nearly one-third of all fish samples.[39] Earlier studies had shown salmon fraud to be a problem in the U.S., but Oceana's 2013 report found the overall mislabeling rate for salmon collected from both grocers and restaurants to be comparatively low at 7 percent.[40,41,42]

The majority of those samples were sockeye salmon collected from grocery stores during a time of year when sockeye were in season and plentiful in the market. Oceana researchers reasoned that the timing and locations of that sampling may have contributed to the low rate of mislabeling. To test this, another survey was conducted during winter months (December 2013 through March 2014) in several regions when wild salmon were not in season. Eighty-two samples from a variety of restaurants, large grocery stores and smaller markets were identified using DNA analysis.[43] Only fish sold as "wild salmon" or having some indication thereof (labeled as Pacific, Alaska, or with a species-specific name like sockeye or coho) were tested.

It is important here to revisit labeling and naming of salmon and to describe how Oceana's researchers determined whether a fish was mislabeled or not. The FDA guidelines offer inconsistent and murky principles for naming seafood. One principle indicates that scientific common names for seafood are the "acceptable market names," as delineated in the FDA Seafood List guidance.[44] In the case of salmon, acceptable market names follow this principle and are species-specific, like coho or sockeye. According to this principle then, fish sold simply as "wild" or "Pacific" salmon would be mislabeled. However, another principle says that it is okay to label fish with "names that are recognized nationally or commonly used by consumers to identify a species." By this principle, fish sold as "wild salmon" would not necessarily be considered mislabeled, as long as the salmon was indeed wild and not farmed.

Oceana used the latter principle—a more conservative interpretation of mislabeling—for this analysis. Had the researchers used the FDA's first principle for naming seafood, there would actually be higher rates of mislabeling than were described in this report. It should also be noted that requiring one name for one fish, as Oceana has recommended, would reduce the confusion inherent in current seafood naming and labeling guidance.

A sample labeled as wild, Pacific or Alaska, but with no species common name, was not considered mislabeled if it was genetically identified as any one of the wild, Pacific or Alaska salmon species (Chinook, sockeye, coho, pink or chum). For example, if a species was sold as Pacific salmon, and DNA testing revealed that it was sockeye salmon, that sample would not be considered mislabeled. It is true that a small amount of Pacific salmon is now being farmed, and a very limited amount of wild Atlantic salmon are wild-caught in Europe. However, based on an analysis of trade data on salmon being imported to the U.S., the researchers made the assumption that virtually all Pacific salmon species identified by DNA testing were wild and that all Atlantic salmon species were farmed.[45]

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[39] Warner, K., Timme, W., Lowell, B., & Hirschfield, M. (2013). Oceana study reveals seafood fraud nationwide. Washington, DC: Oceana.
[40] Burros, M. (2005). Stores say wild salmon, but tests say farm bred. *New York Times*. April 10, 2005
[41] Consumer Reports (2006). The salmon scam: "wild" often isn't. *Consumer Reports,* 15. August 2006
[42] Cline, E. (2012). Marketplace substitution of Atlantic salmon for Pacific salmon in Washington State detected by DNA barcoding. *Food Research International, 45*, 388-393. doi: 10.1016/j.foodres.2011.10.043
[43] Samples were analyzed for species identity via DNA Barcoding at the Canadian Centre for DNA Barcoding in Guelph Canada.
[44] FDA Seafood List Guidance Accessed 9/15/15 at http://www.fda.gov/Food/GuidanceRegulation/ucm113260.htm
[45] Less than 1% of 2013 U.S. salmon imports were farmed Pacific salmon or wild Atlantic salmon. See NOAA Office of Science and Technology. Commercial Fisheries Statistics http://www.st.nmfs.noaa.gov/commercial-fisheries/foreign-trade/applications/annual-product-by-countryassociation

Overall, 43 percent of winter salmon samples were mislabeled – a large increase over the 7 percent mislabeling rate found in the 2013 survey (Table 2). The out-of-season salmon mislabeling rates were more than three times higher in restaurants (67 percent) versus grocery stores (20 percent). Salmon fraud varied by region as well. Mislabeling was highest in Virginia restaurants, where eight of nine samples collected (89 percent) were mislabeled. Eight of 11 samples from Washington, D.C. restaurants were mislabeled. New York City had the lowest restaurant mislabeling rate, at 38 percent, but the highest grocery and market mislabeling, at 36 percent.

