https://doi.org/10.25923/mcrz-7454

NOAA Technical Memorandum NMFS

MAY 2024

ECONOMIC INFORMATION FOR AQUACULTURE OPPORTUNITY AREAS OFF SOUTHERN CALIFORNIA

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NOAA-TM-NMFS-SWFSC-697

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Science Center

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Recommended citation

Dealy, Donna D., James R. Hilger, and Stephen M. Stohs. 2024. Economic information for Aquaculture Opportunity Areas off Southern California. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-697.
https://doi.org/10.25923/mcrz-7454

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Acronyms and Abbreviations

AOA	Aquaculture Opportunity Area
CA	California
NCCOS	National Centers for Coastal Ocean Science
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
PEIS	Programmatic Environmental Impact Statement
SME	Subject Matter Expert
US	United States
WCR	National Marine Fisheries Service West Coast Region

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INTRODUCTION

An Aquaculture Opportunity Area (AOA) is a defined geographic area that has been evaluated to determine its potential suitability for commercial aquaculture (NOAA AOA Website). NOAA is engaged in a process of identifying AOAs off Southern California (WCR AOA Website). The areas under consideration for identification as AOAs in Southern California are offshore but inside the Southern California Bight and the Exclusive Economic Zone (EEZ) of the West Coast. This report provides relevant economic information for areas under consideration for identification as AOAs in the Southern California Bight.

We broadly consider species of interest to aquaculture off Southern California, not limited to a predetermined list of species which may be produced inside AOAs. This approach reflects several considerations: (1) production is not limited to any predefined group of species, (2) future technological developments may increase the range of species that could be produced inside AOAs, and (3) existing aquaculture production outside AOAs is economically relevant to future aquaculture production that may occur inside AOAs.

The following section provides a discussion of economic concepts relevant to AOAs off Southern California along with related references. The next section summarizes insights provided from a series of unstructured interviews with a group of fewer than ten anonymous subject matter experts (SMEs) on the economic potential for aquaculture development off Southern California and related challenges. Following this we present data on seafood imports to the US West Coast. The remainder of the report includes discussion and conclusion sections. Four appendices add 1. information about a potential production possibility frontier analysis, 2. a detailed description of oyster aquaculture, 3. import figures, and 4. import tables.

1. RELEVANT ECONOMIC CONCEPTS

A number of concepts from economics may be helpful to inform discussion of AOAs in Southern California. The following discussion aims to identify relevant economic concepts and provide related references.

1.1. Import Reliance, Food Security, and Trade Leakage

The United States (US) currently relies heavily on imports to meet its seafood consumption demand, including imported aquaculture products. This situation raises issues of food security and trade leakage which could potentially be addressed through increased US aquaculture production.

While many coastal nations have greatly expanded their aquaculture production over recent decades, the US has not kept pace. For example, since 2000, Norway's farmed salmon production expanded threefold from 0.44 to 1.4 million metric tons, while US aquaculture production remained relatively constant at around 0.4 metric tons a year. Meanwhile, US seafood production fails to meet US consumer demand, as the US imports at least two thirds of the seafood to meet its consumption needs, with about half of these imports provided by other nations' aquaculture production (Rubino, Helvey et al.). Such a heavy reliance on imports and, particularly, imported aquaculture products raises a question of whether the US could increase its food security by allocating more of its coastal resources to aquaculture production (Garlock et al.).

A related concern to reliance on imports is trade leakage (Helvey et al.), which results in increased environmental externalities of foreign sector seafood production to support US consumption of imported seafood. Avoiding domestic aquaculture development in favor of a heavy reliance on imported aquaculture may result in trade leakage of US aquaculture consumption with negative impacts on other nations' environments. US aquaculture development subject to appropriate environmental safeguards offers a possible means to increase US aquaculture production, reducing the leakage effects of overreliance on foreign aquaculture production.

1.2. Economic Production

Concepts from the economic theory of production are useful for framing and estimating potential future growth in US seafood production through aquaculture development (Asche et al, Squires, Coelli et al.). Economic productivity is a measure of output relative to the inputs to a production process. A technology is a specific method for producing output; for example, capture fisheries and aquaculture can be described as alternative technologies for seafood production. More broadly, seafood production encompasses a spectrum of production practices, including hybrids such as salmon hatcheries that support wild capture fisheries, tuna and eel fattening, crop rotation of scallops, and herring catch used as bait in lobster pots.

Production that is technically efficient produces the largest possible amount of output for a given level of inputs, and a production function provides a mathematical description of the technically efficient level of production as a function of the levels of inputs. Production may change on the extensive margin, for example due to increasing the number of aquaculture farms in production or reducing available areas for capture fishery operation, or on the intensive margin, if for example technological change enables increased catch per unit of effort in capture fisheries operations or if improved growing methods leads to an increase in aquaculture yields.

A useful conceptual tool for describing technical efficiency is the production possibility frontier, a function that mathematically describes the maximum output which can be produced for a given level of inputs (Coelli et al. 2005, Iliyasu et al. 2014, Sickles and Zelenyuk 2019). Generically, for the simple case of a single output y and a vector of inputs to the production process x, a production function $y = f(x)$ determines y as the maximum possible output that can be produced using input levels x and the production technology associated with f. The single-output production function has been generalized to describe production technologies that use multiple inputs to produce multiple outputs (Mas-Colell, Whinston, and Green).

A potential approach to estimating a production possibility frontier for aquaculture production inside areas under consideration for identification as an AOA in Southern California is described in Appendix I.

1.3. Potential Future Growth in US Seafood Production

Large-scale future growth in US seafood production is likely to primarily come from the aquaculture sector (Anderson et al. 2019). Since the advent of modern fishery management in the latter half of the twentieth century and the establishment of exclusive economic zones out to 200 nautical miles from the coast, capture fisheries management in developed countries has focused on science-based management to maintain biological stocks at levels that maximize sustainable yields (Miles). While US fisheries management under the Magnuson–Stevens Fishery

Conservation and Management Act has produced numerous success stories regarding different biological stocks of fish being rebuilt to sustainable levels of production, there is a limit of biological carrying capacity beyond which further increases in capture fishery production become infeasible.

By contrast, the Blue Revolution led to aquaculture greatly increasing seafood production yields from areas in excess of potential wild seafood production from the same area (Andersen et al.). In US coastal waters, potential aquaculture growth exists at both the extensive margin, through developing aquaculture operations where they don't currently exist, and at the extensive margin, through technical change to increase production rates.

1.4. Allocative Efficiency Measures

One possible role of economics in AOA identification and aquaculture permitting is to provide a framework to guide decision making. While stakeholders naturally view decisions through the lens of their own self-interests, economic theory defines alternative metrics for measuring the efficiency of an allocation of production opportunities. Understanding these efficiency principles may yield insights to challenges in obtaining the social license to develop aquaculture in areas with existing production activities, such as ecotourism, recreational fishing, commercial fishing, and military operations.

A Pareto improvement is defined as a change to an allocation which makes at least one individual better off without making any other individual worse off. Pareto efficiency is defined as an allocation where no further Pareto improvement is possible, since no individual can be made better off without making another individual worse off (Mas-Colell, Whinston and Green). A Pareto efficient allocation is considered optimal because any potential change to the allocation would make someone worse off.

An alternative efficiency metric is given by Kaldor-Hicks, where each individual's utility is measured numerically, with the level of utility monotonically increasing in the numeric value (Stringham, Heath). The Kaldor-Hicks efficiency metric is typically monetary, with an allocation deemed optimal when the highest possible additive measure of utility across individuals in the allocation is obtained. These two metrics of efficiency may be reconciled by noting that a change from the current allocation to a Kaldor-Hicks optimum may be brought to Pareto optimality by compensating everyone whose interests are harmed out of the gains of those who benefit.

Understanding the difference between Pareto and Kaldor-Hicks measures of allocative efficiency may yield insights to the challenges with obtaining the social license to move forward with aquaculture development in US coastal waters. While the Kaldor-Hicks measure may favor aquaculture development, due to increased potential seafood yields in areas where aquaculture is developed, the Pareto efficiency measure may be a better conceptual model of conflicts that need to be resolved for aquaculture development in waters off the US West Coast to move forward.

The Kaldor-Hicks optimality measure could support claims that aquaculture development would be socially beneficial, due to greatly increasing the productive yield per unit of water surface reallocated from existing uses to aquaculture, in excess of the value of any related loss of existing production. Existing users of areas proposed for aquaculture development may counter that such reallocation will deprive them of access to portions of the marine environment they utilize as a source of livelihood, making them worse off and failing to achieve Pareto optimality. Unless compensation is offered to the individuals whose interests are compromised by aquaculture development, strong political opposition to aquaculture development may arise among those whose interests could be harmed. The perception that the interests of existing users may be harmed can create a powerful impediment to aquaculture development, even if such development may represent a net gain when measured in cost-benefit terms by the Kaldor-Hicks metric.

1.5. Production Externalities

Production externalities are a byproduct of a production process which imposes external costs or benefits on nonparties to the market transaction between producers and consumers of the market product. Externalities may be negative, meaning they harm the interests of nonparties to a market transaction, or positive, in the case of a beneficial effect. Classic examples of negative externalities include air pollution due to manufacturing or electrical power generation. Positive externalities could result if a production activity leads to a serendipitous reduction in environmental pollution or if establishing a flower garden created viewing pleasure to others besides the gardener.

Concerns over production externalities have impeded aquaculture development in the US (Anderson et al. 2019). Numerous negative externalities have been identified related to aquaculture operations as they exist around the world, including viewscape, perceived risk of reduced real estate values, eutrophication due to concentrated production of fish waste products and detritus, heightened risk of transfer of pathogens and parasites that may cause disease outbreaks in wild stocks due to increased population density compared to in situ and pollution if discharge of chemicals or antibiotics are in aquatic health management or cleaning of equipment, used to reduce disease risk, release of nonnative species into surrounding wild populations, negative impacts on wild populations due to removals to provide food or brood stock for aquaculture, and access to water and port resources. However, US management under the Magnuson-Stevens Fisheries Conservation and Management Act limits potential impacts of removals from wild forage fish populations to support aquaculture through management to optimize yield. Furthermore, a future switch to using vegetable- or algae-based feeds to substitute for fishmeal and fish oil could reduce pressure on wild forage populations (Anderson et al. 2019).

Many production externalities of aquaculture stem from concentrating marine populations into a much smaller space than wild populations exist *in situ*. The use of space for aquaculture may preclude other uses, and without well-defined property rights or regulation, the space is nonexcludable (Asche et al. 2022).

Congestion externalities refer to external effects that are limited or nonexistent at low levels of production, but which increase with a concentration of activity. A classic example of a congestion externality is freeway congestion, which is limited or nonexistent when few cars are on a roadway, but which increases and eventually leads to gridlock as traffic density increases (Mosquera 2019). In the aquaculture context, congestion externalities may occur at the production site, if a concentration of aquaculture operations crowds out the opportunity for traditional users of the area to pursue their operations; at the port level, if new aquaculture production displaces capacity for landing fish caught by traditional means; and in the marketplace, if aquaculture-produced fish displaces capture-fishery product.

In some cases, aquaculture development may also lead to positive externalities. Possible examples include kelp and mussel and fish aquaculture, where growing operations will provide habitat for kelp bass and other species; filter feeder aquaculture, where growing a food product provides water purification services; and aquaculture infrastructure serendipitously acting as fish aggregating devices, increasing catch rates in surrounding waters (Theuerkauf et al. 2019, Theuerkauf et al. 2020).

Beyond understanding the various types of negative externalities associated with aquaculture operations and developing appropriate technological and regulatory approaches to address them, it is important to recognize that all food production systems have environmental externalities which come as an unintended consequence of providing for human sustenance. Rather than narrowly focusing on various potential harmful effects of aquaculture production, a more productive conversation could start with recognizing the intrinsic environmental impacts of all human food production systems and develop strategies for balancing negative environmental impacts against societal benefits, whether such production is terrestrial or aquatic (Froehlich et al.).

1.6. Economies of Scope

Economies of scope are efficiencies associated with sharing inputs to broaden the scope production to serve a range of purposes. Some aquaculture opponents assume that aquaculture development would fully displace existing productive uses of the areas where farms are developed. Aquaculture farms require a share of the marine environment as an essential input, but this does not preclude sharing this input for other productive uses. For example, areas where aquaculture is developed may also provide fish habitat or may act as fish aggregating devices, increasing fishing yields in surrounding areas.

Some stakeholders seem to assume that any aquaculture development will fully eliminate existing uses of the areas where farms are established, representing a zero-sum tradeoff between aquaculture production and other productive uses. Understanding the concept of economies of scope may be helpful to offset this perception.

Economies of scope are cost savings which arise from the scope, rather than the scale, of production (Panzar and Willig). Economies of scope rely on the ability to share production inputs across multiple uses, and in the aquaculture context, a key question concerns how allocating areas of the water surface to aquaculture might displace other activities dependent on the same area. An ideal situation would be the case were establishing new aquaculture operations in areas with existing productive uses would result in new aquaculture production with no commensurate decrease in existing capture fisheries or other economic production in the area where the farm is established. However, given the aforementioned issue of congestion externalities in production, this ideal may be unattainable. However, through the use of the tools of marine spatial planning, aquaculture operations can be cited to minimize conflict with existing uses (Gentry et al. 2017, Lester et al. 2018, Morris et al. 2021).

Dedicating a share of the marine environment to aquaculture production as an essential input does not preclude sharing this input for other productive uses. For example, areas where aquaculture is developed may also provide fish habitat or may attract fish, increasing fishing yields in surrounding areas. Instances where aquaculture development provides an external benefit to other types of production provide additional examples of economies of scope.

1.7. Substitutes and Complements in Consumption

The microeconomics concepts of substitutes and complements may be helpful for understanding and analyzing the perceived threat that aquaculture development has to existing capture and farmed seafood product demand. If aquaculture species and product forms serve separate markets from existing capture fisheries production, then fears about new aquaculture production leading to reduced demand for existing capture fishery production may be unwarranted. The volumes of product supplied by a particular seafood farm relative to the market for a particular product will also affect prices. However, given a highly competitive market due to the availability of many close substitute seafood products in consumption, especially on the import margin, a small volume of new US aquaculture production is not likely to significantly affect prices unless it is entering a niche market like white tablecloth at high prices.

Microeconomic theory describes the roles of substitutes and complements in consumption (Parkin). Goods which are substitutes are interchangeable in their ability to satisfy consumer demand. In fisheries, consumers may be indifferent between similar product forms of closely related species. If a diner cannot tell the difference between bigeye and yellowfin tuna in a white table restaurant entrée list, then these preparations may act as perfect substitutes in consumption, making the consumer equally satisfied by enjoying either preparation.

Complementary goods are those where an increase in the quantity of one good consumed results in an increase in the demand for the complementary good. A fisheries example of complements in consumption is the relationship between sashimi grade tuna and wasabi (Japanese horseradish), where an increase in sashimi consumption would be predicted to lead to an increase in demand for wasabi as a condiment.

Concerns about aquaculture production as a threat to capture fishery production are partially related to a belief that aquaculture and capture fishery production will act as substitutes in consumption, with an increase in aquaculture production crowding out demand for wild capture fishery products. For example, aquaculture production of farmed salmon could potentially reduce demand for wild and hatchery raised/wild caught salmon. If wild and farmed salmon are labeled as such and consumers view them as distinct product forms which serve separate markets, concerns about farmed salmon acting as a substitute for wild salmon may be unwarranted. It is also worth noting that the technical distinction between wild and farmed salmon is blurred by the existence of hatchery operations to support wild populations (Knapp et al. 2007).

Whether an increase in US West Coast aquaculture production would substitute for domestic capture fishery production depends in part whether aquaculture products would serve the domestic or foreign consumer market, volumes and product form, target markets, etc. For example, if an increase in yellowtail aquaculture production is anticipated to serve the Japanese sushi market, it may pose no threat of substitution for domestic capture fishery and aquaculture products delivered to West Coast ports destined for US filet or sushi markets.

1.8. Causal Inference in Estimating the Effects of Aquaculture Development

An important recent body of work in econometrics focuses on questions of causal inference (Athey and Imbens 2017, Imbens 2022). Data representative of economic phenomena of interest are typically observational rather than experimental, creating difficulty in estimating the causal effects of the treatment under study from the influences of a range of confounding factors.

In the aquaculture field, questions such as whether establishing AOAs is a beneficial approach to foster aquaculture development are challenging to answer, due to a lack of appropriate data. AOA identification is endogenous, making it difficult to separate the effects of aquaculture development inside an AOA from the various factors that led to AOA identification. AOA identification itself may encourage a concentrated pattern of aquaculture development within small areas which may differ significantly from organic aquaculture development at decentralized locations. Any data arising from the periods before and after AOA identification will lack experimental controls to compare outcomes to how aquaculture might have otherwise have developed in the absence of AOA identification, or what might have happened if other areas besides those selected were identified as AOAs, making a quasi-experimental approach infeasible. A randomized controlled trial framework could work if farms were randomly assigned to areas, but such a randomized experimental design is not part of the plans for aquaculture development inside AOAs, to our knowledge. A regression discontinuity framework may be an option to compare experience inside and outside identified AOAs before and after they are established. However, unless comparable aquaculture operations are present in nearby areas outside of AOAs, the effect of AOA identification on the success of aquaculture development inside AOA boundaries will lack a comparison outside AOAs.

1.9. Permitting Costs, Regulatory Uncertainty and Economic Viability Considerations

Although natural resource economists have written extensively on topics related to aquaculture, they have thus far played a limited role in policy evaluation or design of policies and regulations influencing aquaculture development (Anderson et al. 2019). One area where regulations play an important role in aquaculture development is permitting. The start-up cost burden of obtaining and maintaining permits from multiple regulatory authorities, and the potential for litigation at each step of the way, is a significant barrier to entry for private firms interested in establishing and maintaining aquaculture operations. Uncertainty about future regulation of aquaculture production may further limit willingness to invest in start-ups (Rubino 2023). Intensive existing use of near shore waters in Southern California for military operations, commercial and recreational capture fisheries, ecotourism, real estate development, and other existing uses makes aquaculture permitting extremely challenging. The development of the Southern California AOA Atlas by NCCOS (Morris et al.) and the ongoing effort to develop a programmatic EIS as part of AOA identification (NOAA Stakeholders Engagement Report) may help reduce this impediment to aquaculture start-ups by identifying areas for aquaculture development with less potential use conflicts and undertaking environmental review under NEPA.

Frequently cited concerns over potential aquaculture production externalities make an already cumbersome state and federal permit process even more uncertain, costly, and inefficient for a potential permit applicant to navigate. The ability of project opponents to litigate every step of a permit process further dissuades permit applicants. A less cumbersome permitting process which enables new entrants to a) anticipate, limit, and mitigate negative externalities of aquaculture development and operation and b) make the permit process more predictable, efficient, and timely would be helpful to foster aquaculture development.

Beyond the initial cost of obtaining permission to develop aquaculture off the US West Coast, a number of cost considerations create challenges to developing economically viable aquaculture operations off the US West Coast. The high cost of coastal land and high cost of living in Southern California impose infrastructure and labor cost hurdles that must be cleared for aquaculture to succeed, and environmental regulatory requirements create operating constraints which may be costly to meet. The ability to raise revenues to cover costs is limited by competition from imported aquaculture and other seafood products—and anything else that competes for center of the plate attention in the market.

New development which serves high-value product markets and which respects existing uses is more likely to succeed. Mussel and oyster farming both appear to be promising alternatives for further development, based on stakeholder opinions and efforts so far to establish west coast aquaculture operations, although oyster farming may not work well for offshore aquaculture. Macroalgae production from wild populations off Southern California has historically proved to be challenging, and macroalgae aquaculture operations will face similar obstacles, including the lack of a high-value product market and competition from cheap imports. Norway's success as a high-income country in developing salmon aquaculture offers a promising example, but political hurdles among West Coast constituents to developing finfish aquaculture may make it difficult to replicate this success off the US West Coast.

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2. AQUACULTURE SEAFOOD MARKETS

We reviewed existing markets for seafood in Southern California to obtain background information for considering potential future growth in aquaculture production and distribution. To obtain relevant economic information about aquaculture seafood markets in Southern California, we conducted a series of fewer than ten unstructured interviews with anonymous subject matter experts (SMEs) who have first-hand experience in the aquaculture industry as it presently exists in Southern California[1]. This section reports on information collected from these interviews, augmented by relevant references. An appendix provides discussion and summary statistics on west coast oyster aquaculture production.

Industry representatives expressed the opinion that aquaculture under development for production in Southern California is not currently intended for the mass market but rather for luxury consumption, primarily to supply the white tablecloth restaurant market. Retailers face limited demand due to the combination of a high price of local aquaculture products and import competition. Aquaculture products are likely to be consumed as a local, fresh product in Southern California as well as exported as high value products both nationally and internationally. California products command a higher price than aquaculture produced elsewhere. Aquaculture products from Southern California will compete with imported products to varying degrees, depending upon the species. The current high cost of growing and processing relatively small volumes of aquaculture from Southern California may limit the range of product forms during the incubation phase of development to high-value ones needed to achieve an economically viable rate of return on investment.

The current limited production volume of Southern California aquaculture coupled with the presence of imports should limit new aquaculture production in Southern California's near-term impact on prices of existing sources of wild caught fish that serve similar markets. Limited Southern California aquaculture volume also constrains the ability to enjoy lower unit production and processing costs (economies of scale) that helps with price competition.

Shellfish, especially mussels and to a lesser extent, scallops, but not oysters or abalone, might be cultivated in AOAs. Oysters are better suited for estuaries and abalone are better suited for nearshore conditions. Some industry representatives believe that consumers prefer oysters to mussels, and suggest that oysters are higher priced as a result. Oysters are sold in multiple product forms. A higher percentage profit margin or higher production volume is required for lower-trophic level species because more labor is involved. If producers are unable to raise their prices to cover high labor costs, due to highly elastic product demand, then thin profit margins will result, requiring increased production volume to cover fixed costs. If producers have a degree of market power, enabling them to increase prices and obtain higher profit margins to offset labor costs, then higher production volumes may not be necessary to compensate for additional labor requirements

[1] To protect confidentiality of our sources, the names of the individuals and firms we interviewed will remain anonymous. Passages in this section with no specific reference represent expert opinion informed by these interviews.

Finfish species suitable for production in California and with proven production technologies that might be grown in AOAs include yellowtail (*Seriola lalandi and Seriola quinqueradiata*), white sea bass (*Atractoscion nobilis*), and striped bass, but not halibut because it sits on the bottom. Industrial-scale macroalgae production may be financially feasible at some point in the future. Macroalgae like kelp were formerly harvested in the wild off California, but this no longer occurs, primarily due to changed market conditions (anonymous SME). Giant kelp (*Macrocystis pyrifera*), which were formerly harvested in the wild in Southern California, is also a species of interest for potential production in AOAs.

Product qualities and marketability of cultured versus wild capture fish are different categories in the eyes of consumers. These preferences may be species dependent. Captured fish may have a cost advantage because there is no need to pay for aquaculture feed to support their early growth years or to maintain pen infrastructure; however, this may be offset by fuel, vessel purchase and maintenance, and other costs of harvesting operations and market disadvantages due to variable supply and quality. By contrast, cultured fish may also have the advantage of more predictable costs and revenues because they may be available year-round in quantities that meet specifications for many buyers. Differences in production cost and success at market between cultured and captured seafood production vary widely by species and are likely to be influenced by future fisheries regulations, local and global market conditions, and technological change.

Southern California aquaculture faces the issue of being adjacent to Mexico that has well-established trade channels between Mexico and the US. Mexico's coastline is less developed, thereby reducing potential user conflicts and costs, such as with coastal landowners, recreational activities, etc., and leaving more lower-cost areas suitable for aquaculture. Moreover, production, processing, and labor costs are lower in Mexico overall than Southern California. The distance, time, and costs to Southern California markets is not an issue, although currently there are issues getting fresh food across the border. Industry sources note that Mexican cartels have moved into the seafood business, mostly through taxing truckers across one of the two roads to the border.

Where Are Seafood Farms Located in California?

Currently, aquaculture facilities that produce food products are located up and down the coast, and in ponds and tanks inland. For example, oysters are grown in Humboldt, Tomales, Morro, and San Diego Bays, and in Agua Hedionda Lagoon just north of San Diego. There are mussel farms in the Santa Barbara Channel and off Long Beach, with potential significant future expansion of mussel farming off the coast of Ventura. Abalone, a popular delicacy, is raised both on land in Santa Barbara, Cayucos (near Morro Bay), Davenport (near Santa Cruz) and in the ocean under a wharf in Monterey. Tilapia, striped bass, carp, catfish, and bass are being raised in the Coachella Valley, with sturgeon farmed near Sacramento.

Finfish

Yellowtail

Yellowtail are amberjacks, part of a large family of fish species known as Jack Fish or Jacks. This includes California yellowtail *(Seriola lalandi*), longfin yellowtail *(Seriola rivoliana),* Japanese yellowtail *(Seriola quinqueradiata*), and Greater amberjack *(Seriola dumerili),* the latter which is decidedly unpopular for human consumption. Japanese words more recognizable to sushi lovers include *Hamachi* (Japanese yellowtail)*, kampachi* (longfin yellowtail*),* and *hiramasa* (California yellowtail). The California species is the same as Australia's and New Zealand's "kingfish." Yellowtail grows fast in warm water.

Interest in *Seriola* species aquaculture has steadily increased since the 1960s, resulting in the rapid expansion of the global industry. Farming *Seriola* traditionally requires a relatively low level of initial capital (Mazzola et al., 2000), and the species often garner a high price point in regional and international markets (McLeod and McElroy, 2010). *Seriola* species are distributed across a wide range of environments and thermal regions, suggesting phenotypic adaptability to captive rearing in both land-based structures and ocean pens in numerous regions (Gillanders et al., 2001). The global aquaculture industry produced over 166,000 metric tons (MT) of *Seriola* species in 2017, representing a value at first sale of more than $1.1 billion (FAO, 2019).

Cultured yellowtail (*Seriola)* production in California would potentially compete with imports for the sushi market sourced from aquaculture product from Mexico, Hawaii, Japan and Australia but not with the locally wild caught fish, due to differences in product quality and target markets. Australian yellowtail differs from Japanese yellowtail and from Hawaiian yellowtail. California-caught *hiramasa* yellowtail ex-vessel value is less than $80,000 per year and enters a different market than the sushi-grade cultured yellowtail (anonymous SME).

Japan was the pioneer in yellowtail farming, starting in 1927 with the grow-out of undersized yellowtail in shore enclosures, then moving to floating net-pen aquaculture following World War II. Until recently, only Japan had commercialized it. Japanese yellowtail mariculture has developed remarkably due to the abundant supply and low price of wild-caught juveniles (*Mojako*) and sardines used as the main component of the fishmeal used as fish feed (Nakada 2008). Other critical elements that supported the growth of yellowtail farming include the existence of abundant suitable culture sites along the Japanese coast and innovative technical developments. Farmers prefer to use wild-caught fingerlings/small fish over hatchery-produced fingerlings, as the latter are generally more expensive and are usually too small for successful rearing. Most cage farms use fresh fish or artificial pellets as feed.

In 2019, yellowtail made up 9 percent of Japan's fish and fishery product exports - third by value behind scallops and pearls (Loew 2021). Primarily, Japan's yellowtail exports consist of frozen filets, with a small amount of frozen loin. The total frozen export quantity had been steadily rising before the COVID-19 outbreak, growing from under 1,000 metric tons (MT) in 2008 to over 8,000 MT in 2019. Air shipments of chilled product to the US –Japan's top yellowtail market – were steady over the period at about 1,000 MT.

In Australia, Australia's native yellowtail kingfish (*Seriola lalandi*, *hiramasa* in Japanese) supports a growing aquaculture industry.

A January 2021 presentation by NOAA (Purcell and Hyde 2021), "Status of *Seriola* Aquaculture in the United States of America," estimates the sushi restaurant market for *Seriola* species at USD 20 billion, primarily on the East Coast and West Coast, and in particular near Los Angeles (White 2020). *Ceviche*, *poke*, *tacos*, and grilled applications may further expand the market size. The total may be overly optimistic, since Japanese Customs reports that Japan's exports of frozen filets of *Seriola* to the US in 2019 were valued at JPY 13.3 billion (USD 116 million, EUR 100 million).

Blue Ocean Mariculture, based in Kona, Hawaii, is currently the only company in the production stage in the US (Loew 2021). It cultures about 800 MT of *Seriola rivoliana* (branded as Hawaiian Kampachi) in open-ocean cages. BlueOcean's Hawaii operation – which produces almaco jack (*Seriola rivoliana),* branded as Hawaiian *kampachi* – is the only fish farm operating in the US to be certified by the Aquaculture Stewardship Council (ASC) as environmentally- and socially-responsible (Hill 2021). The firm's fish are raised in open-ocean pens in the waters near the Big Island of Hawaii, close to Kona.

In Mexico, privately-held Omega Azul Seafood raises *Seriola rivoliana* (*kampachi*) using a closed-cycle hatchery system (Loew 2021). The head office, hatchery, and ocean farm are all located in La Paz, Mexico. Omega Azul sells its product domestically in Mexico, and exports to the US and Canada. In 2021, sales and revenue of the company's branded Baja Kampachi were small, though the company expects growth as the US dining scene re-opens.

Two other yellowtail projects exist in Mexico: Baja Seas, with pens in Magdalena Bay, and King Kampachi in La Paz (Loew 2021). The former was founded in 2012 and produces *Seriola lalandi* (*hiramasa*) from a recirculating aquaculture system (RAS) hatchery. The company introduced its products to the US in 2014 with distribution through Catalina Offshore Products. However, the company's website and social media are now dormant, and its products are out of stock at vendors that previously featured them. Magdalena Bay's warmer water lowers the fish fat content that sushi chefs want. They will have a hatchery, nursery, and farm, but no processing and distribution, i.e., it is not vertically integrated.

King Kampachi Farms raises *Seriola rivoliana* and can trace its roots to Kona Blue Water Farms in Kona, Hawaii (Loew 2021). The company operates a land-based hatchery and an offshore farm site. The product has been available in restaurants in the US and Mexico since March of 2019. In response to the COVID-19 pandemic, the company created national US distribution channels through Los Angeles-based Riviera Seafood Club, a web-based food delivery company. Prior to the outbreak, King Kampachi planned to produce 1,200 MT per year.

Currently, the primary competitors in California to Japanese production are all in either a start-up or growth phase, with operations funded by new investors rather than revenue from sales (Loew 2021). With potential high operating costs for new entrants, tight profit margins could result from a potential removal of the stocking limits of international production, which may limit profitability for new entrants facing reduced global prices.

California Capture Production of Yellowtail

As established by the Marine Life Management Act, the California Fish and Game Commission regulates the yellowtail fishery, and the California Department of Fish and Wildlife manages it. As yellowtail is caught as bycatch by fisheries targeting other species, this species is not included in any specific fishery management plan, but still falls under the jurisdiction of NOAA fisheries under the Magnuson-Stevens Fishery Conservation and Management Act and CDFW and CFGC as per the Marine Life Management Act. Yellowtail is sometimes caught incidentally in the drift gillnet fishery; it is also targeted with hook and line. If targeting yellowtail with drift gillnets, the mesh size must be ≥3.5 inches.

Yellowtail is a highly sought-after sportfish, but no decline in population sizes has been detected in areas where it is targeted off California. Commercial catch declined when purse seining (1973), and later, gillnets (1994) were banned in California waters (CDFG 2001). The fishery is not currently under active management, with no stock assessment or fishery management plan in place for California yellowtail. Yellowtail is a secondary and tertiary consumer in its ecosystems, so its presence helps create the population structure for its prey. Removal of yellowtail may impact populations of its prey and predators.

Yellowtail Feed

Feed is one of the largest costs in most aquaculture operations, and as such, aquaculturists are continually striving to improve on ingredient sourcing and formulations to increase growth and performance while reducing costs.

Interest in aquaculture of *Seriola* species has steadily increased since the 1960s, resulting in the rapid expansion of the global industry. Farming *Seriola* traditionally requires a relatively low level of initial capital (Mazzola et al., 2000), and the species often garner a high price point in regional and international markets (McLeod and McElroy, 2010). *Seriola* species are distributed across a wide range of environments and thermal regions, suggesting phenotypic adaptability to captive rearing in both land-based structures and ocean pens in numerous regions (Gillanders et al., 2001). The global aquaculture industry produced over 166,000 MT of *Seriola* species in 2017, representing a value at first sale of more than $1.1 billion (FAO, 2019). While the broader aquaculture industry has advanced significantly over the last several decades, the need to improve existing culture methods for carnivorous finfish is of the utmost importance in order to achieve a level of resource efficient and environmentally responsible production (Klinger and Naylor, 2012). Improving feed ingredients and formulations remains a key challenge (Naylor et al., 2009).

Historically, aquaculture facilities within Japan, China, and the Mediterranean farmed yellowtail (*S. quinqueradiata and S. dumerili*) with diets comprised of wild caught fish such as sardines and anchovies. While escalating demand for forage fish used in aquaculture and terrestrial animal feeds more recently resulted in a substantial increase in operating expenses for fish farms (Nakada, 2002; Ottolenghi et al., 2004), more recently a growing amount of feed has come from the utilisation of by-products as raw material (IFFO).

In addition to the rising cost of forage fish used as feed, various nutritional disorders have been documented from unbalanced captive diets comprised entirely of whole fish, resulting in insufficient protein and energy loads (Nakada, 2000; Nakada, 2002). In an effort to address these and other issues, many finfish farms now use processed formulated feeds instead of whole fish (FAO, 2014).

Advances in yellowtail aquaculture nutrition have resulted in production of a soft, dry pellet, with superior nutritional content than a whole fish diet (Hertrampf and Piedad-Pascual, 2012). Formulated feeds allow farm managers to provide cost-effective diets with adequate nutritional value, while also reducing the reliance on wild forage fish stocks (Alder et al., 2008; Glencross et al., 2007). Improved feed conversion rates in yellowtail have been noted in numerous studies, validating the continued efforts placed forth towards developing novel techniques to understand and analyze feed efficiency (Sicuro and Luzzana, 2016; Wegner et al., 2018). Despite the advantages gained from formulated diets in marine aquaculture, the use of unprocessed, whole fish as a dietary source is still prevalent in many regions of the world (Tacon and Metian, 2009).

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Seabass

Based on conversations with SMEs, it is unclear why sea bass hasn't received the same attention as yellowtail. White seabass are not like European sea bass, which are marketed as branzino. Sea bass are a popular restaurant fish, but with substantially less potential for the sushi market than yellowtail. White seabass have been successfully grown in Southern California for over 40 years. Possible reasons SMEs offer for the lack of success include insufficient profitability, due to low prices and the time requirements, and insufficient food conversion rate or filet yield to support economically viable operations.

Bluefin

Based on conversations with SMEs, bluefin tuna are unlikely to be cultured in Southern California. Complete cycle culture of bluefin tuna from egg to harvest size is still in the experimental stage in pilot commercial and research ventures around the world. Tuna ranching, the capture of wild stock blue tunas and pen fattening, has been underway in Mexico and other countries (e.g., Spain) for a long time and is currently more economically viable compared to complete cycle culture operations that currently remain experimental. Other species of tuna are also candidates for aquaculture, but like bluefin tuna, are at the experimental stage of development. See Vergara-Solana et. al (2019) for an overview of capture-based aquaculture for Atlantic bluefin in Mexico.

Finfish Aquaculture References

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Seaweed Aquaculture

At a global level, the commercial seaweed market includes red, brown, and green seaweed production in liquid, powdered and flake product forms. Applications include fertilizer, animal feed, food, cosmetics, pharmaceuticals, bioplastics, textiles, and waste treatment (World Bank 2023).

Seaweed has been grown in land-based tanks in California since the early days of abalone farming in the 1970s; farmed seaweed was used as a feedstock for the abalone. The first land-based facility focused on growing seaweed for human consumption. In 2015, Monterey Bay Seaweeds was launched in Moss Landing, a small town on the western edge of the Salinas Valley. Monterey Bay Seaweeds is a family farm, started by a professor and phycologist (seaweed biologist) at California State University's Moss Landing Marine Laboratories and a chef and restaurateur. The sustainable, land-based recirculating system is completely natural and never contaminated by chemicals or any additives. The only inputs are water and sunlight. This red seaweed farm benefits from growing on university land and intakes that would otherwise have huge cost, an implicit subsidy on infrastructure. The product supplies high end restaurants, a limited market. The result from this type of farming is a fresh, delicious and sustainable seaweed ready to be used in human consumption, such as salads, soups, main dishes, desserts and even cocktails. This seaweed product is alive rather than dried and dead, and available year-round.

Fresh edible seaweed for human consumption could be financially viable as a local product but there currently is not a large market in the US. Based on conversations with SMEs, the few businesses that produce seaweed commercially aren't making substantial profits. Seaweed farms can produce products for the human food market but the US does not eat seaweed at the same rate as Asians. In general, seaweed consumption is not like in Asian countries, and there is not an export market to Asia because they do not need our product and we are not competitive. China and Korea have large seaweed farms.

Bioplastics, alternative fertilizers, and agar are some of the products which rely on seaweed as inputs. The Nature Conservancy has explored use of seaweed for carbon credits but it is not promising, due to limited value. Wild seaweed harvest still has growth potential.

The first pilot-scale commercial open-water seaweed farm in California opened in 2020 in Humboldt Bay. In 2021, two more operations received permits, one for a research farm and one for a demonstration project.

Various local ports are creating innovation hubs, efforts to reduce barriers to entry into seaweed farming. The Aquaculture & Blue Technology Program at the Port of San Diego, for example, supports a startup called Sunken Seaweed, which is growing a variety of species on a quarter-acre plot in San Diego Bay. Sunken Seaweed is also collaborating with researchers at San Diego State University's Kelp Ecology Lab to assess the effects of farming on the bay's ecosystems. Larger aquaculture companies in the state are also drawn to seaweed cultivation. For example, Hog Island Oyster Company has recently initiated a collaboration with Sunken Seaweed at their Humboldt Bay site, allowing Sunken Seaweed to farm local seaweeds in tanks onshore. This project was also supported by the Port of San Diego's Blue Economy Incubator.

Macroalgae

Macroalgae, included in the category of plants, are widespread in the coastal areas of the world's seas and oceans. Depending on the color of the pigments in their biomass, macroalgae are classified into three categories (Guiry, 2012): green algae—*Chlorophyta* division; red algae—*Rhodophyta* division; and brown algae—*Phaeophyta* division. But, in addition to the color of the pigments, the three classes of macroalgae also differ in the content and type of carbohydrates, proteins, and lipids in their structure.

Macroalgae are macroscopic, multicellular algae that live in watery environments. The red algal genera *Kappaphycus* and *Eucheuma*, mostly grown to produce carrageenan, make up a third of global production. The brown genera *Laminaria* and *Saccharina*, which are consumed by people directly, make up another third.[5] Green algae currently make up a small portion of global production, though some species such as sea lettuce are grown for consumption.

After macroalgae is harvested, sometimes manually, sometimes via boat-mounted mechanical equipment, it must be processed. The specific techniques will depend on how the macroalgae is used. Though some macroalgae is eaten raw, even in these cases, the macroalgae must be properly stored to retain its moisture content and prevent the growth of pathogens. For other culinary products, the macroalgae must be dried, blanched or cut into noodles.

For non-culinary products, processing tends to be more extensive. When macroalgae is harvested for use in animal feed, it's dried and hammer-milled.

Historically there was a macroalgae based operation in Southern California, involving the harvest of wild kelp for the production of agar for industrial uses. San Diego was formerly the giant kelp

(*Macrocystis pyrifera*) capital of the world. Kelco, a multimillion-dollar San Diego company, founded in San Diego in 1929, is the world's largest harvester of the brown kelp. As of 1978, Kelco was one of only three companies in the world engaged in the business of commercially harvesting seaweed, and was by far the largest producer of algin (San Diego Reader 1978). Monsanto purchased Kelco in 1995 and sold it five years later to a joint venture between Hercules Inc. and Lehman Brothers Merchant Banking Partners II. Kelco is now part of CP Kelco in turn part of Huber Company of Atlanta. Kelco left San Diego, principally due to its high costs.

More recently, agar production was discontinued locally and production moved to other countries where land, labor, and production costs are more competitive. It currently shows up in import statistics to the US West Coast (see IV. Imports below).

Seaweed Aquaculture References

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Shellfish

Oysters

The US market for live oysters served in restaurants and raw bars has grown substantially during the past 20 years. Oysters are popular served raw on the half shell, but they can also be marketed as frozen product. According to SME interviews, there are high quality standards, resulting in value to the high-end consumer market. The current US farm gate prices for live oysters (the price that oyster farmers receive for their product when it leaves their farm and is sold to buyers) destined for raw bars ranges from 35 cents to over $1 per oyster, making oysters highly profitable for some efficient growers.

Domestic oysters have a shorter supply chain and hence lower-cost freight and smaller carbon supply footprint compared to oysters imported from distant sources.

Raw oysters, like other raw shellfish, have the potential to make people sick if they are contaminated with vibrio or other pathogens, such as hepatitis. Because of pathogens that may cause disease or illness in humans, oysters must be grown in approved water bodies.

Oysters thrive in estuaries. There aren’t too many estuaries suitable for growing oysters in California, unlike Washington which has many. Offshore oyster aquaculture could be challenging, due to a lack of suitable oyster habitat.

Oysters require more careful manipulation than mussels. If not correctly handled, they can become misshapen, leading to a decline in value.

A detailed discussion of oyster production off the West Coast of the United States, including figures, summary statistics and references, is provided in Appendix II.

Mussels

Mussels are a candidate species for offshore aquaculture. While better suited to the offshore environment than oysters, mussels don’t tolerate changes in salinity like oysters do. Some SMEs suggest that oysters and even mussels may not work offshore, while others are actively developing mussel production technologies for offshore use.

There is an international market for mussels, and some SMEs believe there is ample demand, with no risk of saturating California or other US markets.

Mussels are imported predominately from Canada, New Zealand, and to a lesser extent from Chile, entering the US consumer market through Los Angeles. Canadian imports can be trucked in, making them more reliable than imports sourced from elsewhere. Domestically produced mussels are a substitute for imports. The California market is for live and locally produced mussels.

Domestic mussels and oysters enter the luxury consumer market, including white tablecloth restaurants, high-end retail stores, and large supermarket chains. Green mussels are popular among chefs. They are also sold directly to consumers in farmer's markets, as abalone are similarly sold. Small growers have no need to use a distributor to add value. By contrast, larger offshore farms will need to employ a distributor or rely on in-house distribution teams to market their product.

The population of mussels in Southern California does not extend north of Monterey. In theory there are wild collections, but there does not seem to be a comparable level of wild collections to those seen in New Zealand or France. Currently, the seed is sourced from hatcheries and selective breeding, requiring expensive dry microalgae for use as feed.

Mussels are filter feeders that do not require the expense and effort of providing them with commercial feed. The only time feed is required for mussels is when a hatchery is used to grow them. In France, growers use spat as feed.

Mussels grown in Southern California are Mediterranean (*Mytilus galloprovincialis*). So far, California mussels are found in the wild but not grown in Southern California. The spat has to come from a hatchery, not from the wild, requiring feed to support hatchery operations. Some SMEs believe there could be a future problem with non-native species of mussels escaping into the wild.

Abalone

Abalones are shellfish belonging to the family *Haliotidae*. There are more than 100 species of abalone worldwide, around 15 species of which are grown in aquaculture (Aquaculture Stewardship Council). Today, more than 95% of the world's abalone seafood comes from aquaculture. They are bred and raised in saltwater pens onshore, or in suspended cages in the ocean, taking three to four years to reach market size. Optimum sites for abalone farming are coastal areas surrounded by islands, where seaweeds and algae, the natural food of abalones, grow abundantly. Farm sites should be far from fresh water inflows, and have clear waters and a slow current. Stony and rocky seabeds are favorable for abalone culture. The site should have few predators, and be convenient for transportation. The ecological conditions of the selected sites are important for culturing the abalones to the marketable size. Suitable conditions for abalone cultivation are not expected to be available in the areas being evaluated for potential identification as AOAs off Southern California.

Scallops

Some farming of scallops occurs in Japan and on a few farms in Maine using the so called "ear hanging" method. Favorable growing conditions include protected waters with little wave and storm action. Scallop farming is undergoing development in California (California Sea Grant).

Shellfish Aquaculture Production References

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3. IMPORTS

Overview

Information on seafood product imports provides context for the potential of domestic aquaculture. The development of aquaculture off the coast of Southern California is expected to focus on a suite of species, which includes finfish, shellfish, and macroalgae, that are both biologically and environmentally suitable for production, and economically viable in terms of both production costs and access to markets. The expansion of existing and introduction of new Southern California aquaculture production operations could increase a domestic supply of seafood products produced regionally, reducing reliance on imported seafood products. Additional supply may increase the proportion of domestic regional products in local and regional markets, and improve seafood trade balances through substitution from imported products to domestic products and the export of domestic seafood products. Domestic regional aquaculture production may increase the demand for labor, increase domestic, local and regional employment, and provide a substitute for imported seafood products for local, regional, national, and international markets. The extent of these potential outcomes depends on global and regional markets as characterized by multiple factors including: input and output prices; import and domestic product volumes, product quality, international and domestic consumer preferences, and trade policies.

The development and expansion of regional aquaculture operations may include the production of a suite of heterogeneous products in terms of species, product type (raw v. finished), primary market (e.g., industrial inputs, commercial food production inputs, and retail products), and price. Domestic production of products that are economic substitutes may improve the U.S. balance through both increases in consumption of domestic products (which may reduce foreign imports) and expansion of exports of domestic products.

The factors of production are highly varied over countries and product types. More specifically, labor, land, energy prices, and environmental regulations vary between regions (both domestically and internationally). Transportation costs are, in part, a function of distance traveled, existing trade routes, product type (e.g., fresh vs canned product), and trade policy. An in-depth discussion of production and transportation costs is beyond the scope of this section.

Imports of Fishery Products

This chapter reports on seafood imports into west coast ports in the contiguous U.S. for the period from 2013 through 2022. Reporting is based on data accessed from the Foreign Trade query tool managed by NOAA (NOAA 2023).[2] Import values are defined as customs values, which include the price paid for merchandise when sold for export to the U.S.; the customs value prices exclude charges incurred in exporting to the U.S., such as for U.S. import duties, freight, and insurance.

[2] NOAA Fisheries Office of Science and Technology, Foreign Trade Query, Available at: www.fisheries.noaa.gov/foss, Accessed 12/13/2023

Seafood imports are stratified by trade product categories that are defined by the product categories of the Harmonized Tariff Schedule of the United States as developed by the United States International Trade Commission.[3] As trade categories are often based on a broad suite of products, products are often non-species specific and disaggregation into specific products cannot be carried out. Imports are defined as "a combination of entries into the United States for immediate consumption and withdrawals from customs-bonded warehouses."[4] Data reflect the actual entry into U.S. consumption channels of commodities that originated outside the U.S. Imports may include a substantial amount of U.S. domestic fishery catch that was exported for further processing and returned to the U.S. as an import in a processed form. Estimates of the scale of this "circular trade" are not provided.

A general graphical and tabular overview of the import market by port of entry, export continent, export country, value, weight and price for each species group is provided. This section is aimed towards readers interested in background information that is relevant to west coast seafood markets in the context of import markets. Fisheries imports statistics may be useful in the evaluation of potential markets for aquaculture products.

Statistics on import value and weight are provided for a set of seafood products that may serve as proxies for a wide range of species of interest for future aquaculture production off the coast of Southern California. Statistics are stratified by multiple characteristics including: seafood product group, U.S. Customs District of import, export continent, export country, and year. Data is not reported for all combinations of the above characteristics. Summary statistics on prices are provided by percentiles. Value statistics are reported in 2022 U.S. dollars. In Figures, values are scaled to millions (M) or billions (B). Weight statistics are reported in metric units (e.g., kg and kT). Price statistics are reported in 2022 U.S. dollars per pound.

Species, Product, and Trade Category Selection

Due to the limited product granularity of the import data a proxy product approach was adopted. Reporting is focused on a list of species and products that serve as proxies for species of interest for Southern California aquaculture production that include finfish, shellfish, and macroalgae. Product group proxies were developed to provide the best available information as to the import product space that potential aquaculture products may compete against.