Table 2: Winter Salmon Mislabeling 2013/2014[1]

	Percent Mislabeled		
Region	**All**	**Restaurant**	**Grocery/Market**
All regions	43 % (35/82)	67 % (27/41)	20 % (8/41)
Virginia	48 % (10/21)	89 % (8/9)	17 % (2/12)
Washington, DC	45 % (9/20)	73 % (8/11)	11 % (1/9)
Chicago, IL	38 % (5/13)	71 % (5/7)	0 % (0/6)
New York City	37 % (10/27)	38 % (5/13)	36 % (5/14)

[1]*See Appendix 3 for detailed sample results, including the one restaurant result for Savannah, GA.*

The most common form of mislabeling was farmed Atlantic salmon being sold as “wild salmon.” There were also six instances in which supposed high-value Chinook or king salmon were actually farmed Atlantic, and one in which the cheaper chum salmon was sold as king salmon. It appears vague names, like “wild,” “Alaskan” and “Pacific,” lent themselves to higher mislabeling rates. With the exception of the lucrative Chinook/king salmon substitutions, none of the fish that featured a species-specific name was mislabeled (the one “silverbrite” sample does not count, since “silverbrite” is not an acceptable market name) (Figure 2).

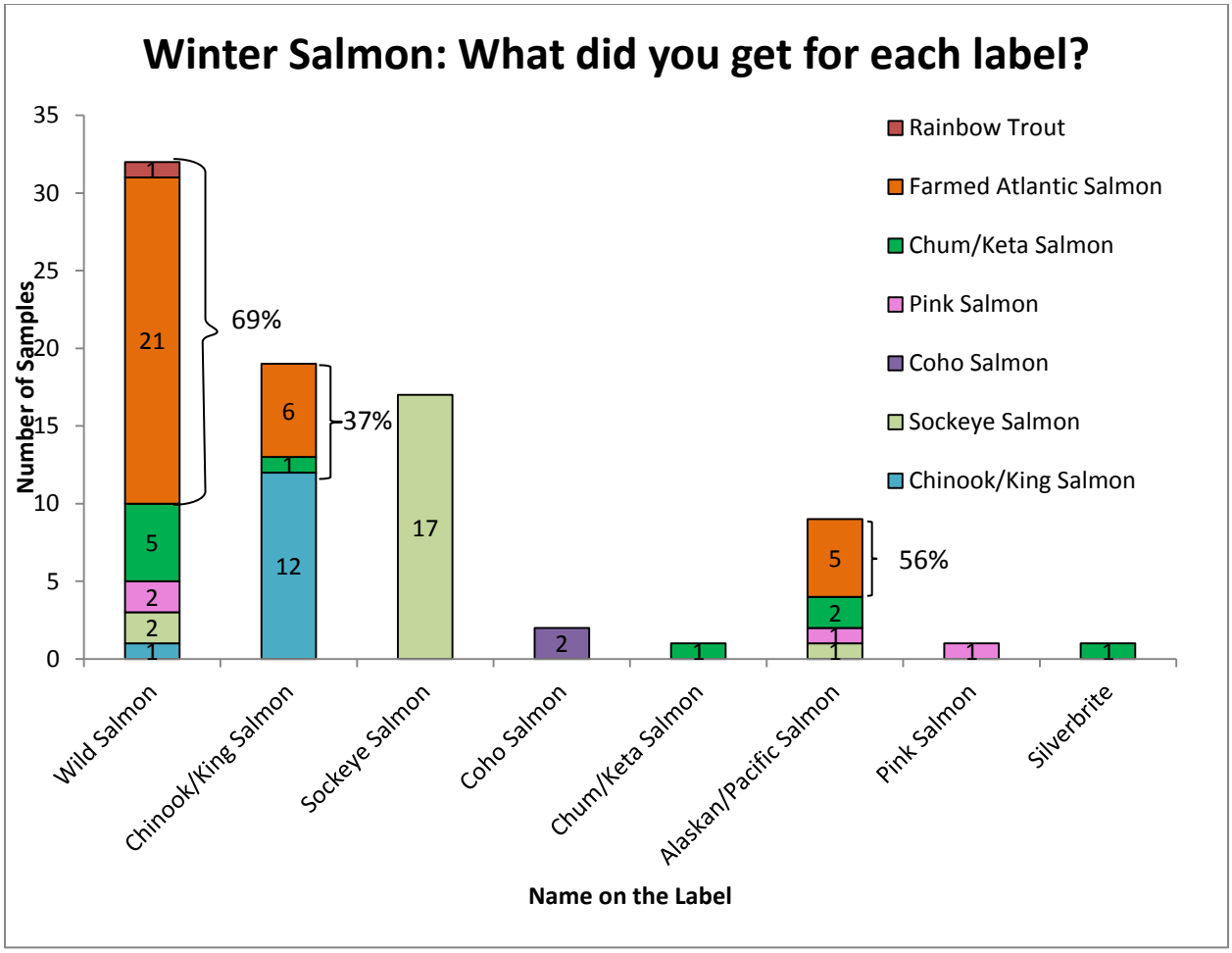


Figure 2: *Salmon species identified as sold under each label during winter 2013/2014 sampling. Percentages reflect the amount of mislabeling in each label.*

The Bigger Picture: Combining the Data

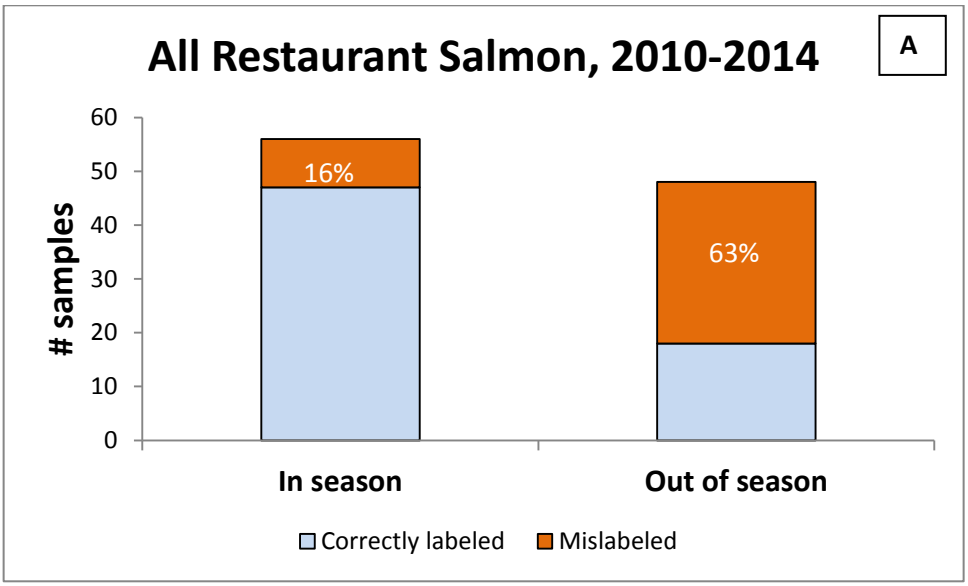
To get a more robust picture of salmon mislabeling, Oceana's investigators combined the 384 salmon samples from the 2013 national seafood fraud report with the 82 samples from this winter salmon survey. This data set of 466 samples[46] represents the largest single study of salmon mislabeling in the U.S., covering fish purchased from 2010 through 2014, in over 100 municipalities in 19 states and the District of Columbia. Salmon were purchased from all types of retail outlets, including fish markets, small and large grocers, sushi venues, and casual and fine dining establishments.