Mapping of species of interest for Southern California aquaculture product to proxy product categories was determined in consultation with the NOAA Fisheries Regional Aquaculture Coordinator. Proxy product categories are based on aggregations of trade categories, or "products" that are established within the Harmonized Tariff Schedule of the United States. This schedule is developed by the United States International Trade Commission (see https://usitc.gov/harmonized_tariff_information). See *Table 3-1: S. CA Aquaculture Species of Interest and Import Proxy Species*.

[3] U.S International Trade Commission, Harmonized Tariff Schedule. https://hts.usitc.gov/

[4] NOAA Fisheries Office of Science and Technology. "Frequently Asked Questions for Foreign Trade" https://www.fisheries.noaa.gov/foss/f?p=215:10:4894430206249:::::

Table 3-1: S. CA Aquaculture Species of Interest and Import Proxy Species

Species of Interest	**Proxy Species / Product**
Yellowtail - Finfish	Tuna
White Sea Bass - Finfish	Bass
Striped Bass - Finfish	Bass
Mediterranean Mussel - Shellfish	Mussel
Pacific Oyster - Shellfish	Oyster
Purple-hinged Rock Scallop - Shellfish	Scallop
Native/Olympia oyster	Oyster
Native/CA mussel	Mussel
Giant kelp - Macroalgae	Seaweed
Giant kelp - Macroalgae	Agar

To provide detail to the analysis, product proxy groups are stratified as “fresh” or “other” products for finfish and shellfish, and “edible” or “non-edible” for seaweed based on an analysis of the product names provided. In addition to reporting on the individual proxy product categories, reporting is also provided for three aggregate groups: a coastwide aggregate category, denoted as “ALL”, which includes all west coast port fisheries products regardless of their inclusion into any of the proxy species groups mentioned above; a Proxy_Fresh group defined as the aggregate subset of all fresh and edible proxy product groups; and a Proxy_Other group defined as the aggregate subset of non-fresh and non-edible proxy products. See *Table 3-2: Analysis Product Group Proxy categories and definitions*.

Table 3-2: Analysis Product Group Proxy categories and definitions

Number	Group	Description
1	ALL	All seafood products imported to the West Coast
2	Proxy_Fresh	Aggregate Subset of Fresh and Edible Proxy Species / Products
3	Proxy _Other	Aggregate Subset of Non-Fresh and Non-Edible Proxy Species / Products
4	Tuna	Fresh Tuna products
5	Tuna Other	Tuna products (non-fresh)
6	Bass	Fresh Bass products
7	Bass Other	Bass products non-fresh
8	Oyster	Fresh Oyster products
9	Oyster Other	Oyster products non-fresh
10	Mussel	Fresh Mussel products
11	Mussel Other	Mussel products (non-fresh)
12	Abalone	Fresh Abalone products
13	Abalone Other	Abalone products (non-fresh)
14	Scallop	Fresh Scallop products
15	Scallop Other	Scallop products (non-fresh)
16	Seaweed Edible	Seaweed and other Algae - Edible
17	Seaweed Other	Seaweed and other Algae (non-edible)
18	Agar	Gelatinous substance obtained from various kinds of red seaweed and used in biological culture media and as a thickener in foods.

Product category definitions are generally broad. Information of interest is not always available; for instance, information of whether the product is sourced from wild capture or aquaculture was only available for oyster (fresh and other) and mussel (fresh) products (See Table A4-8-5- OYSTER_FRESH: Value, Weight, Price by Product, Table A4-9-5 OYSTER_OTHER: Value, Volume, Price by Product: 2013-2022, and Table A4-10-5 MUSSEL_FRESH: Value, Volume, Price by Product: 2013-2022 for more information.)

West Coast Ports

West coast ports are economically important for the nation's domestic and international trade. NOAA Fisheries Office of Science and Technology's Foreign Trade Query provides import statistics based on the following U.S. Customs District port areas, listed from South to North: San Diego, Los Angeles, San Francisco, Portland, and Seattle. See www.fisheries.noaa.gov/foss.

Import of Fisheries Products Statistics

Summary

This section reports on seafood imports into west coast ports in the contiguous U.S. for the period from 2013 through 2022. For context, the U.S. imported 2.7 million metric tonnes of seafood products valued at $21.4 billion in 2020 (NOAA 2022).

These data are produced by the U.S. Census Bureau, as part of their Foreign Trade Data Series that covers all Merchandise Trade (FT900). These data are a subset of Census data set that includes only fishery relevant products. https://www.census.gov/foreign-trade/index.html

Table 3-3: West Coast Import Value and Weight by Year- Total and Proxy Fresh Products - 2013-2022

-	Value (2022$, millions)			Weight (MT)		
Year	**Total**	**Proxy Fresh**	**Proxy Fresh %**	**Total**	**Proxy Fresh**	**Proxy Fresh %**
2013	$7,266	$127	1.7%	868,407	13,039	1.5%
2014	$7,890	$127	1.6%	881,740	13,342	1.5%
2015	$7,042	$129	1.8%	886,937	14,173	1.6%
2016	$7,201	$123	1.7%	894,587	13,797	1.5%
2017	$7,738	$133	1.7%	901,097	14,205	1.6%
2018	$7,892	$154	2.0%	928,449	15,726	1.7%
2019	$7,319	$159	2.2%	863,510	15,575	1.8%
2020	$6,903	$117	1.7%	845,080	11,421	1.4%
2021	$7,731	$194	2.5%	888,234	17,990	2.0%
2022	$7,564	$241	3.2%	864,973	19,169	2.2%

Table 3-4: West Coast Import Value and Weight by Port- Total and Proxy Fresh Products - 2013-2022

-	Value (2022$, millions)			Weight (MT)		
U.S. Customs District	**Total**	**Proxy**	**Proxy %**	**Total**	**Proxy**	**Proxy %**
SAN DIEGO, CA	$2,260	$397	17.6%	364,353	37,979	10.4%
LOS ANGELES, CA	$51,430	$847	1.6%	6,248,772	74,303	1.2%
SAN FRANCISCO, CA	$4,279	$216	5.1%	602,843	16,913	2.8%
PORTLAND, OR	$53	$0.291	0.6%	8,526	26	0.3%
SEATTLE, WA	$16,524	$195.466	1.2%	1,598,520	19,216	1.2%

Table 3-5: West Coast Import Value and Weight by Continent - Total and Proxy Fresh Products - 2013-2022

-	Value (2022$, millions)			Weight (MT)		
Continent	**Total**	**Proxy Fresh**	**Proxy Fresh %**	**Total**	**Proxy Fresh**	**Proxy Fresh %**
AFRICA	$718	$20	2.8%	98,746	1,306	1.3%
ASIA	$45,082	$675	1.5%	5,811,092	51,170	0.9%
CARIBBEAN	$17	$0.164	1.0%	794	6	0.7%
CENTRAL AMERICA	$515	$22	4.3%	61,346	2,165	3.5%
EUROPE	$9,038	$147	1.6%	548,012	13,814	2.5%
N AMERICA - CANADA	$6,662	$132	2.0%	797,407	12,785	1.6%
N AMERICA - MEXICO	$1,608	$398	24.7%	277,745	38,158	13.7%
OCEANIA	$2,264	$250	11.1%	260,987	27,356	10.5%
SOUTH AMERICA	$8,641	$11.275	0.1%	966,884	1,676	0.2%

For each set of product groups listed in Table 3-2: Analysis Product Group Proxy categories and definitions, fishery product import data will be presented in both figures and tables. A set of figures reporting import statistics are presented in Appendix 3. A set of tables reporting import statistics are described below; see Appendix 4.

Species Group Breakouts Figures

Each proxy species / product group section contains the following figures.

Figure 1 reports import value and weight to the U.S. West Coast market. Value is reported in 2022 inflation adjusted U.S. dollars. Weight is reported in metric kilotonnes (kT).

Figure 2 reports proxy species / product group weight and price for imports to the U.S. West Coast market. Value is reported in 2022 inflation adjusted U.S. dollars; weight is reported in metric units; price is reported in inflation adjusted dollars (2022$) per pound (lb.).

Figure 3 reports product group import price percentiles to the U.S. West Coast market. Prices are given at the 1st, 25th, 50th, 75th, and 99th percentiles.

Figure 4 reports the import value distribution by major port area for products to the U.S. West Coast market. Value is reported in 2022 inflation adjusted U.S. dollars.

Figure 5 reports the import weight distribution by major port area for products to the U.S. West Coast market. Weight is reported in metric kilotonnes (kT).

Figure 6 reports the import value by major port area and year for products to the U.S. West Coast market. The stacked area plot shows the breakout by port area for the aggregate import value by year to the U.S. West Coast. Value is reported in 2022 inflation adjusted U.S. dollars.

Figure 7 reports the import weight by major port area and year for products to the U.S. West Coast market. The stacked area plot shows the breakout by port area for the aggregate import weight by year to the U.S. West Coast. Weight is reported in metric kilotonnes (kT).

Figure 8 reports the import value distribution by continent of origin for products to the U.S. West Coast market. Value is reported in 2022 inflation adjusted U.S. dollars.

Figure 9 reports the import weight distribution by continent of origin for products to the U.S. West Coast market. Weight is reported in metric kilotonnes (kT).

Figure 10 reports the import value by continent of origin and year for products to the U.S. West Coast market. The stacked area plot shows the breakout by continent of origin for the aggregate import value by year to the U.S. West Coast. Value is reported in 2022 inflation adjusted U.S. dollars.

Figure 11 reports the import weight by continent of origin and year for products to the U.S. West Coast market. The stacked area plot shows the breakout by continent of origin for the aggregate import weight. Weight is reported in metric kilotonnes (kT).

Figure 12 reports the import value distribution by country of origin for products to the U.S. West Coast market. Value is reported in 2022 inflation adjusted U.S. dollars.

Figure 13 reports the import weight distribution by country of origin for products to the U.S. West Coast market. Weight is reported in metric kilotonnes (kT).

Figure 14 reports the import value by country of origin and year for products to the U.S. West Coast market. The stacked area plot shows the breakout by country of origin for the aggregate import value by year to the U.S. West Coast. Value is reported in 2022 inflation adjusted U.S. dollars.

Figure 15 reports the import weight by country of origin and year for products to the U.S. West Coast market. The stacked area plot shows the breakout by country of origin for the aggregate import weight by year to the U.S. West Coast. Weight is reported in metric kilotonnes (kT).

Figures number, title prefix, and title descriptions are reported in Table 3-6. Corresponding figures utilize the numbering convention: Fig_A3-{product group number}-{figure number}-{product group name}, where # and XXX denotes the product group number and product group name as listed in Table 3-2.{figure number} corresponds to Table 3-6.

See Appendix 3 for a series of 15 figures for each product group breakout.

Table 3-6: Species Group Level Figure List

Figure Number	**Title Prefix**	**Title Description**
1	Fig_A3-#- -1: XXX	Weight & Value by Year
2	Fig_A3-#- 2: XXX	Value & Price by Year
3	Fig_A3-#-3: XXX-	Price Percentiles by Year
4	Fig_A3-#-4: XXX	Value by Port, Proportion
5	Fig_A3-#-5: XXX	Weight by Port, Proportion
6	Fig_A3-#-6: XXX	Value by Port by Year
7	Fig_A3-#-7: XXX	Weight by Port by Year
8	Fig_A3-#-8: XXX	Value by Continent, Proportion
9	Fig_A3-#-9: XXX	Weight by Continent, Proportion
10	Fig_A3-#-10: XXX	Value by Continent by Year
11	Fig_A3-#-11: XXX	Weight by Continent by Year
12	Fig_A3-#-12: XXX	Value by Country, Proportion
13	Fig_A3-#-13: XXX	Weight by Country, Proportion
14	Fig_A3-#-14: XXX	Value by Country by Year
15	Fig_A3-#-15: XXX	Weight by Country by Year

Species Group Breakouts Tables

Tables are provided in Appendix 4. Information for the "ALL" product group is provided in a set of four tables for value, weight, and price stratified by each of the following variables: year, U.S. customs district, continent of origin, and country of origin. Information for each of the remaining 18 product groups is provided with the above four tables and a fifth table providing stratification by product name.

Table 1 reports the value, weight, price by year for imports (sorted by year). Table 2 reports the value, weight, price by U.S. customs district port (sorted south to north by district) for the period 2013 to 2022. Table 3 reports the value, weight, price by continent (sorted alphabetically by continent) for the period 2013 to 2022. Table 4 reports the value, weight, and price by country for imports ((sorted alphabetically by country) for the period 2013 to 2022. Table 5 reports the value, weight, and price by product (sorted alphabetically by product name) for the period 2013 to 2022. Values are reported in 2022 dollars. Weights are reported in kilograms.

Table number, title prefix, and title descriptions are reported in Table 3-7. Corresponding tables utilize the numbering convention: A4-#, where # and XXX denotes the product group number and product group name as listed in Table 3-2. Where {figure number} corresponds to Table 3-6.* denotes the product group and # denotes the table number as listed in Table 3-7.

See Appendix 4 for a series of 5 figures for each product group breakout (note, product group 1 – All has 4 tables).

Table 3-7: Species Group Level Table List

Number	Title Prefix	Title Description
1	Table A4-#-1 XXX	Value, Weight, Price by Year
2	Table A4-#-2 XXX	Value, Weight, Price by Customs District Port: 2013-2022
3	Table A4-#-3 XXX	Value, Weight, Price by Continent: 2013-2022
4	Table A4-#-4 XXX	Value, Weight, Price by Country: 2013-2022
5	Table A4-#-5 XXX	Value, Weight, Price by Product: 2013-2022

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NOAA, 2023. NOAA Fisheries Office of Science and Technology, Foreign Trade Query, Available at: www.fisheries.noaa.gov/foss, Accessed 12/13/2023.

4. DISCUSSION

As aquaculture becomes more widely adopted for seafood production in US coastal waters, questions are likely to arise about whether coastal infrastructure is sufficient to accommodate new aquaculture production in addition to existing capture fisheries operations and other ocean uses. Whether use conflict arises depends in part on the potential to achieve economies of scope in utilizing extant coastal infrastructure, such as seafood processing plants and other supply chain capacity, and also on the potential to establish new supply chain capacity where necessary. Where currently underutilized processing capacity exists opens opportunity for new aquaculture production to develop without crowding out existing capture fishery utilization. Appropriate co-marketing of wild and farmed local production has the potential to rebuild US markets for US seafood, provided there is a sufficient volume of product from both sectors to maintain economic viability of commercial fishing ports and associated processing facilities (NOAA 2023).

While the SMEs we interviewed generally suggested that aquaculture production in the Southern California Bight would primarily supply high-end consumer markets, this could change with future expansion of aquaculture production. Experience with the technology adoption cycle in other industries suggests that prices tend to be high at the initial stage of adoption of a new production practice, when product volume is low and the costs of research, development, and in the case of aquaculture, permitting, must be absorbed. Once a technology is adopted at a more widespread level and gains acceptance by consumers, an increased volume of production depends on reaching a broader range of consumers at a range of price points more representative of a cross-section of society. The range of aquaculture products is likely to diversify away from the high-end white tablecloth consumer to a broader range of product forms and price points. Hence SME observations about current state of west coast aquaculture may not be representative of the state of the west coast aquaculture industry at a later stage of development.

The US seafood trade deficit reflects in part domestic market availability of what US consumers demand at competitive price points with imports. Hilger et al. (2019) find empirical evidence of a preference for US-caught fish among US consumers. By contrast, Asche et al. (2022) offer the example of European sea bass (*Dicentrarchus labrax*) as a species where the growth in US imports from near zero to over 10,000 mt product weight over a ten-year period is attributed to satisfying US consumer preferences for fresh product, sustainable certification, and close resemblance to other popular species. Preferences among individual US consumers may vary across a spectrum from lexicographically preferring US product, with no price sensitivity whatsoever, to extreme price elasticity among consumers who always prefer imported substitutes if cheaper.

If price-sensitive consumers cannot obtain the quantity demanded from US sources at a price that competes with import substitutes, they will choose to purchase imported products, contributing to the seafood trade deficit. An increase in US aquaculture production of substitutes for imports at competitive price points could reduce the US seafood trade deficit. Increased US aquaculture production of abalone, oysters, *Seriola*, and other farmed species could also in some cases be relatively less valuable to US consumers compared to foreign sector demand, resulting in a higher price on the export market than the domestic market. The resulting increase in US seafood exports in this case would also serve to reduce the US seafood trade deficit.

The present high level of reliance on imports to meet US seafood consumption demand raises conservation and food security concerns. While a range of conservation laws and regulatory processes are in place to limit the conservation impacts of US seafood production, these laws do not generally apply to other countries which supply US seafood imports (Helvey et al.). Besides reducing the conservation footprint of US seafood consumption in foreign sector fisheries, an increase in aquaculture production in US coastal waters could shorten the seafood supply chain, reducing fossil fuel consumption needed to support shipping products to the US from distant sources. Furthermore, heavy reliance on imports to supply US seafood consumption creates food security concerns in case of trade disputes or other impediments to open international commerce in seafood products. Researchers have noted the potential for aquaculture to add resilience to the global food system through diversification of product source (Troell et al. 2014). The COVID-19 pandemic experience heightened awareness of the potential impact of trade disruptions on seafood supply (Rubino 2023). Increased aquaculture production could offer a more reliable source of locally produced seafood not subject to potential disruption in international trade flows.

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5. CONCLUSION

Many factors favor aquaculture development off Southern California, including abundant coastal resources for aquaculture production, a large base of consumer demand for seafood, and an entrepreneurial culture with numerous potential participants in a fledgling industry. These advantages are offset by intensive existing uses of the waters off California, including for commercial and recreational fishing, tourism, shipping, and military purposes, and potentially by emerging new uses such as offshore wind energy development. Existing users of coastal waters are concerned about potential production externalities of aquaculture development.

Permitting costs and related political opposition from existing users are major impediments to aquaculture development off Southern California. While identifying AOAs would not create automatic permission to establish new aquaculture operations in Southern California, the effort underway to identify AOAs may reduce the cost of establishing aquaculture start-ups.

We have reviewed potential markets for aquaculture of finfish, shellfish, or macroalgae.

Developments catering to lucrative markets and respecting current uses stand a better chance of thriving. SMEs suggest mussel and oyster farming as promising alternatives in establishing aquaculture on the West Coast, although oyster aquaculture may not be suitable for offshore production. Harvesting wild macroalgae in Southern California has historically been difficult, and similar challenges will confront macroalgae aquaculture, including the absence of high-value markets and competition from inexpensive imports. While Norway's success in salmon aquaculture provides inspiration, political obstacles among West Coast stakeholders may hinder the replication of this success in finfish aquaculture off the US West Coast.

Section IV of this report documents the diverse range of seafood and inedible marine products which are imported to the US West Coast. A majority of the import volume and value enters the West Coast through the Los Angeles port complex. These products cover multiple price points and originate from a range of trading partners.

This report provides information on economic aspects of the potential for aquaculture development off Southern California and the impediments which must be overcome for it to meet its potential. A larger scale of future operations could change the nature of the industry from its present status as a high-end seafood product market supplier to a protein source for a more representative cross section of seafood consumers.

ACKNOWLEDGMENTS

The coauthors would like to thank the NOAA Fisheries Office of Aquaculture for their contributions to developing, reviewing, and publishing this report. We additionally thank a number of anonymous SMEs who contributed information and comments to draft versions of the report.

APPENDIX 1. PRODUCTION POSSIBILITY FRONTIER ANALYSIS

Much of the discussion thus far about aquaculture development off Southern California has been qualitative in nature, with advocates citing the large potential gains in seafood production if more aquaculture was permitted, and opponents raising concerns about negative impacts on the environment or on existing production activities or coastal ocean uses like real estate/homes/viewscape (NOAA 2023). Absent quantitative estimates of the amount of new aquaculture production that could be expected, there is little evidence available to justify establishing new farms in areas with existing productive uses which may be displaced. However, the absence of existing farms inside Southern California areas under consideration for identification as AOAs precludes using traditional production econometric techniques, such as data envelopment or stochastic frontier analysis, to estimate the production frontier. Further, while some mixture of shellfish, macroalgae, or finfish aquaculture could be farmed inside areas under consideration for identification as AOAs, the exact species and nature of production is unknown at this time. In light of these data limitations, we propose a methodology to estimate the production possibility frontier as a three-dimensional surface, using a convex combination of maximum potential production for each of the three modes. Outputs may be measured using either physical volumes (e.g., weights of output produced) or financial units (e.g., revenues). Comparison of the resulting production estimates to potential lost production from existing activities (which may be displaced) can provide a preliminary estimate of the effect of developing aquaculture inside areas under consideration for identification as AOAs on seafood production.

Methodology

Outputs may be measured using either physical volumes (e.g., weights of output produced) or financial units (e.g. revenues). The approach developed here assumes fixed-proportion (Leontief) technologies to produce shellfish, macroalgae, and finfish, and assumes that output for each type of aquaculture under consideration is directly proportional to the farm area within an area under consideration for identification as an AOA allocated to its production.

To reflect uncertainty about what modes of aquaculture production are likely to develop, we model total aquaculture production within an area under consideration for identification as an AOA using:

$$Y = \alpha_1 S + \alpha_2 M + \alpha_3 F,$$

where $Y =$ total potential production inside the area, $S =$ maximum potential shellfish production, $M =$ maximum potential macroalgae production, $F =$ maximum potential finfish production, with $\alpha_i \geq 0$ and $\sum \alpha_i \leq 1$. The α_i may be interpreted as the share of available aquaculture production capacity allocated to production mode i. This specification assumes production for each of the three modes is in linear proportion to the amount of farm production capacity allocated to it in a given AOA. Given estimates of S, M and F, the range of values of Y that result from different feasible choices of α_i represent the feasible production set over different possible combinations of shellfish, macroalgae, (kelp) and finfish production. We suggest a similar approach to that taken in Lester et al. (2018), choosing representative species of shellfish (mussels), macroalgae (kelp), and finfish (yellowtail) to carry out an analysis to illustrate potential production in Southern California areas under consideration for identification as AOAs.

The production possibility frontier is represented by values of total aquaculture production Y which result when $\sum \alpha_i = 1$. This specification of the production frontier as a convex combination of the levels of shellfish, macroalgae, and finfish production reflects a lack of prior knowledge of what proportion of areas under consideration for identification as AOAs will be allocated to the different forms of aquaculture.

Non-stochastic and stochastic approaches are both possible for estimating the production surface. A non-stochastic approach defines *S, M,* and *F* as expected production levels under the maximum possible allocation of production within areas under consideration for identification as AOAs to shellfish (*S*), macroalgae (*M*)), and finfish (*F*) production. In this framework, *Y* denotes the expected maximum production for different convex combinations of shellfish, macroalgae, and finfish production.

A stochastic approach is to define *S, M,* and *F* as normally-distributed random variables representative of the potential ranges of production under the maximum possible allocation of production within areas under consideration for identification as an AOA to shellfish (*S*), macroalgae (*M*), and finfish (*F*) production. In a Bayesian framework, these can be described as informative priors, calibrated using known information about the potential range of production possibilities for each of the three modes of production within areas under consideration for identification as an AOA. Once these priors are determined, *Y* may be determined as a convex combination of *S, M,* and *F*, which is again normally distributed as a linear combination of normally distributed random variables. The stochastic approach supports describing the range of production possibilities for any convex combination of areas allocated to shellfish, macroalgae, and finfish production as a Bayesian confidence interval that reflects the priors.

APPENDIX 2. OYSTER PRODUCTION AND CONSUMPTION OFF THE WEST COAST OF THE UNITED STATES[5]

Oyster production along the West Coast of the contiguous United States has had a long history, dating back to initial coastal settlement by both Native Americans and migrants from the Eastern United States in the 1800s. The primary species harvested historically were Olympia oysters (*Ostrea lurida*), which are native to the West Coast. However, overharvesting and degradation of native oyster habitat led cultivators to introduce Pacific oysters (*Crassostrea gigas*) to the region in the early 1900s in order to meet the strong demand for oyster products (MacKenzie 1996; Kirby 2004; Booker 2006). Pacific oysters remain the primary species cultivated in the region today.

Table 1 shows the average pounds produced, revenue generated, and prices for oyster products by state and species (Pacific, Eastern (*C. virginica*), Olympia, and European Flat/Belon oysters (*O. edulis*)), and Figures 1 - 3 show total production relative to revenues over time for Pacific oysters by state using NOAA FOSS Landings data from 1950 to 2022 (National Oceanic and Atmospheric Administration 2022). The largest producer of oysters on average by volume and revenue across most oyster species has been Washington, followed by California and Oregon. Washington production is consistently at least an order of magnitude higher than either of the others two states. The spike in production for West Coast oysters in the mid-1980s was likely due to increased demand from the East Coast in order to offset reductions in regional production from an epidemic of *Perkinosis marinus*, a parasite that causes oyster mortality, in the Chesapeake Bay (Schulte 2017). In addition, the drop in production during the latter half of the 2000s for California, Oregon and, to a lesser extent, Washington was attributed to a major ocean acidification event that prevented hatcheries and farms that relied on natural spawning from maintaining seed stock (Public Broadcasting Service 2012; Seigliano 2015).

Unfortunately, data are not available on oyster imports by state, region or species. However, oyster imports to the United States were primarily prepared products (e.g., frozen, brined) rather than live oysters, though live oyster imports have increased since the 1950s relative to prepared. The vast majority of oyster production from Canada and Mexico was exported to the US market (Botta et al. 2020). Figure 4 shows the imports of oyster products in tons by live and prepared oysters from 1976 to 2021 using data from FishStat (FAO 2022).

Oyster farming occurs primarily in state-owned waters, which are then leased through either the Department of Fish and Game Commission (California), Department of Agriculture (Oregon) or Department of Natural Resources (Washington) (National Oceanic and Atmospheric Administration 2021; Oregon State Department of Agriculture 2023; Washington State Department of Natural Resources 2023). The primary cultivation areas in Washington are the Puget Sound and Willipa Bay estuaries. Some farms are privately owned while others are leased from state-owned land. Cultivated areas are split between both Indigenous- and non-Indigenous-owned farms, with the largest producer by volume and revenue being Taylor Shellfish, Co. as of 2018 (Northern Economics, Inc. 2013; Varriano 2018). In California, the primary cultivations areas

[5] This appendix, including references and figures, was written by Erica Chuang.

are Humboldt and Tomales Bay, with smaller cultivation areas in Morro Bay and Carlsbad. The largest producer by volume in the state is Hog Island Oyster Co., followed by Tomales Bay Oyster Co. California has far fewer leases than Washington, recorded at 17 leases held by 10 companies in 2020 (California Department of Fish and Wildlife 2021)." "Oysters are grown in Humboldt, Tomales, Morro, and San Diego Bays, and in Agua Hedionda Lagoon just north of San Diego. Oregon has the lowest amount of production relative to the other two states. The areas that are approved for cultivation are Tillamook Bay, Netarts Bay, Yaquina Bay, Umpqua River and Triangle, Coos Bay and the South Slough (in Coos Bay) (Oregon State University 2022). While it is not a major producer of oysters, it is home to Oregon State University, which is a major public hatchery and the primary research institution in the region developing new lineages of oysters to help the industry adapt to the expected impacts of climate change, e.g. higher ocean acidification and higher sea surface temperatures (Oregon State University 2021).

Though oyster reproduction occurs naturally in the summer months through the expulsion of egg and sperm in water (larvae are then formed that swim around until they affix to some hard substrate), lower ocean pH due to higher atmospheric CO2 has led to an expansion of the hatchery industry (Public Broadcasting Service 2012). As mentioned above, Oregon State University is the largest public hatchery. Major private hatcheries include oyster producers Taylor Shellfish Co. and Hog Island Oyster Co., as well as dedicated private hatchery Pacific Hybreed (Hog Island Oyster Co. 2022; Pacific Hybreed 2022; Taylor Shellfish Farms 2023a). Farms that buy oyster seed from hatcheries first grow out the juveniles in FLUPSYs (Floating Upweller Systems) to a given size, which is dependent on the final cultivation technique and material. The juveniles are then transferred to the final grow-out bag or rack to grow to market size.

The primary cultivation techniques for the region are non-reef-based aquaculture, usually through on-bottom or off-bottom grow-out bags or off-bottom racks. Older and less common techniques include line culture and off-bottom reef harvesting (MacKenzie 1996; California Department of Fish and Wildlife 2021). The average cultivation time to market is approximately 18 months, after which the vast majority of oysters are sold for the half-shell restaurant market. There are several size classes of oysters that are sold, and the typical ones sold for the half shell market are small (2-2.5 inches). Medium and large size oysters are typically for the pre-shucked jar and frozen market, and command a lower price per unit of output (Industry sources).

In recent years, product differentiation in the oyster industry has become commonplace. Due to the fact that shellfish are filter feeders, salinity, sea surface temperature, cultivation technique, composition of ambient nutrients and algae, and other environmental characteristics play a role in final oyster taste and texture. Farms have started to differentiate Pacific oysters through creative names like Fat Bastards and Grassy Bars, the latter of which is named after a specific farm, with individual farms often offering multiple Pacific oyster products (Taylor Shellfish Farms 2023b; Hog Island Oyster Co. 2023; Giovanni's Fish Market & Galley 2023). In addition, some farms also cultivate Kumamoto (*C. sikamea*), Olympia and Belon/European flat oysters, which command higher market prices due to their relative rarity. Olympia and Belon oysters are not often found far from the cultivating region because they are much are often not as robust to shifts in air exposure and temperature (for example, Belon shells usually do not close entirely) relative to Pacific oysters, which make long distance shipping difficult and expensive (Pangea Shellfish Company 2014; California Sea Grant 2023).

Table 1. Summary Statistics by State and Species

State	Species	Metric Tons (Shelled Weight)	Revenue (2022 USD)	Price/Lb (2022 USD)
California	Pacific	437.98 (219.26)	5,990,157.43 (4,390,637.17)	6.85 (4.49)
	Eastern	4.72 (3.48)	185,818.99 (151,258.18)	19.61 (6.55)
	Olympia	1.57 (2.07)	35,983.70 (24,019.73)	15.14 (10.49)
	European Flat	2.25 (2.63)	101,662.30 (113,893.02)	26.39 (12.71)
Oregon	Pacific	193.88 (106.20)	2,079,988.22 (1,368,406.89)	5.30 (2.42)
	Eastern	-	-	-
	Olympia	0.50 (0.53)	42,095.46 (33,131.18)	30.99 (5.86)
	European Flat	-	-	-
Washington	Pacific	3635.82 (894.36)	32,314,533.23 (16,796,795.2)	4.05 (1.63)
	Eastern	2.78 (3.49)	119,405.53 (183,523.05)	15.83 (9.13)
	Olympia	12.93 (14.72)	696,454.93 (539,355.42)	38.22 (21.19)
	European Flat	5.10 (3.96)	358,652.77 (278,740.53)	33.06 (10.00)

Average quantities and revenue from 1950 - 2022 from NOAA FOSS Landings Data. Dollar values in 2022 USD.

Figure A2-1. Pacific Oysters, California

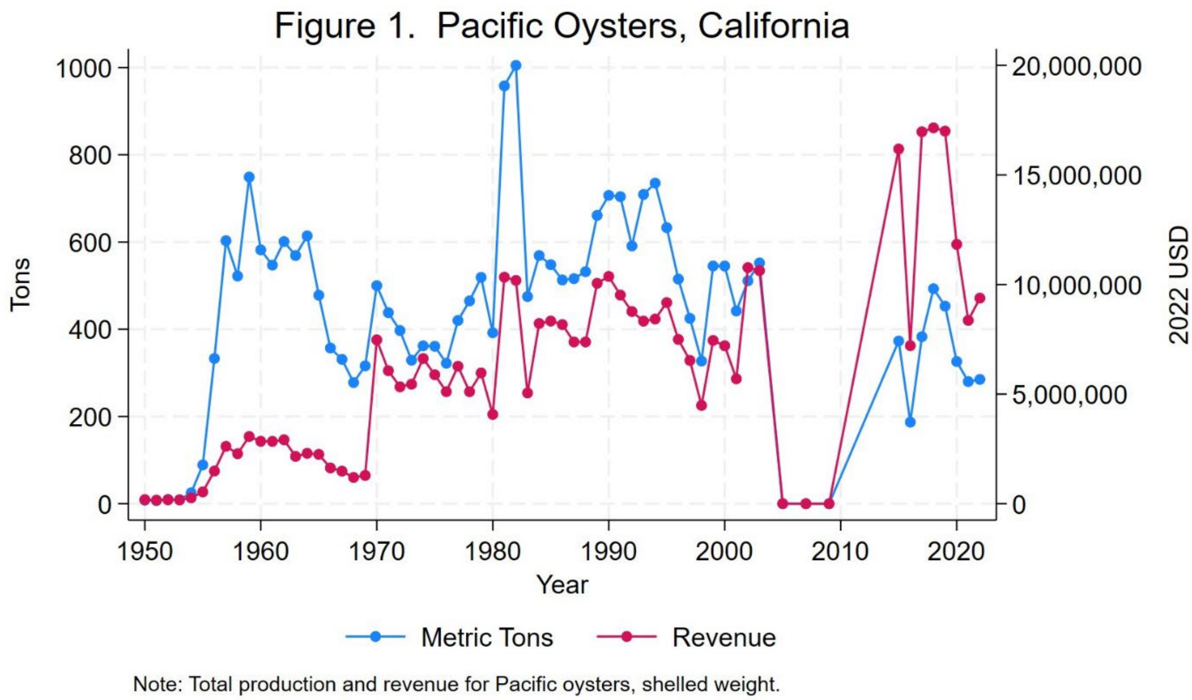


Figure A2-2. Pacific Oysters, Oregon

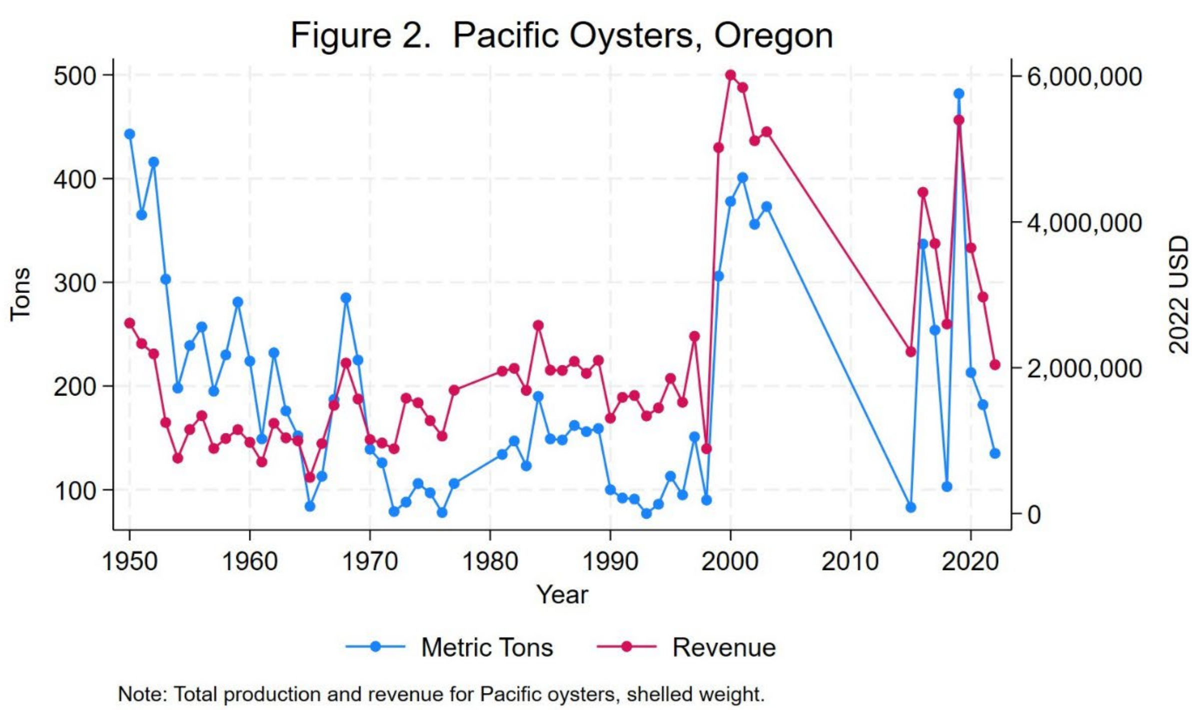
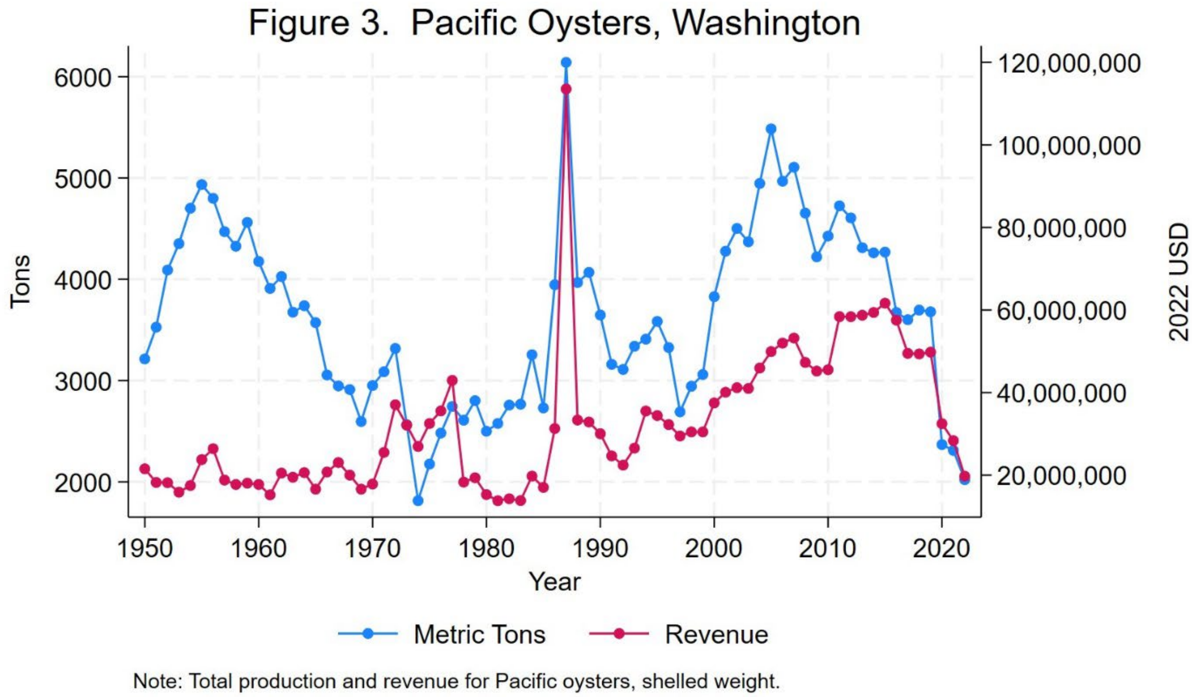