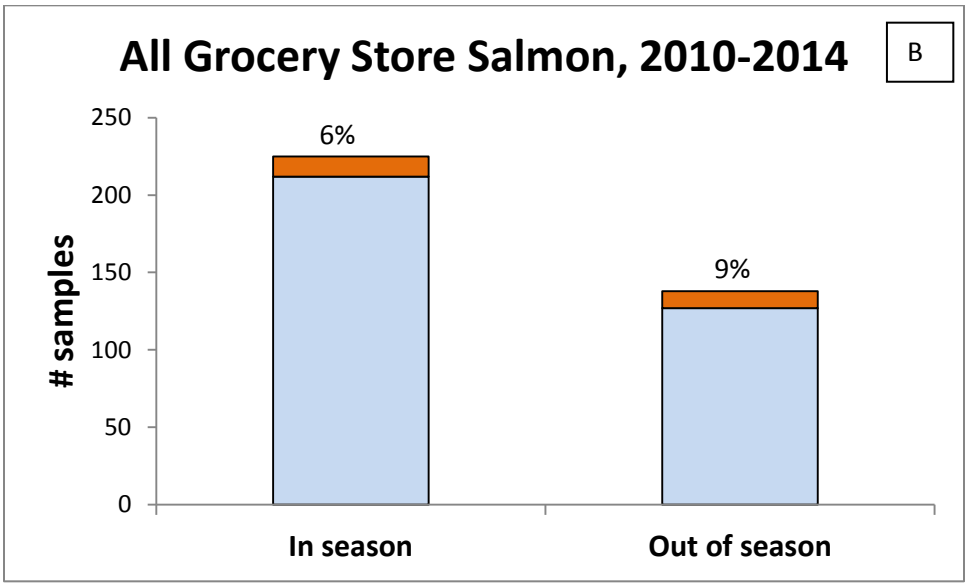
The overall salmon mislabeling rate, regardless of season and type of venue, was 14 percent, double the rate from the 2013 report. However, when teasing out purchase retail type and season, a starker picture emerged. Diners were five times more likely to be misled in restaurants than grocery stores, regardless of

[46] The data set includes 281 in-season (May-Nov) and 186 out-of-season (Dec-April) samples; 363 from grocery stores and 104 from restaurants.

season (38 vs. 7 percent) Salmon purchased out-of-season from all retail types was three times more likely to be mislabeled than salmon purchased in-season (23 percent vs. 8 percent, respectively).

Looking at both the season and the place of purchase in the combined data set revealed a clear pattern: salmon purchased in restaurants in winter months had the highest likelihood of being mislabeled (63 percent), consistent with what was found in the smaller winter survey (Fig. 3a). Salmon purchased in grocery stores, regardless of season, were the most likely to be properly labeled (Figs 3b). Samples obtained from smaller local markets (61) were far fewer than those collected from large national or regional chains (302), but shoppers in small markets were eight times more likely to get mislabeled salmon than shoppers in large grocery chains (25 vs. 3 percent, respectively).





Figures 3 A & B: *Effect of salmon season and retail type on salmon mislabeling in U.S. Note the different scale for A & B.*

What This All Means

This investigation demonstrated that salmon mislabeling and species substitution is widespread, but varies depending on when and where salmon is purchased — findings that are similar to what others have found in some smaller regional studies.[47,48] Consumers are most likely to get what they pay for if purchasing salmon at a large grocery store, as opposed to a small market. Selections called "wild salmon" purchased at a restaurant, especially in the winter, are more likely to be mislabeled.

Not only does this kind of mislabeling cheat consumers out of getting the higher-value fish they expect, but it also can mislead consumers into thinking they are getting more sustainably caught fish that support domestic economies, rather than lower-value, potentially ecologically damaging substitutions. If all seafood (including salmon) were required to be accompanied by information like species-specific names, where and how a fish was caught or if it was farmed, then it would be more difficult to intentionally defraud consumers.