Figure A2-3. Pacific Oysters, Washington



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APPENDIX 3. IMPORT FIGURES

Figures for ALL product group

Fig A3-1-1: ALL Weight & Value by Year

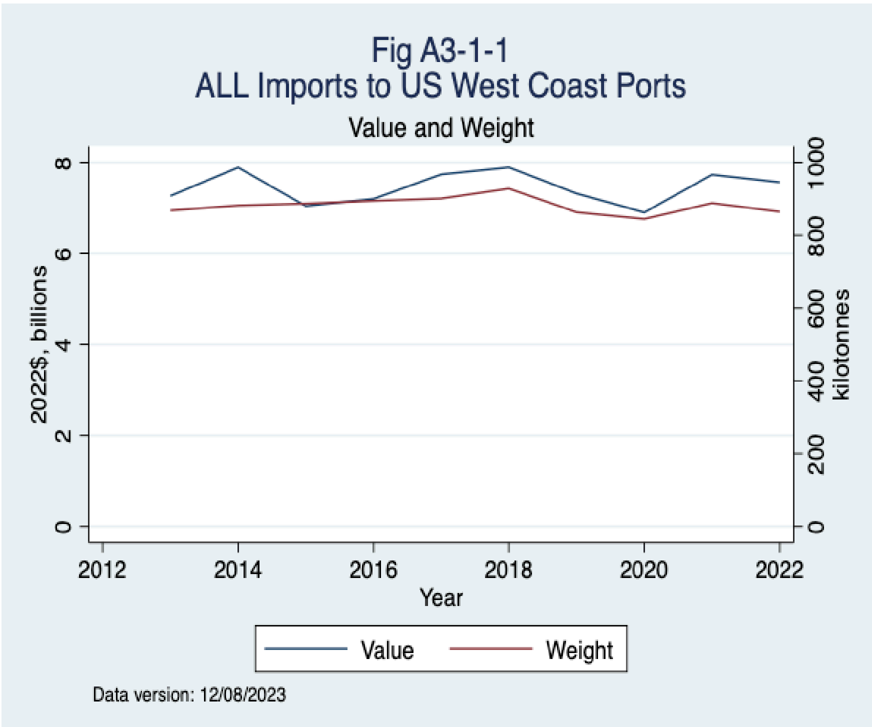


Fig A3-1-2: ALL Value & Price by Year

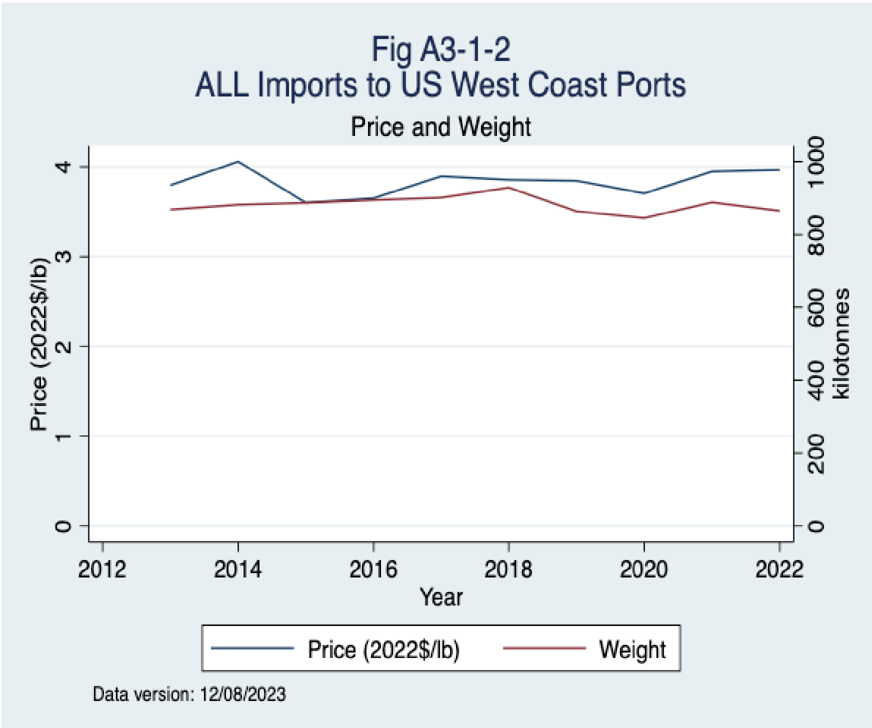


Fig A3-1-3: ALL Price Percentiles by Year

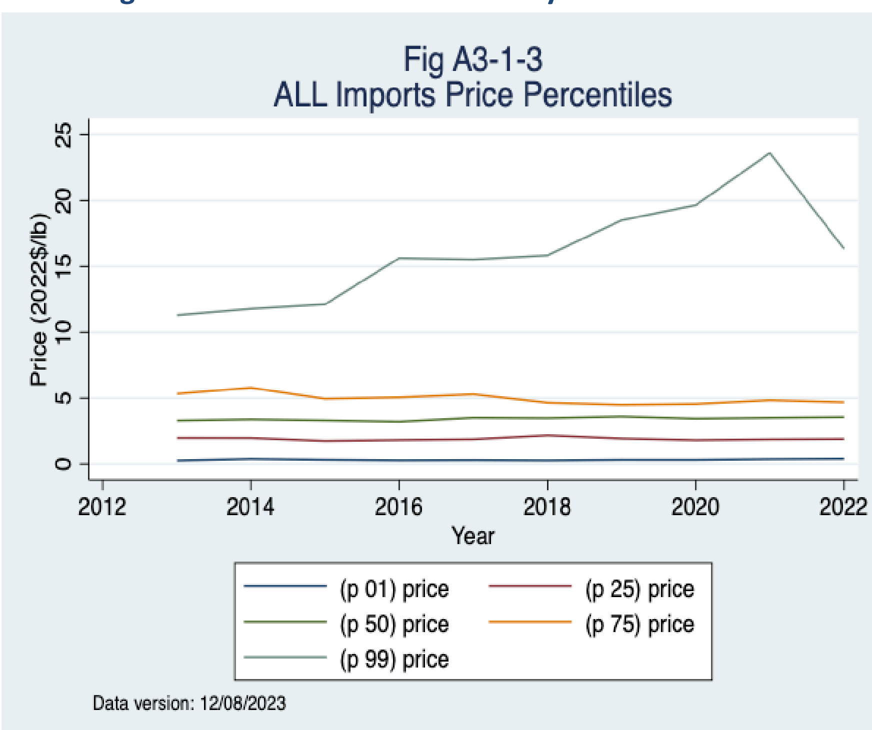


Fig A3-1-4: ALL Value by Port, Proportion

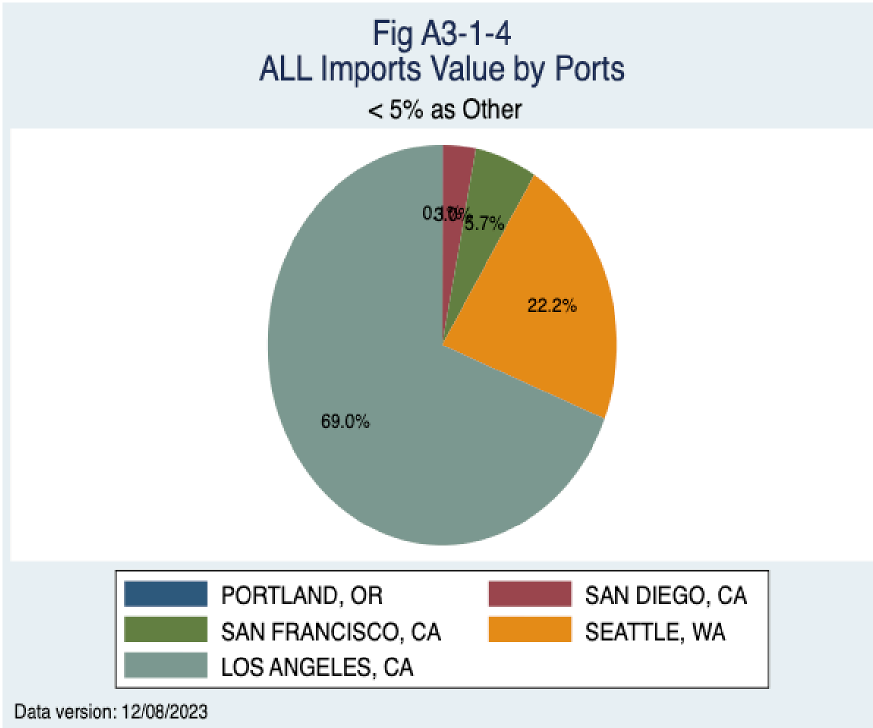


Fig A3-1-5: ALL Weight by Port, Proportion

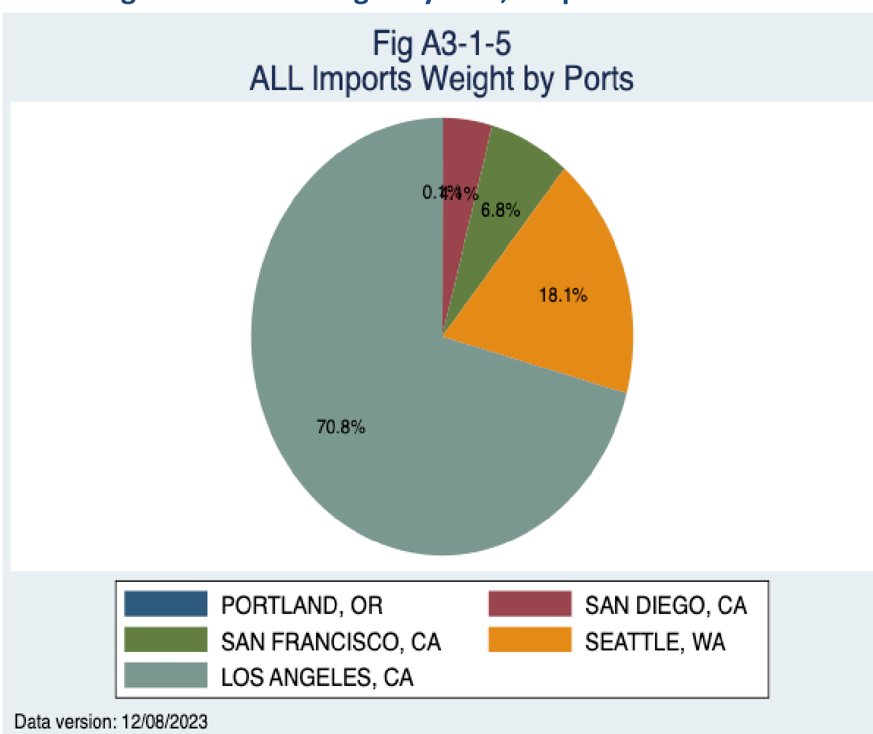


Fig A3-1-6: ALL Value by Port by Year

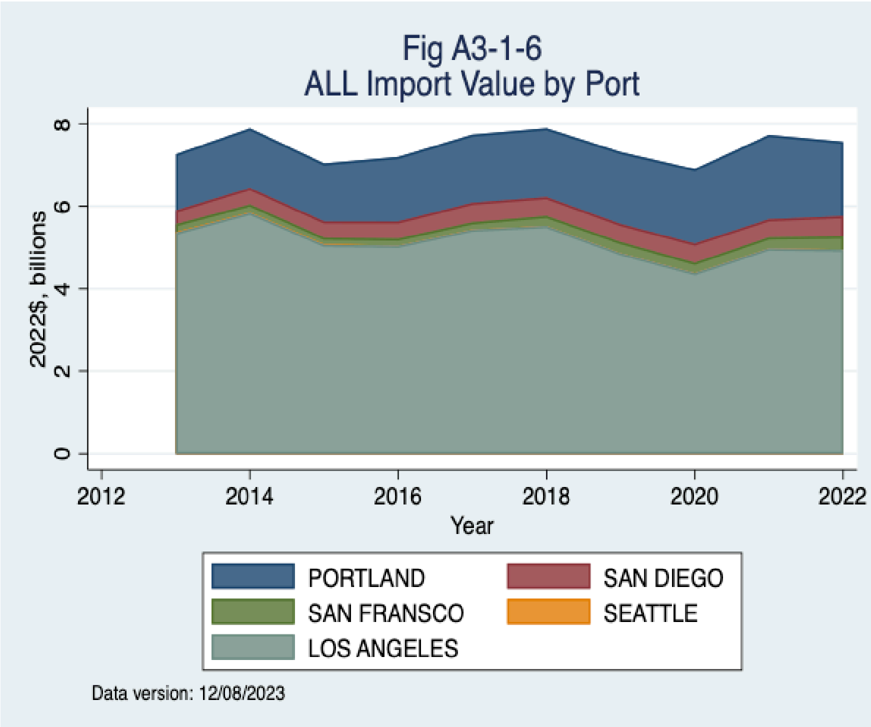


Fig A3-1-7: ALL Weight by Port by Year

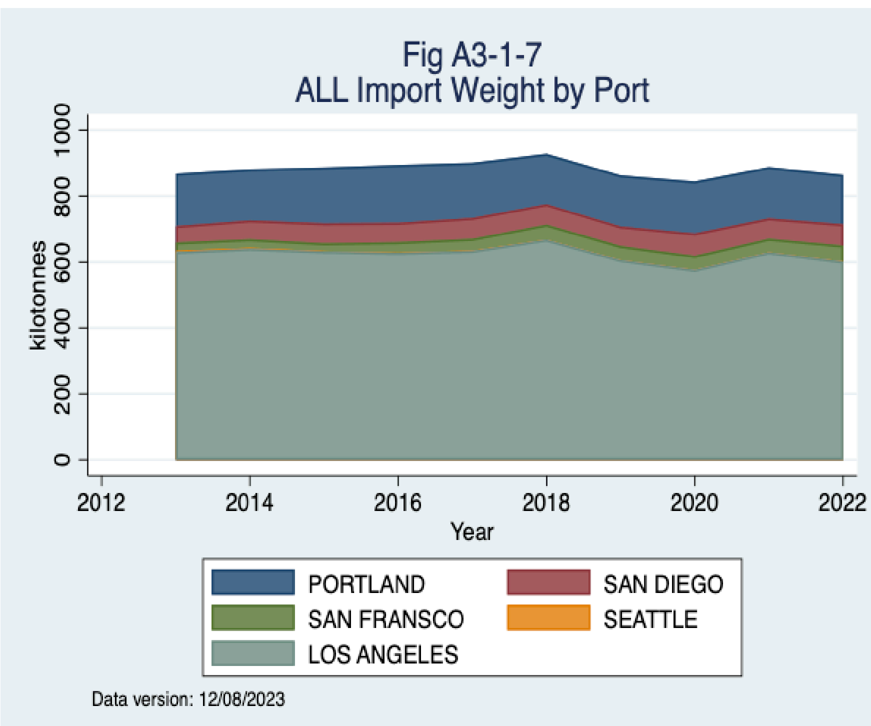


Fig A3-1-8: ALL Value by Continent, Proportion

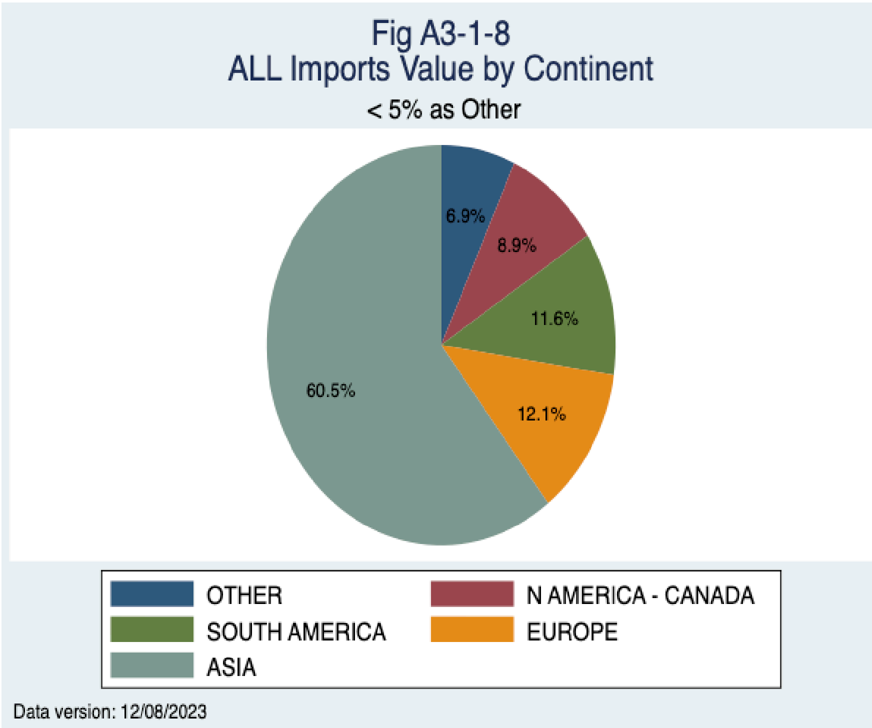


Fig A3-1-9: ALL Weight by Continent, Proportion

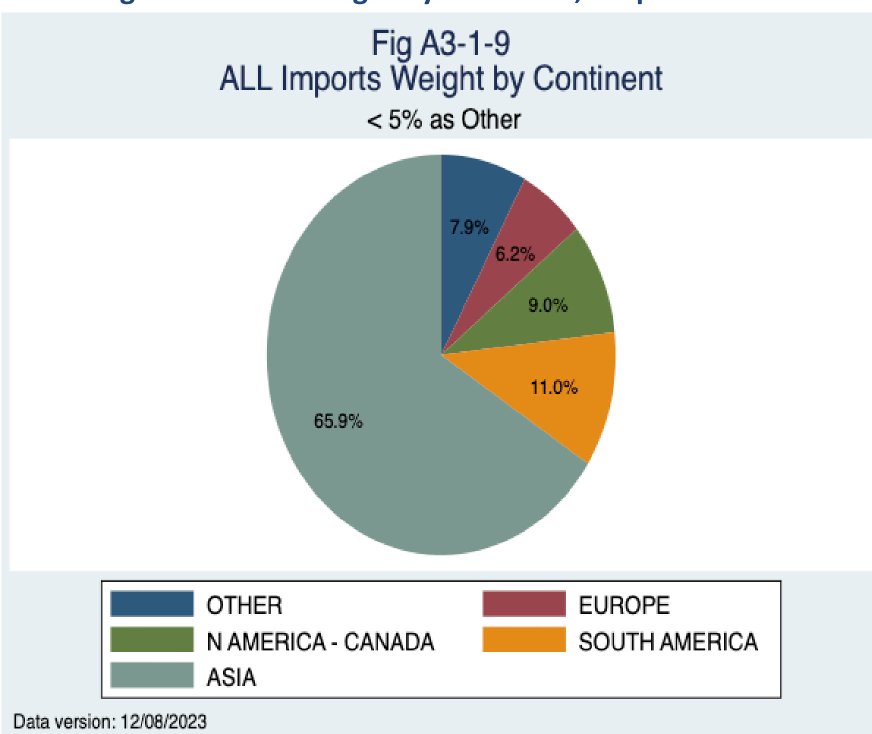


Fig A3-1-10: ALL Value by Continent by Year

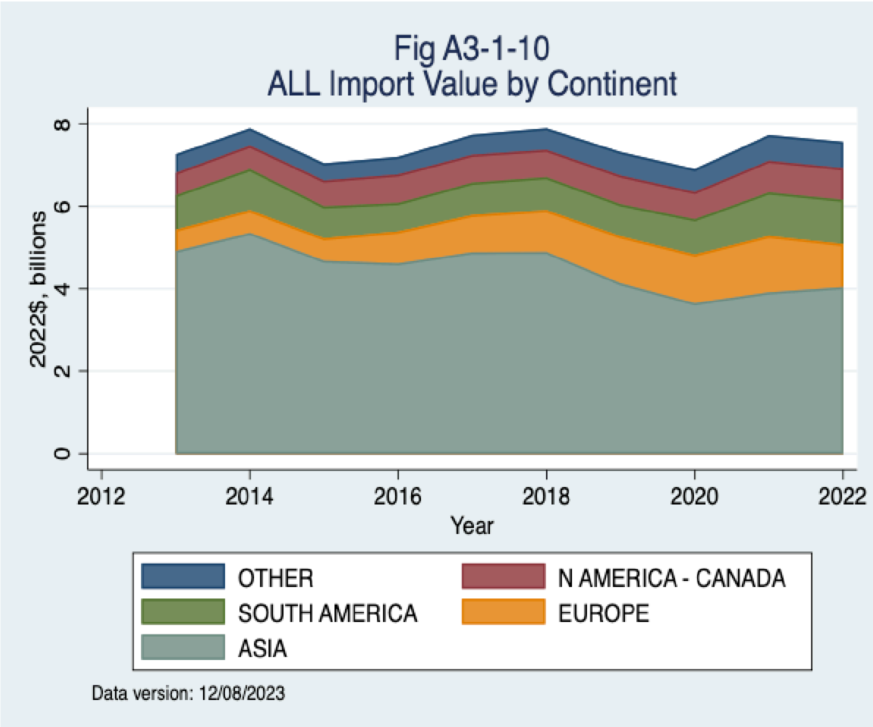


Fig A3-1-11: ALL Weight by Continent by Year

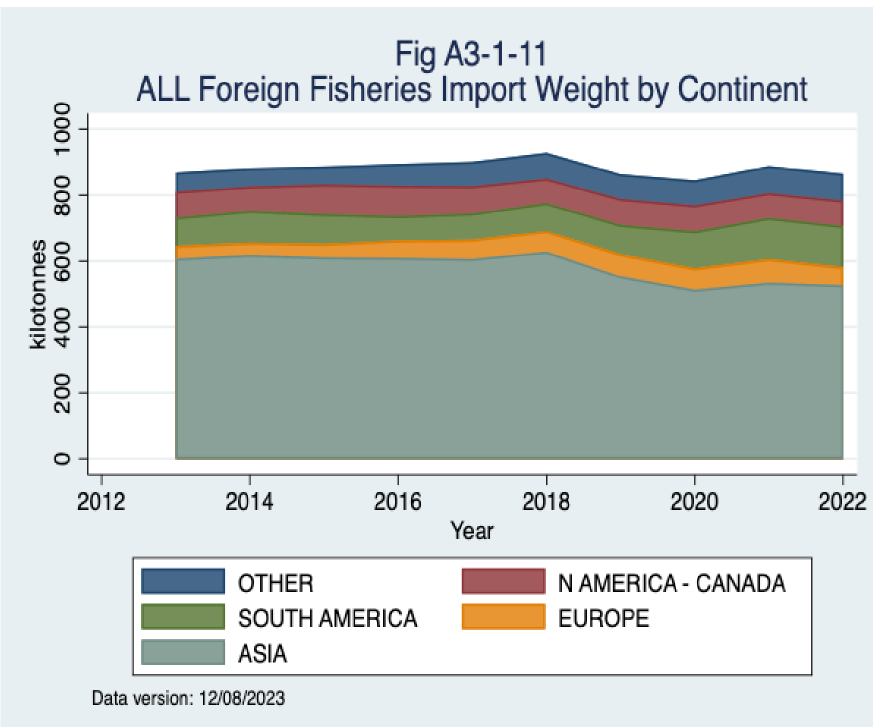


Fig A3-1-12: ALL Value by Country, Proportion

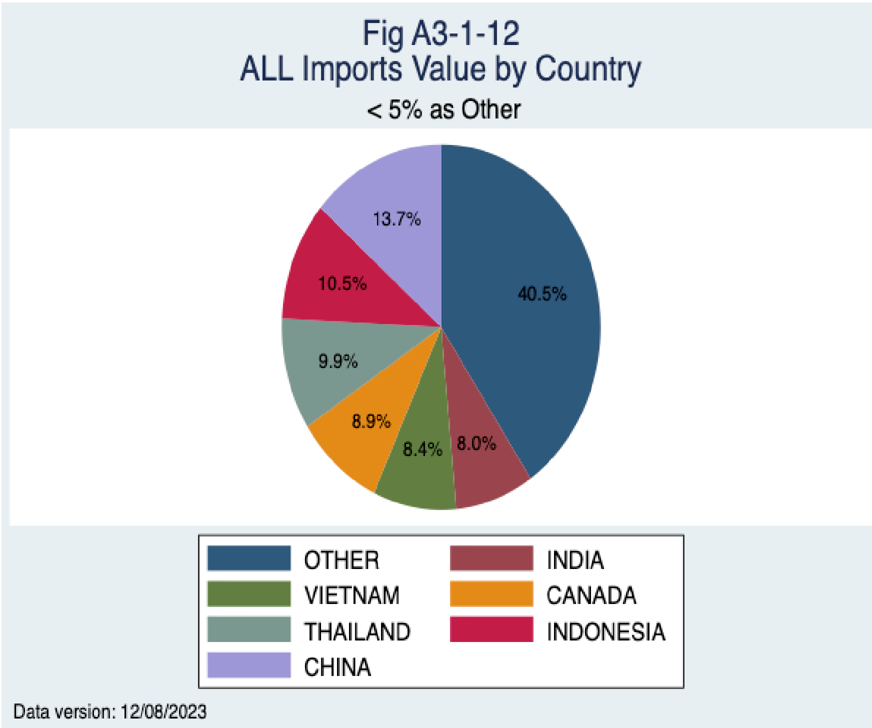


Fig A3-1-13: ALL Weight by Country, Proportion

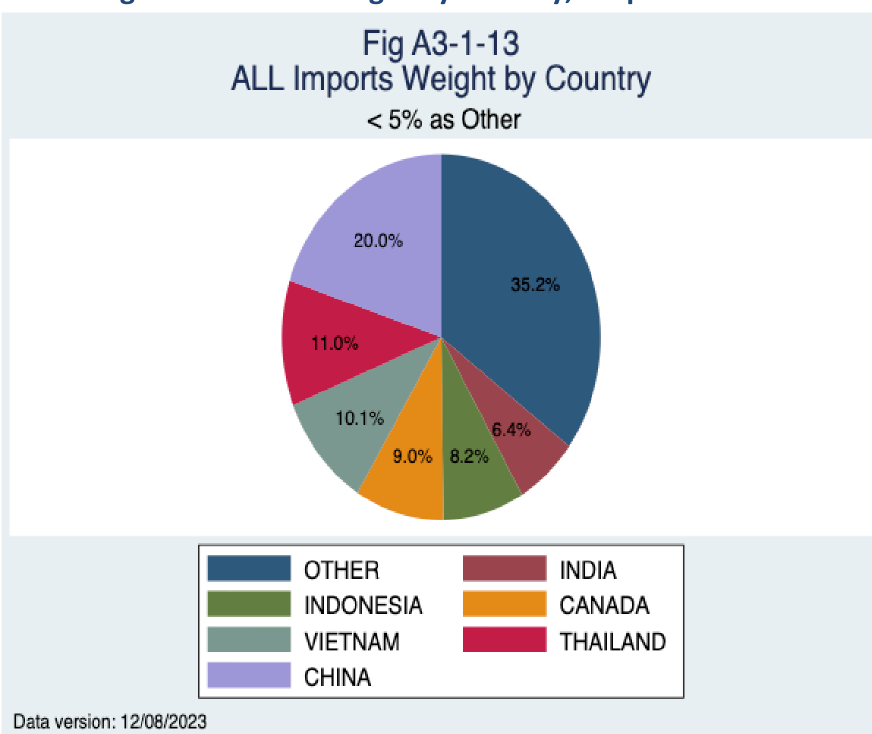


Fig A3-1-14: ALL Value by Country by Year

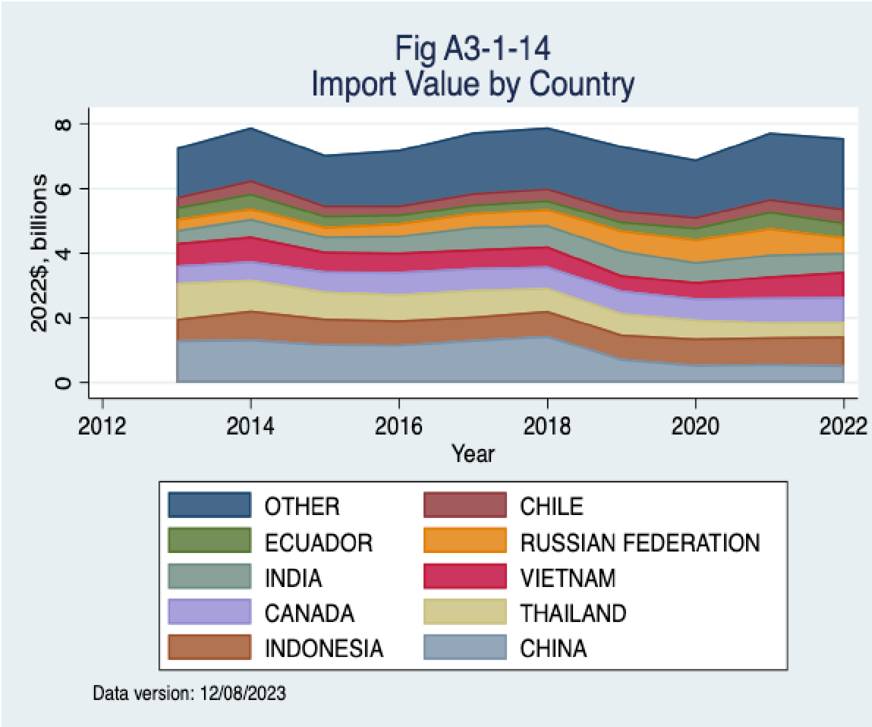
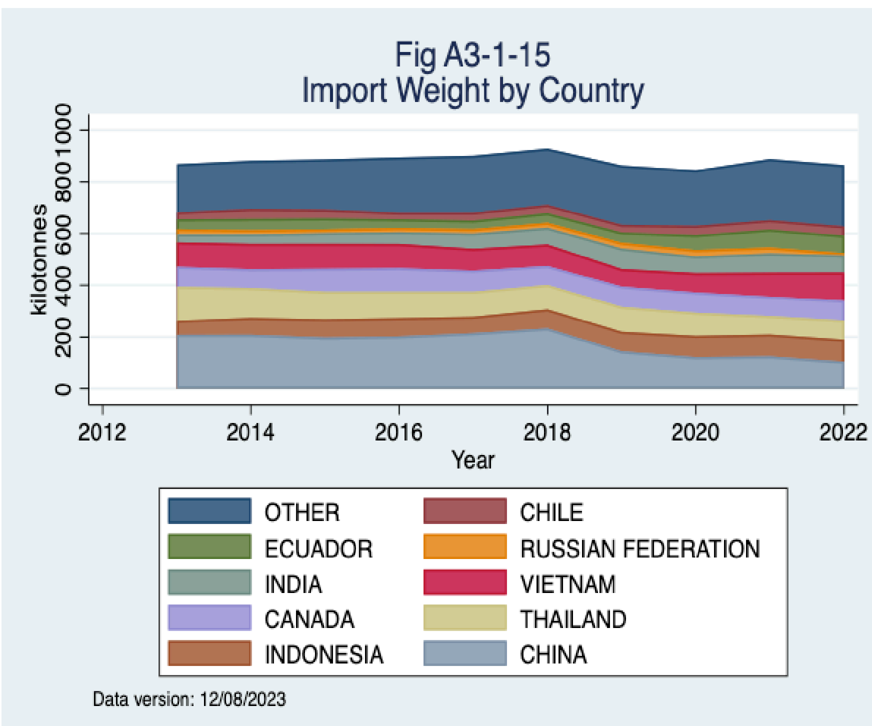


Fig A3-1-15: ALL Weight by Country by Year



Figures for PROXY_FRESH product group

Fig A3-2-1: PROXY_FRESH Weight & Value by Year

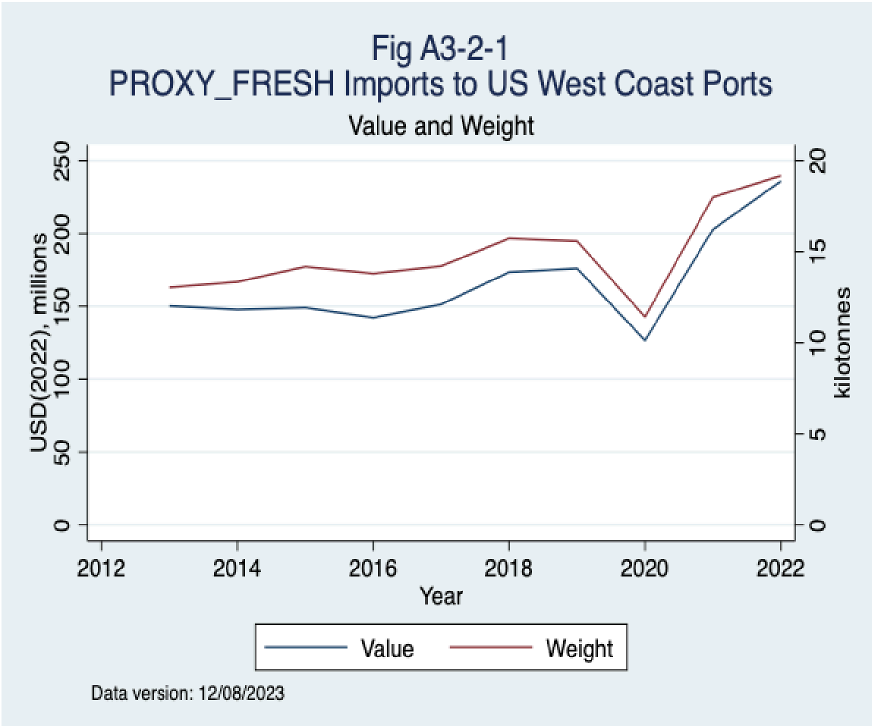


Fig A3-2-2: PROXY_FRESH Value & Price by Year

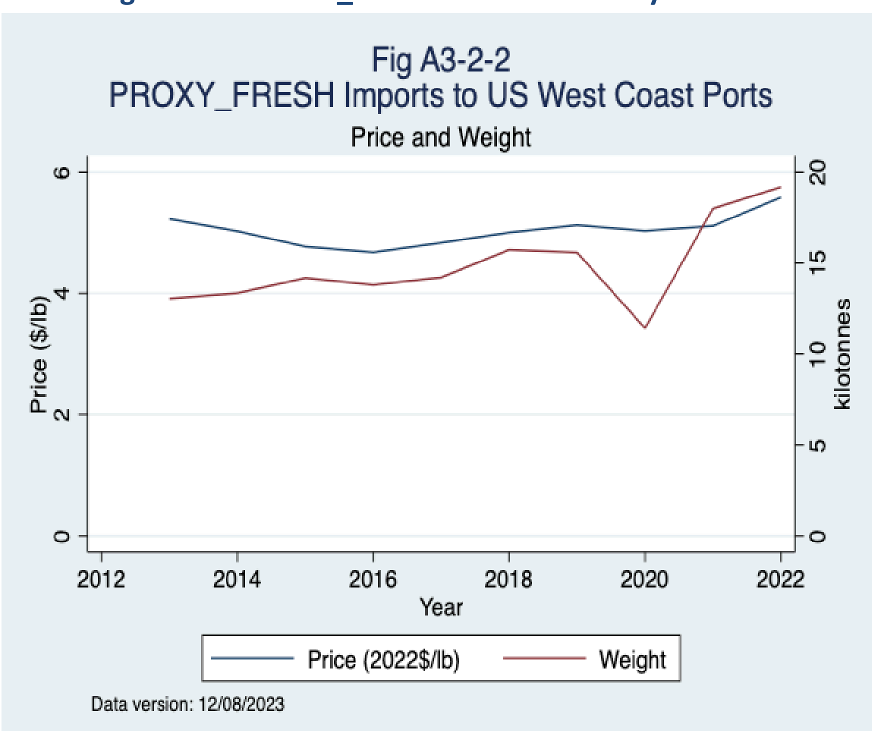


Fig A3-2-3: PROXY_FRESH Price Percentiles by Year

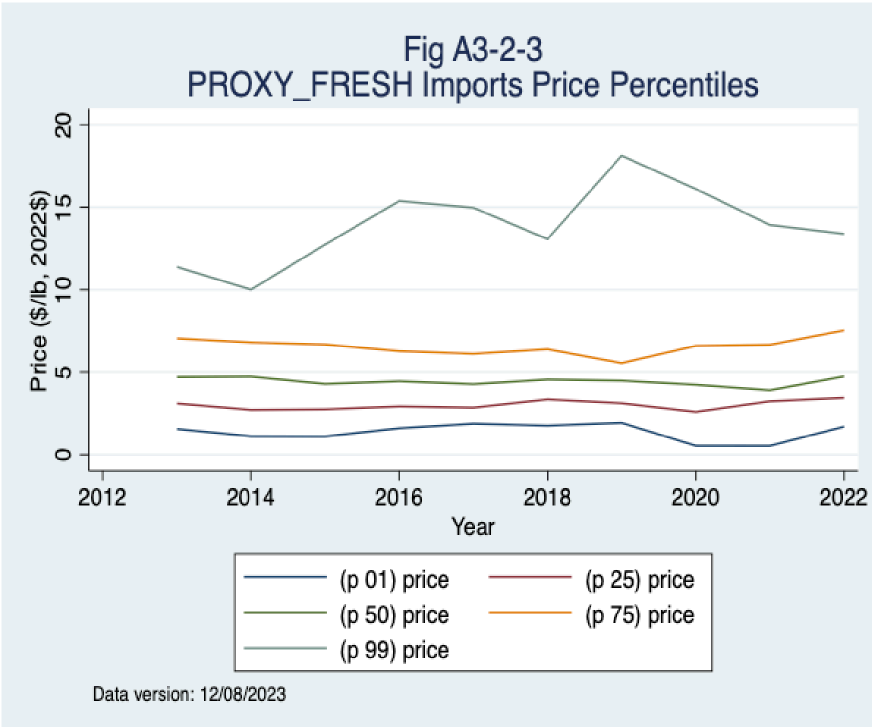


Fig A3-2-4: PROXY_FRESH Value by Port, Proportion

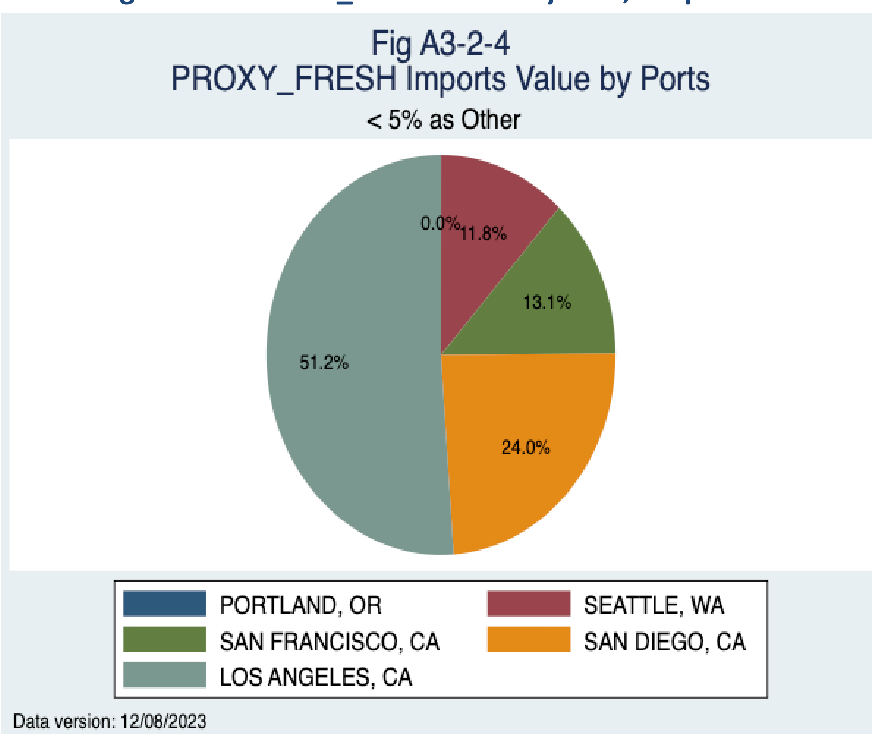


Fig A3-2-5: PROXY_FRESH Weight by Port, Proportion

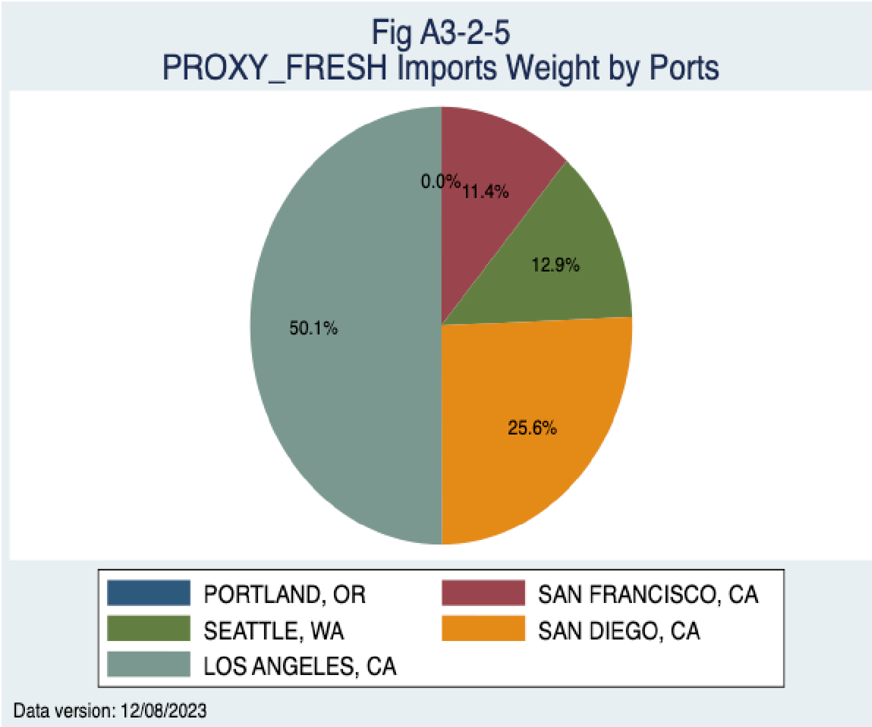


Fig A3-2-6: PROXY_FRESH Value by Port by Year

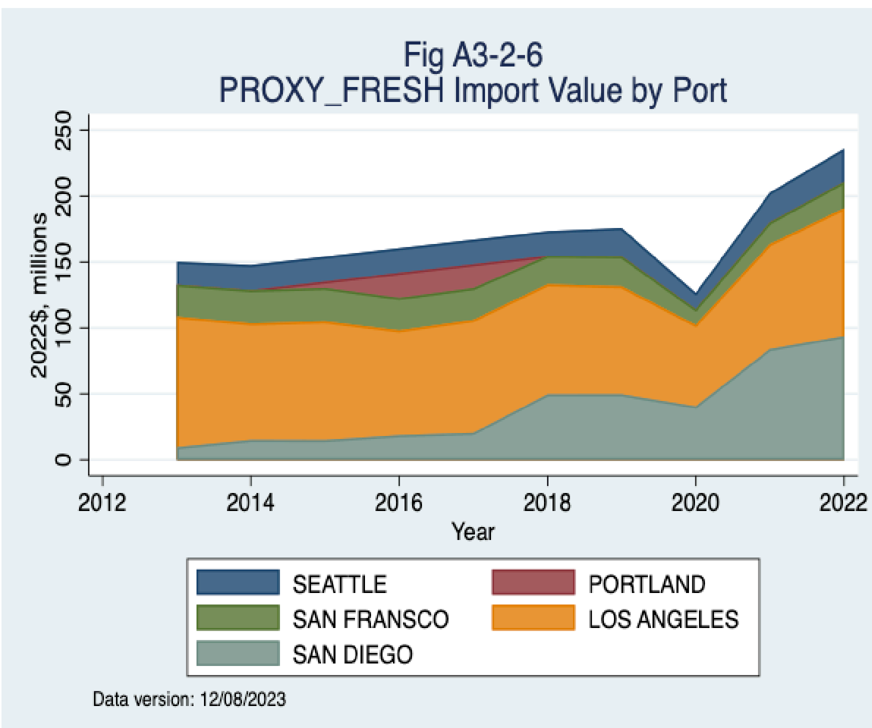


Fig A3-2-7: PROXY_FRESH Weight by Port by Year

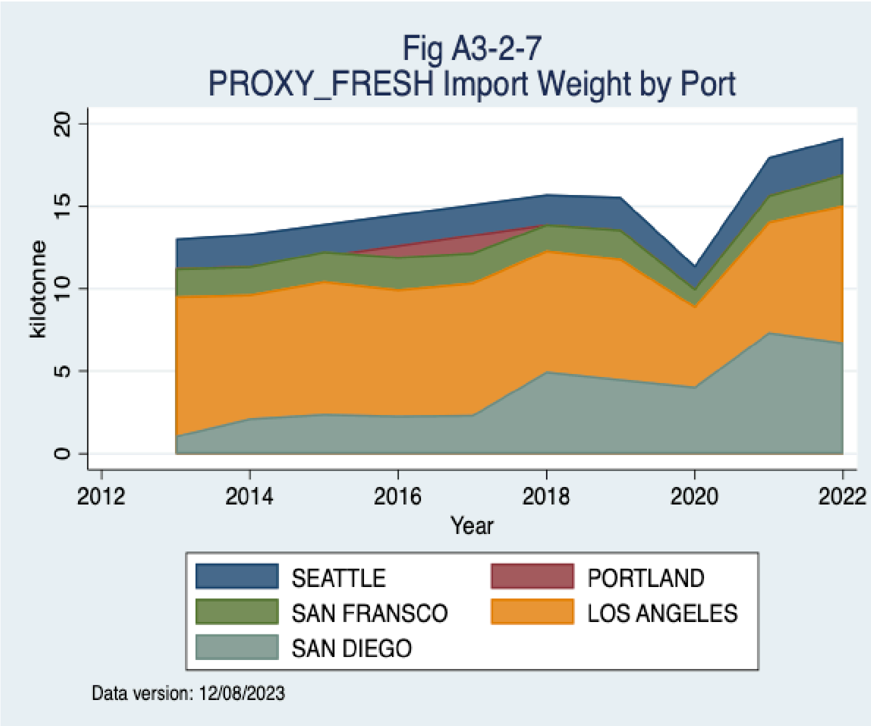


Fig A3-2-8: PROXY_FRESH Value by Continent, Proportion

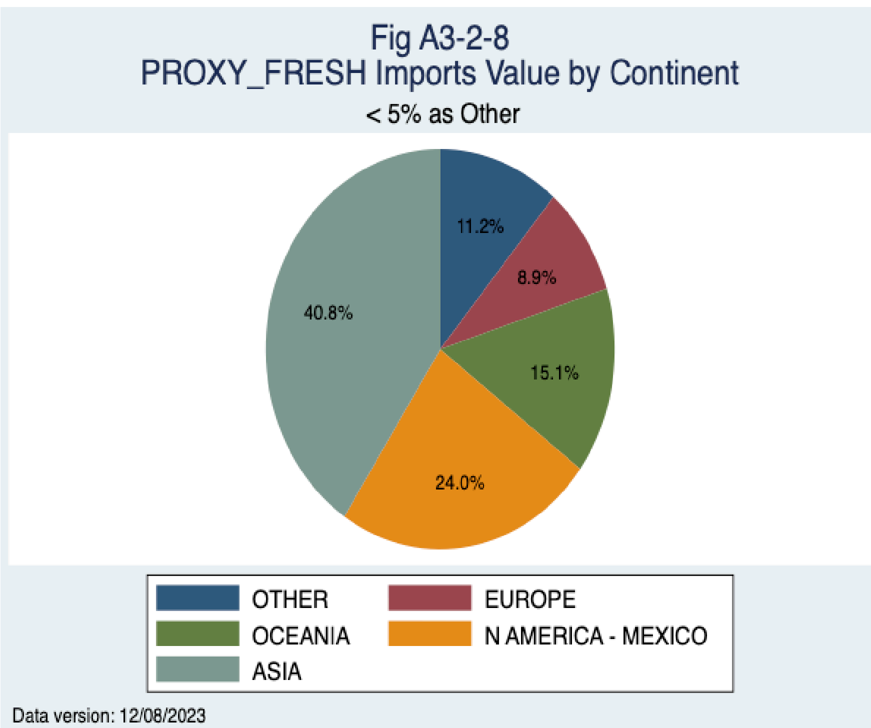


Fig A3-2-9: PROXY_FRESH Weight by Continent, Proportion

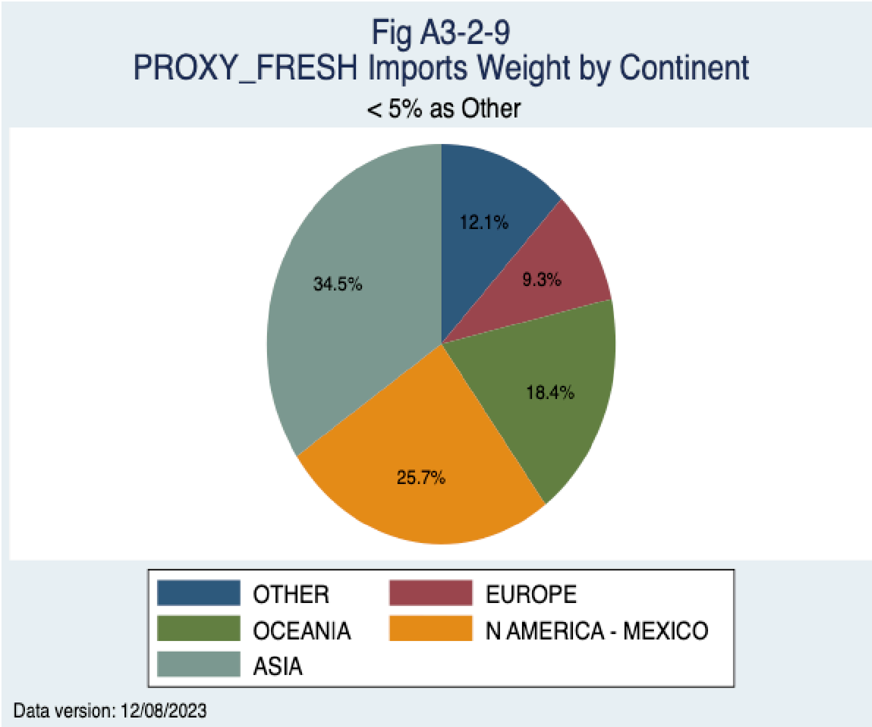


Fig A3-2-10: PROXY_FRESH Value by Continent by Year

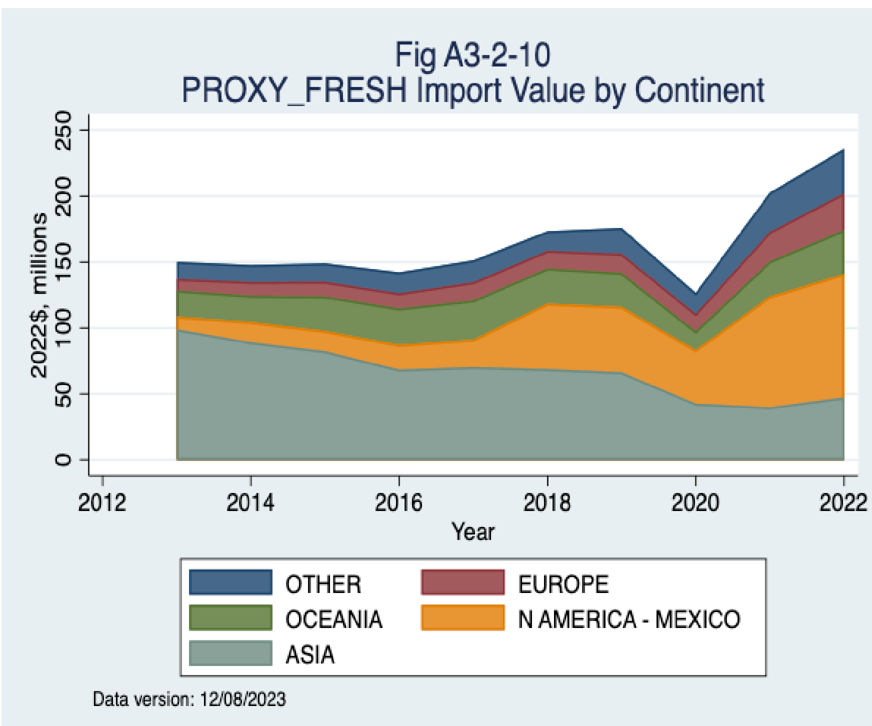


Fig A3-2-11: PROXY_FRESH Weight by Continent by Year

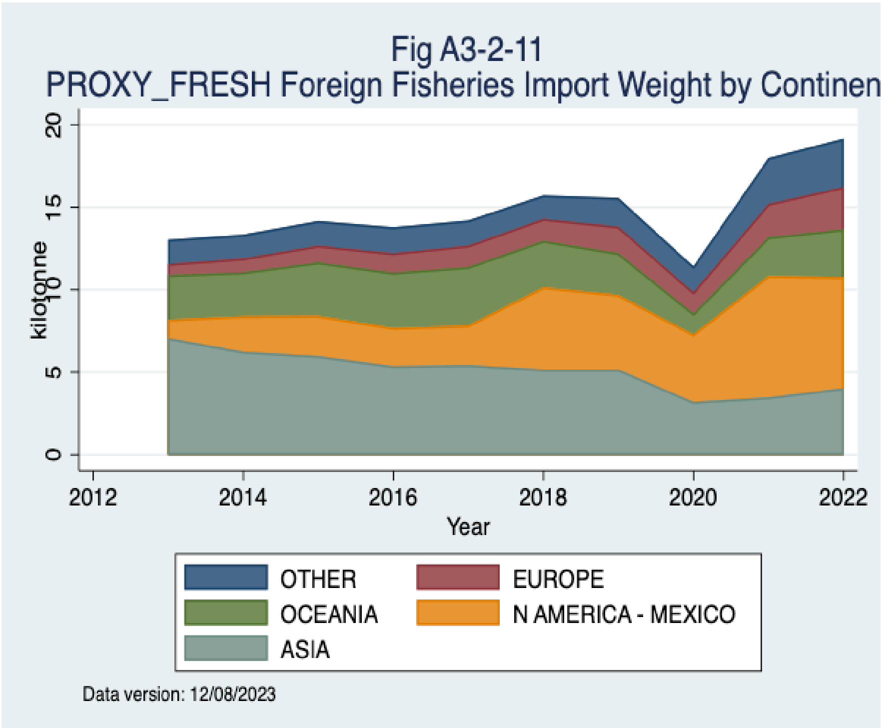


Fig A3-2-12: PROXY_FRESH Value by Country, Proportion

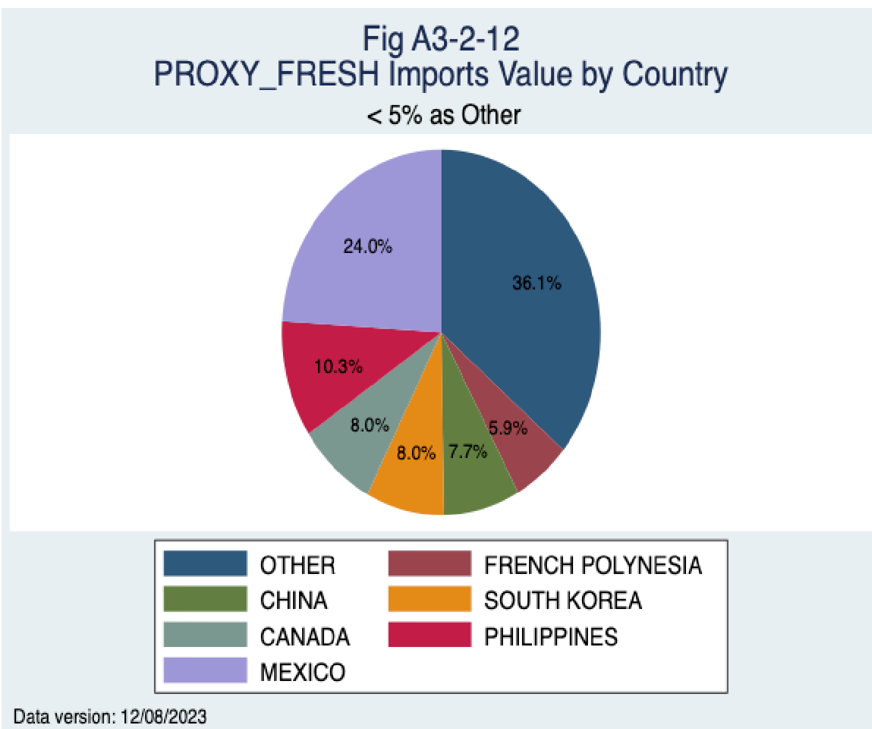


Fig A3-2-13: PROXY_FRESH Weight by Country, Proportion

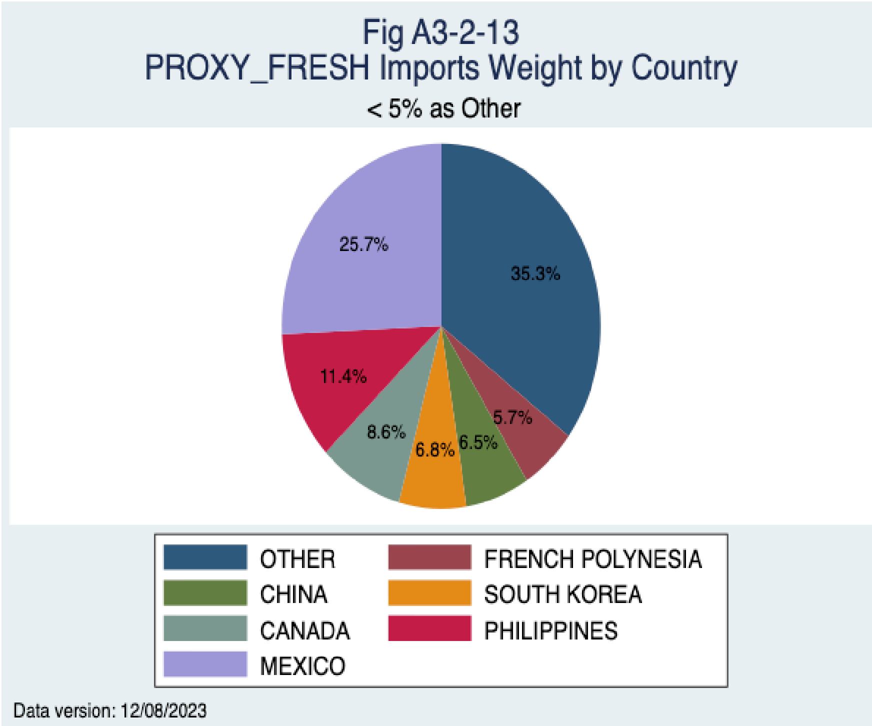


Fig A3-2-14: PROXY_FRESH Value by Country by Year

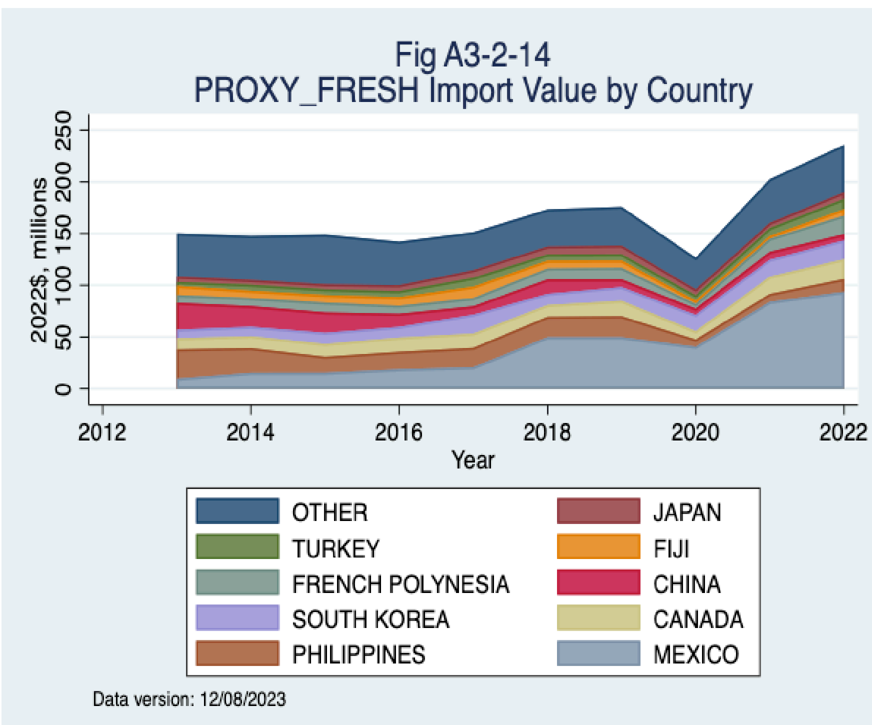
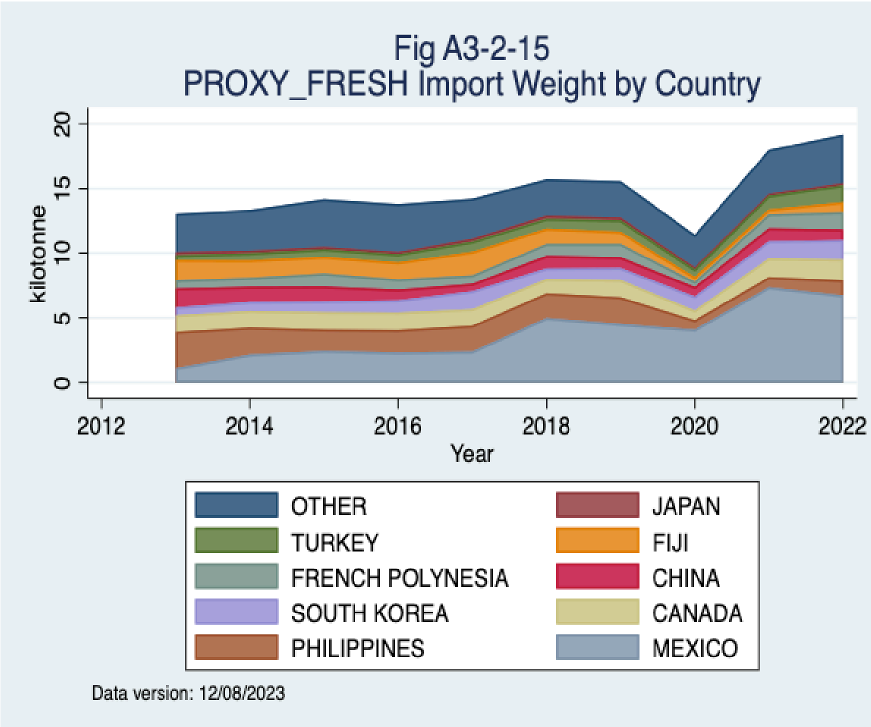


Fig A3-2-15: PROXY_FRESH Weight by Country by Year



Figures for PROXY_OTHER product group

Fig A3-3-1: PROXY_OTHER Weight & Value by Year

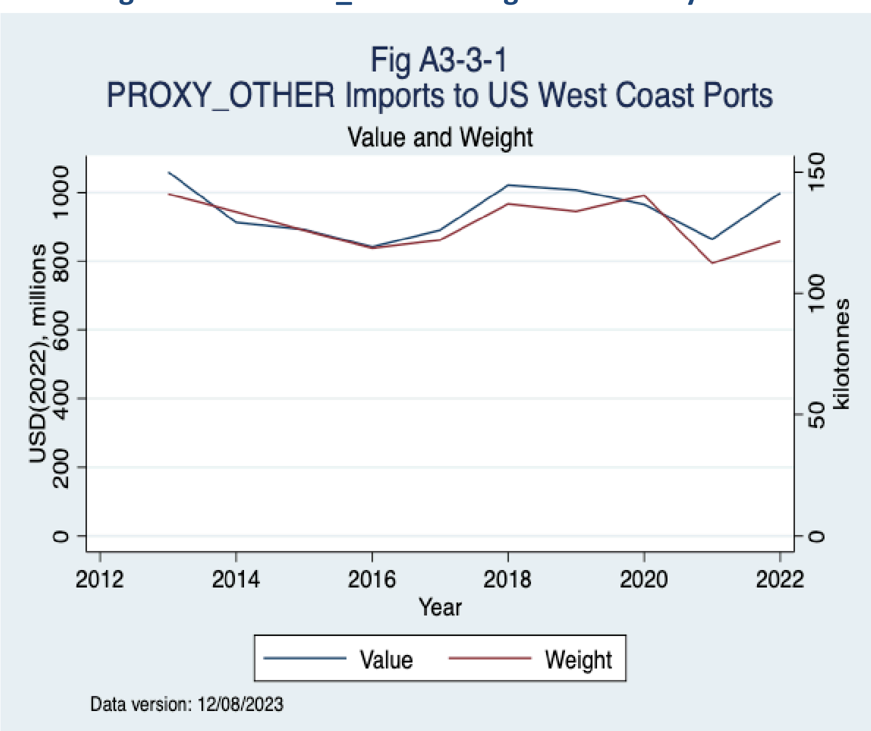


Fig A3-3-2: PROXY_OTHER Value & Price by Year

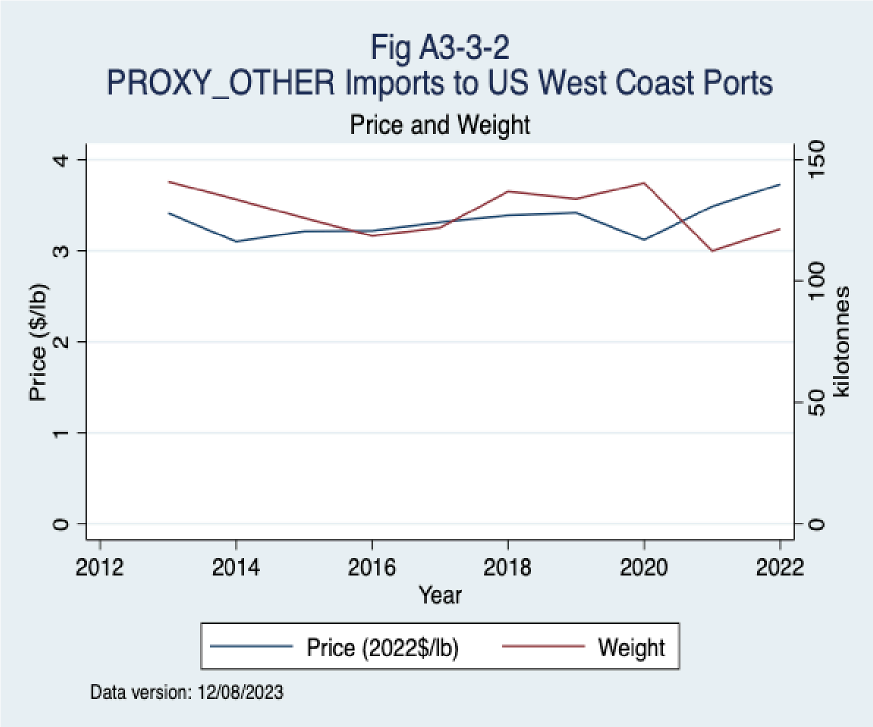


Fig A3-3-3: PROXY_OTHER Price Percentiles by Year

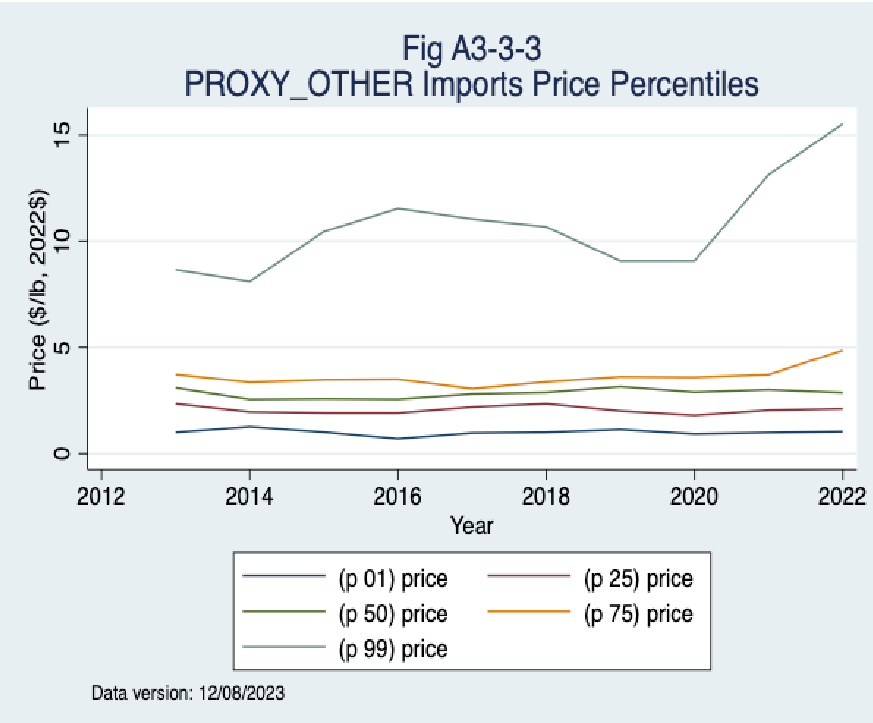


Fig A3-3-4: PROXY_OTHER Value by Port, Proportion

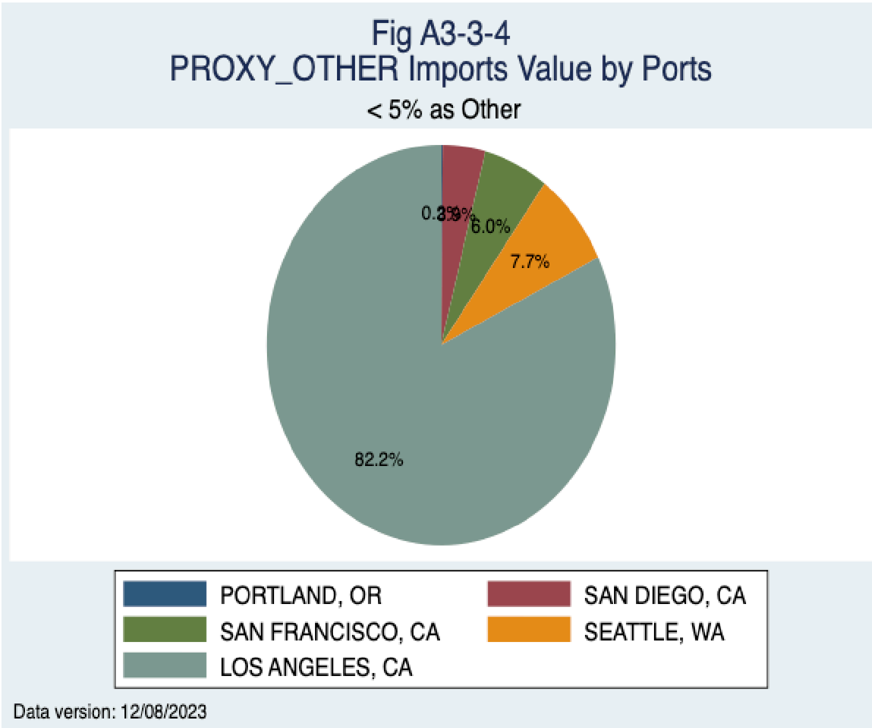


Fig A3-3-5: PROXY_OTHER Weight by Port, Proportion

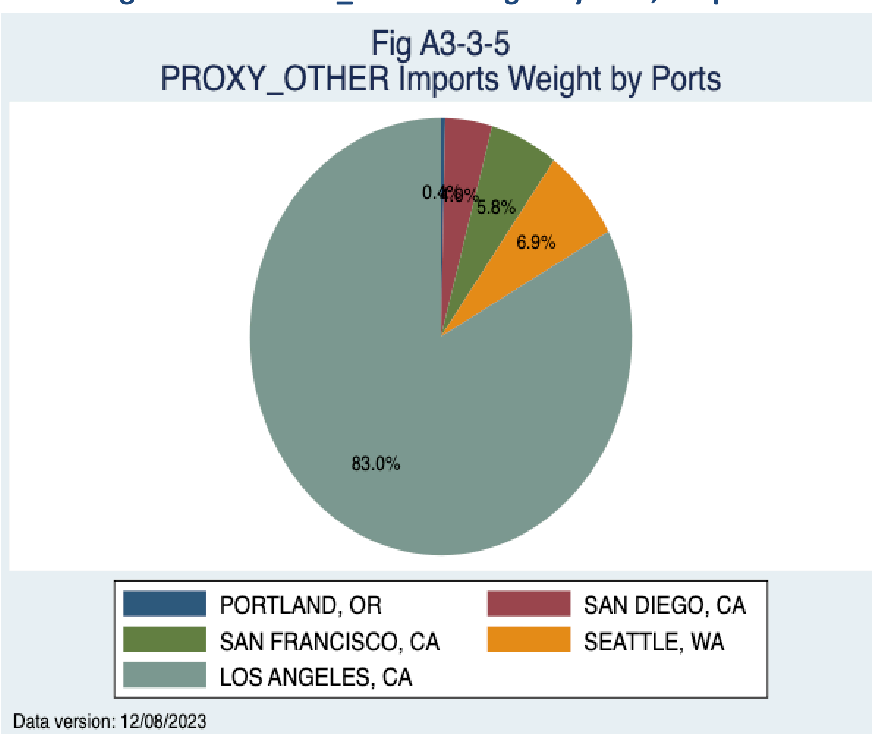


Fig A3-3-6: PROXY_OTHER Value by Port by Year

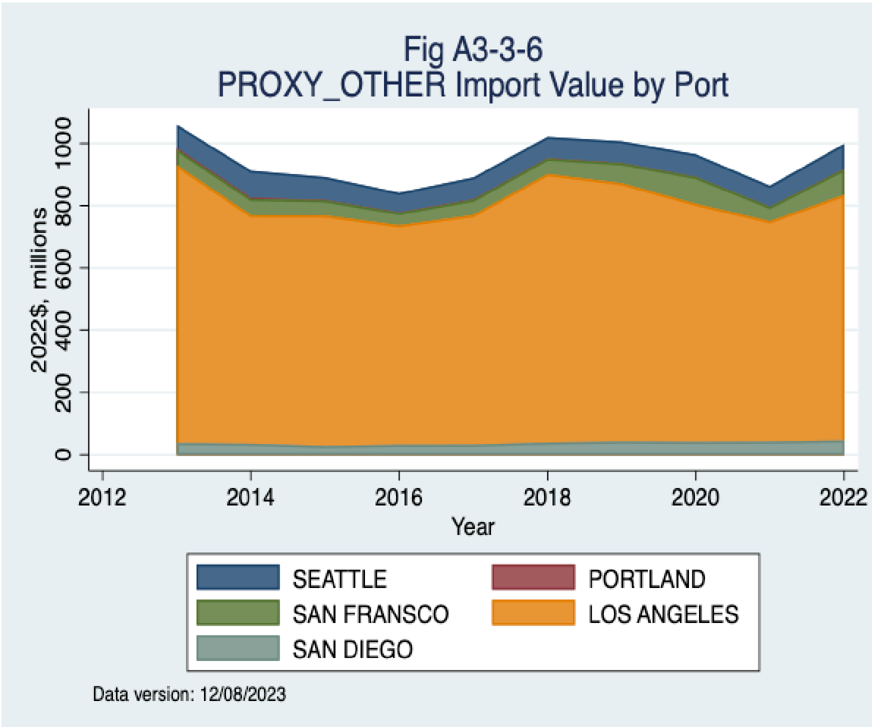


Fig A3-3-7: PROXY_OTHER Weight by Port by Year

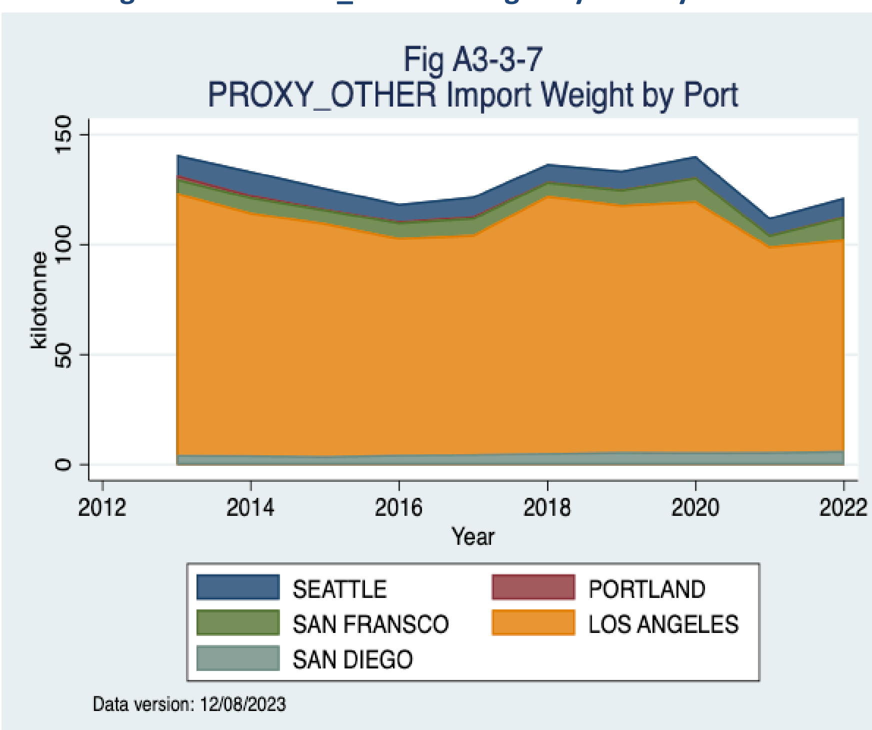


Fig A3-3-8: PROXY_OTHER Value by Continent, Proportion

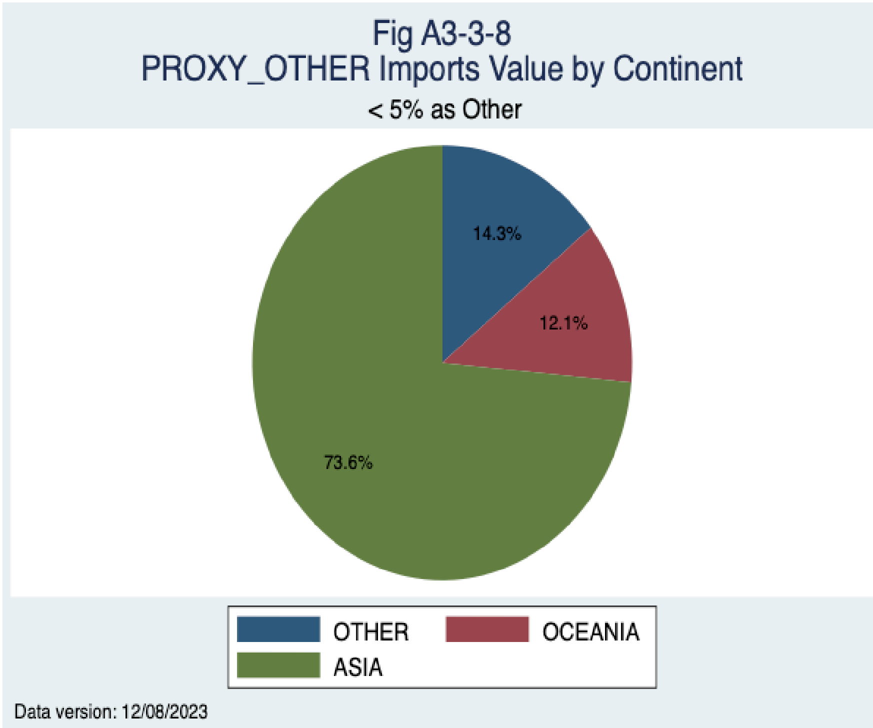


Fig A3-3-9: PROXY_OTHER Weight by Continent, Proportion

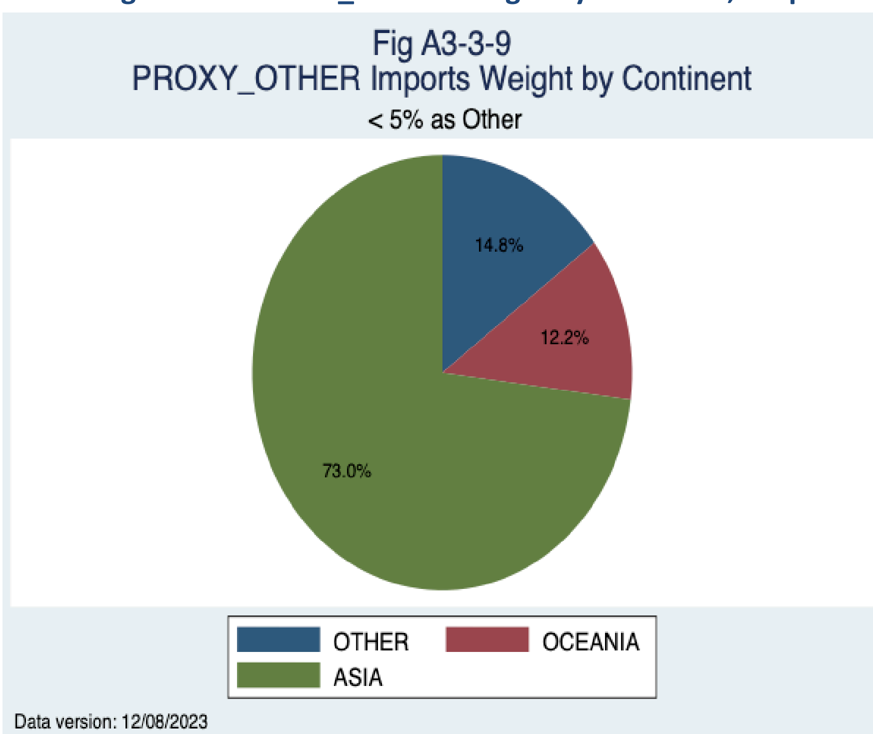


Fig A3-3-10: PROXY_OTHER Value by Continent by Year

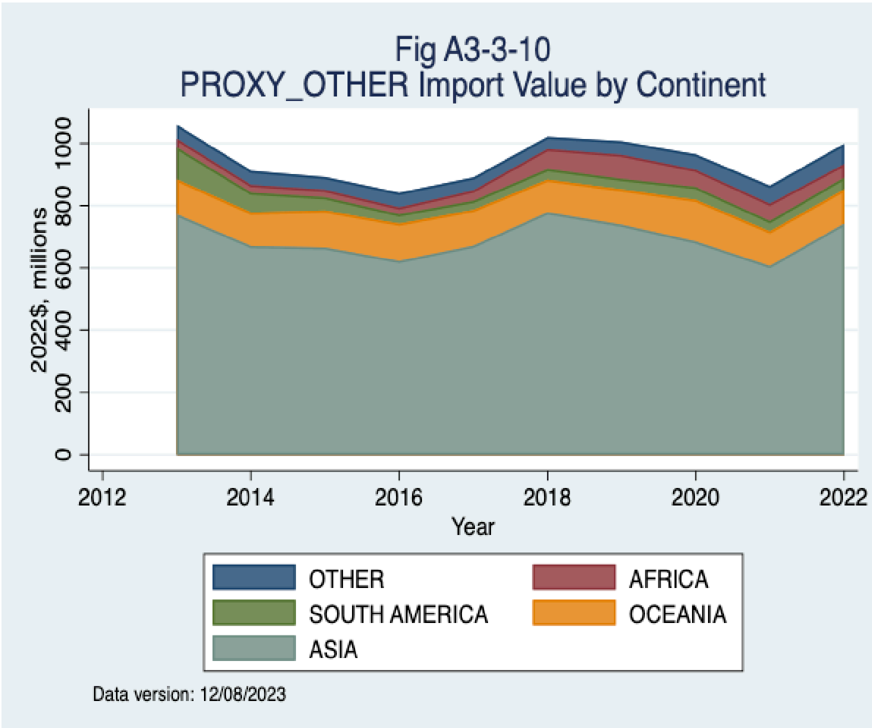


Fig A3-3-11: PROXY_OTHER Weight by Continent by Year

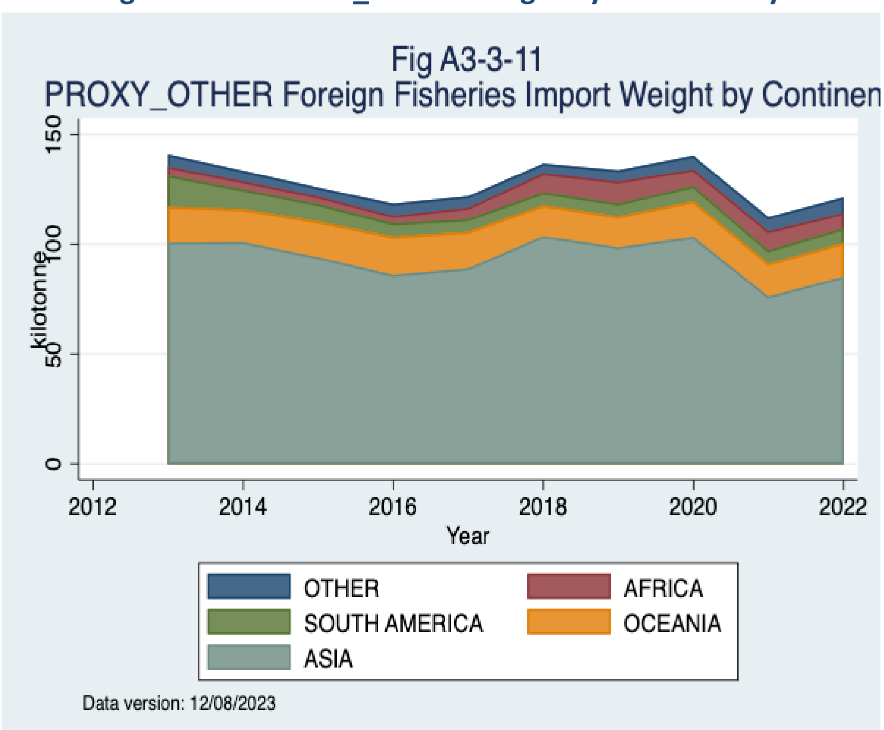


Fig A3-3-12: PROXY_OTHER Value by Country, Proportion

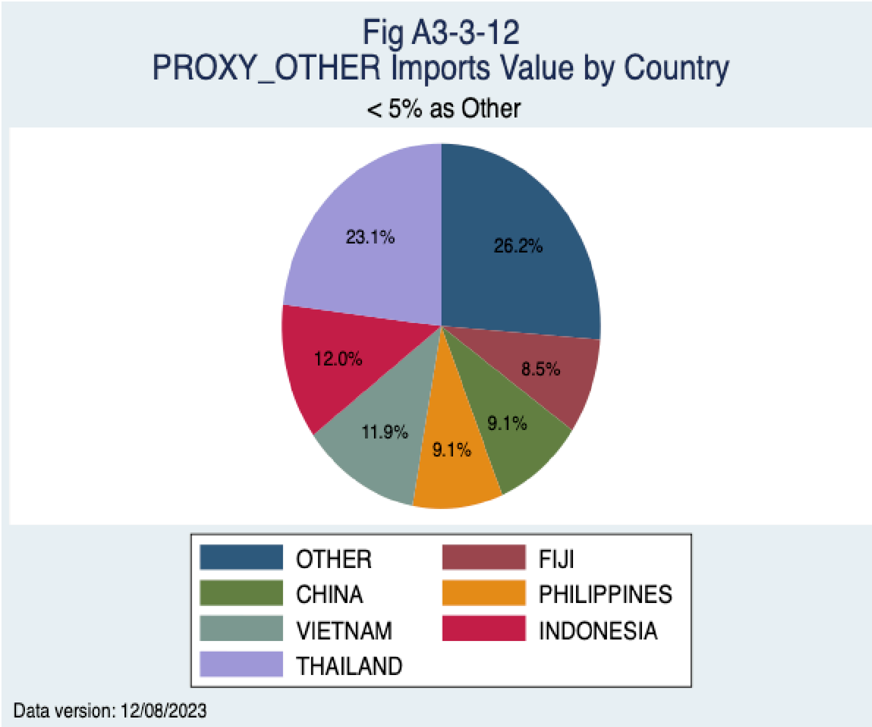


Fig A3-3-13: PROXY_OTHER Weight by Country, Proportion

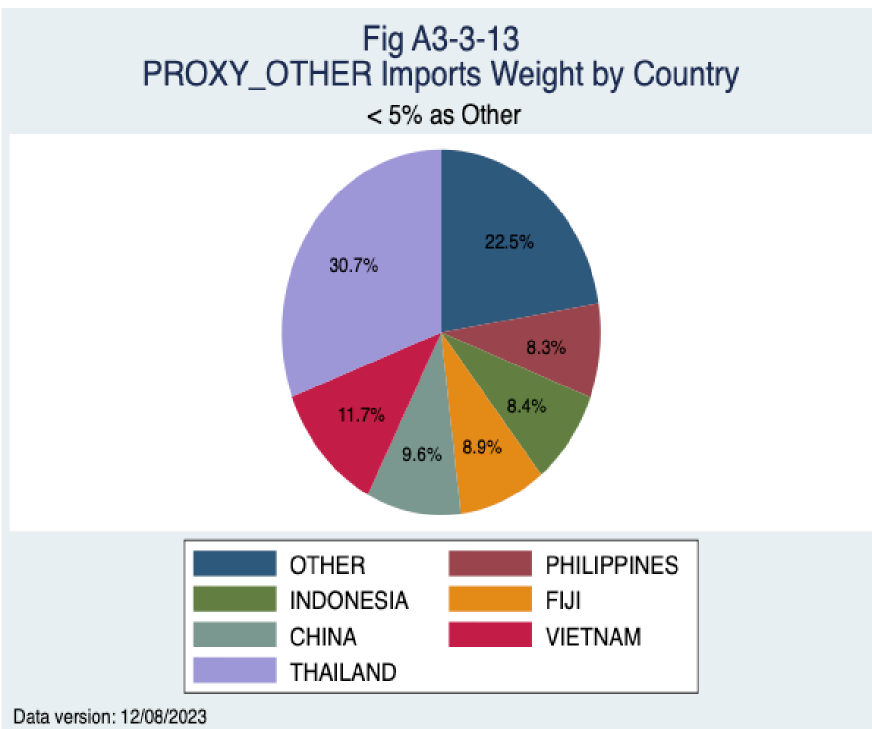


Fig A3-3-14: PROXY_OTHER Value by Country by Year

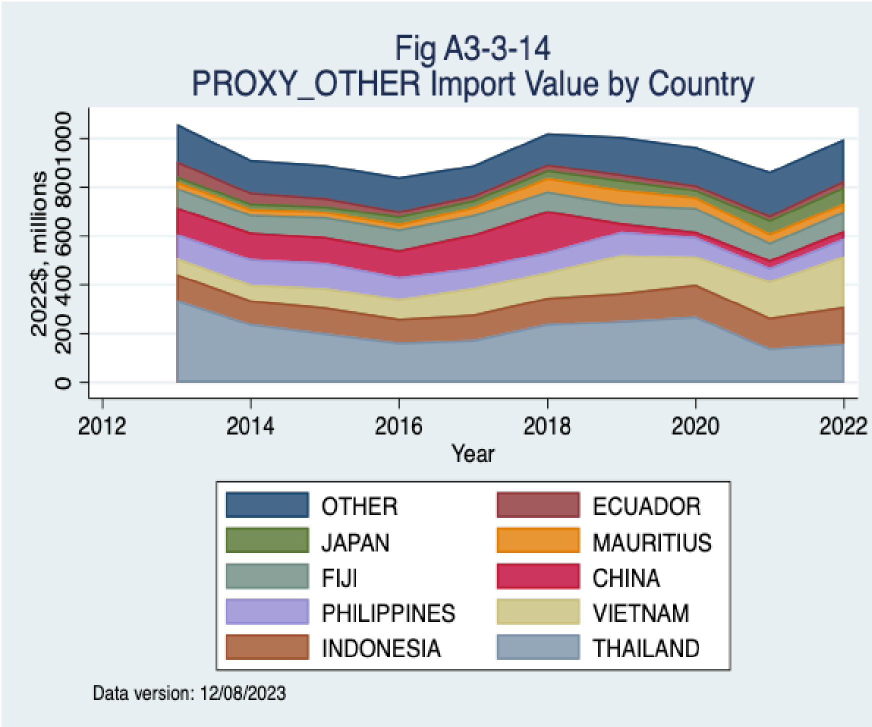
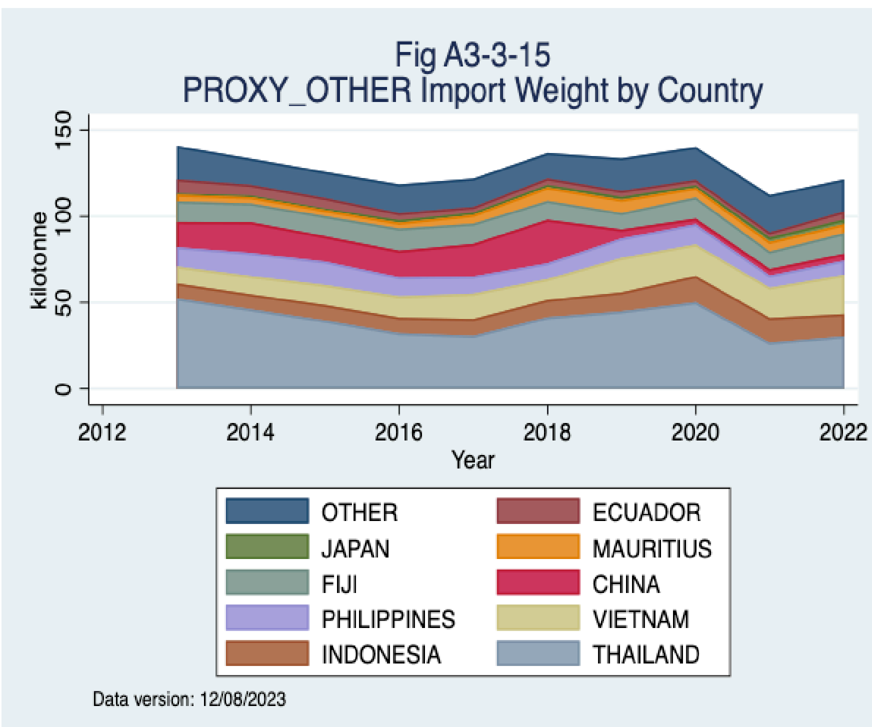