The U.S. has some of the highest-quality salmon, caught by responsible fishermen, in some of the best-managed fisheries in the world. Yet most of the salmon we consume is lower-value, imported fish, supporting farming practices that can be detrimental to the environment. In some cases, the purchase of America's favorite fish may even be even supporting organized crime as well as governments that are poor stewards of natural resources. If more Americans were aware of these issues, we might see a purchasing shift toward the more sustainable, domestic salmon. But for that to happen, people need to know where their fish was caught or if it was farmed as well as its real name.

The Presidential Task Force on Combating IUU Fishing and Seafood Fraud is poised to create new rules to close our markets to pirate fishing and protect consumers and seafood buyers. Catch documentation for all seafood, full-chain traceability and making more information available to consumers would help ensure that all seafood sold in the U.S., including salmon, is safe, legally caught and honestly labeled.

Until that happens, below are a number of ways consumers can reduce their chances of falling victim to a bait and switch when buying salmon:

- Ask questions. Seafood buyers should ask more questions, including what kind of fish it is, if it is wild-caught or farm-raised, and where and how it was caught.
- Support traceable seafood. If the seafood has a story, you are more likely to be getting what you paid for. Products that included additional information for consumers, like the type of salmon (Chinook, king, coho, etc.), were less likely to be mislabeled.
- Check the price. If the price is too good to be true, it probably is. You may be purchasing a different fish than what is on the menu or label.

[47] Consumer Reports (2006)
[48] Cline (2012)

Appendices

Appendix 1: Global Salmon Trade and U.S. Demand-Methodology

Oceana calculated an estimated average U.S. salmon demand for 2012 and 2013 as follows:

{Landings (3386663) + Imports (356484)} – Exports (271200) = Demand (471947) tons round weight, (2012/2013 averages).

When compared to round weight U.S. landings, Oceana determined that U.S. fishermen catch enough wild salmon to supply 82 percent of our *national demand* (i.e. (Imports+Landings)-Exports), while exporting 70% of that total catch abroad (based on round weight comparisons between exports and landings). These findings are consistent with those cited in Greenberg.[49] Because the U.S. does not track how much of our domestic wild salmon is returned to the U.S. as processed salmon imports, we can only be assured that, on average, 24% of the salmon consumed in the U.S. is of domestic origin, i.e. ((landings-exports)/ demand).

All trade data were converted to (metric ton) round weight to be consistent with landings data which are reported in round weight. Trade weight conversion factors for whole fish (1.15) and fillets [and cured] (1.3) were taken from Tate[50], while canned salmon conversion factors (1/0.66) were the average of canned conversion factors reported in Knapp et al.[51]

Salmon landings and trade data for 2012/2013 were obtained mostly from the 2013 Fisheries of the U.S. (FUS)[52] but supplemented with NOAA trade statistics for imported cured salmon and roe for 2012 and 2013[53], which were not included in the 2013 FUS.

Trade Deficit

The trade deficit was determined by calculating the difference between imports and exports, using averages of 2012 and 2013 dollar values from the NMFS trade statistics database.[54] The trade deficit utilized averages of 2012/2013 statistics in order to remain consistent with earlier calculations.

[49] Greenberg, P. (2014). *American Catch: the Fight for our Local Seafood*. New York: Pengun Press.

[50] Tate, M. *Oregon Adminstrative Rules.* Edited by Department of Fish and Wildlife. 2015. Accessed 9/15/15 at http://www.dfw.state.or.us/OARs/recently_adopted/Tribal%20Dressed%20Salmon%20ef%205-1-15.pdf

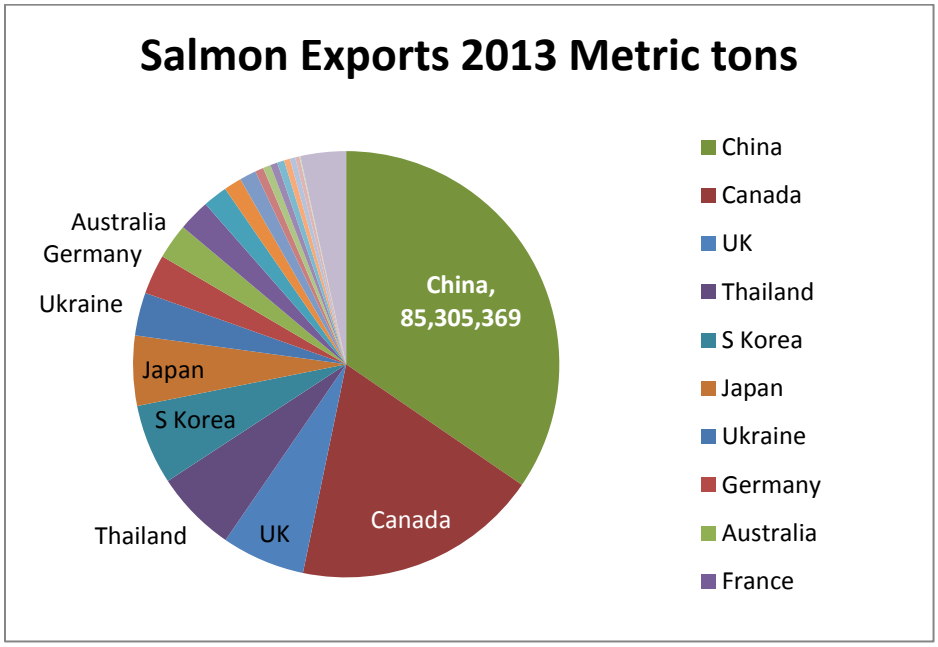
[51] Knapp, G., C. A. Roheim and J. L. Anderson. 2007 *The Great Salmon Run: Competition between Wild and Farmed Salmon*. TRAFFIC North America; World Wildlife Fund,

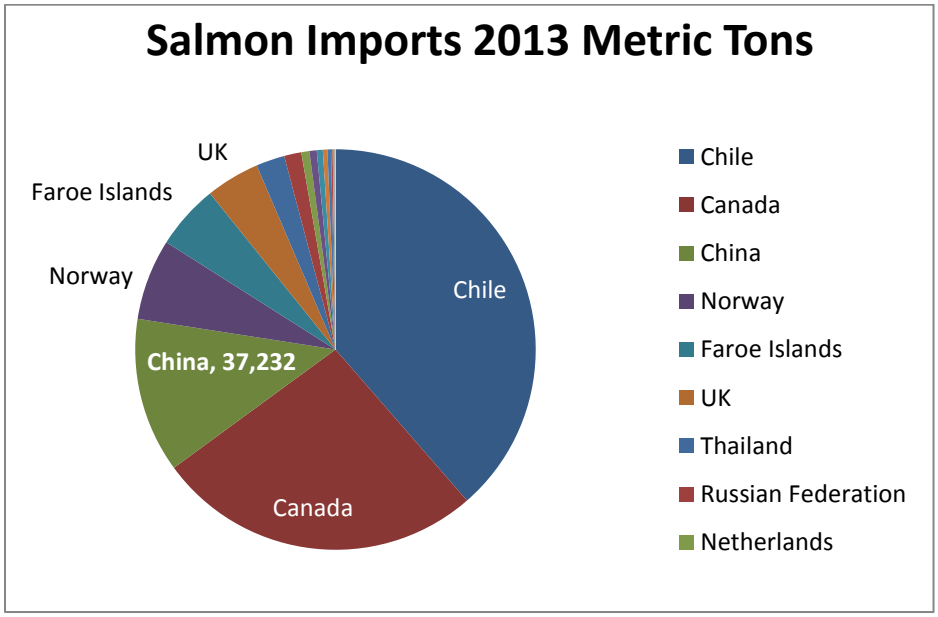
[52] NOAA Office of Science and Technology. 2013 *Fisheries of the United States 2013*. National Oceanic and Atmospheric Administration.

[53] NOAA Office of Science and Technology, "Annual Trade Data by Product, Country/Association", National Marine Fisheries Service http://www.st.nmfs.noaa.gov/commercial-fisheries/foreign-trade/applications/annual-product-by-countryassociation (accessed August, 2015).