Fig A3-3-15: PROXY_OTHER Weight by Country by Year



Figures for TUNA_FRESH product group

Fig A3-4-1: TUNA_FRESH Weight & Value by Year

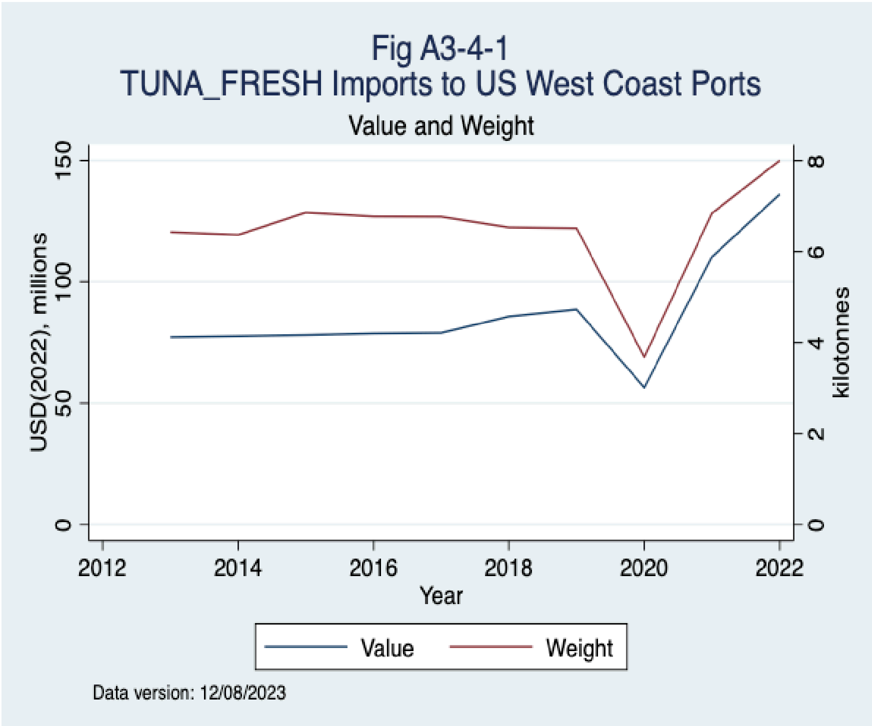


Fig A3-4-2: TUNA_FRESH Value & Price by Year

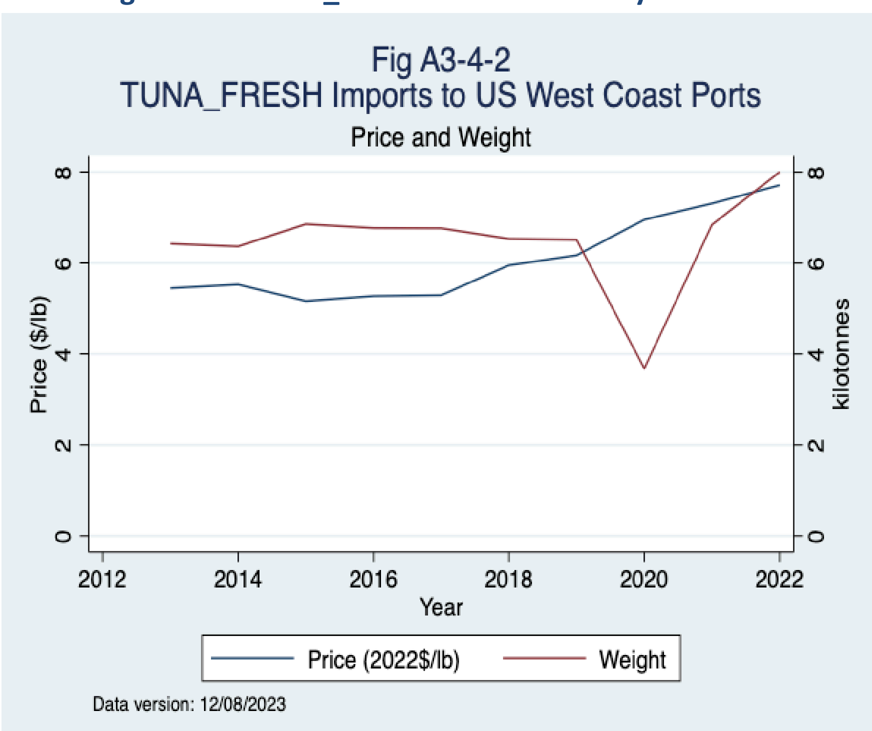


Fig A3-4-3: TUNA_FRESH Price Percentiles by Year

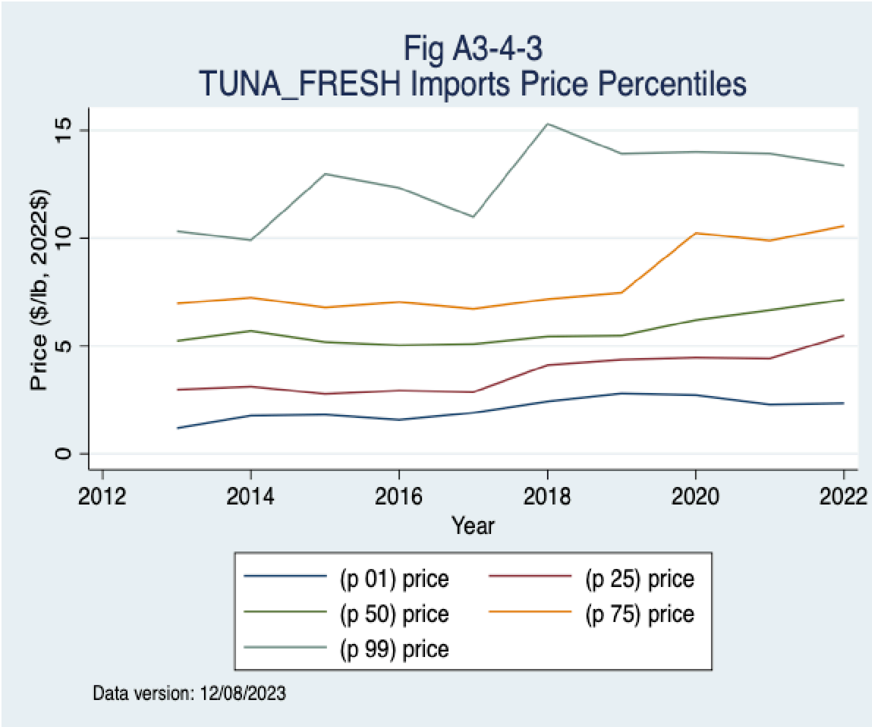


Fig A3-4-4: TUNA_FRESH Value by Port, Proportion

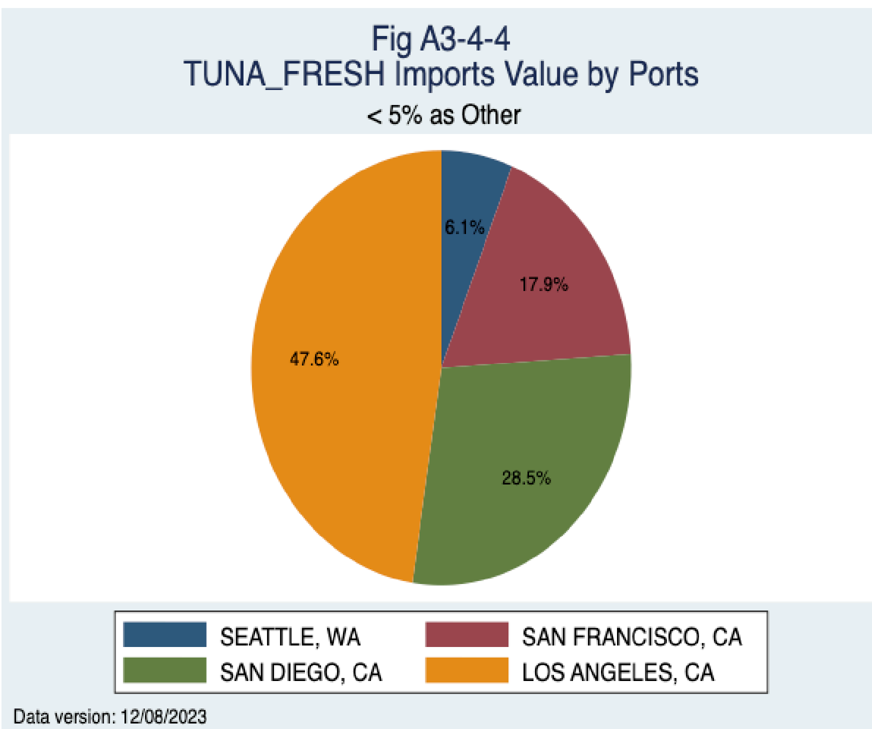


Fig A3-4-5: TUNA_FRESH Weight by Port, Proportion

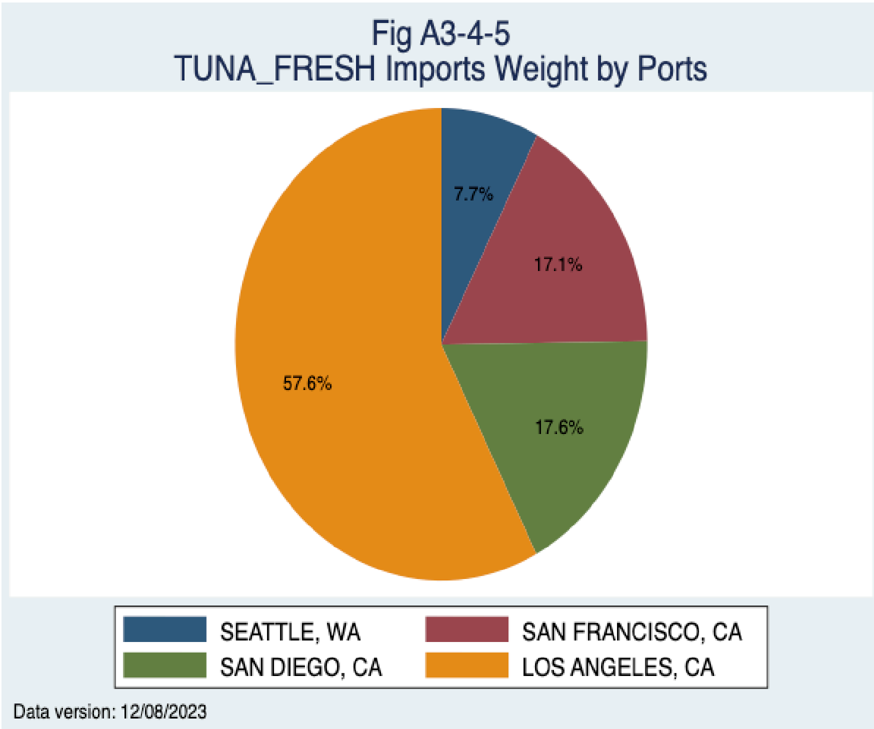


Fig A3-4-6: TUNA_FRESH Value by Port by Year

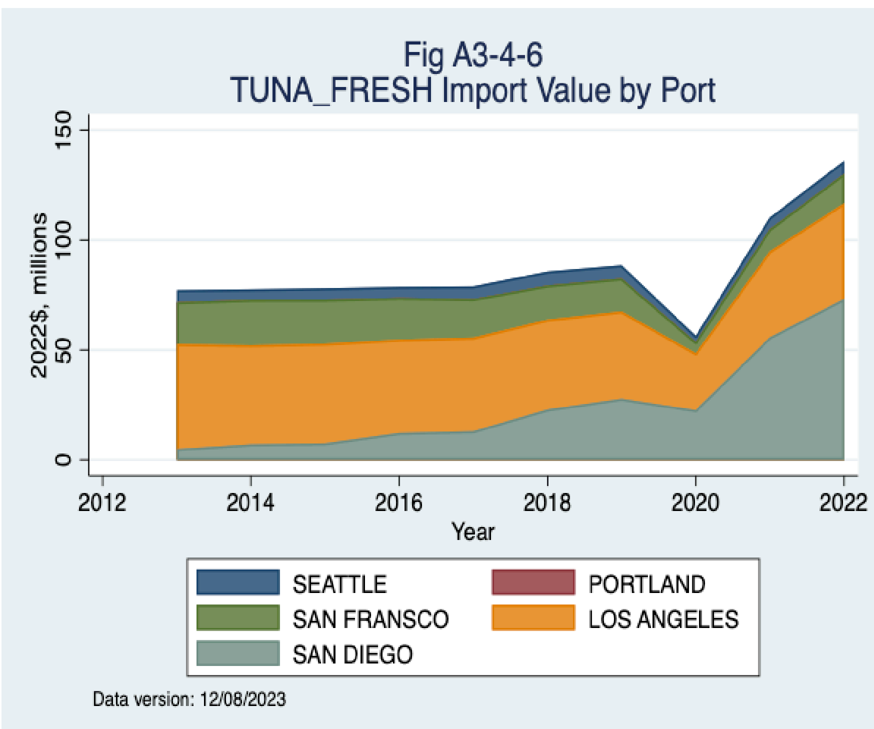


Fig A3-4-7: TUNA_FRESH Weight by Port by Year

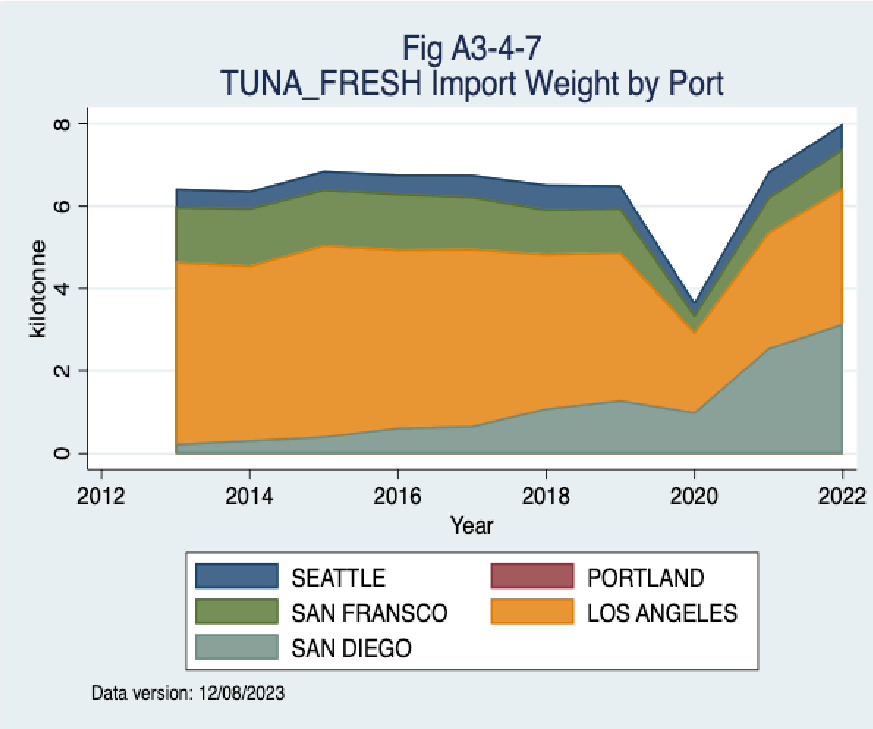


Fig A3-4-8: TUNA_FRESH Value by Continent, Proportion

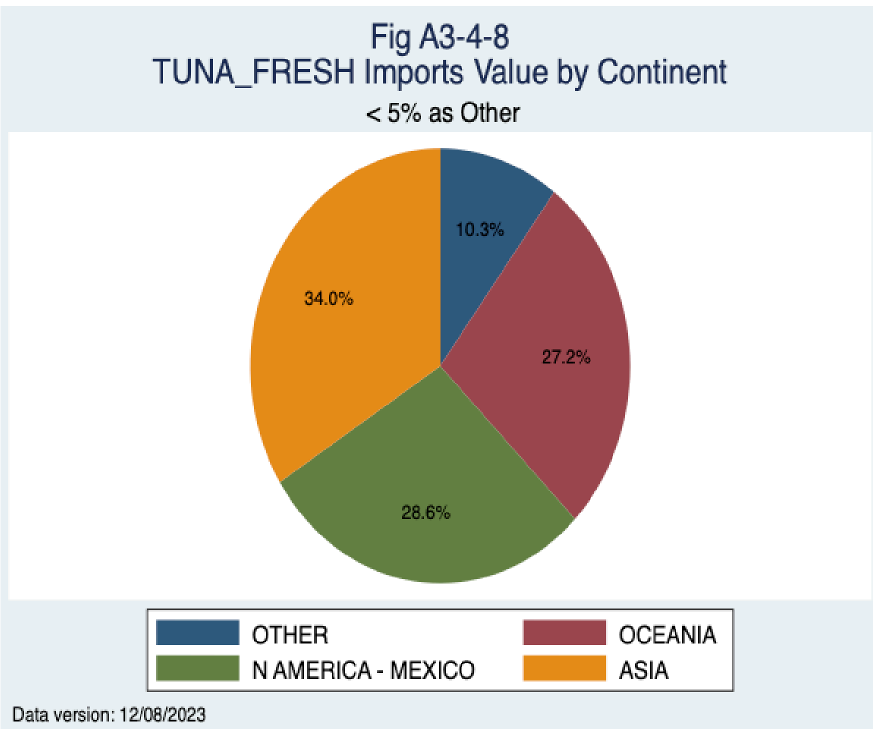


Fig A3-4-9: TUNA_FRESH Weight by Continent, Proportion

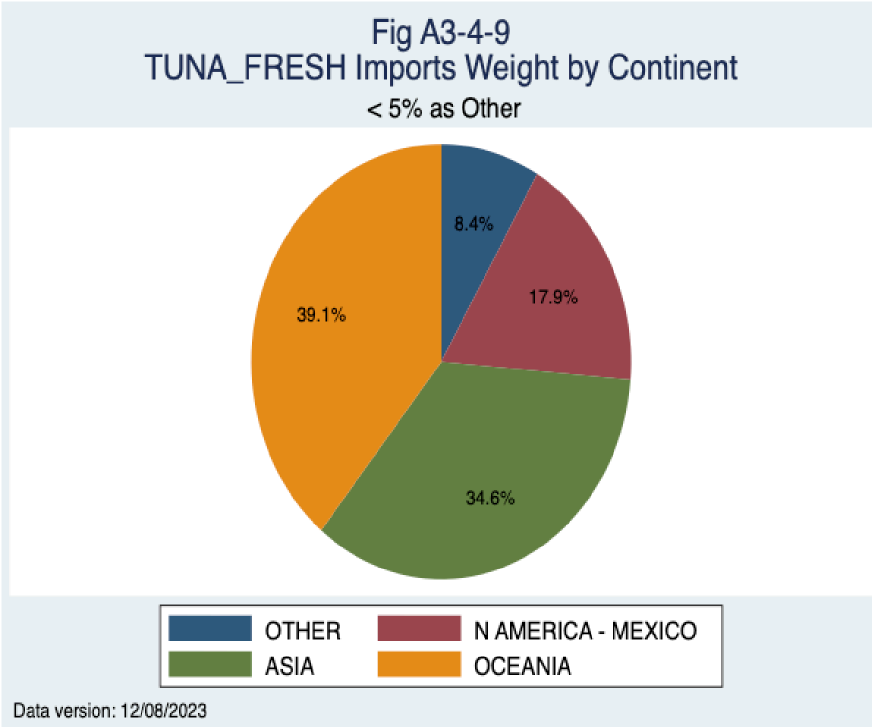


Fig A3-4-10: TUNA_FRESH Value by Continent by Year

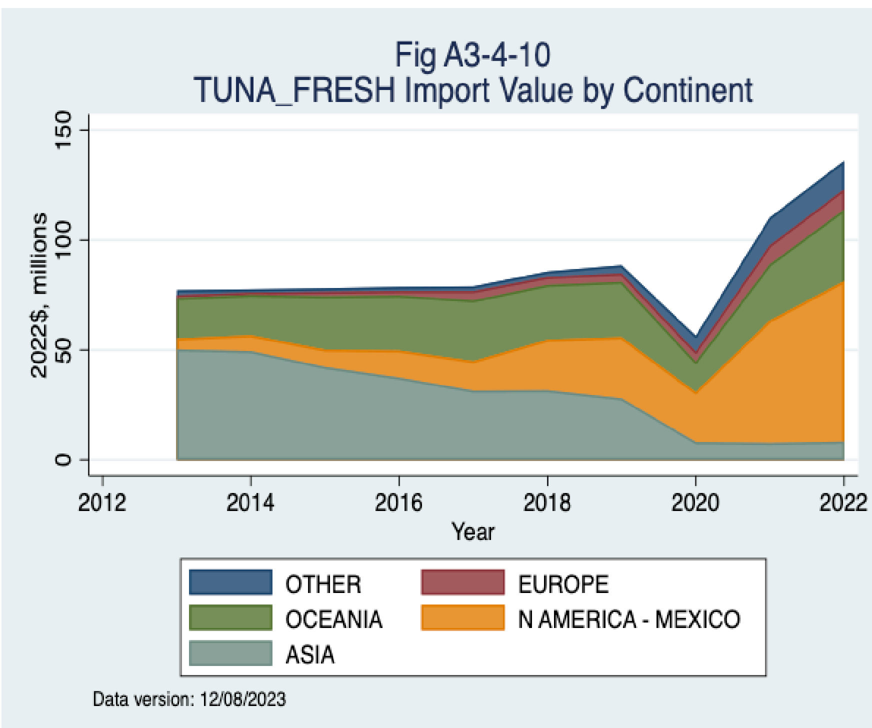


Fig A3-4-11: TUNA_FRESH Weight by Continent by Year

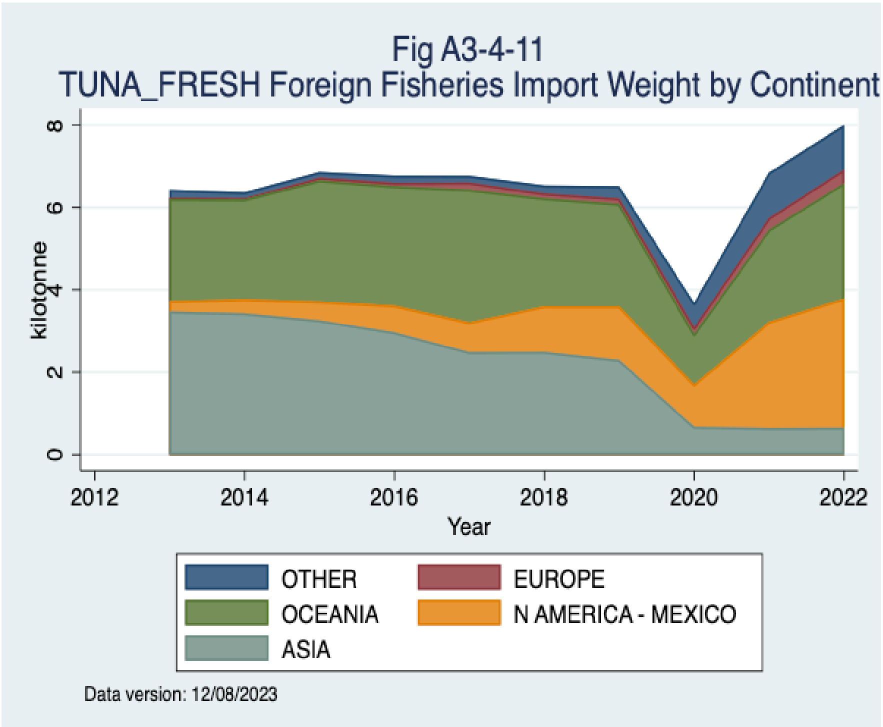


Fig A3-4-12: TUNA_FRESH Value by Country, Proportion

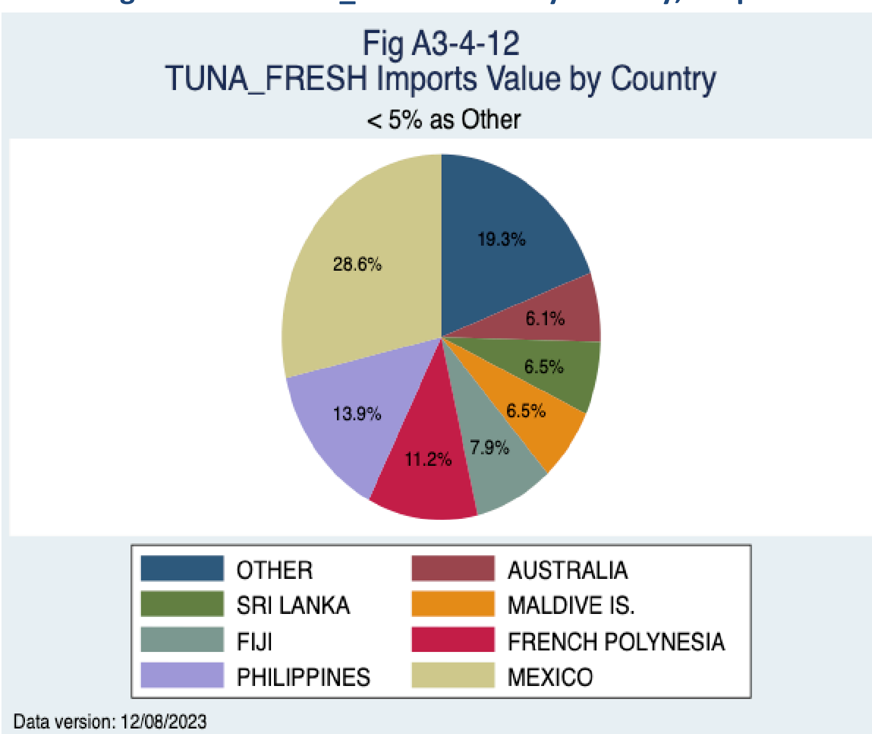


Fig A3-4-13: TUNA_FRESH Weight by Country, Proportion

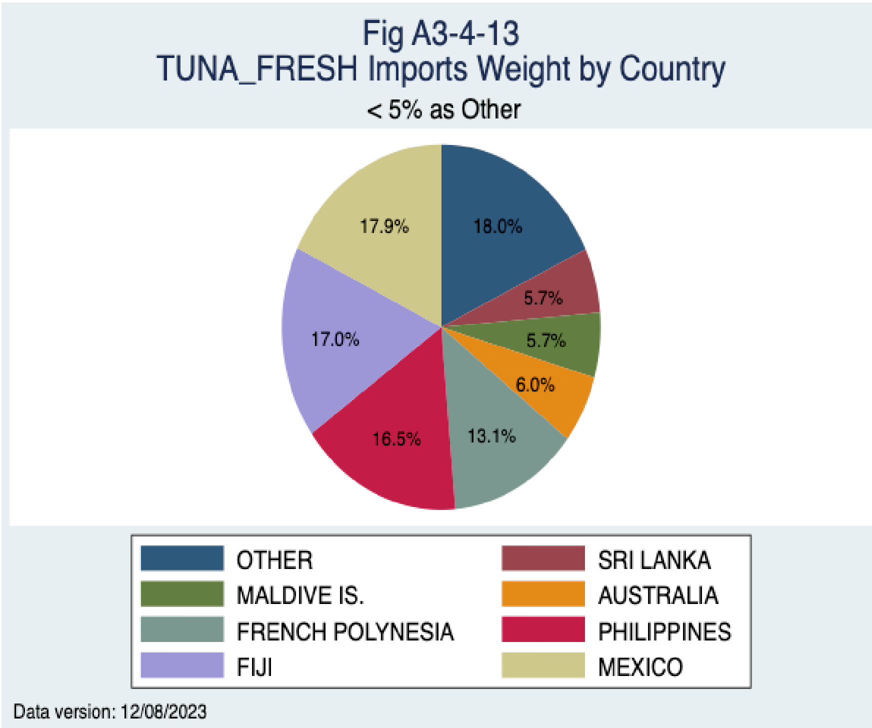


Fig A3-4-14: TUNA_FRESH Value by Country by Year

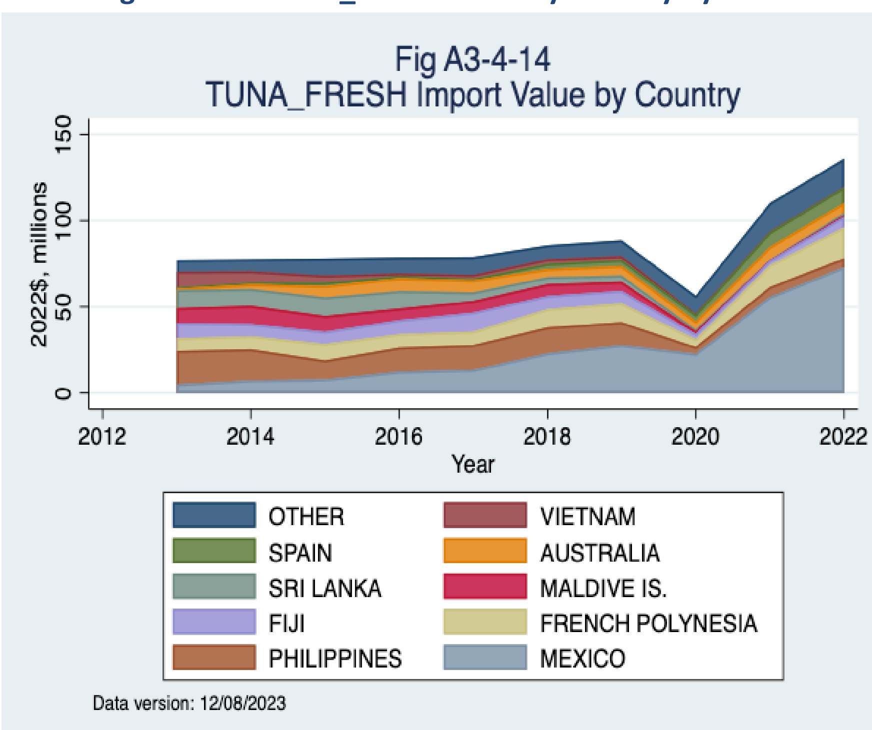
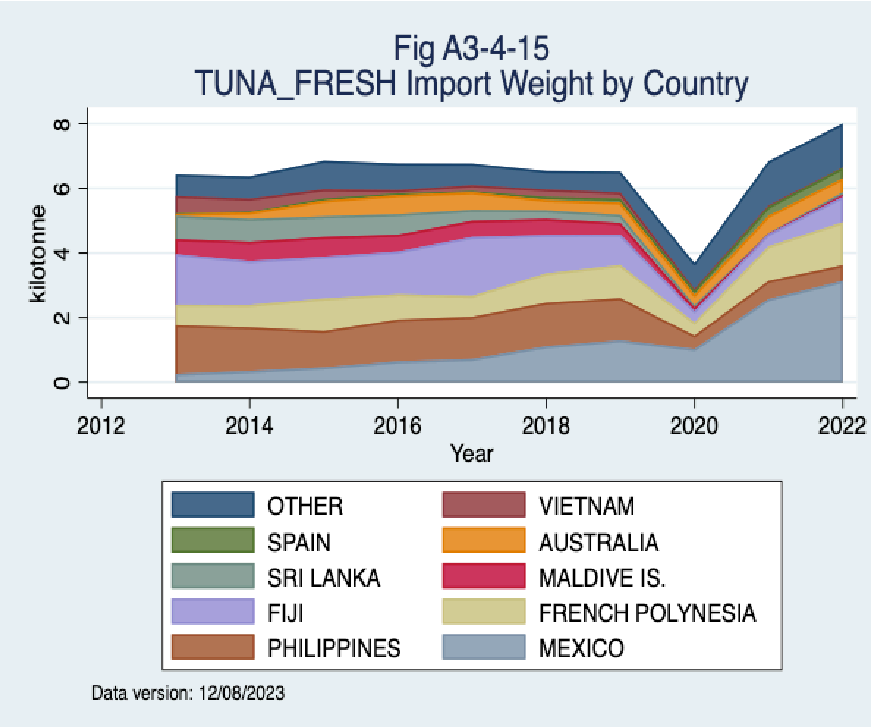


Fig A3-4-15: TUNA_FRESH Weight by Country by Year



Figures for TUNA_OTHER product group

Fig A3-5-1: TUNA_OTHER Weight & Value by Year

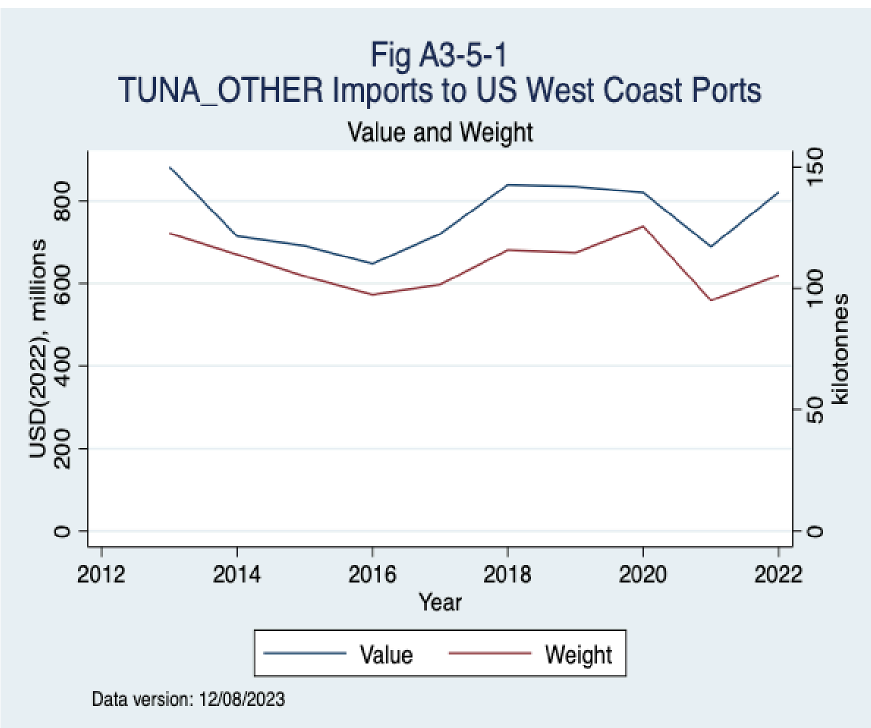


Fig A3-5-2: TUNA_OTHER Value & Price by Year

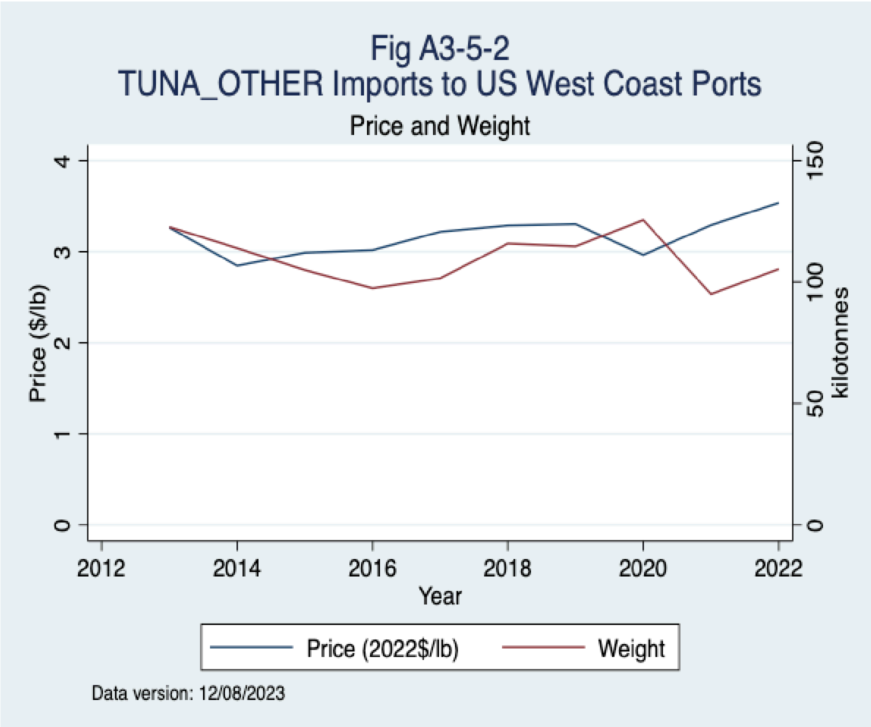


Fig A3-5-3: TUNA_OTHER Price Percentiles by Year

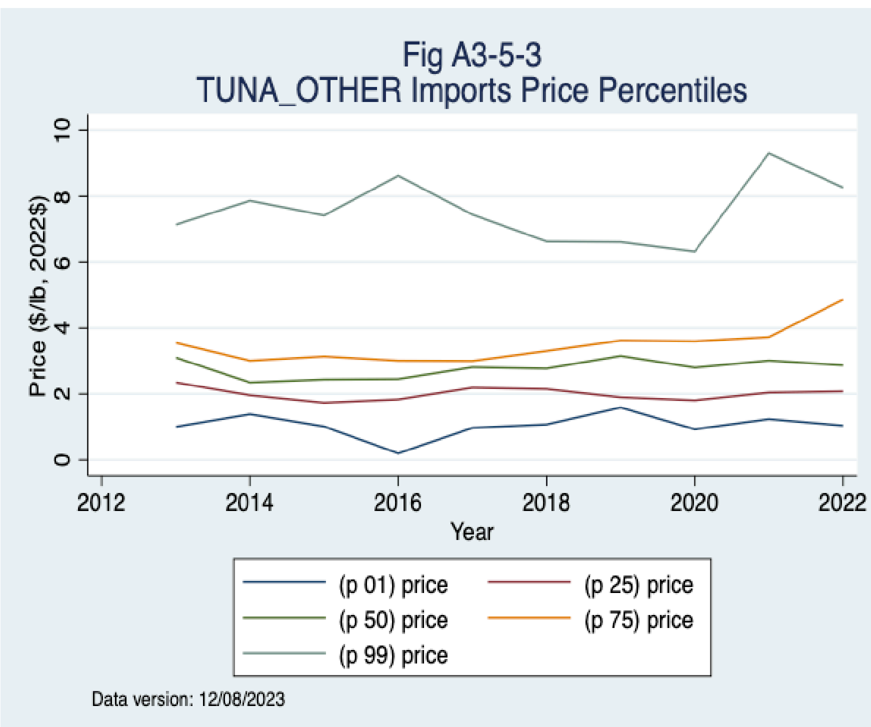


Fig A3-5-4: TUNA_OTHER Value by Port, Proportion

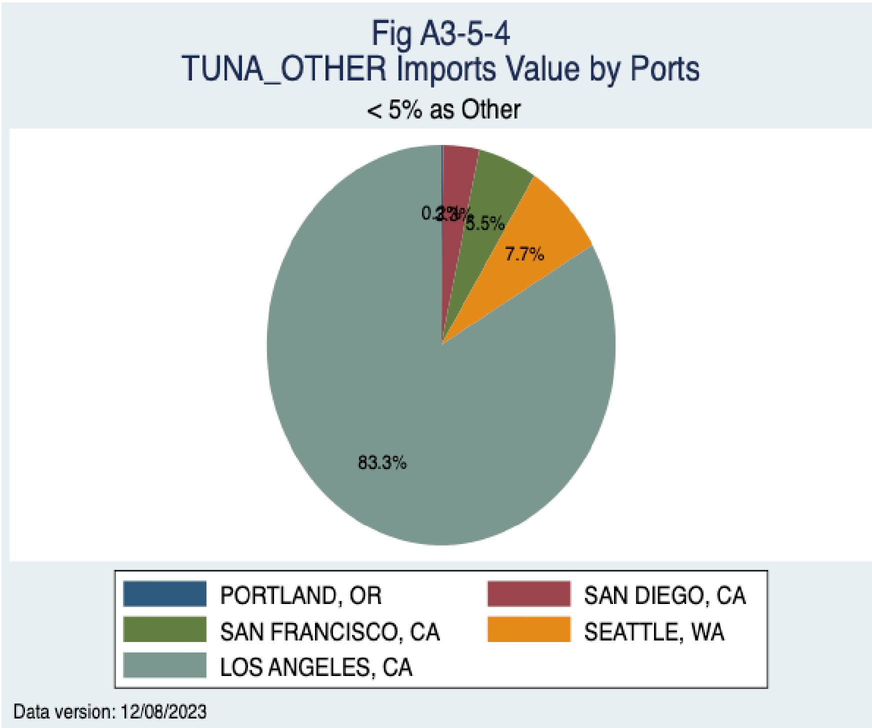


Fig A3-5-5: TUNA_OTHER Weight by Port, Proportion

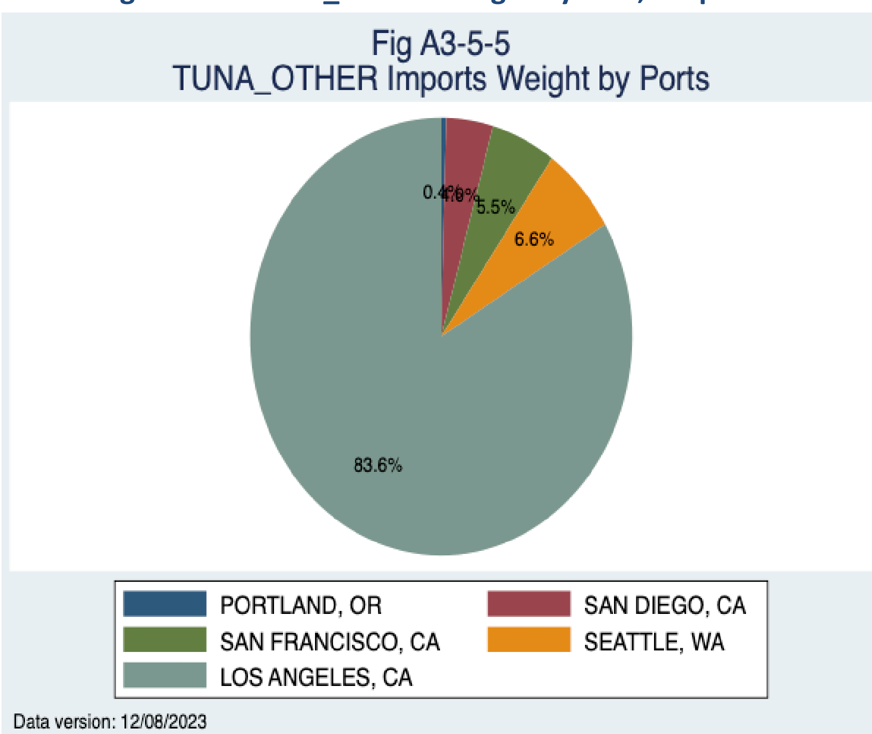


Fig A3-5-6: TUNA_OTHER Value by Port by Year

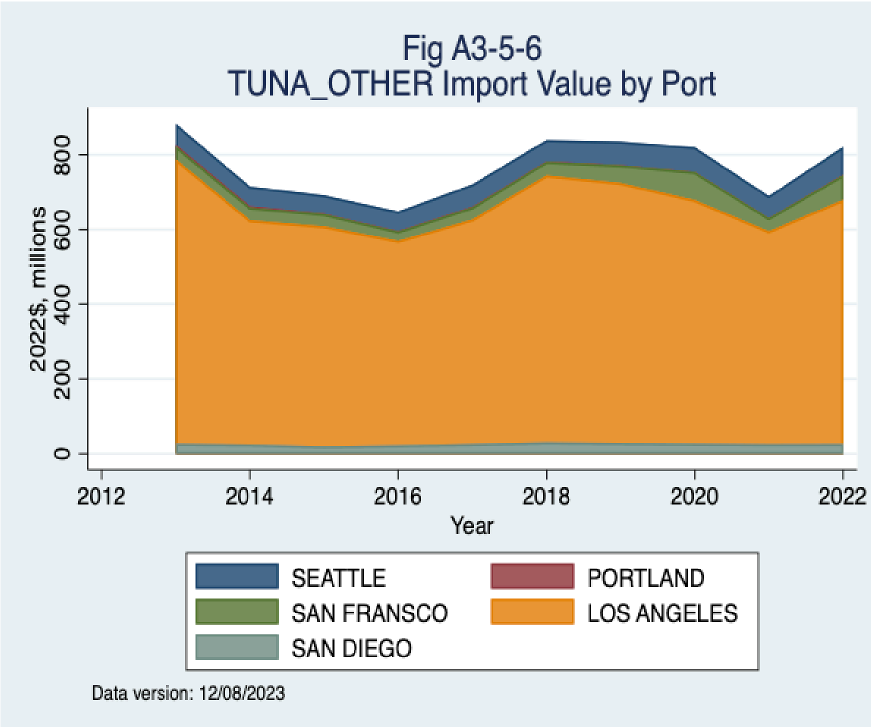


Fig A3-5-7: TUNA_OTHER Weight by Port by Year

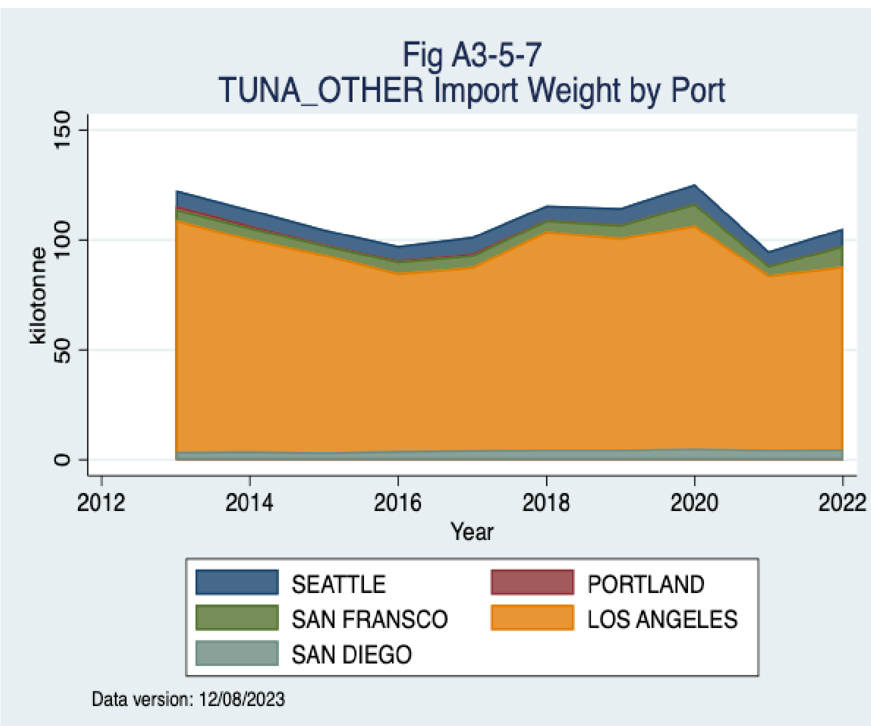


Fig A3-5-8: TUNA_OTHER Value by Continent, Proportion

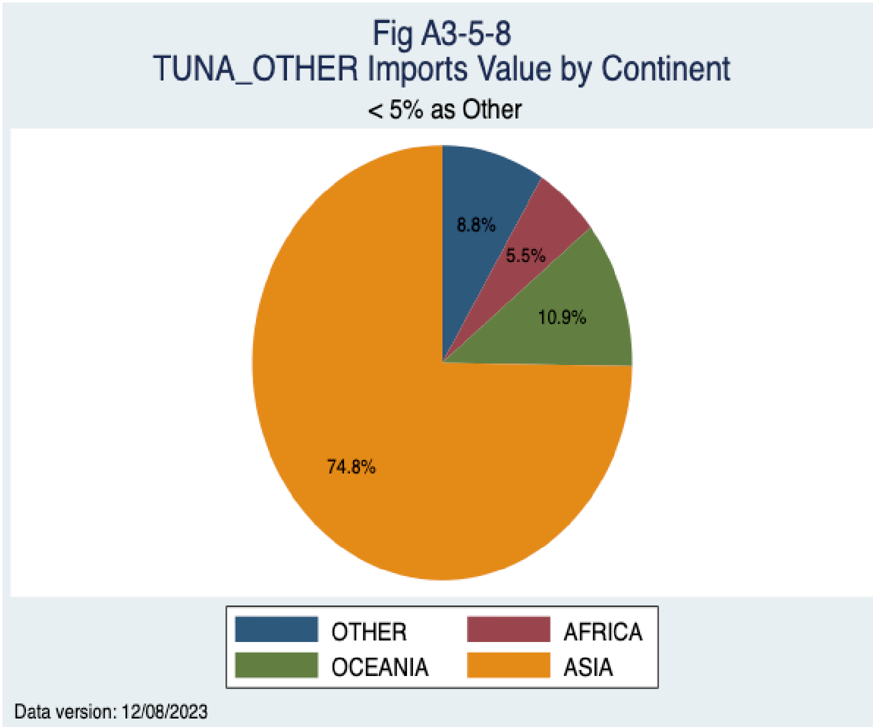


Fig A3-5-9: TUNA_OTHER Weight by Continent, Proportion

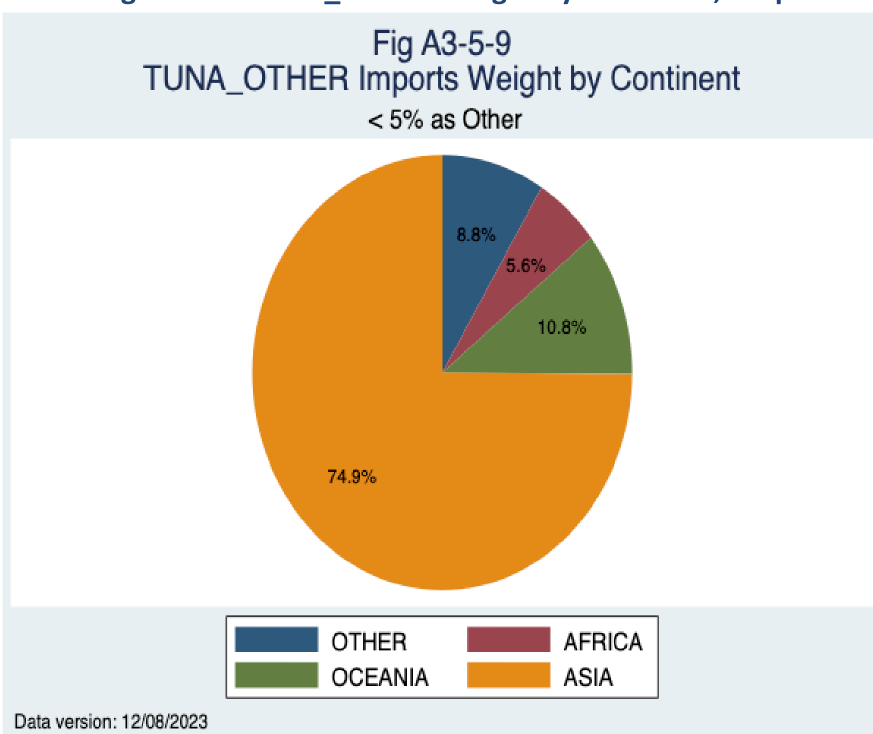


Fig A3-5-10: TUNA_OTHER Value by Continent by Year

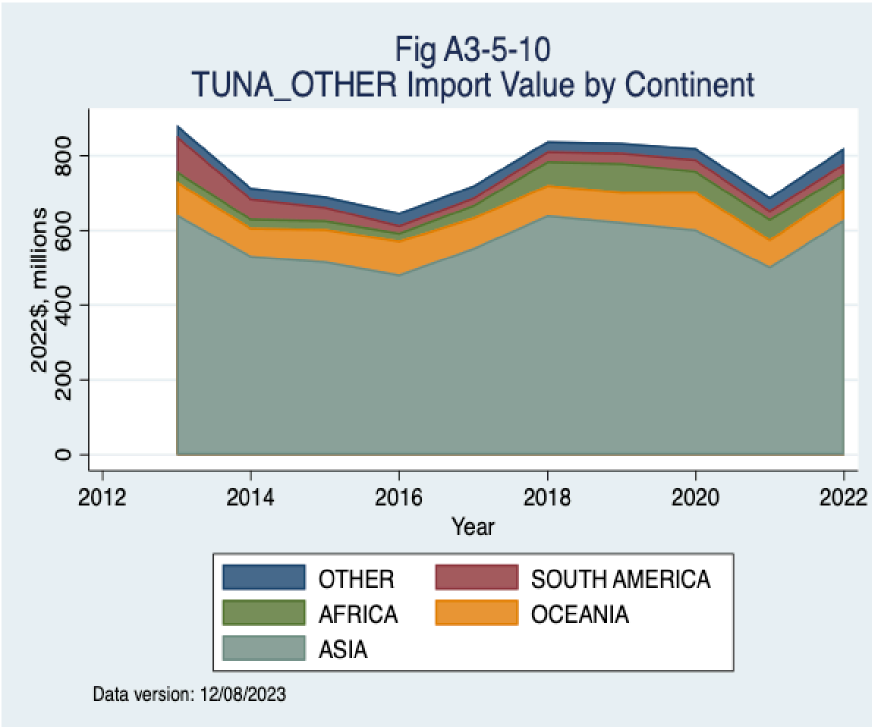


Fig A3-5-11: TUNA_OTHER Weight by Continent by Year

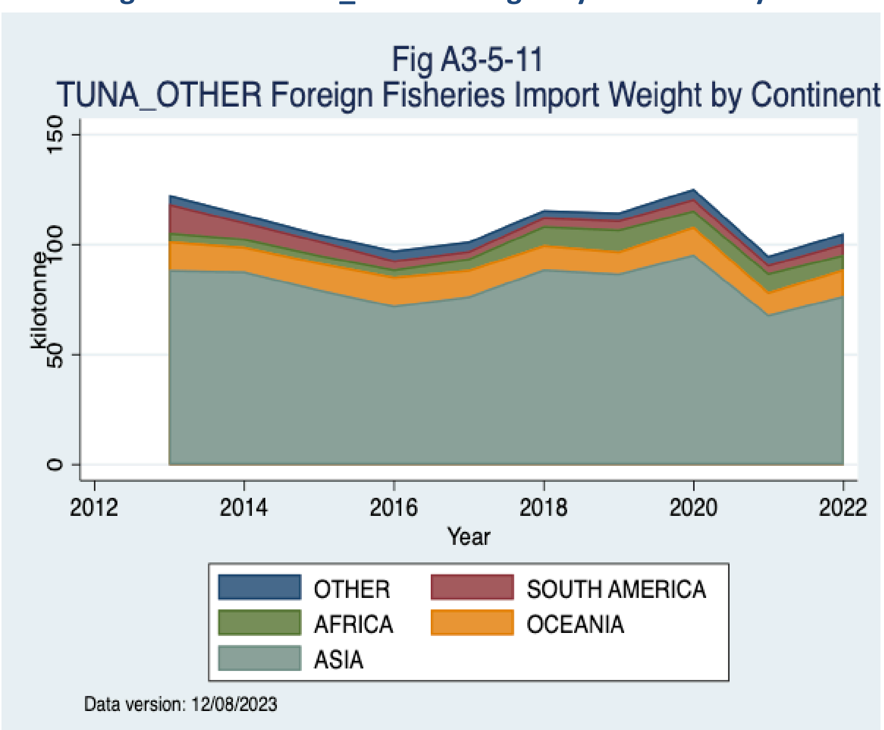


Fig A3-5-12: TUNA_OTHER Value by Country, Proportion

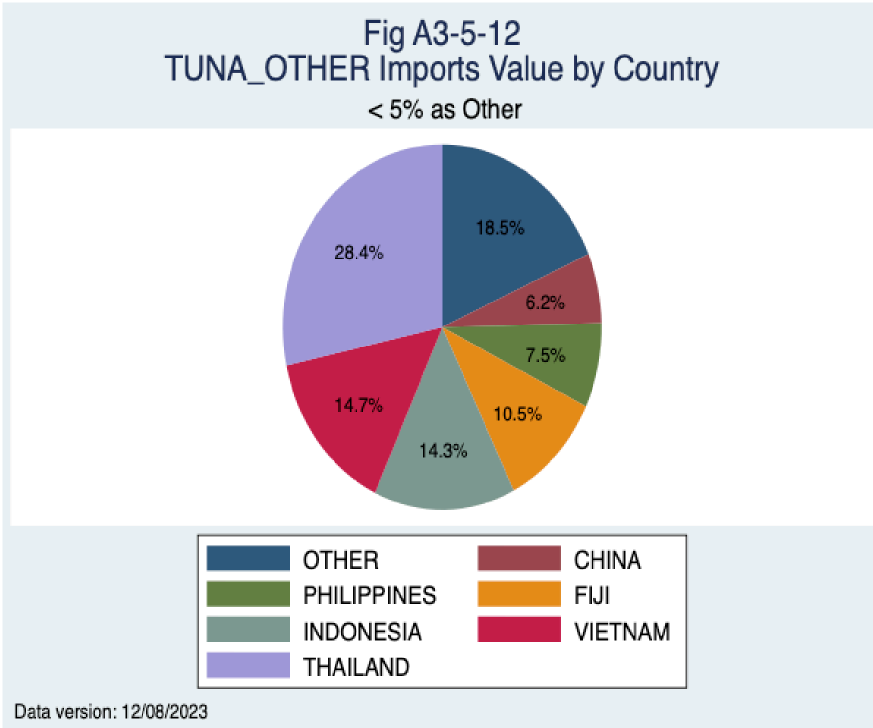


Fig A3-5-13: TUNA_OTHER Weight by Country, Proportion

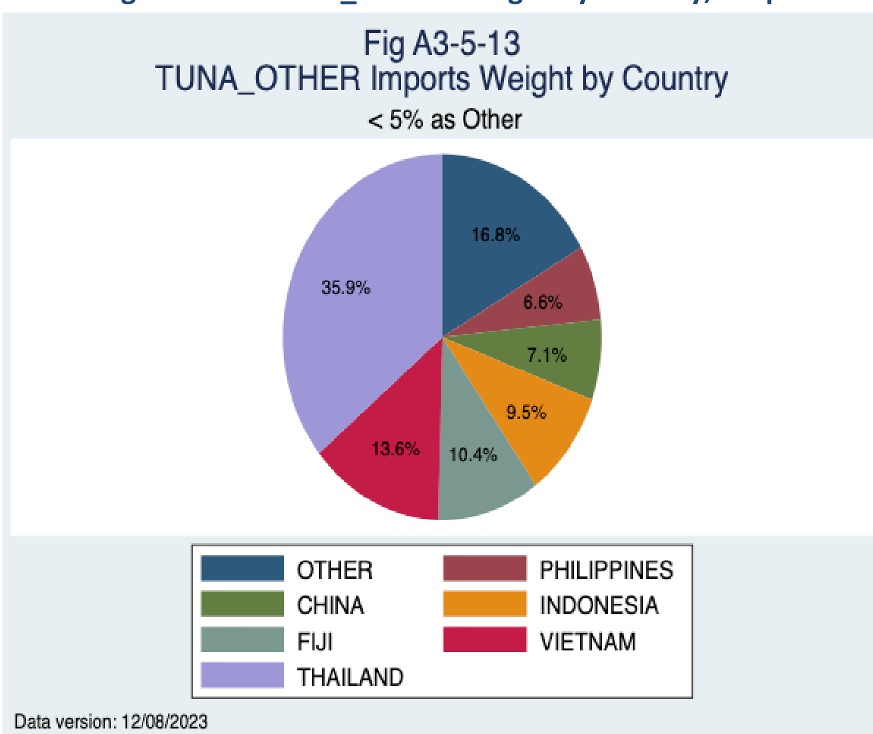


Fig A3-5-14: TUNA_OTHER Value by Country by Year

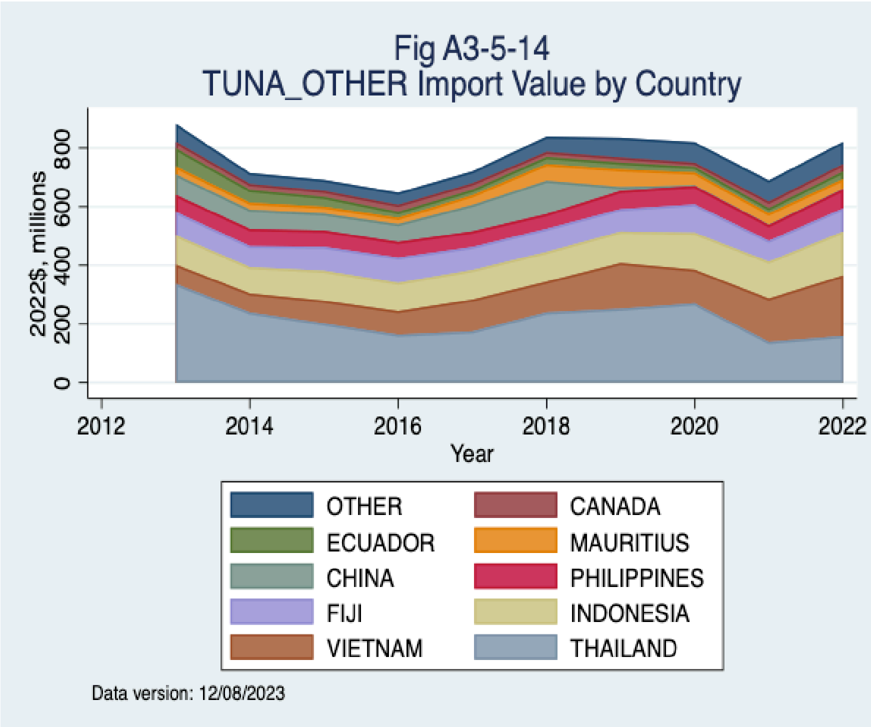
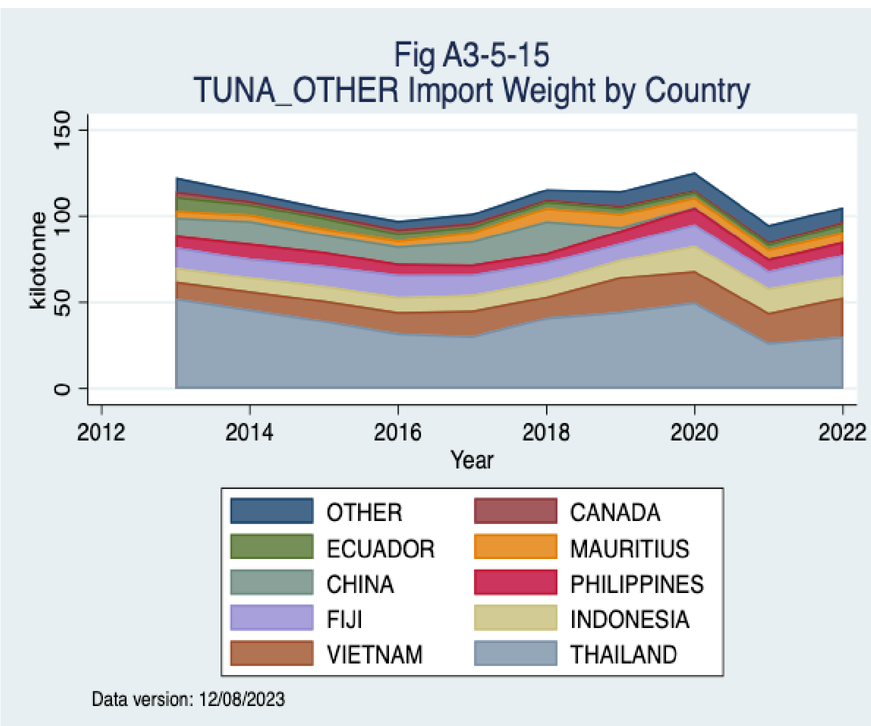