[54] Ibid

Appendix 2: U.S. Salmon Exports[55] and Imports[56] for 2013 and Trade with China





[55] Ibid
[56] Ibid

China – U.S. Trade

The value of Chinese-U.S. salmon trade was reached by accessing the U.S. NMFS trade statistics database for imports and exports of salmon to China over the years 2011-2014. For each year assessed, imports were listed as being valued at, at-least, $200,000,000 (see table below). As a total valuation of trade, the U.S.-China salmon trade is worth roughly $470,000,000 on average, or "hundreds of millions of dollars annually."

Table A1: U.S.-China Salmon import and export value

Year	Imports $	Exports $	Sum $	Yearly average ($)
2011	243000000	306665000	549665000	
2012	212700000	209660000	422360000	
2013	207600000	242300000	449900000	
2014	245000000	215400000	460400000	**$470,581,250**

Data source: http://www.st.nmfs.noaa.gov/commercial-fisheries/foreign-trade/applications/monthly-product-by-countryassociation

Oceana used the NMFS trade statistics database for the salmon trade between the U.S. and China in the years 2012 and 2013 as a data source, and sorted the salmon imports and exports by product name, noting the total weight of each product type listed, and averaged the 2012 and 2013 data.[57] This analysis revealed that while U.S. exports of wild salmon to China are 97% properly named (by species-56 percent pink, 36 percent chum, 5 percent sockeye, only 3 percent "not-specified"), salmon imports from China are predominantly categorized as "not-specified." Specifically, imports of salmon from China are 74 percent "not-specified"; 20 percent Atlantic (most likely farmed); 3 percent "salmon fillet blocks frozen"; and 3 percent pink salmon. In summation, the U.S. exports to China, wild salmon that is 97 percent correctly labeled by species, and then imports from China 97 percent "not-specified" or farmed salmon. This naming and labeling issue likely allows illegally caught Russian salmon to enter the US (as was discussed previously in the report).

Appendix Table A2: List of mislabeled salmon collected in the U.S. from 2010-2014

Type of salmon (#mislabeled/ #total)	**Salmon label**	**Species ID**	**Scientific common name (FDA market name)**	**Retail code[1]**	**Year**	**City, State**
Salmon, Wild (29/65)	salmon, wild	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Chicago, IL
	salmon, wild	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Chicago, IL
	salmon, wild	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Chicago, IL
	salmon, wild	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Chicago, IL

[57] Ibid

salmon, wild	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Silver Spring, MD
salmon, wild	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Washington, DC
salmon, wild	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Washington, DC
salmon, wild	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Washington, DC
salmon, wild	*Salmo salar*	salmon, Atlantic (Atlantic salmon)	M	2012	Los Angeles, CA
salmon, wild	*Salmo salar*	salmon, Atlantic (Atlantic salmon)	S	2011	Fort Lauderdale, FL
salmon, wild	*Salmo salar*	salmon, Atlantic (Atlantic salmon)	R	2011	Fort Lauderdale, FL
salmon, wild	*Salmo salar*	salmon, Atlantic (Atlantic salmon)	R	2012	Queens, NY
salmon, wild	*Salmo salar*	salmon, Atlantic (Atlantic salmon)	G	2012	New York, NY
salmon, wild	*Salmo salar*	salmon, Atlantic (Atlantic salmon)	M	2012	Forest Hills, NY
salmon, wild	*Salmo salar*	salmon, Atlantic (Atlantic salmon)	M	2012	New York, NY
salmon, wild	*Salmo salar*	salmon, Atlantic (Atlantic salmon)	G	2012	Kew Gardens, NY
salmon, wild	*Oncorhynchus mykiss*	trout, rainbow (trout, rainbow or steelhead)	M	2012	New York, NY
salmon, wild	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	M	2014	New York, NY
salmon, wild	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	M	2014	New York, NY
salmon, wild	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	New York, NY
salmon, wild	*Oncorhynchus mykiss*	Rainbow Trout (trout, rainbow or steelhead)	R	2014	New York, NY
salmon, wild, organic	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	New York, NY
salmon, wild	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Long Island City, NY
salmon, wild	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Astoria, NY
salmon, wild	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	S	2012	Portland, OR
salmon, wild	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Savannah, GA