Fig A3-5-15: TUNA_OTHER Weight by Country by Year



Figures for BASS_FRESH product group

Fig A3-6-1: BASS_FRESH Weight & Value by Year

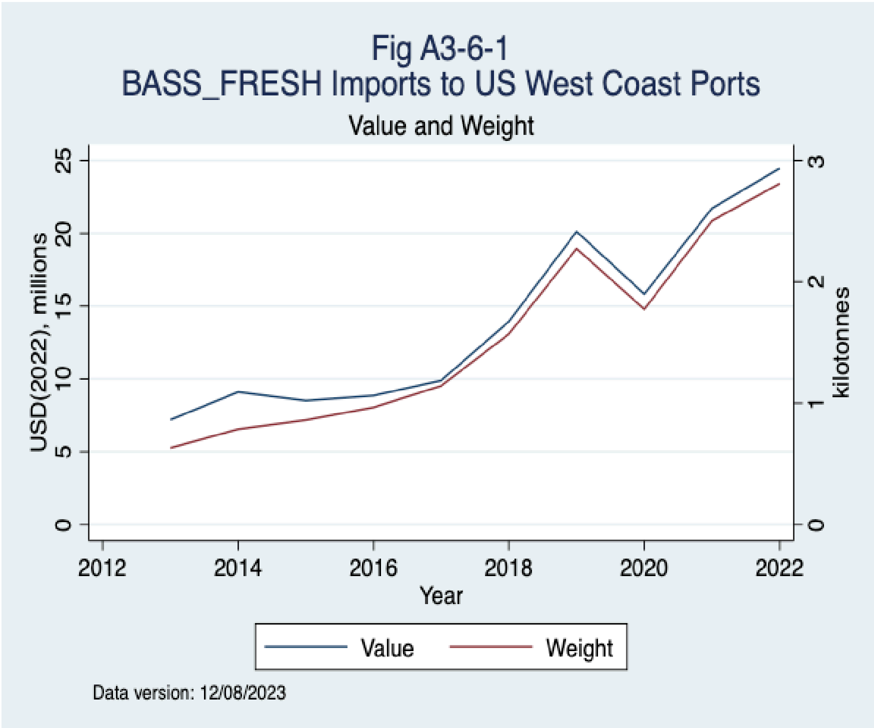


Fig A3-6-2: BASS_FRESH Value & Price by Year

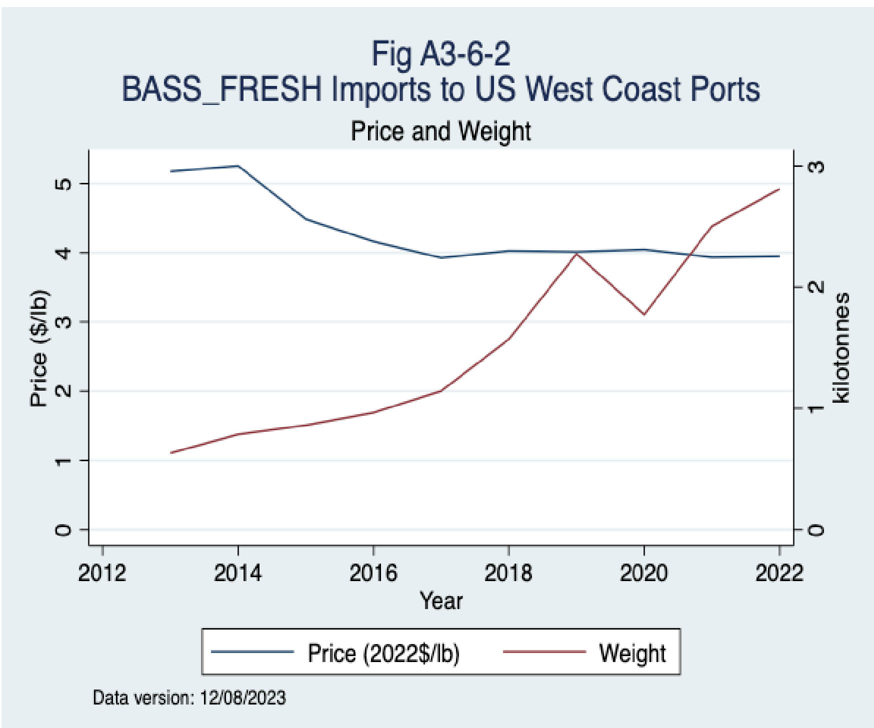


Fig A3-6-3: BASS_FRESH Price Percentiles by Year

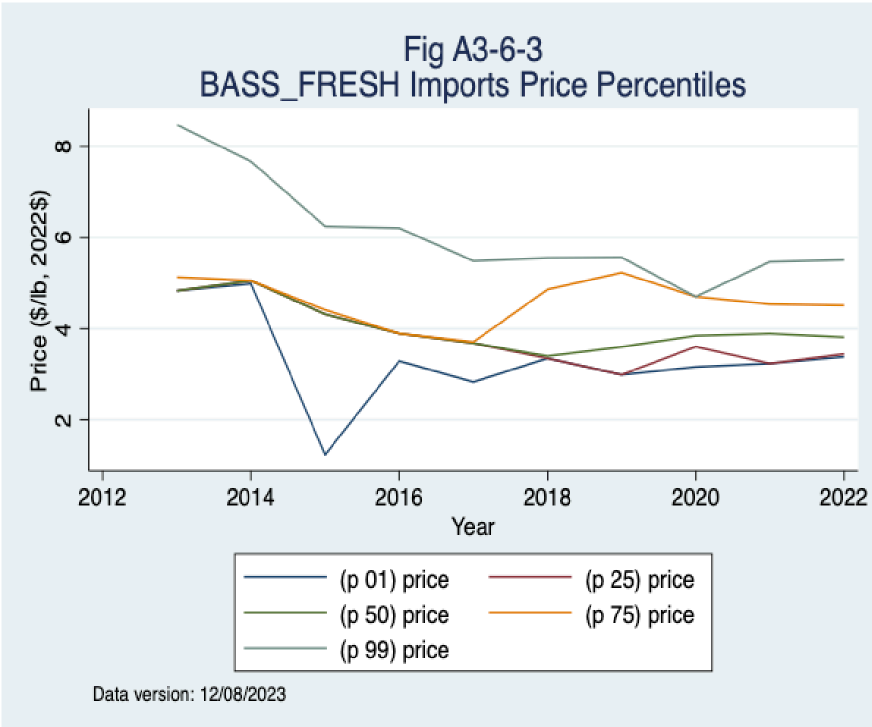


Fig A3-6-4: BASS_FRESH Value by Port, Proportion

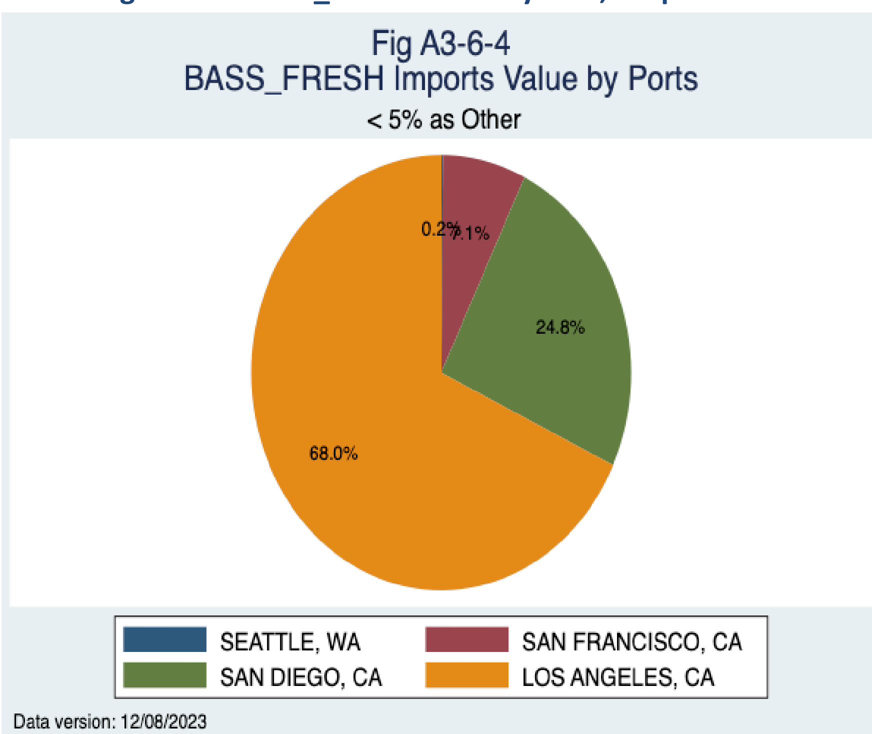


Fig A3-6-5: BASS_FRESH Weight by Port, Proportion

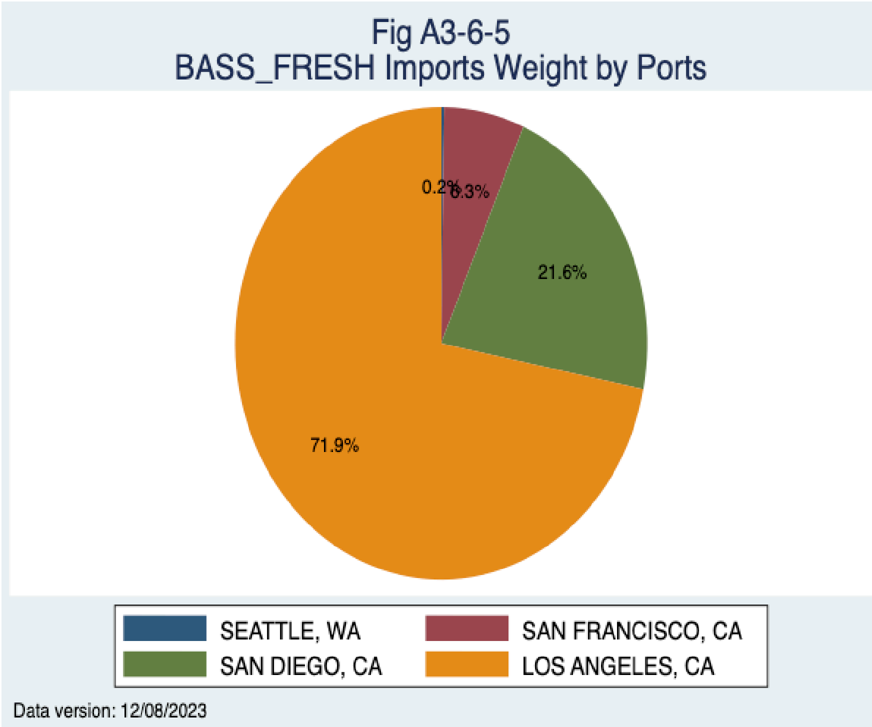


Fig A3-6-6: BASS_FRESH Value by Port by Year

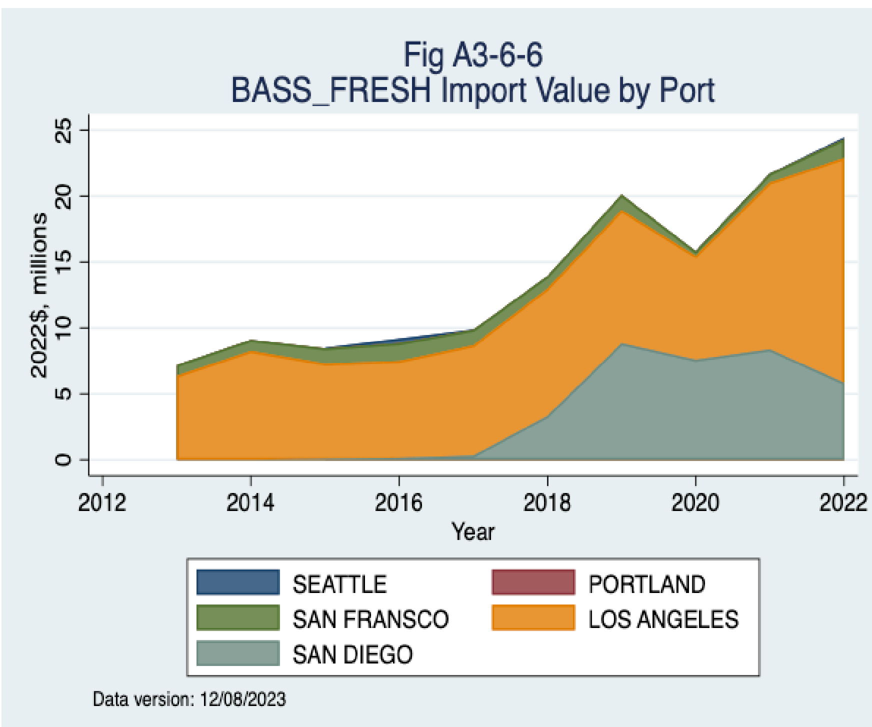


Fig A3-6-7: BASS_FRESH Weight by Port by Year

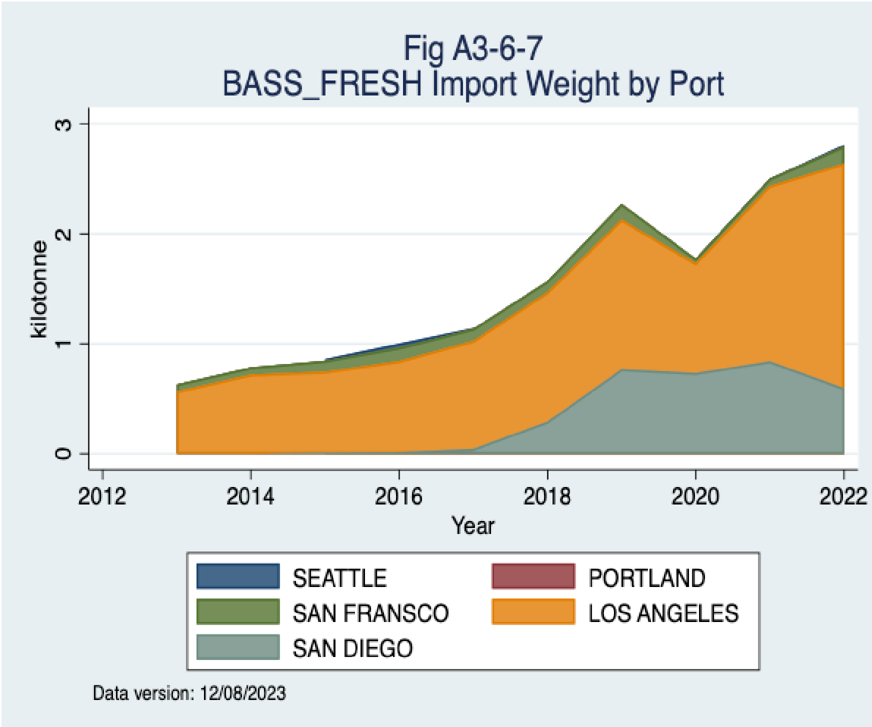


Fig A3-6-8: BASS_FRESH Value by Continent, Proportion

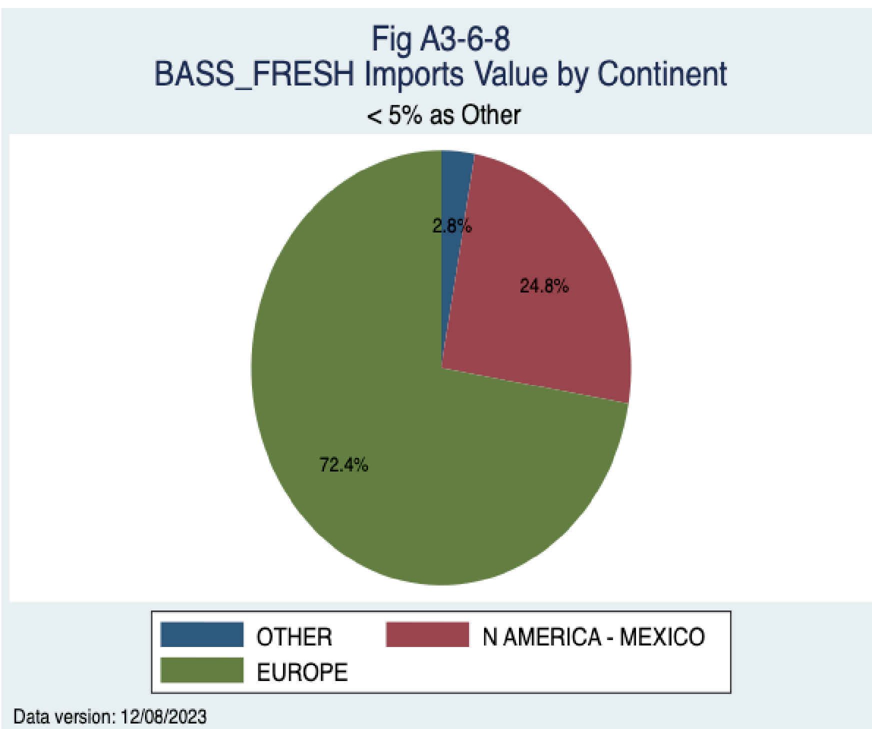


Fig A3-6-9: BASS_FRESH Weight by Continent, Proportion

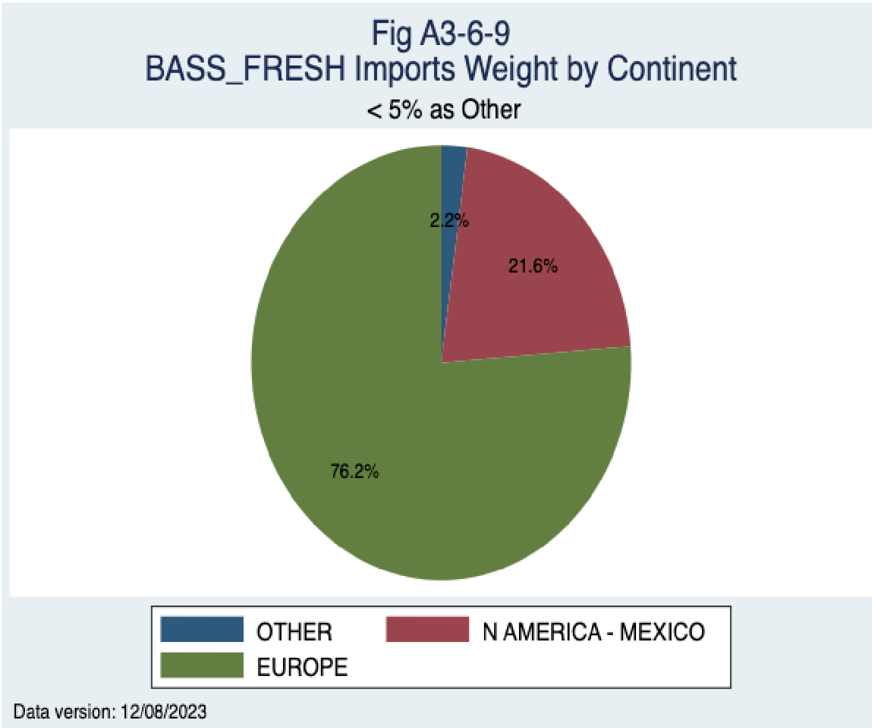


Fig A3-6-10: BASS_FRESH Value by Continent by Year

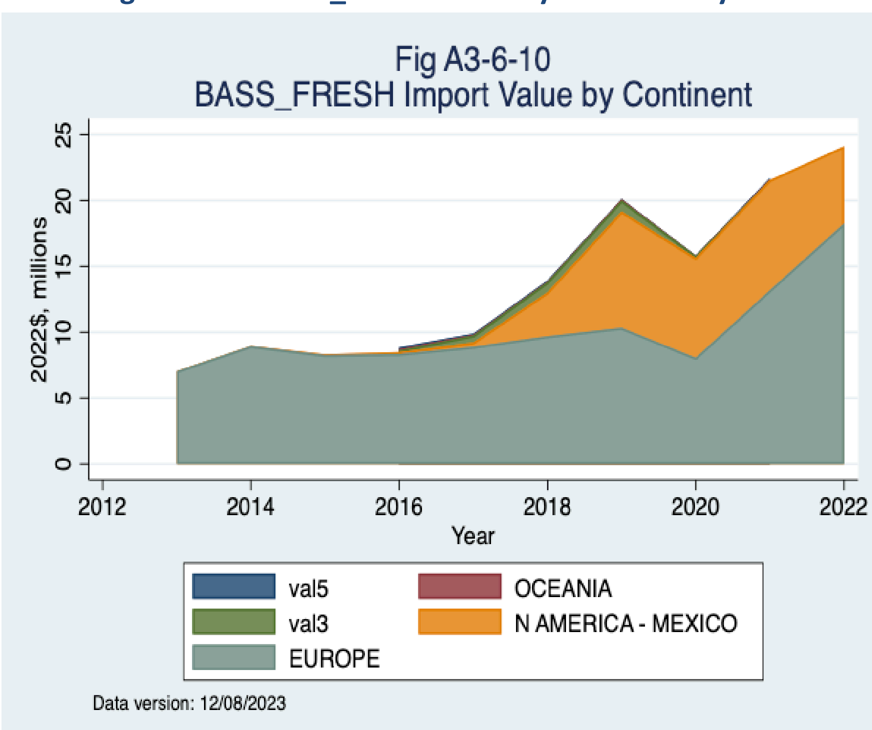


Fig A3-6-11: BASS_FRESH Weight by Continent by Year

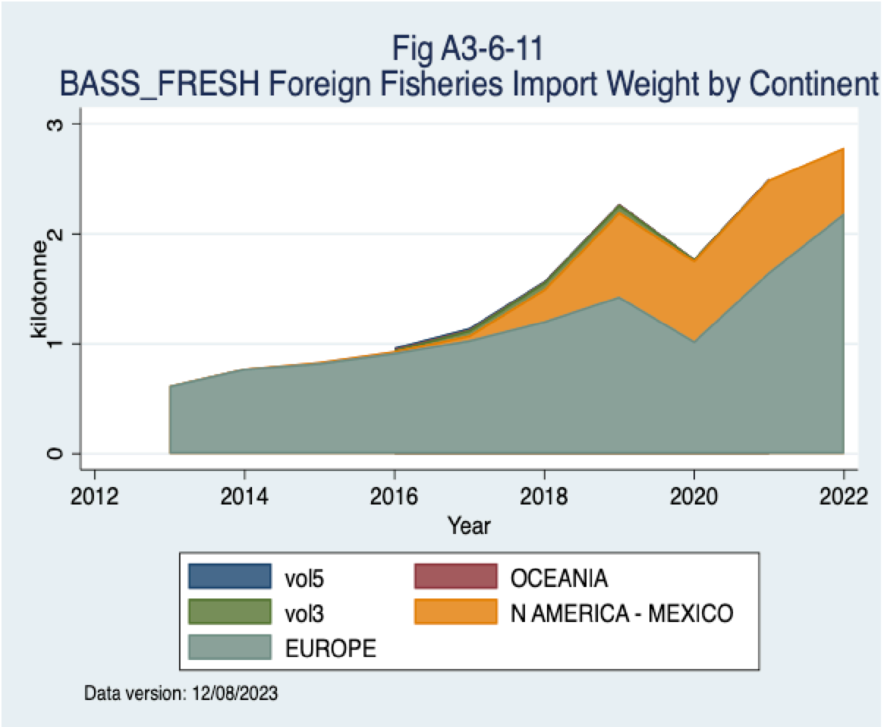


Fig A3-6-12: BASS_FRESH Value by Country, Proportion

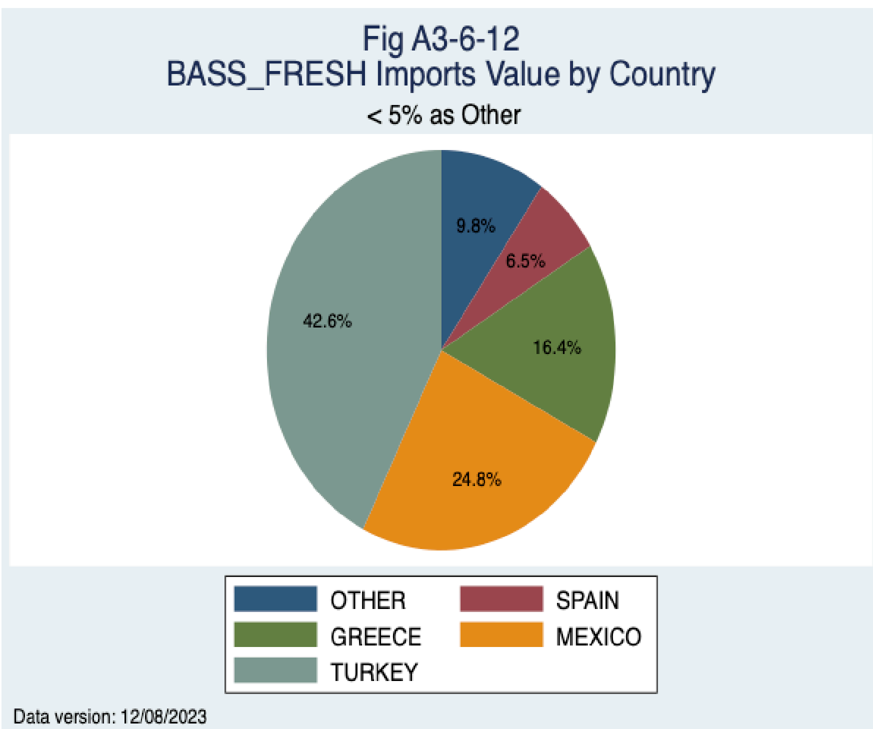


Fig A3-6-13: BASS_FRESH Weight by Country, Proportion

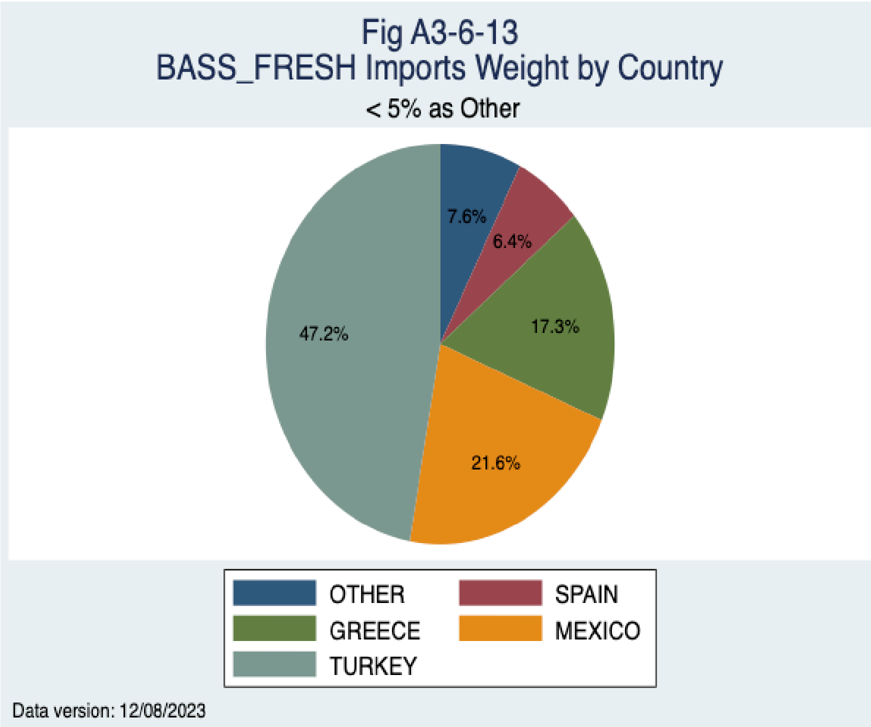


Fig A3-6-14: BASS_FRESH Value by Country by Year

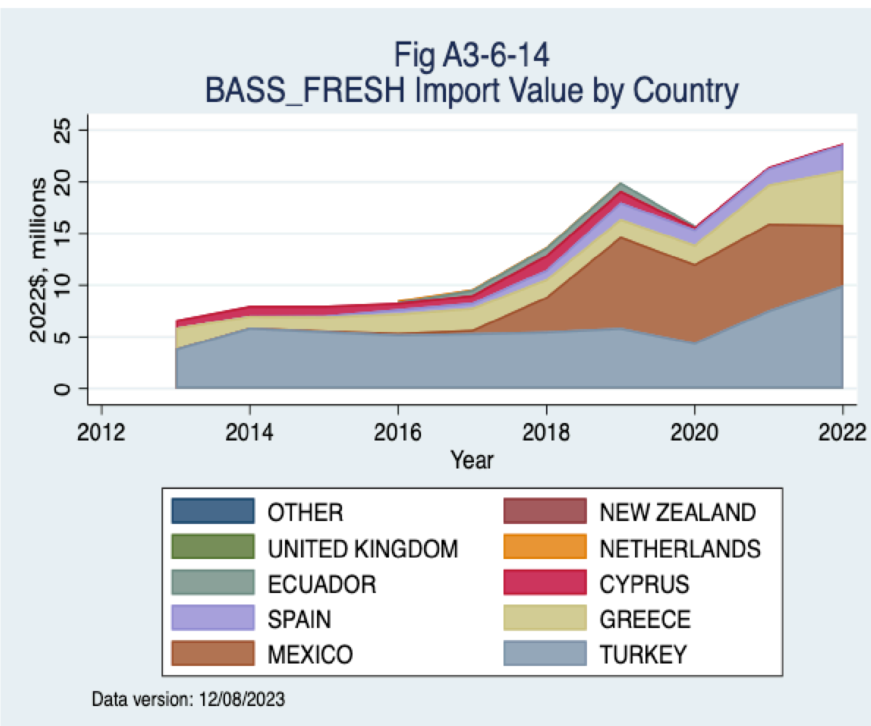
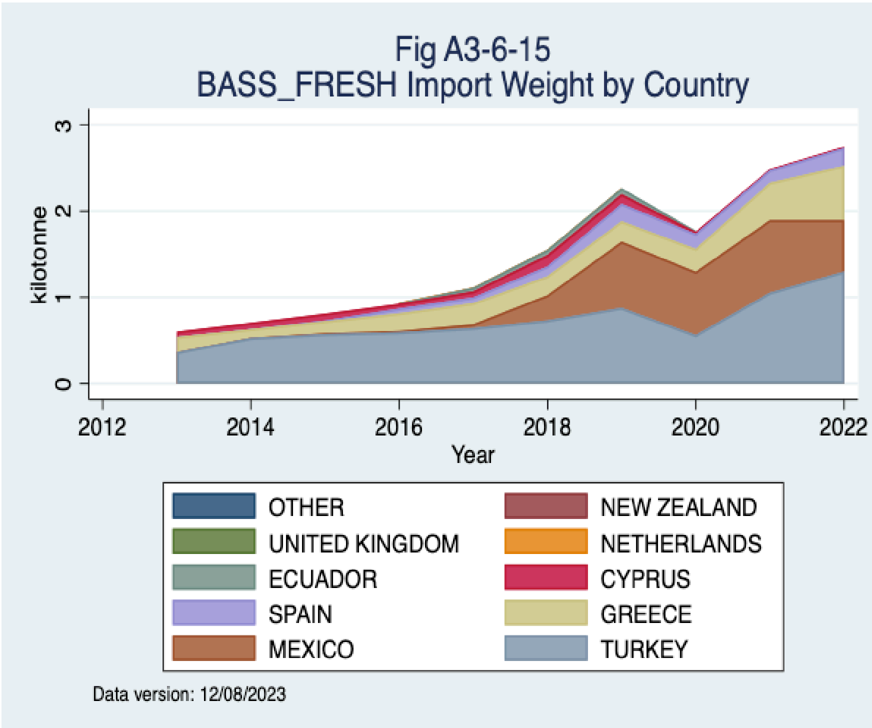


Fig A3-6-15: BASS_FRESH Weight by Country by Year



Figures for BASS_OTHER product group

Fig A3-7-1: BASS_OTHER Weight & Value by Year

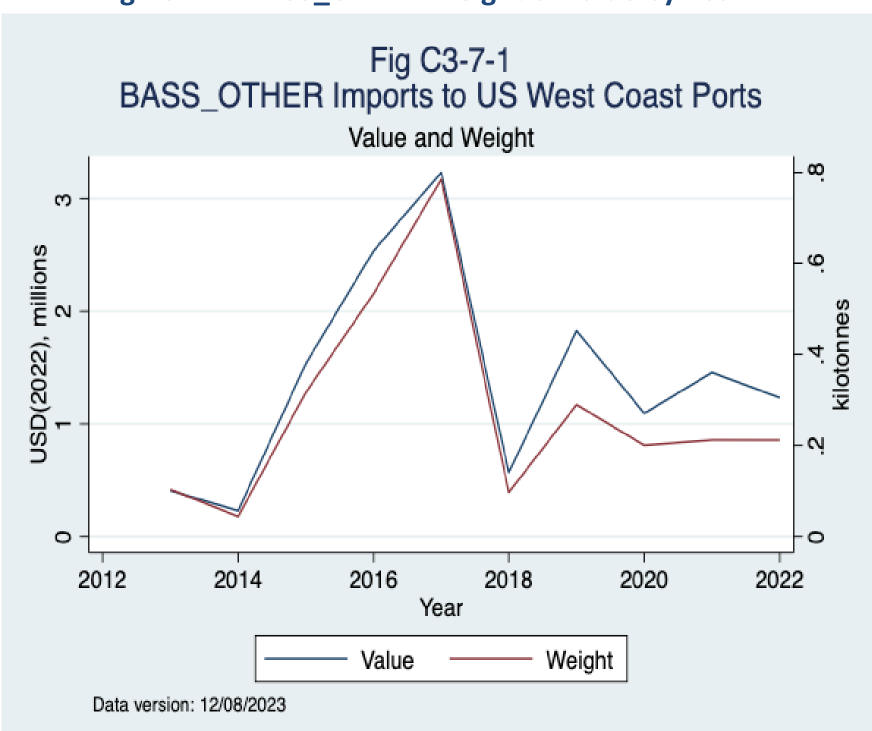


Fig A3-7-2: BASS_OTHER Value & Price by Year

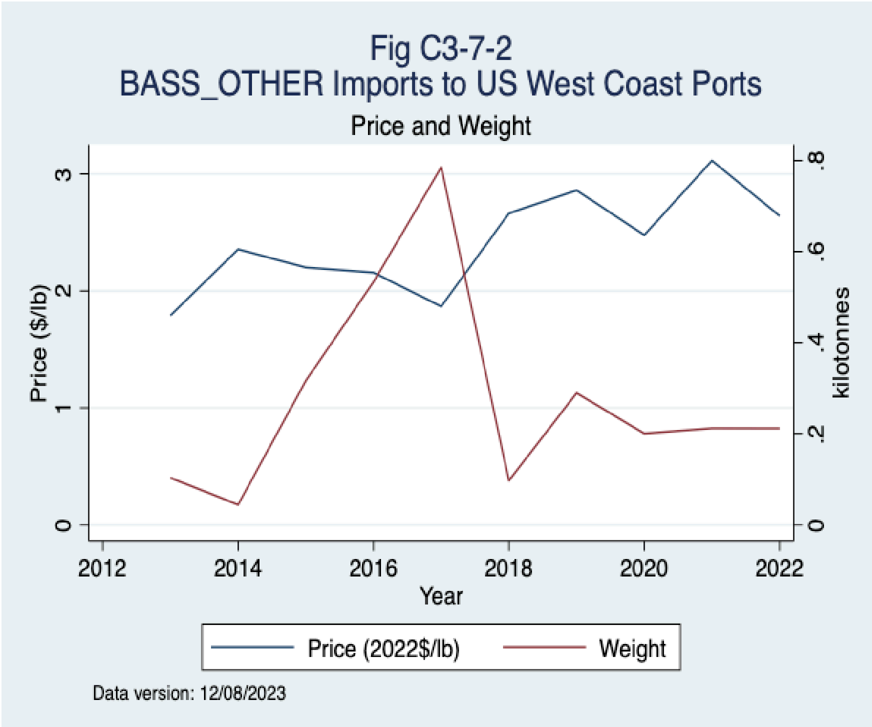


Fig A3-7-3: BASS_OTHER Price Percentiles by Year

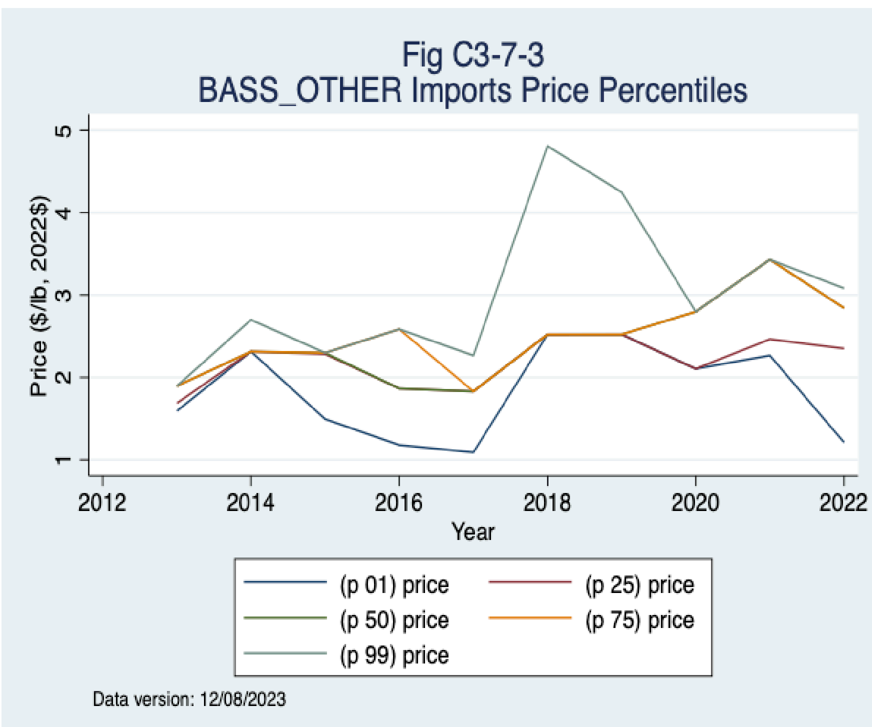


Fig A3-7-4: BASS_OTHER Value by Port, Proportion

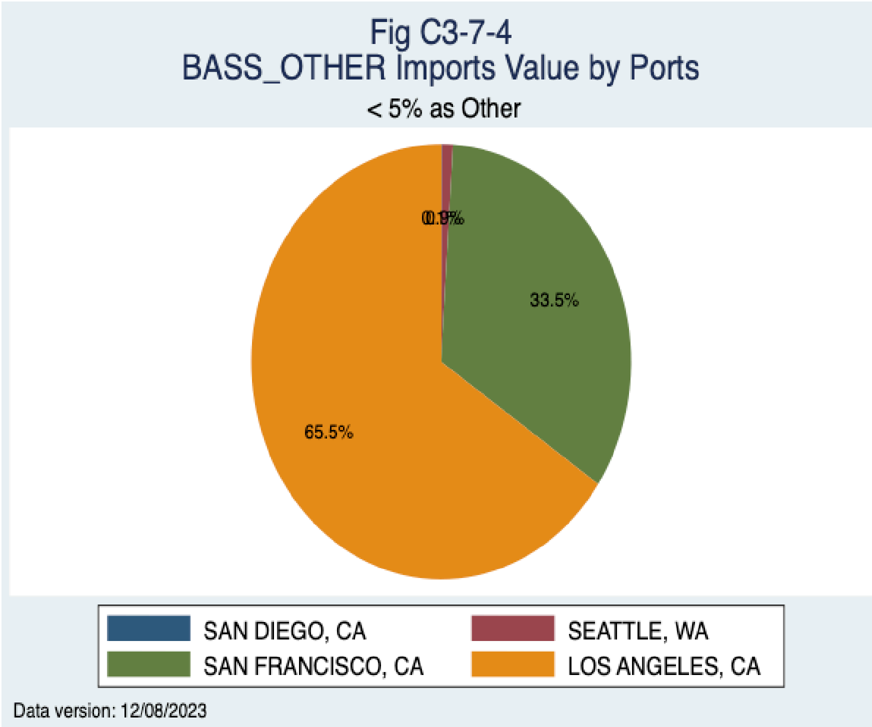


Fig A3-7-5: BASS_OTHER Weight by Port, Proportion

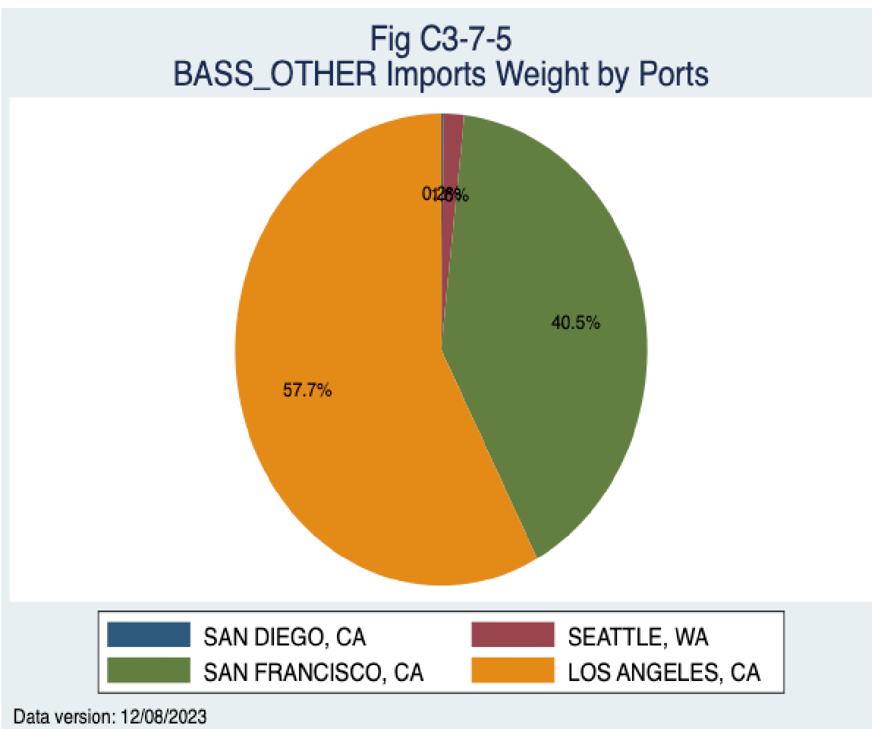


Fig A3-7-6: BASS_OTHER Value by Port by Year

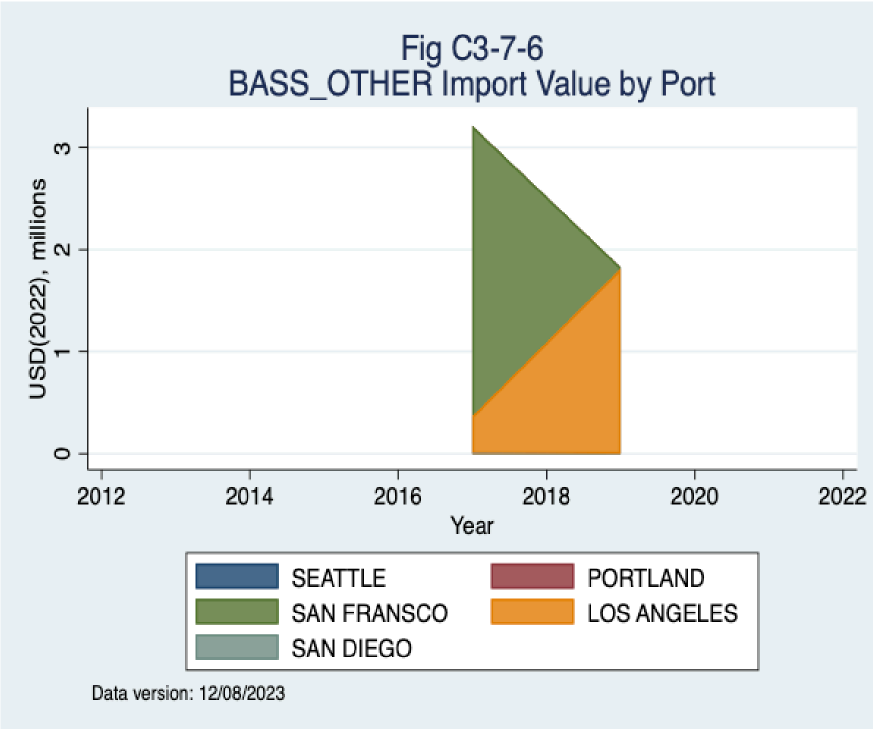


Fig A3-7-7: BASS_OTHER Weight by Port by Year

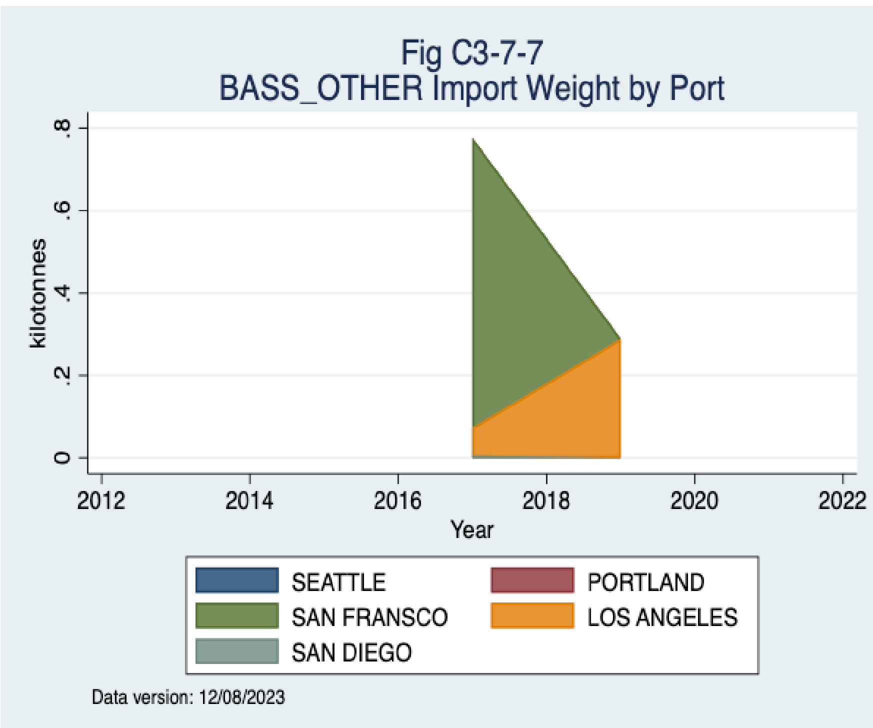


Fig A3-7-8: BASS_OTHER Value by Continent, Proportion

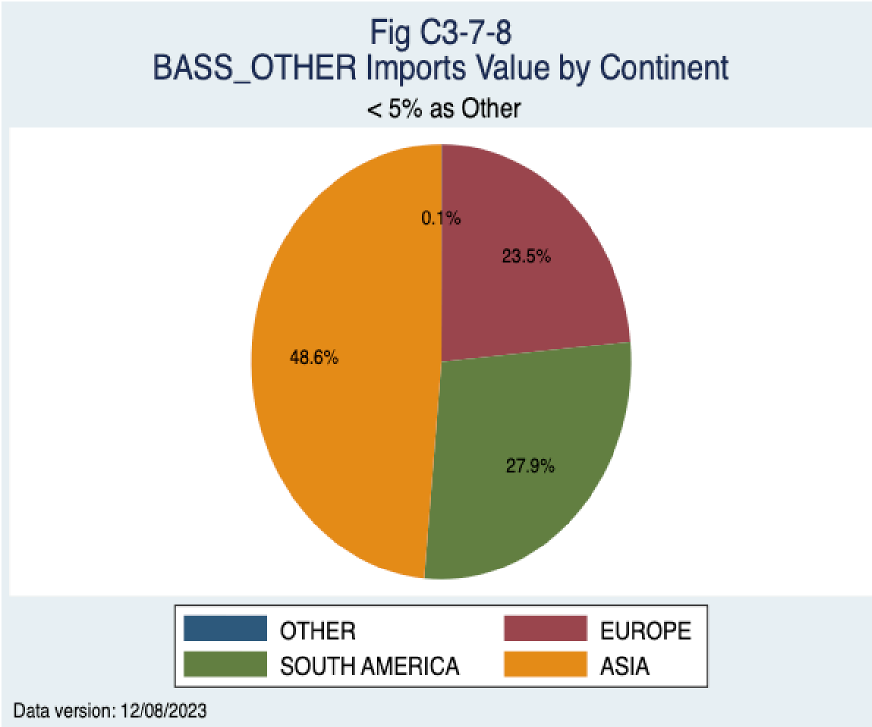


Fig A3-7-9: BASS_OTHER Weight by Continent, Proportion

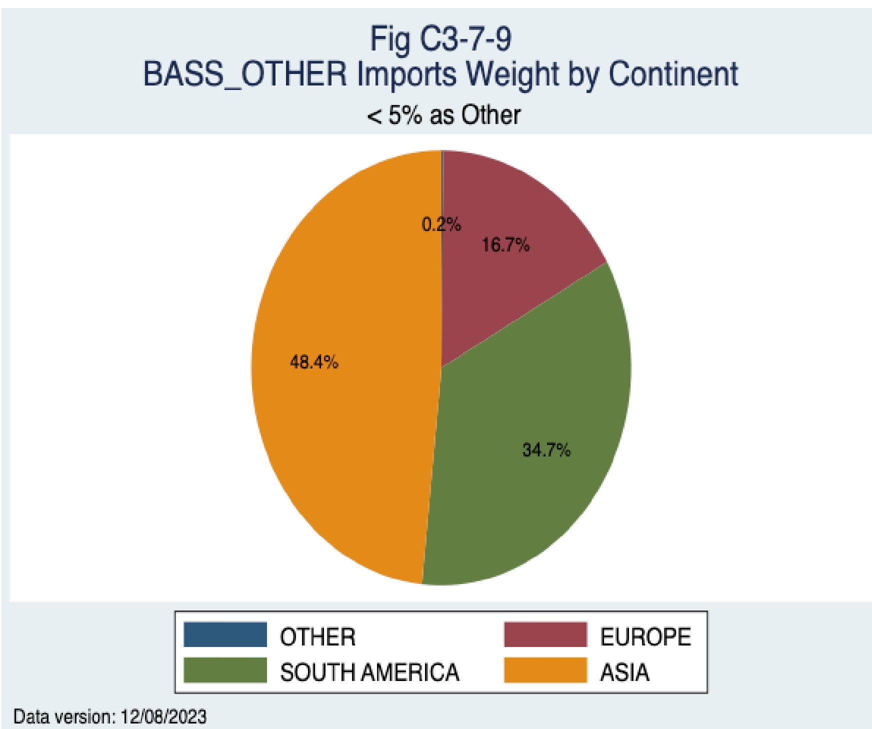


Fig A3-7-10: BASS_OTHER Value by Continent by Year

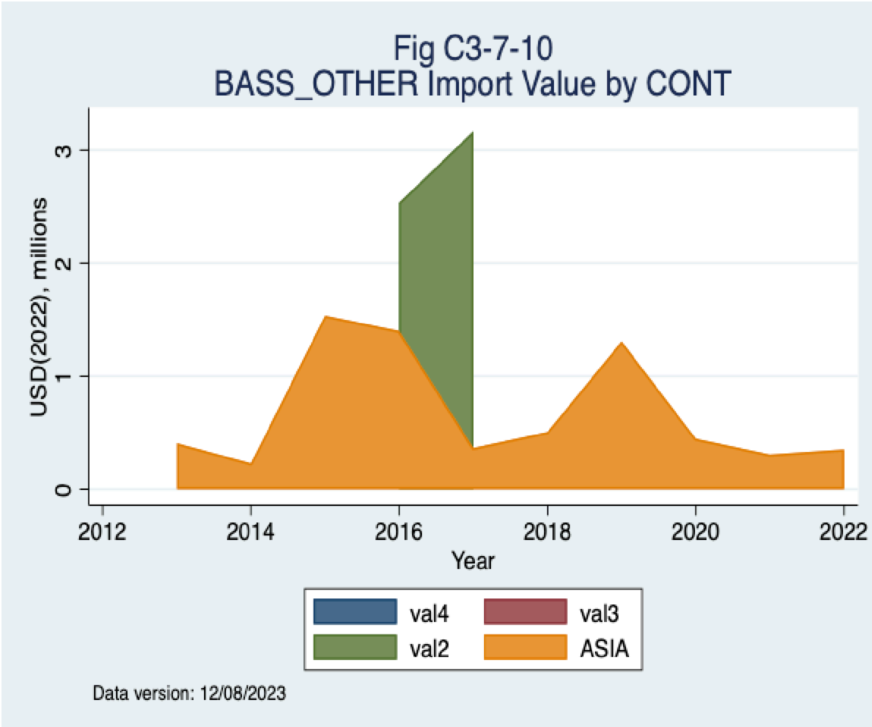


Fig A3-7-11: BASS_OTHER Weight by Continent by Year

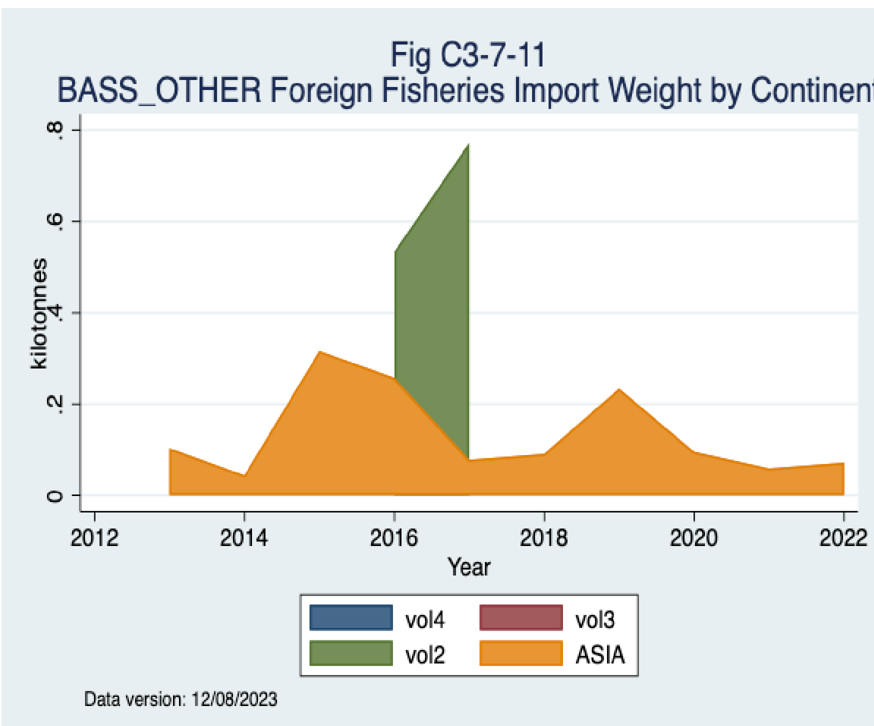


Fig A3-7-12: BASS_OTHER Value by Country, Proportion

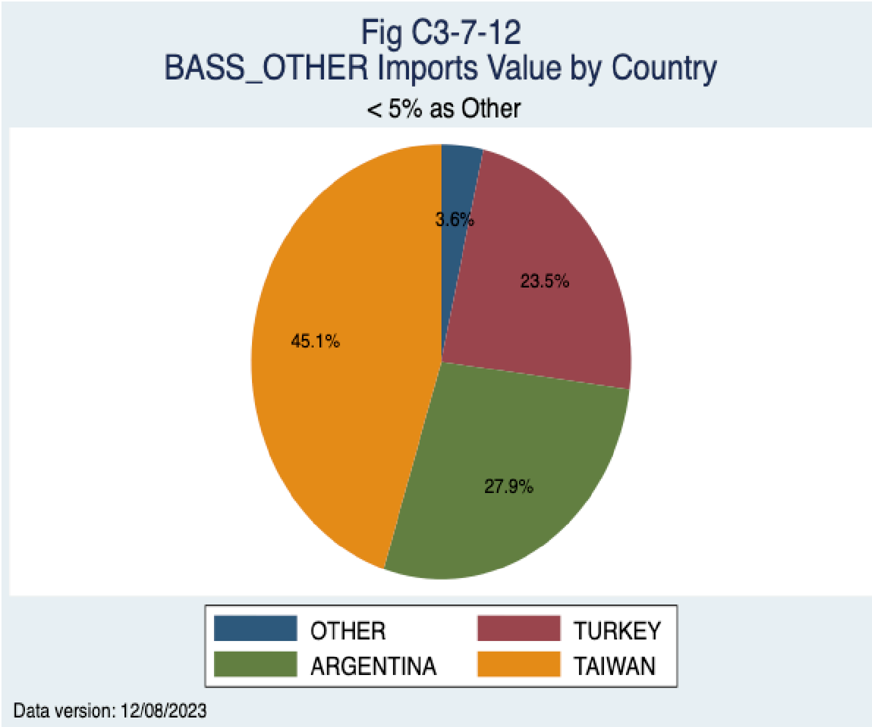


Fig A3-7-13: BASS_OTHER Weight by Country, Proportion

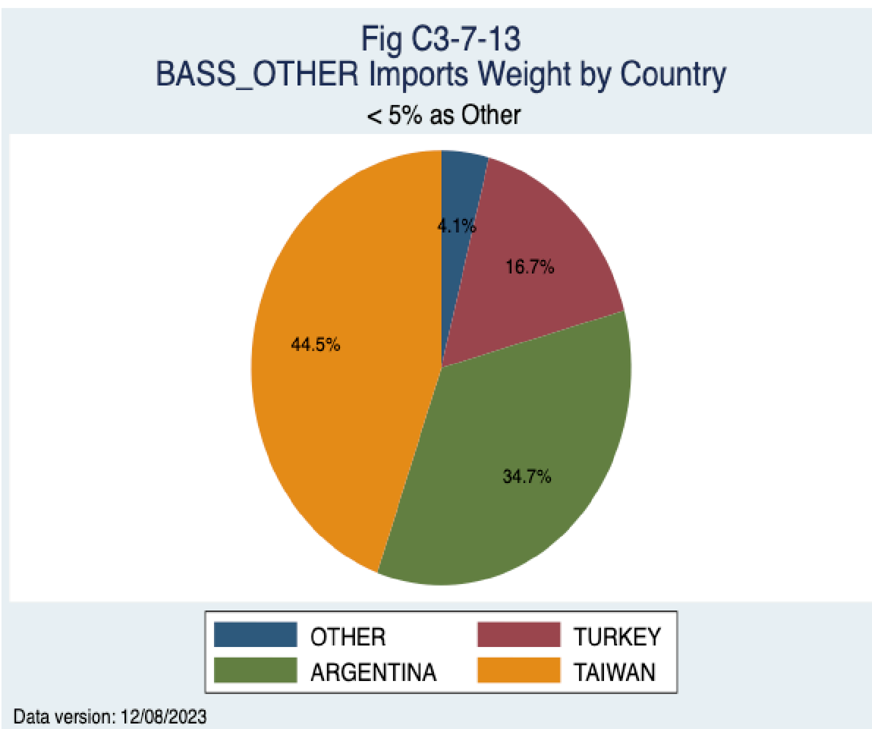


Fig A3-7-14: BASS_OTHER Value by Country by Year

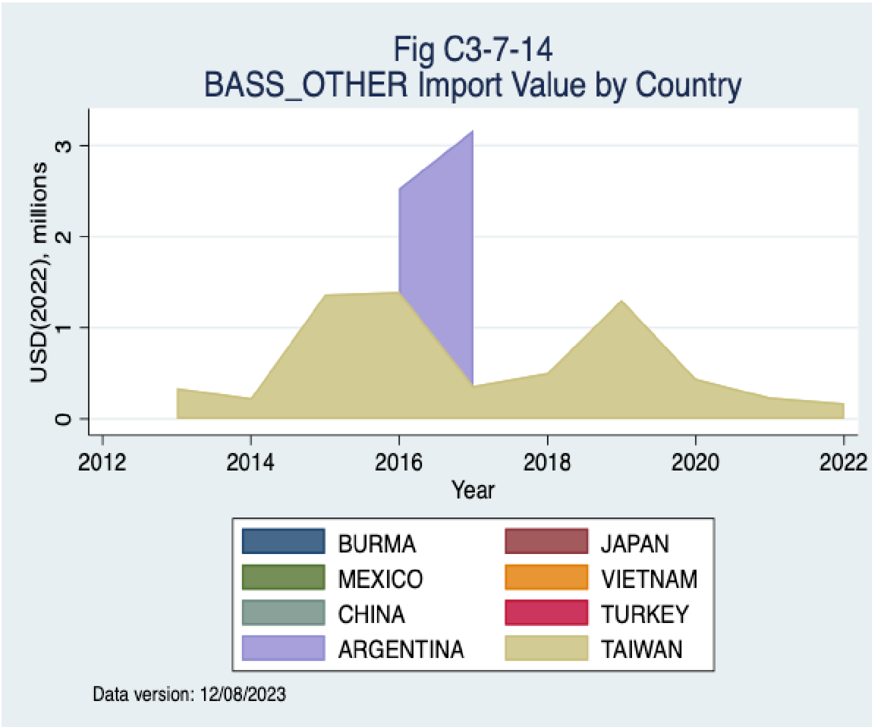
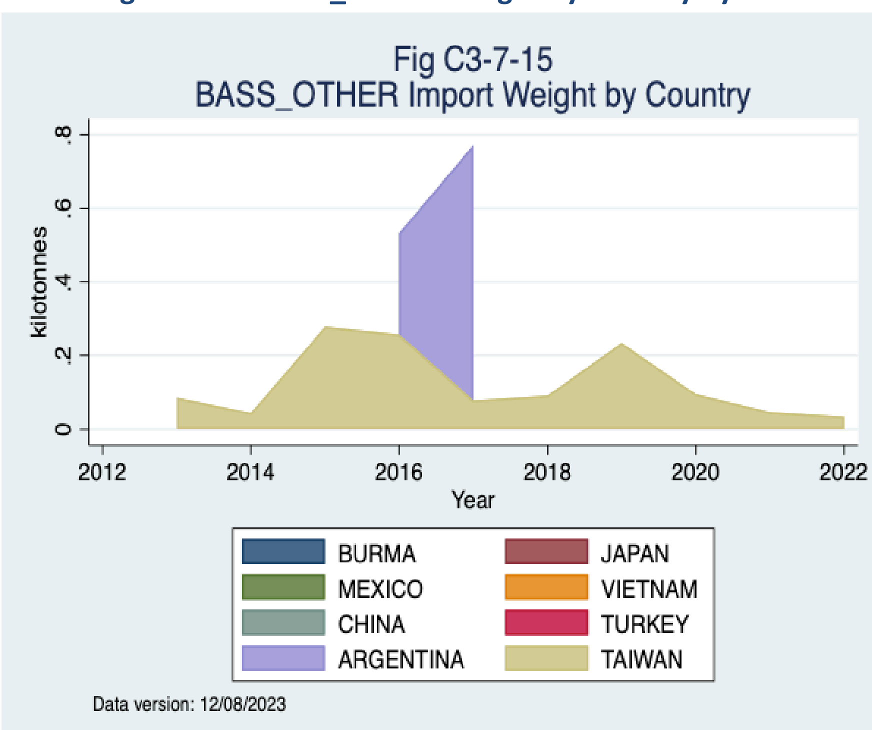


Fig A3-7-15: BASS_OTHER Weight by Country by Year



Figures for OYSTER_FRESH product group

Fig A3-8-1: OYSTER_FRESH Weight & Value by Year

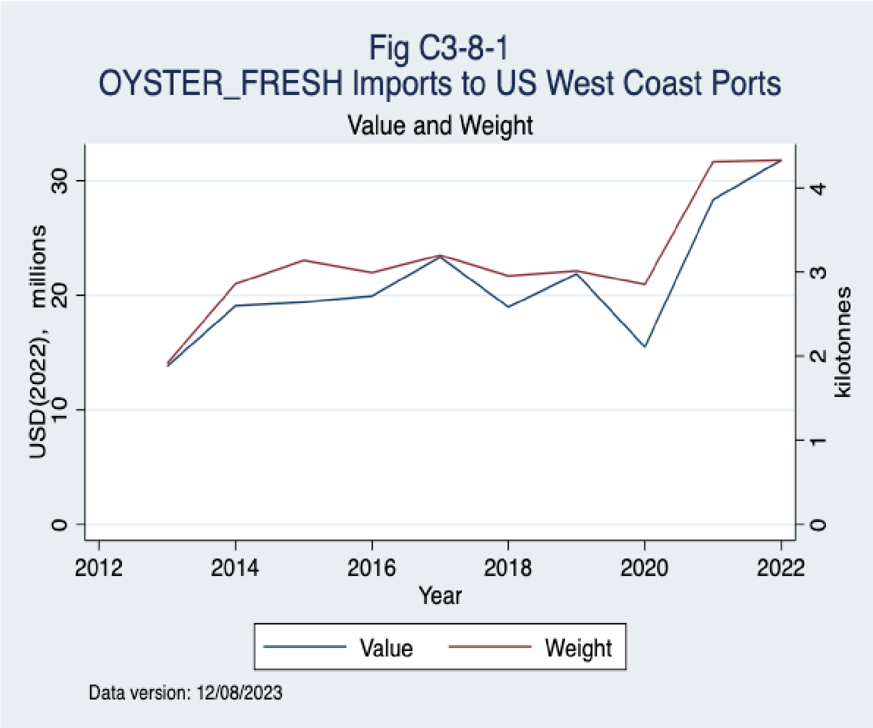


Fig A3-8-2: OYSTER_FRESH Value & Price by Year

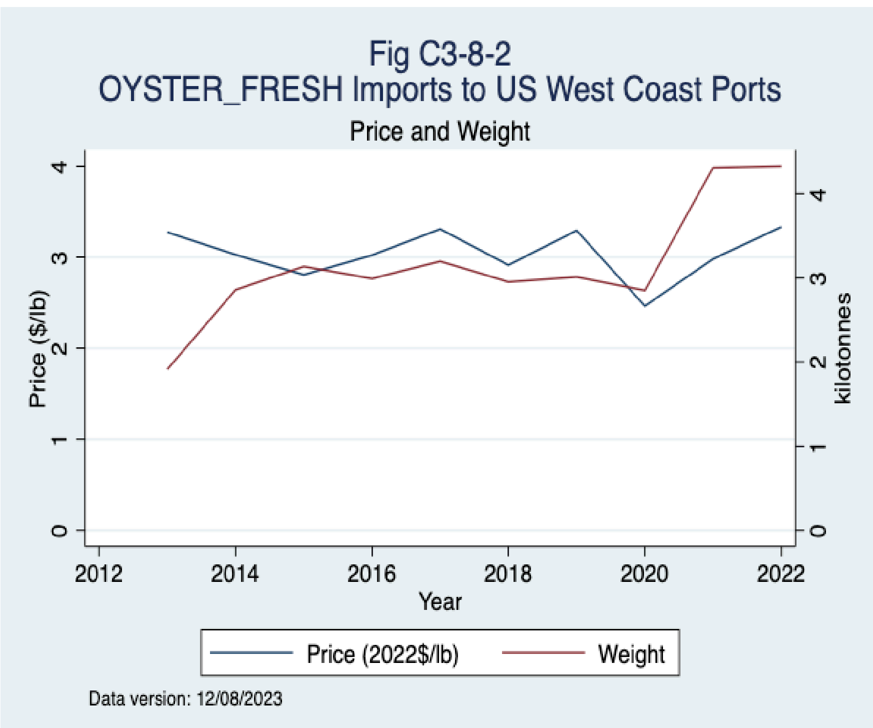


Fig A3-8-3: OYSTER_FRESH Price Percentiles by Year

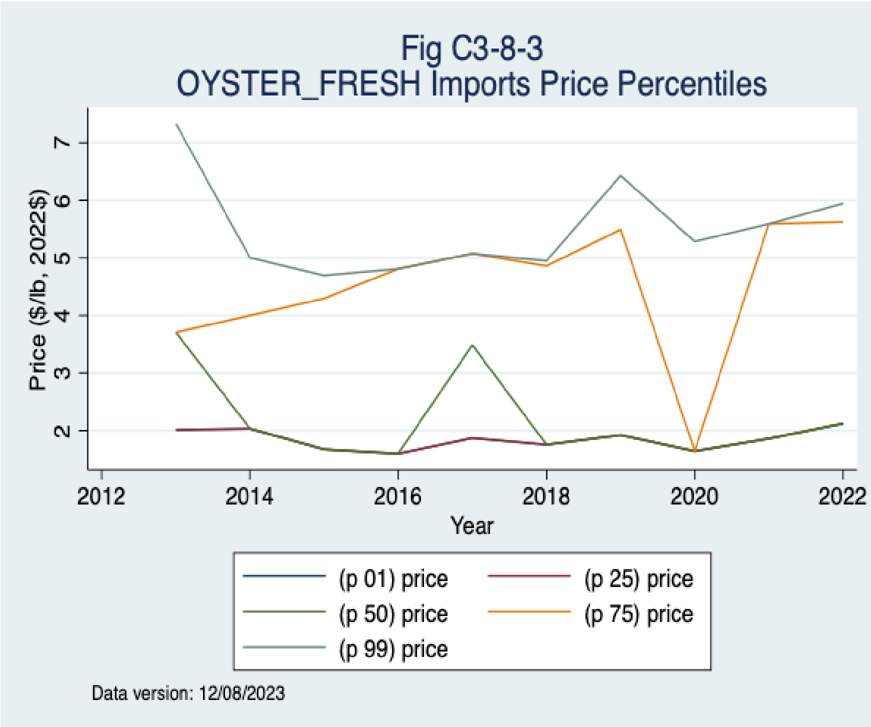


Fig A3-8-4: OYSTER_FRESH Value by Port, Proportion

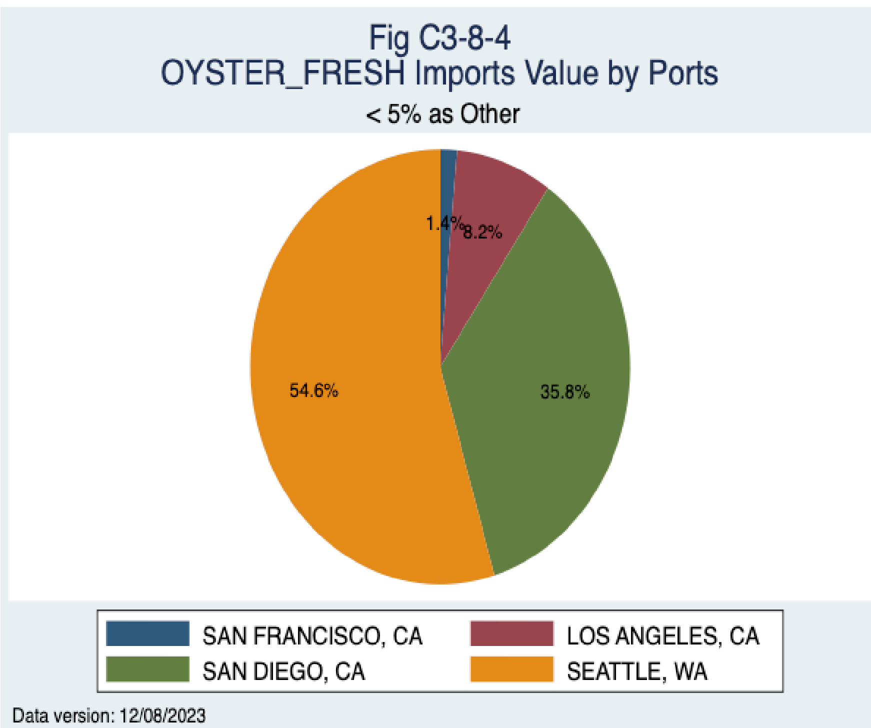


Fig A3-8-5: OYSTER_FRESH Weight by Port, Proportion

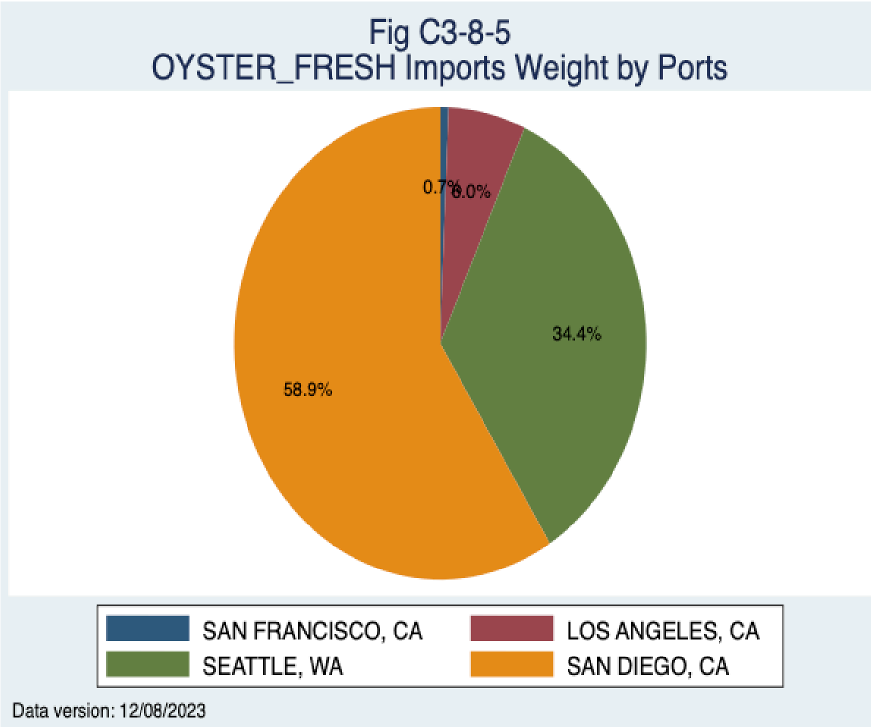


Fig A3-8-6: OYSTER_FRESH Value by Port by Year

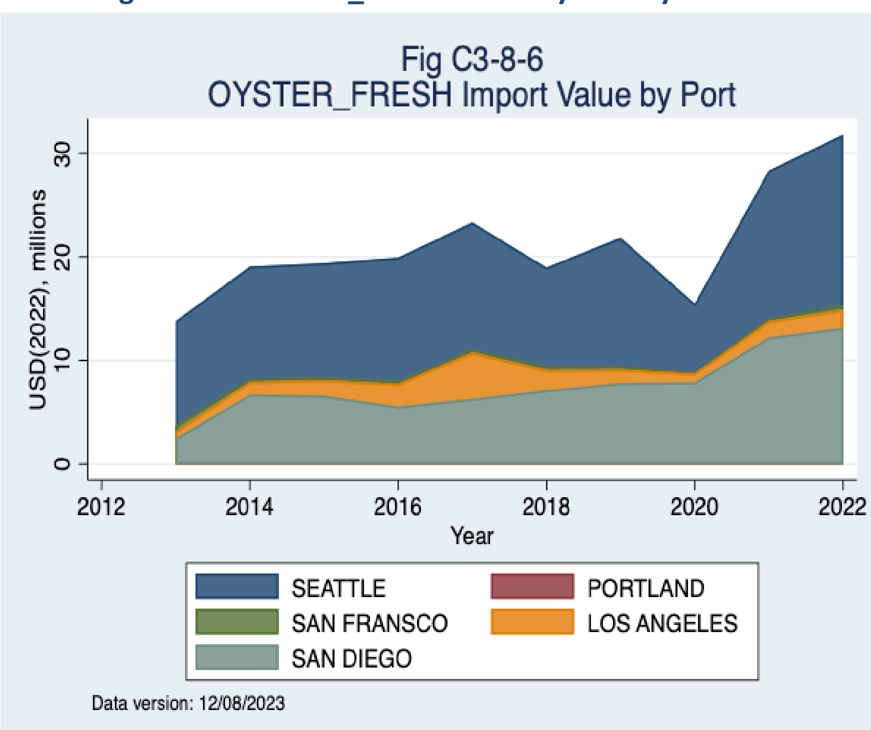


Fig A3-8-7: OYSTER_FRESH Weight by Port by Year

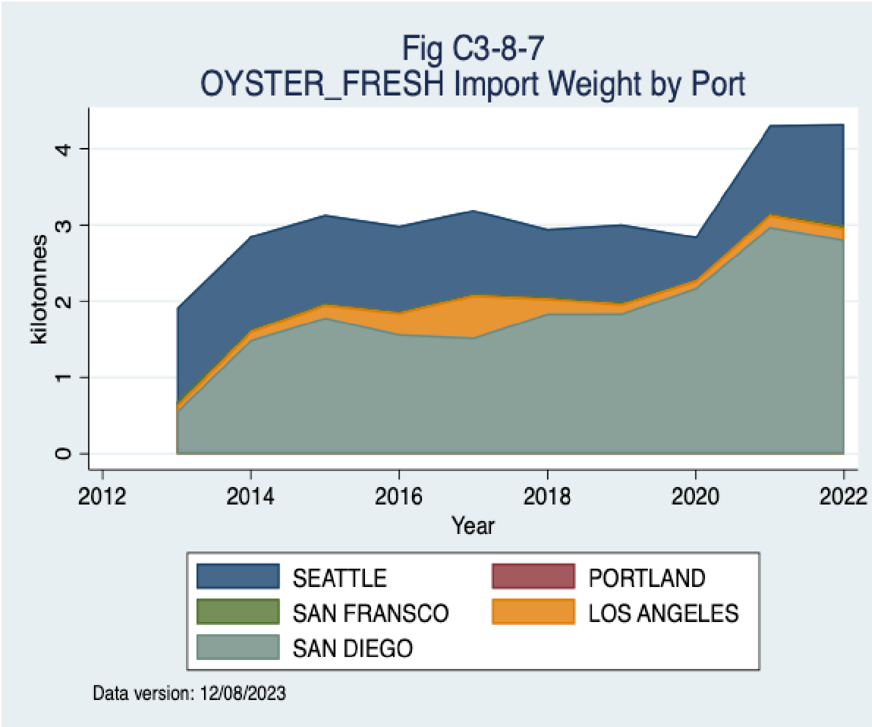


Fig A3-8-8: OYSTER_FRESH Value by Continent, Proportion

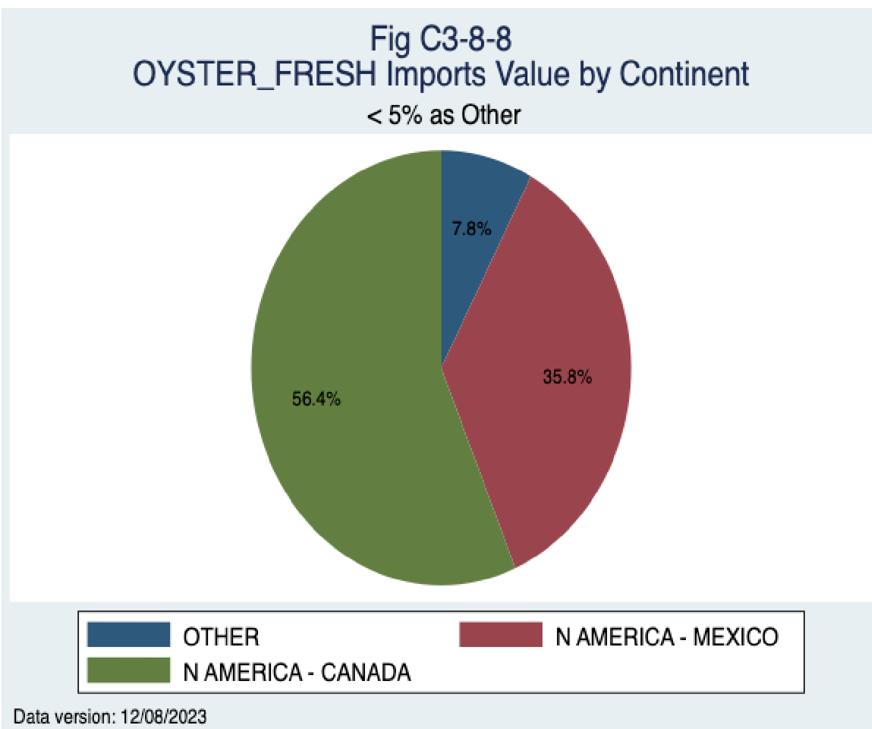


Fig A3-8-9: OYSTER_FRESH Weight by Continent, Proportion

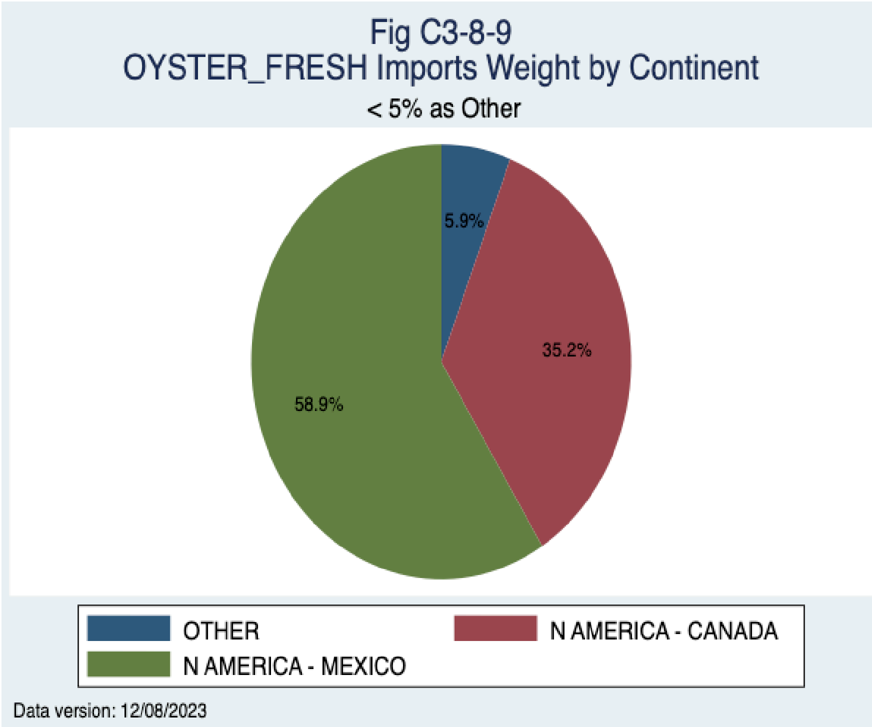


Fig A3-8-10: OYSTER_FRESH Value by Continent by Year

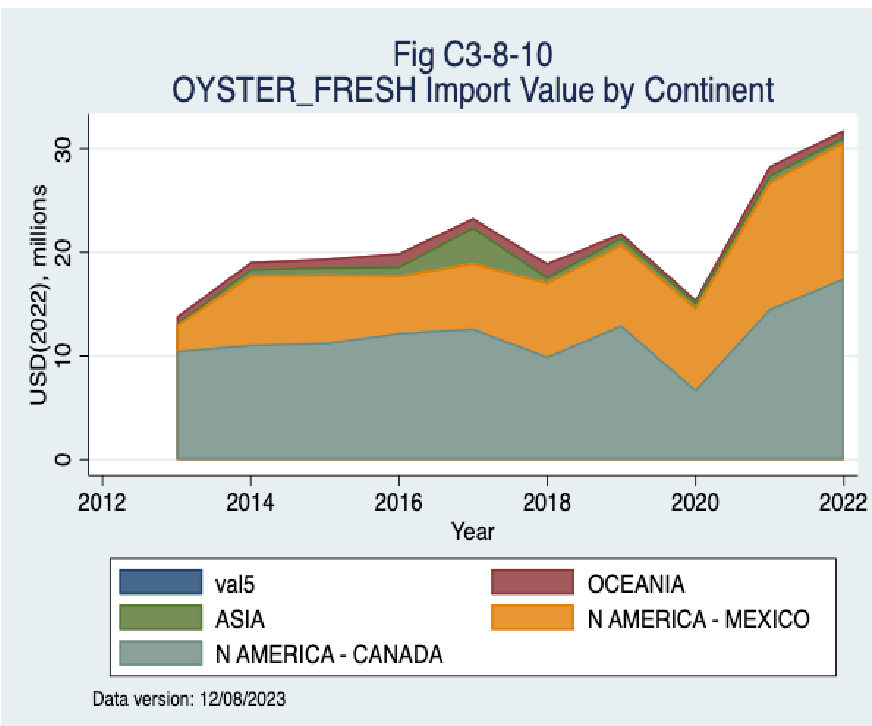


Fig A3-8-11: OYSTER_FRESH Weight by Continent by Year

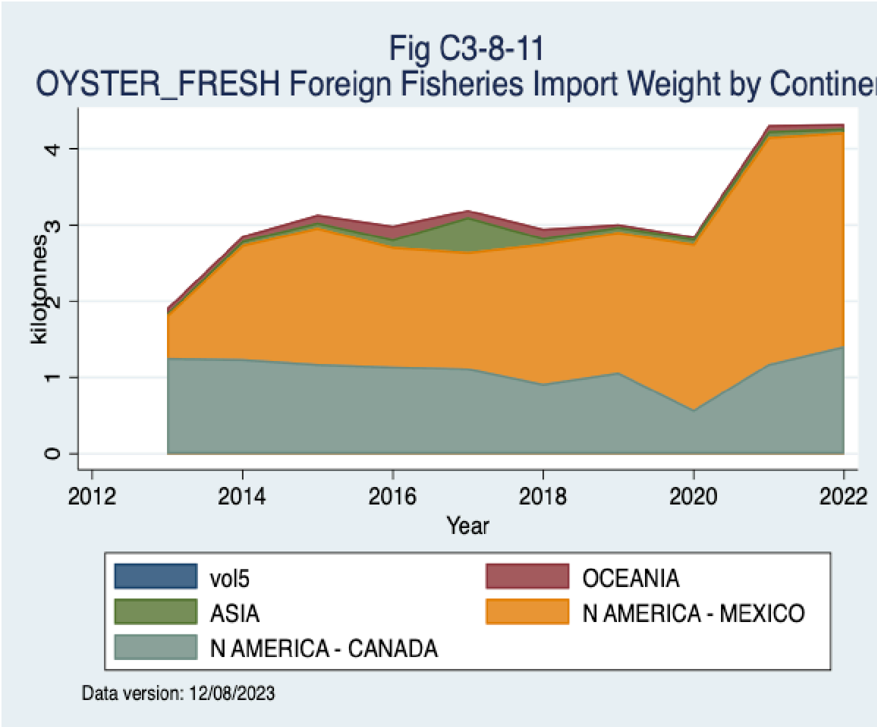


Fig A3-8-12: OYSTER_FRESH Value by Country, Proportion

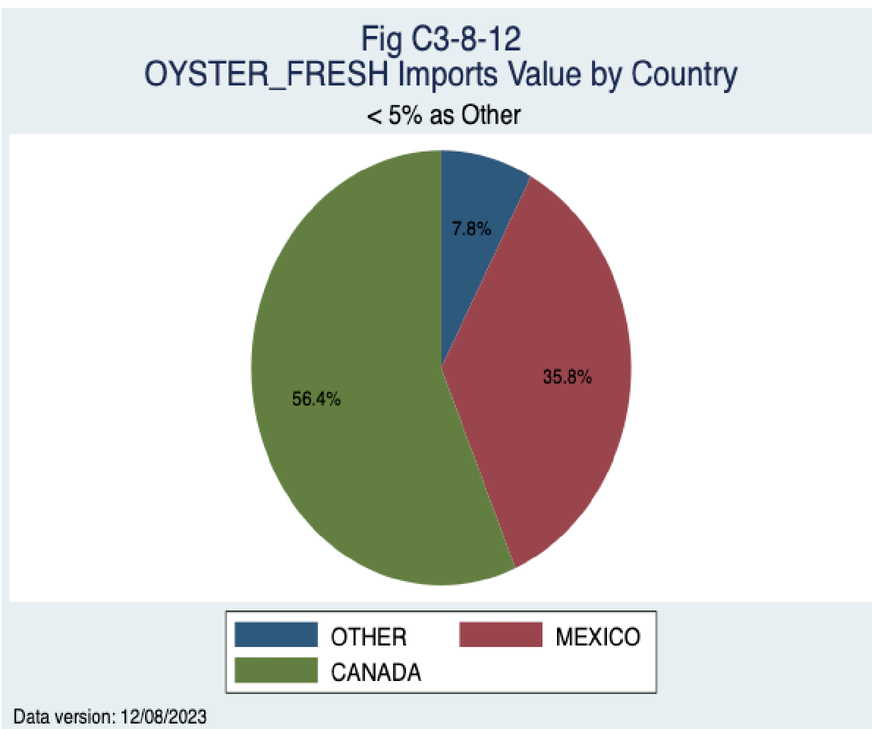


Fig A3-8-13: OYSTER_FRESH Weight by Country, Proportion

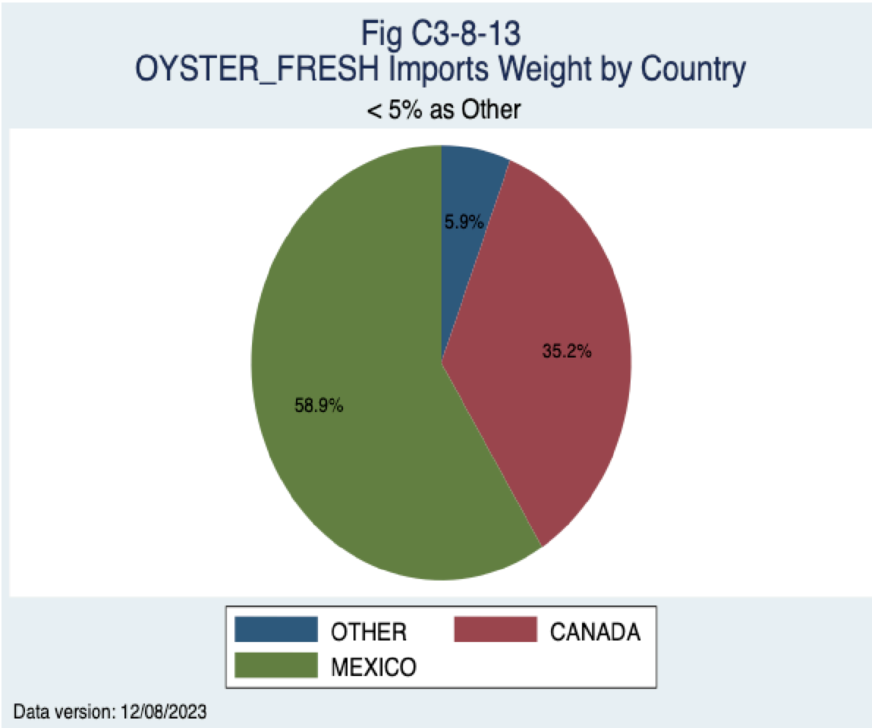


Fig A3-8-14: OYSTER_FRESH Value by Country by Year

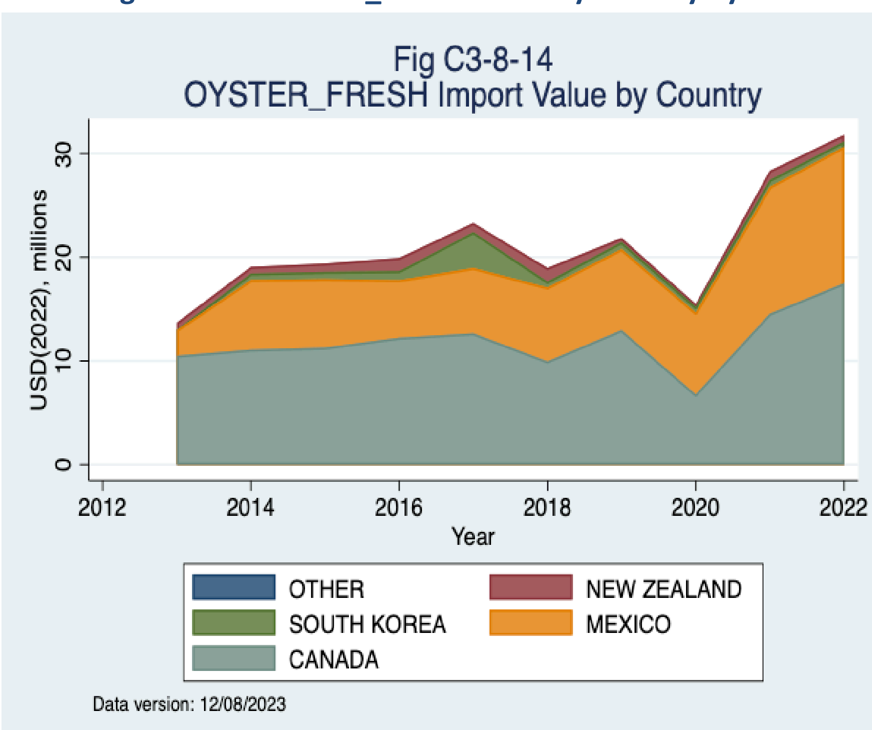
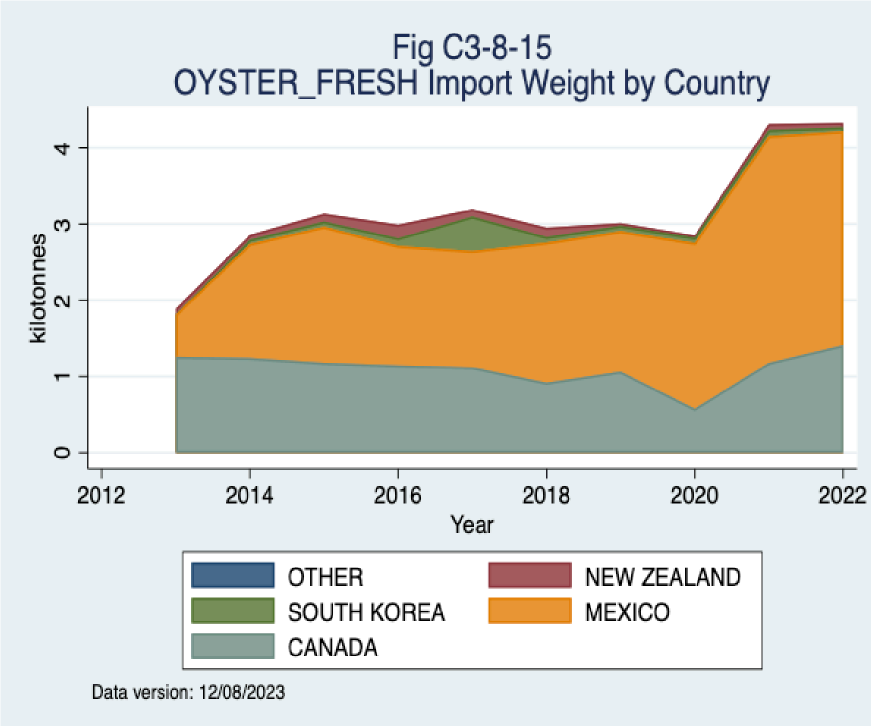