	salmon, wild	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Norfolk, VA
	salmon, wild	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Newport News, VA
	salmon, wild	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Richmond, VA
Salmon, labeled by location (7/35)	salmon, wild, Alaska	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Chicago, IL
	salmon, wild, Canada	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	M	2014	Washington, DC
	salmon, wild, Alaska	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Washington, DC
	salmon, Pacific	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2012	San Francisco, CA
	salmon, wild, Canada	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	M	2014	Williamsburg, VA
	salmon, Pacific	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Norfolk, VA
	salmon, wild, Faroe Island	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Virginia Beach, VA
	salmon, wild, Pacific	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Fredericksburg, VA
	salmon, wild, Alaska	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Richmond, VA
	salmon, wild, Atlantic	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	G	2014	Astoria, NY
Salmon, King or Chinook (14/77)	salmon, king	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Washington, DC
	salmon, king	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Silver Spring, MD
	salmon, king	*Oncorhynchus keta*	salmon, chum (salmon, chum or keta)	R	2014	Falls Church, VA
	salmon, king Alaska	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2011	Miami, FL
	salmon, king	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	G	2012	New York, NY
	salmon, king	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2012	New York, NY
	salmon, king Scottish wild	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	M	2012	New York, NY
	salmon, wild, king	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	G	2014	New York, NY

	salmon, wild, king, USA	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	M	2014	New York, NY
	salmon, king wild	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	S	2012	Astoria, OR
	salmon, king wild	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	S	2012	Portland, OR
	salmon, king	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	M	2012	San Francisco, CA
	salmon, king	*Oncorhynchus kisutch*	salmon, coho (salmon, coho or silver or medium red)	G	2012	San Francisco, CA
	salmon, king	*Salmo salar*	Atlantic Salmon (salmon, Atlantic)	R	2014	Williamsburg, VA
Salmon, Sockeye (5/205)	salmon, sockeye Alaskan	*Oncorhynchus keta*	salmon, chum (salmon, chum or keta)	G	2012	Seal Beach, CA
	salmon, sockeye	*Oncorhynchus kisutch*	salmon, coho (salmon, coho or silver or medium red)	R	2012	New York, NY
	salmon, sockeye	*Salmo salar*	salmon, Atlantic (Atlantic salmon)	G	2011	Laguna Beach, CA
	salmon, sockeye	*Oncorhynchus tshawytscha*	salmon, chinook (salmon, chinook or king or spring)	M	2012	Davis, CA
	salmon, sockeye wild Alaskan	*Oncorhynchus tshawytscha*	salmon, chinook (salmon, chinook or king or spring)	R	2012	Seattle, WA
Salmon, Coho (3/27)	salmon, coho	*Oncorhynchus tshawytscha*	salmon, chinook (salmon, chinook or king or spring)	G	2012	Santa Fe, NM
	salmon, coho	*Oncorhynchus nerka*	salmon, sockeye (salmon, sockeye or red or blueback)	G	2012	New York, NY
	salmon, coho Alaskan	*Oncorhynchus nerka*	salmon, sockeye (salmon, sockeye or red or blueback)	R	2012	Portland, OR
Salmon, Keta/chum (1/7)	salmon, keta	*Oncorhynchus gorbuscha*	salmon, pink (salmon, pink or humpback)	G	2012	Austin, TX
Salmon, silverbrite[2] (2/2)	salmon, wild, silverbrite, USA	*Oncorhynchus keta*	salmon, chum (salmon, chum or keta)	G	2014	Virginia Beach, VA
	salmon, silverbrite, wild, US	*(no data)*		G	2014	Falls Church, VA

[1] *G: grocery store; M: market; R: Restaurant; S: Sushi venue.*

[2] *"Silverbrite" is not an acceptable market name for any salmon species*