Fig A3-8-15: OYSTER_FRESH Weight by Country by Year



Figures for OYSTER_OTHER product group

Fig A3-9-1: OYSTER_OTHER Weight & Value by Year

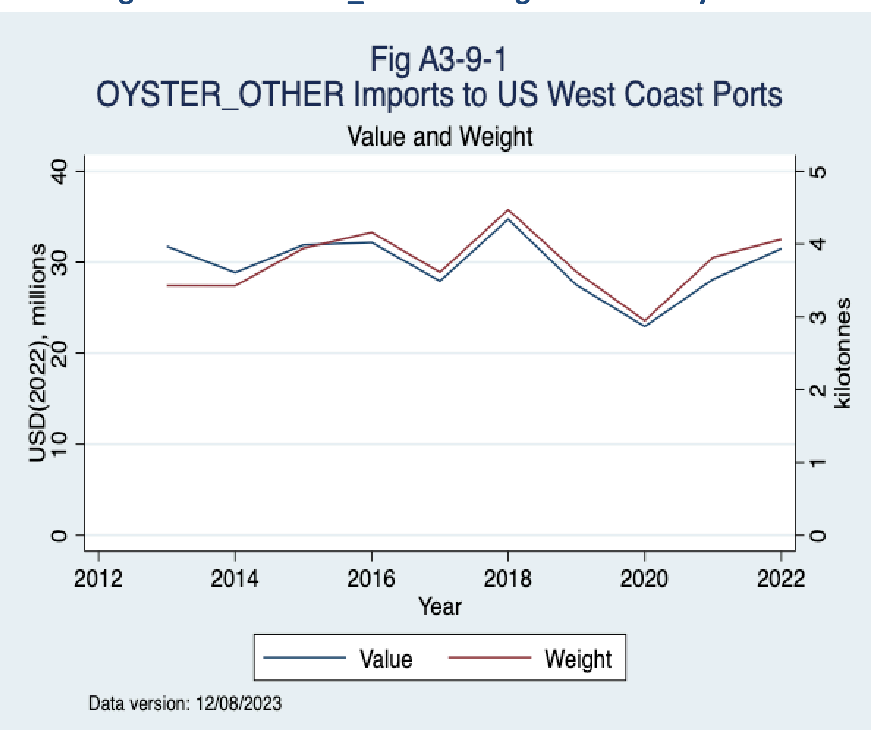


Fig A3-9-2: OYSTER_OTHER Value & Price by Year

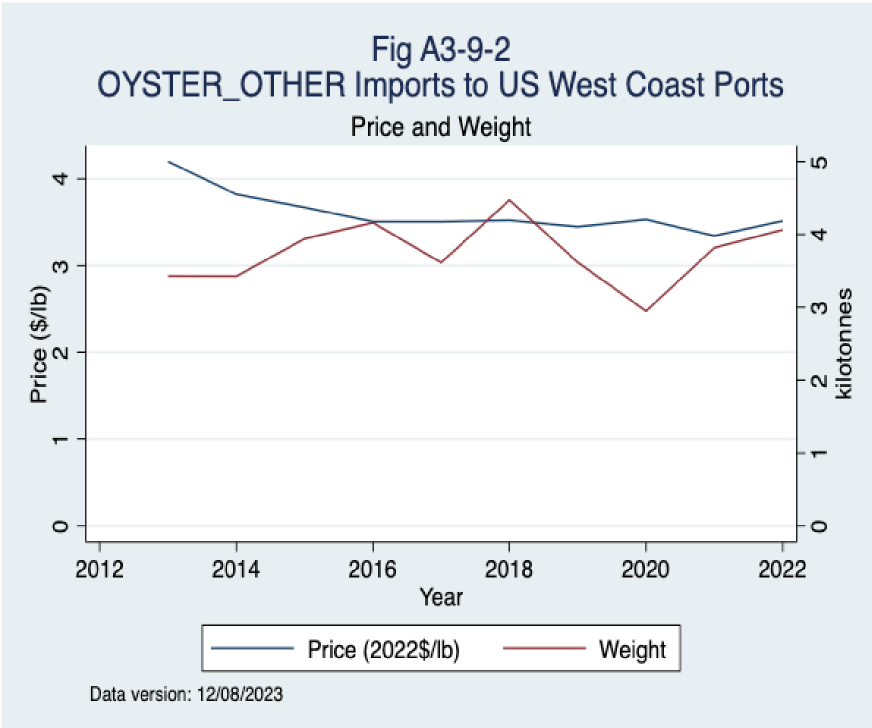


Fig A3-9-3: OYSTER_OTHER Price Percentiles by Year

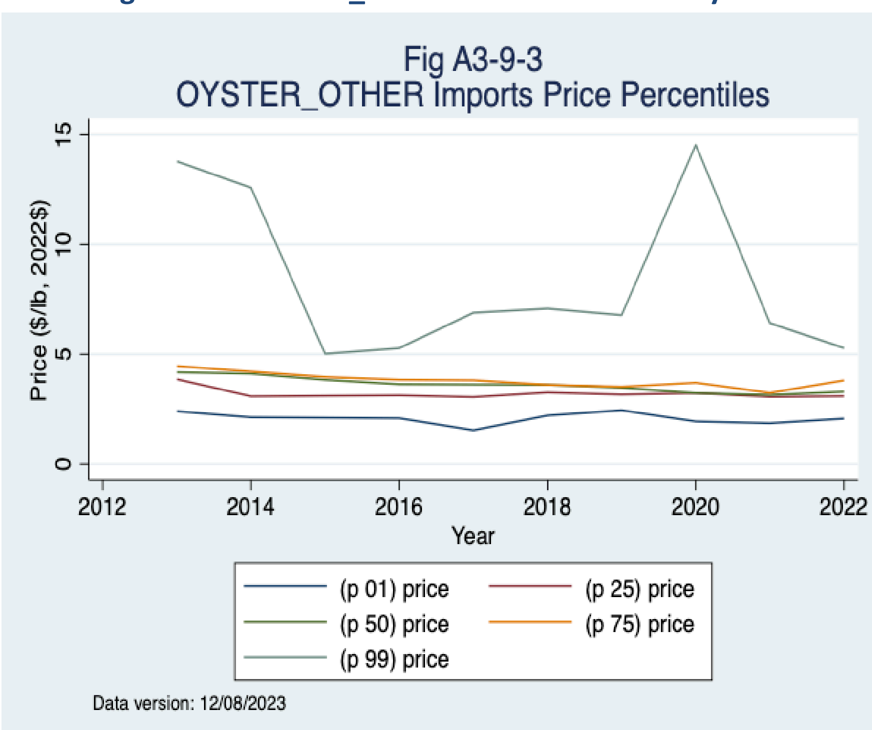


Fig A3-9-4: OYSTER_OTHER Value by Port, Proportion

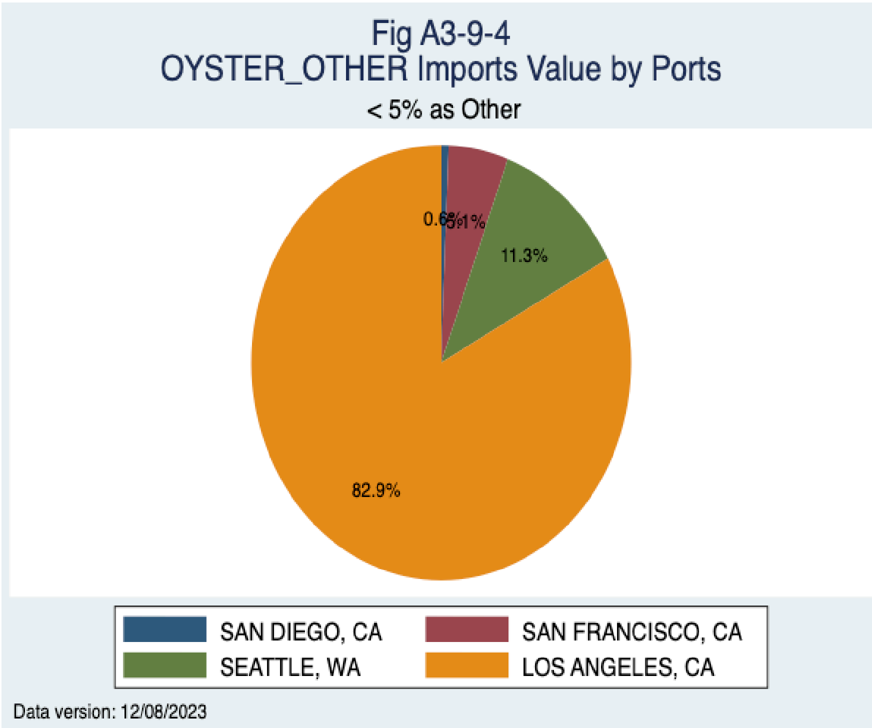


Fig A3-9-5: OYSTER_OTHER Weight by Port, Proportion

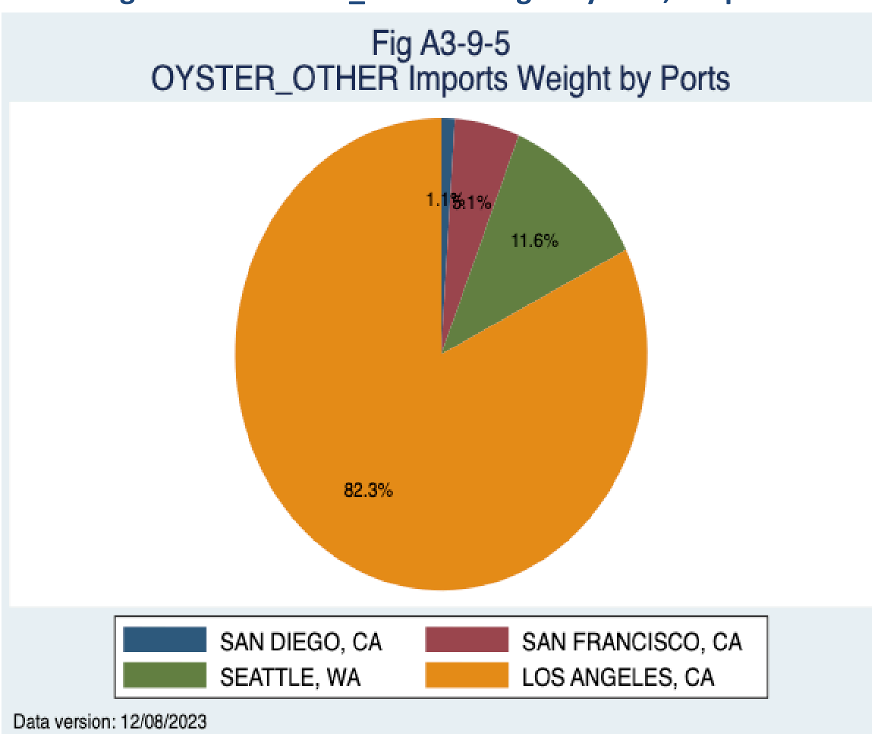


Fig A3-9-6: OYSTER_OTHER Value by Port by Year

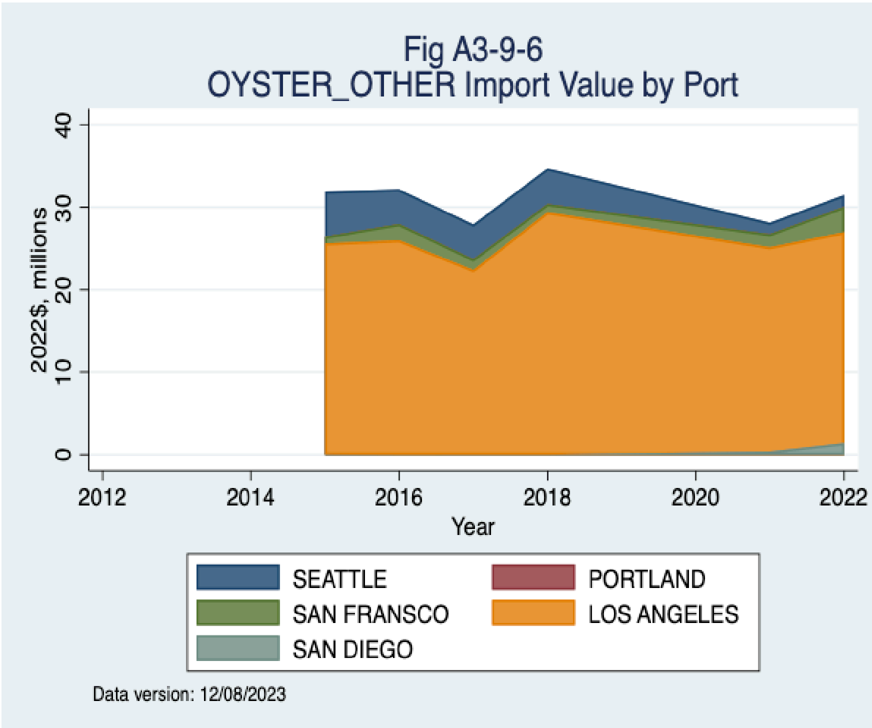


Fig A3-9-7: OYSTER_OTHER Weight by Port by Year

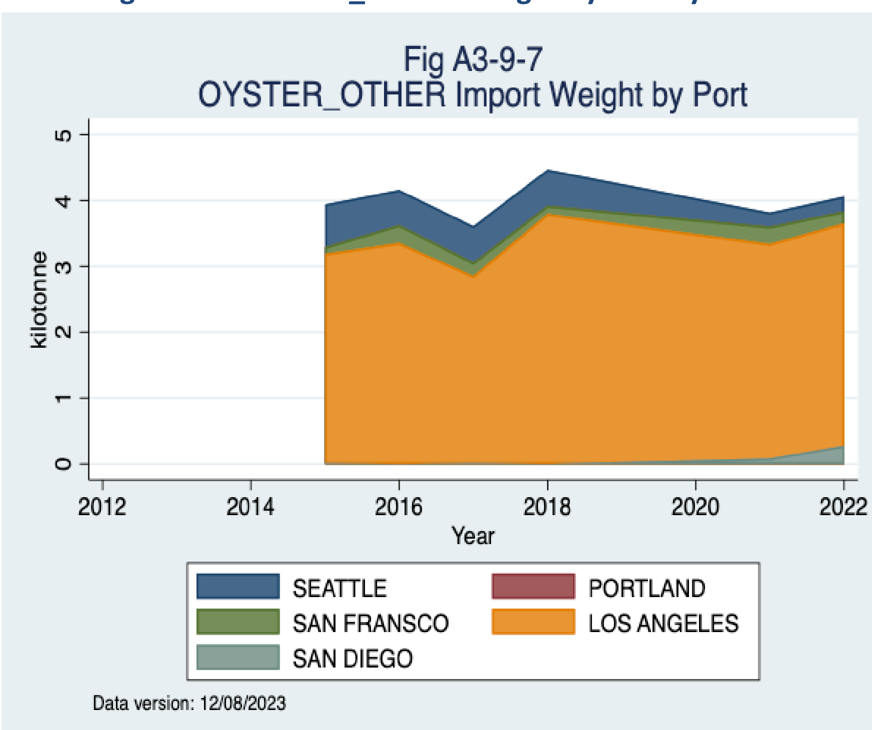


Fig A3-9-8: OYSTER_OTHER Value by Continent, Proportion

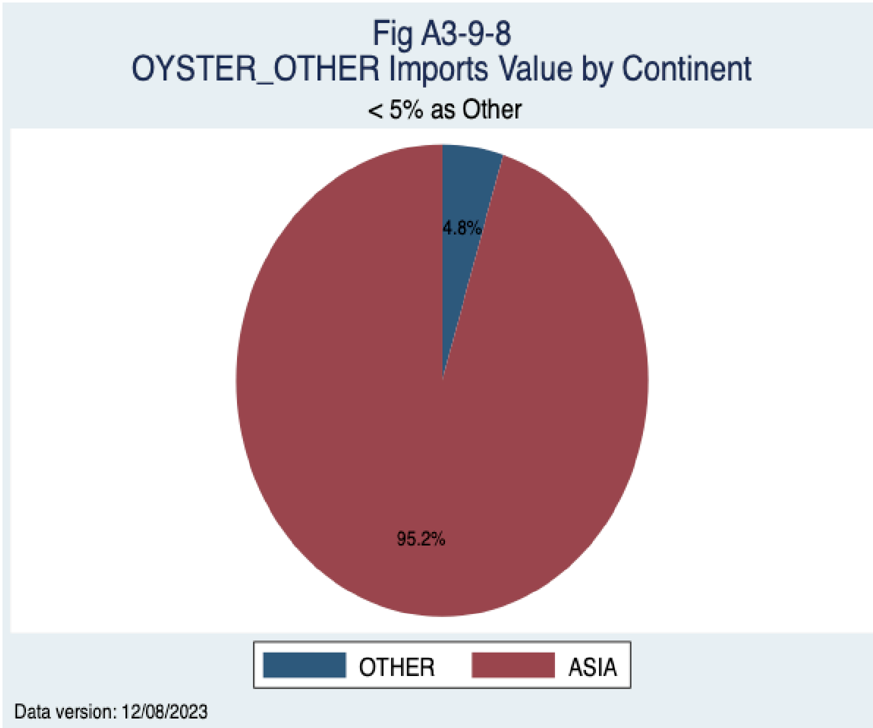


Fig A3-9-9: OYSTER_OTHER Weight by Continent, Proportion

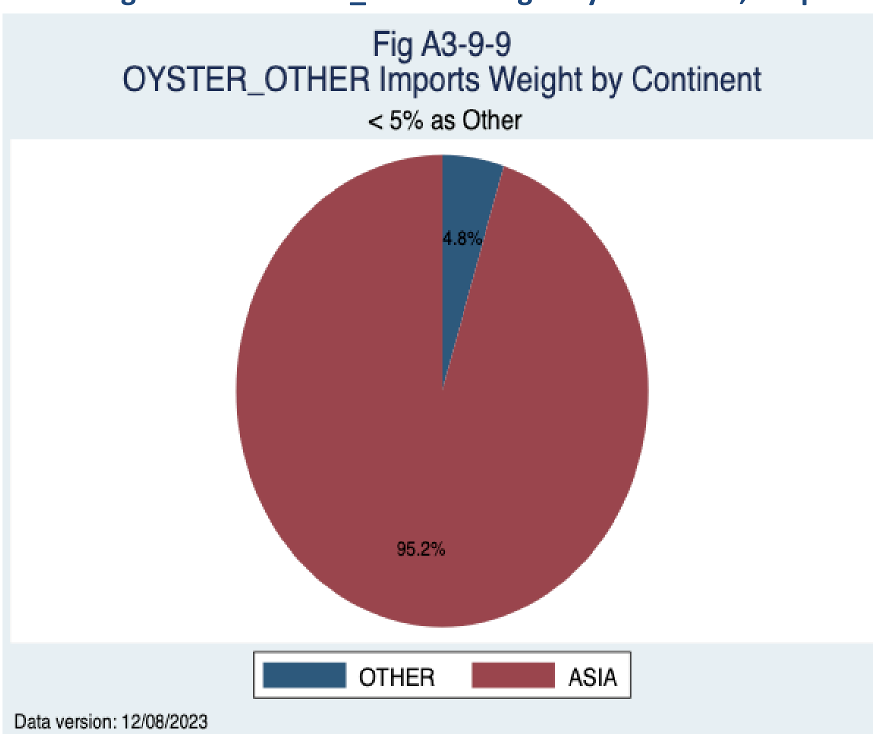


Fig A3-9-10: OYSTER_OTHER Value by Continent by Year

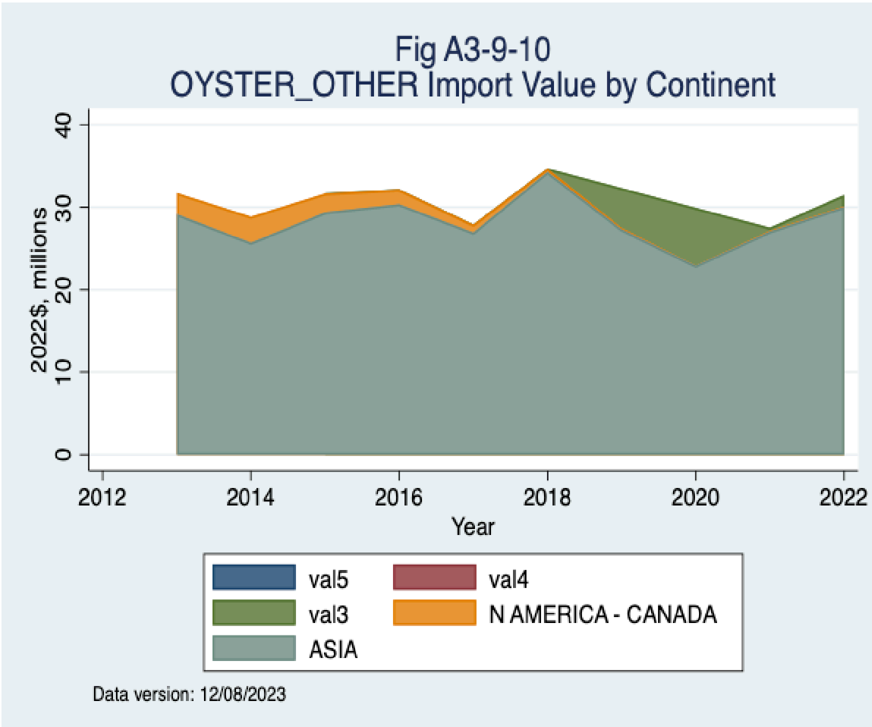


Fig A3-9-11: OYSTER_OTHER Weight by Continent by Year

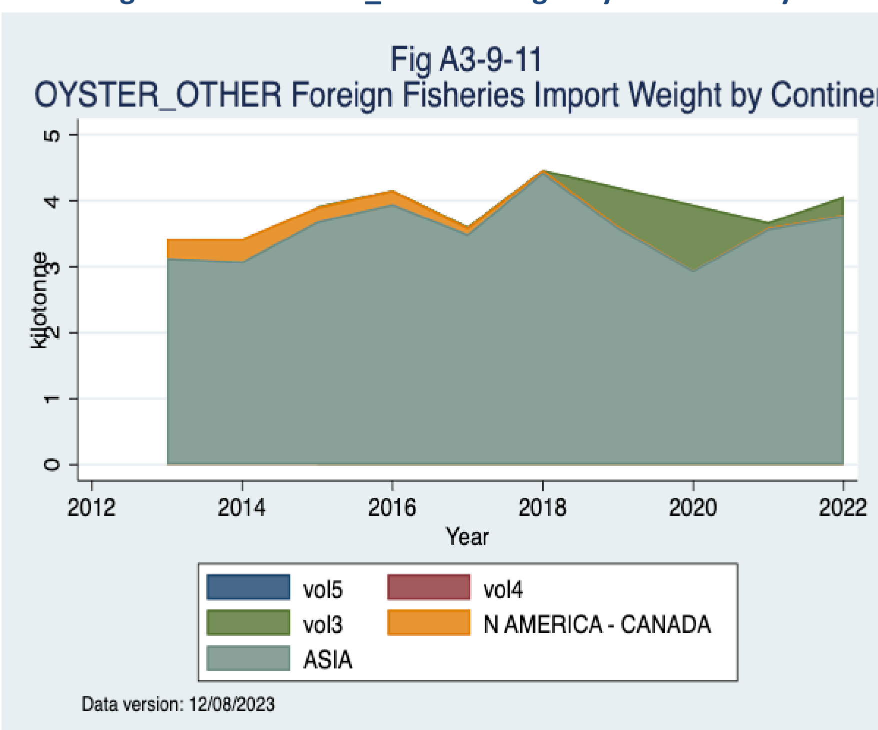


Fig A3-9-12: OYSTER_OTHER Value by Country, Proportion

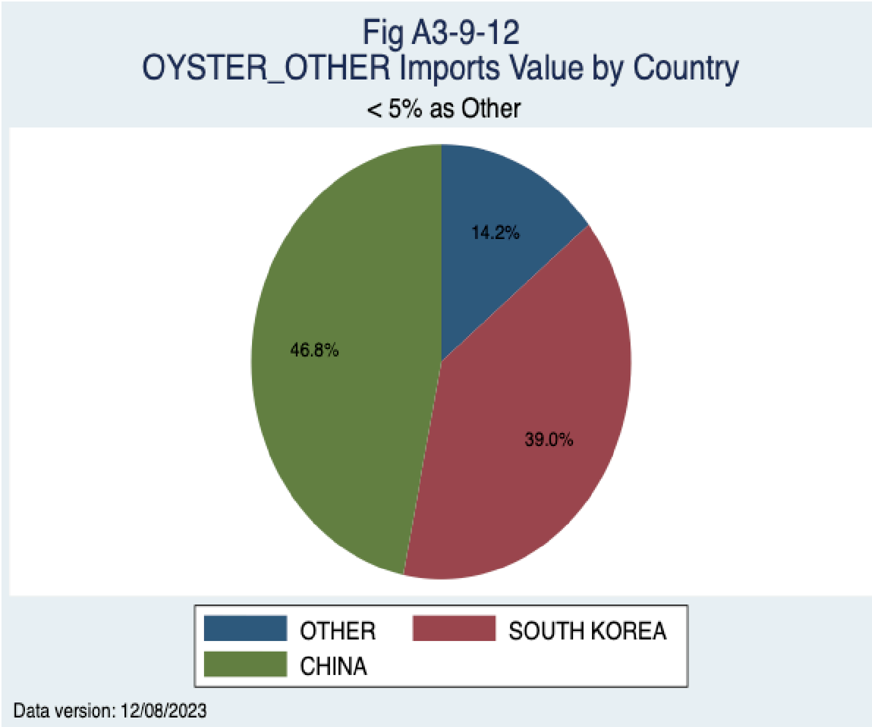


Fig A3-9-13: OYSTER_OTHER Weight by Country, Proportion

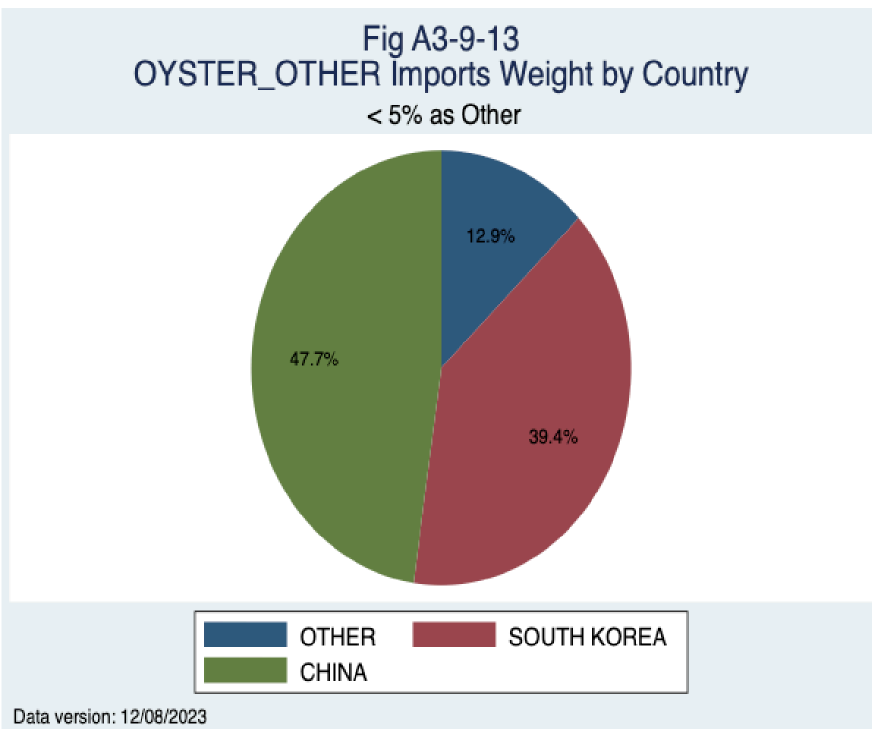


Fig A3-9-14: OYSTER_OTHER Value by Country by Year

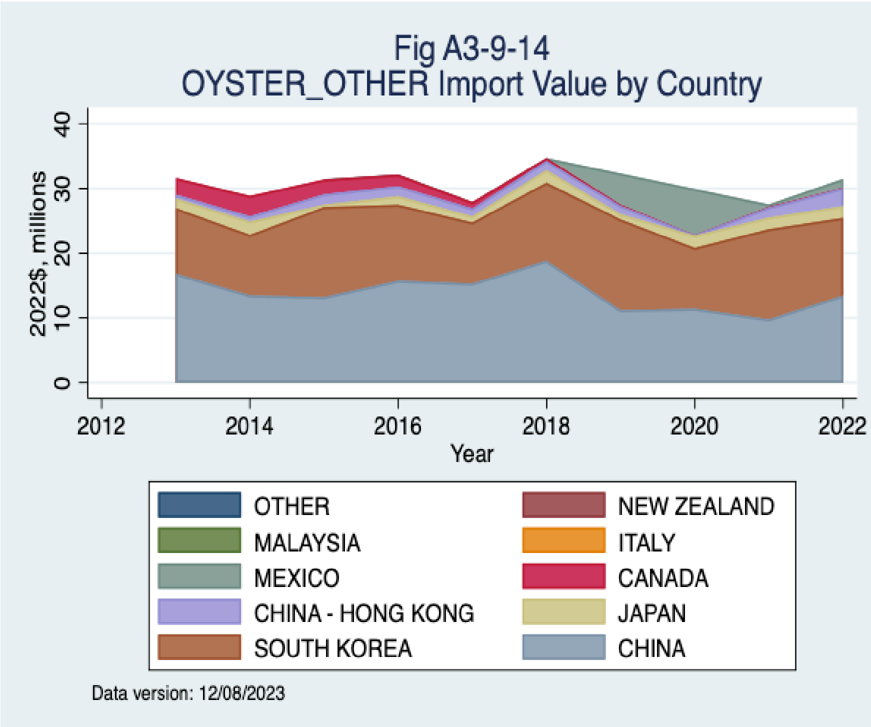
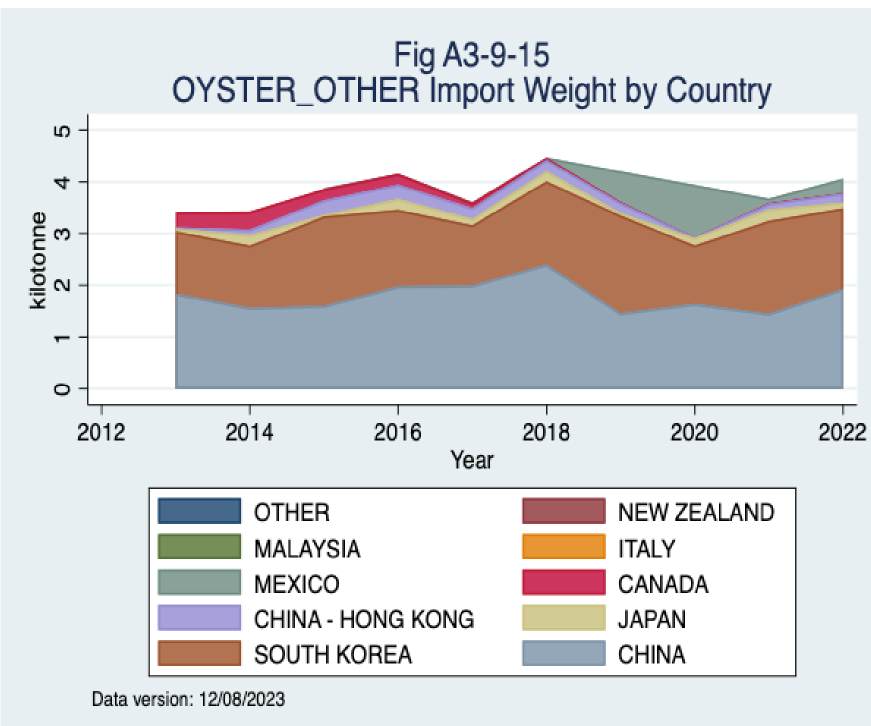


Fig A3-9-15: OYSTER_OTHER Weight by Country by Year



Figures for MUSSEL_FRESH product group

Fig A3-10-1: MUSSEL_FRESH Weight & Value by Year

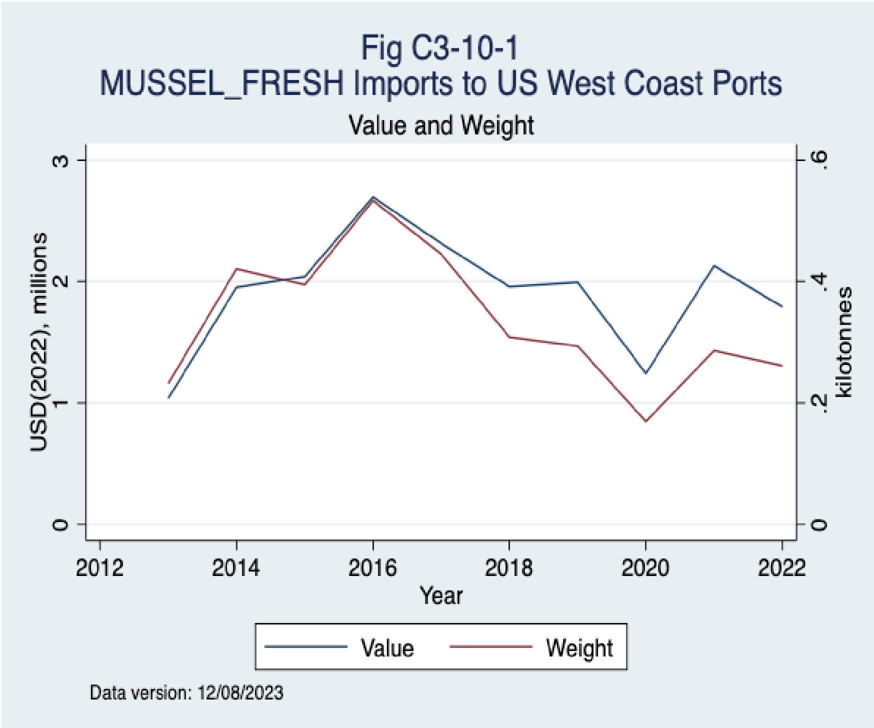


Fig A3-10-2: MUSSEL_FRESH Value & Price by Year

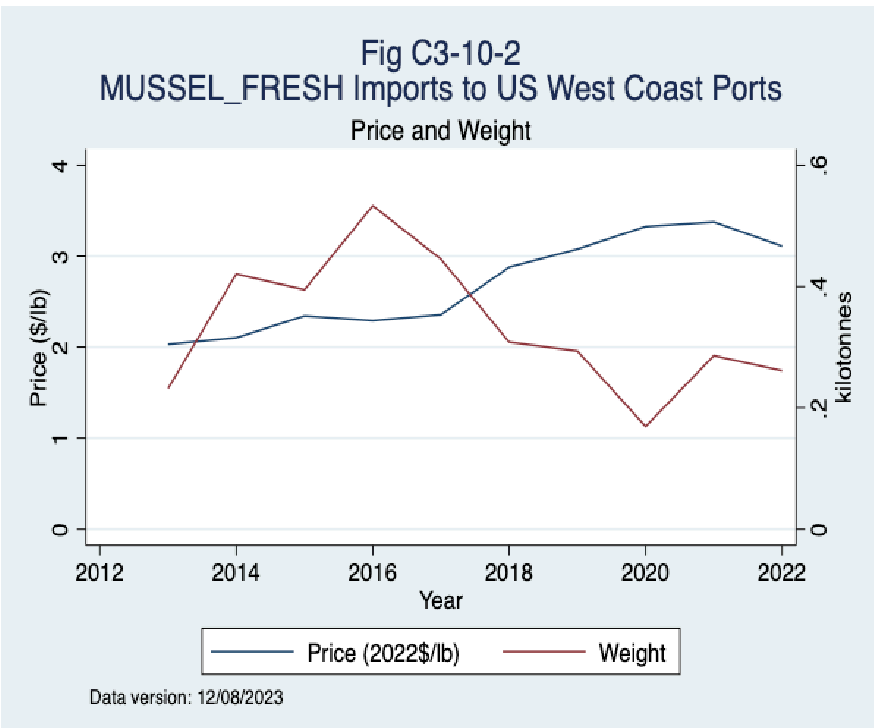


Fig A3-10-3: MUSSEL_FRESH Price Percentiles by Year

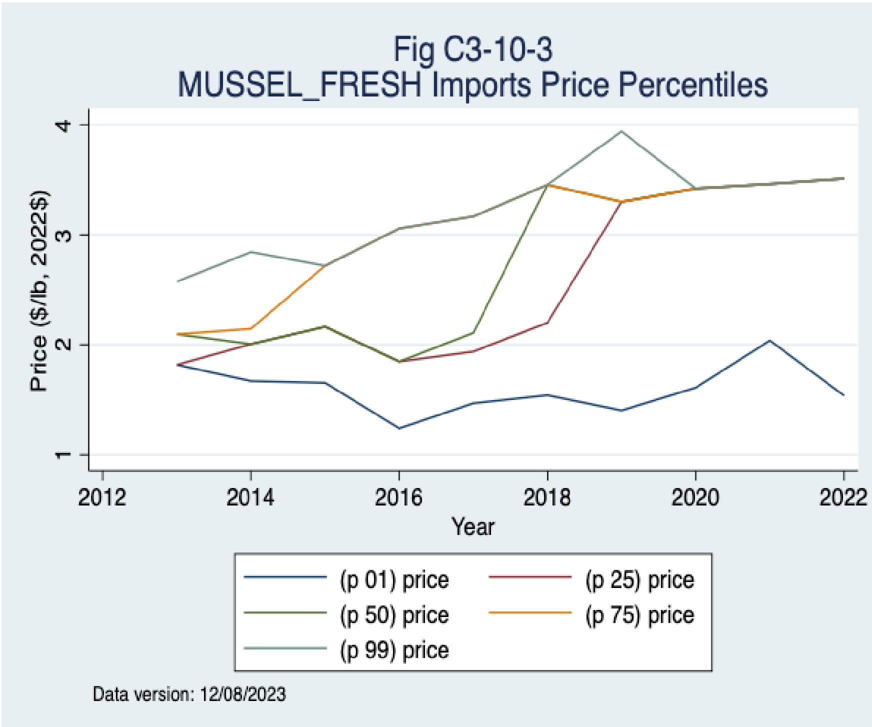


Fig A3-10-4: MUSSEL_FRESH Value by Port, Proportion

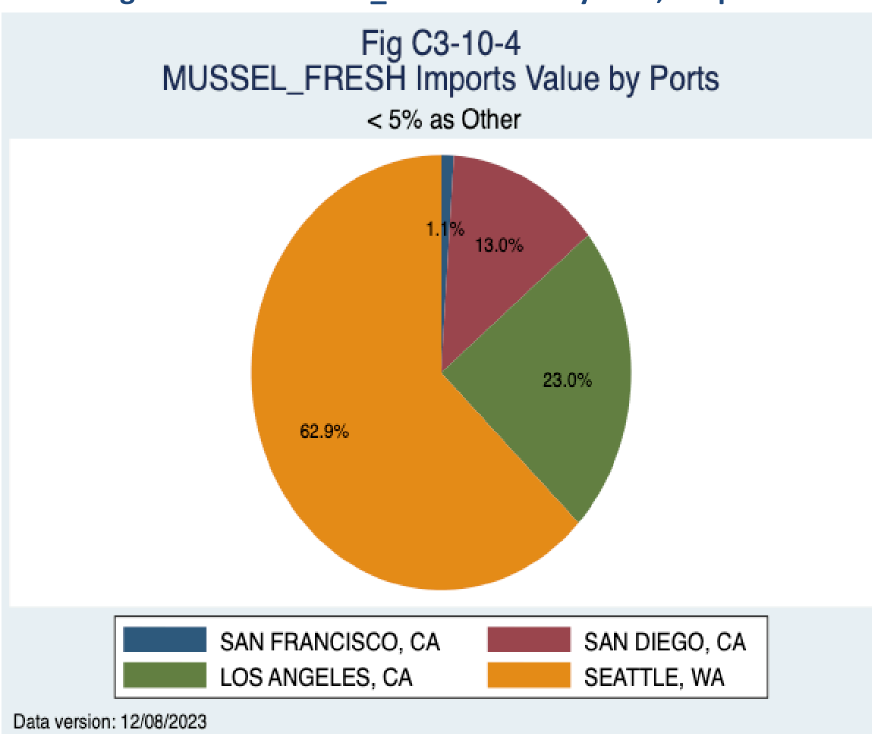


Fig A3-10-5: MUSSEL_FRESH Weight by Port, Proportion

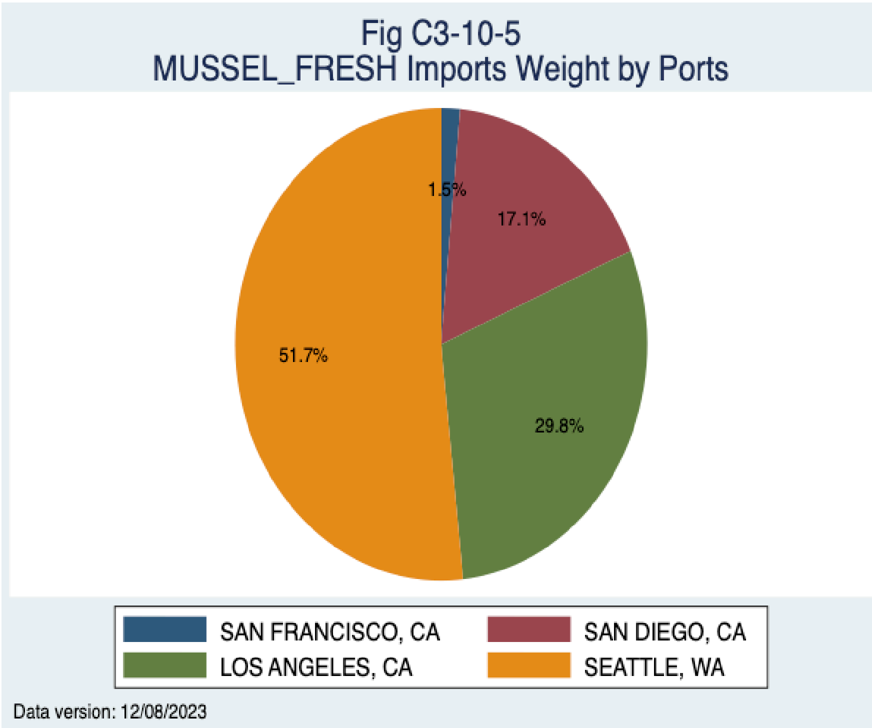


Fig A3-10-6: MUSSEL_FRESH Value by Port by Year

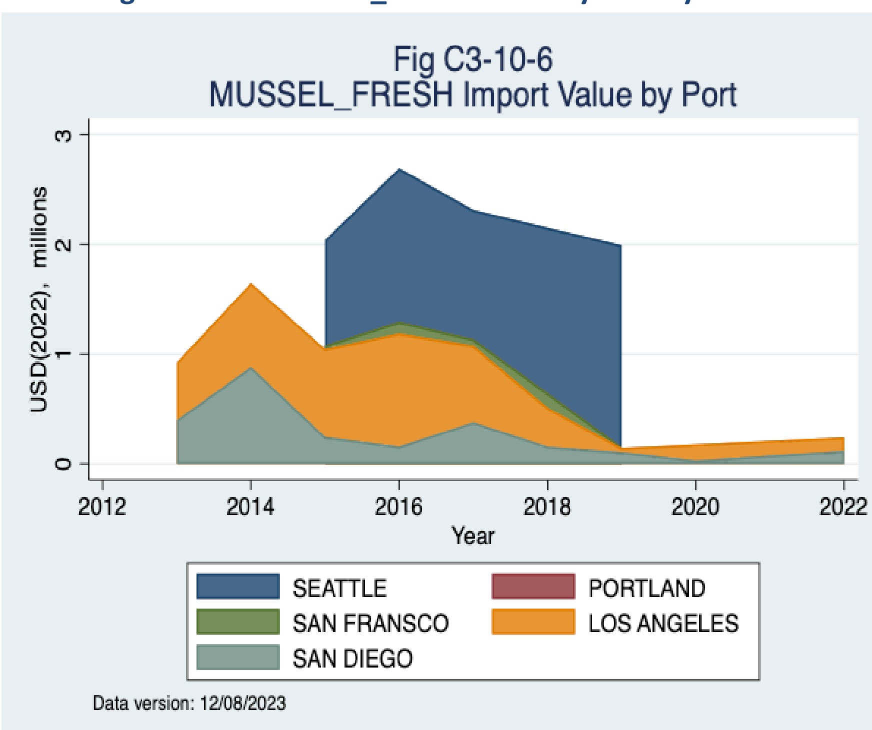


Fig A3-10-7: MUSSEL_FRESH Weight by Port by Year

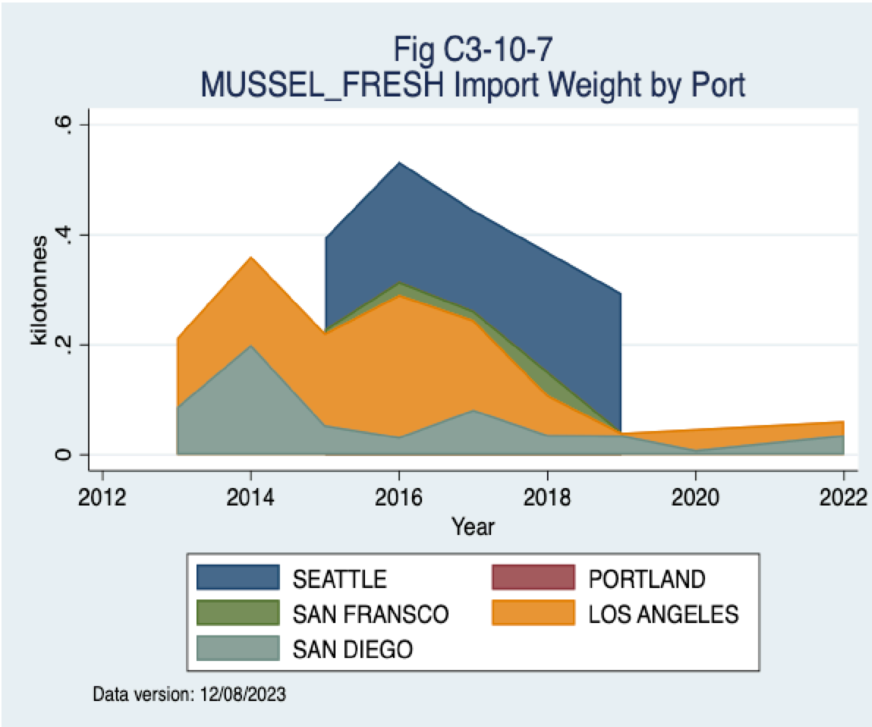


Fig A3-10-8: MUSSEL_FRESH Value by Continent, Proportion

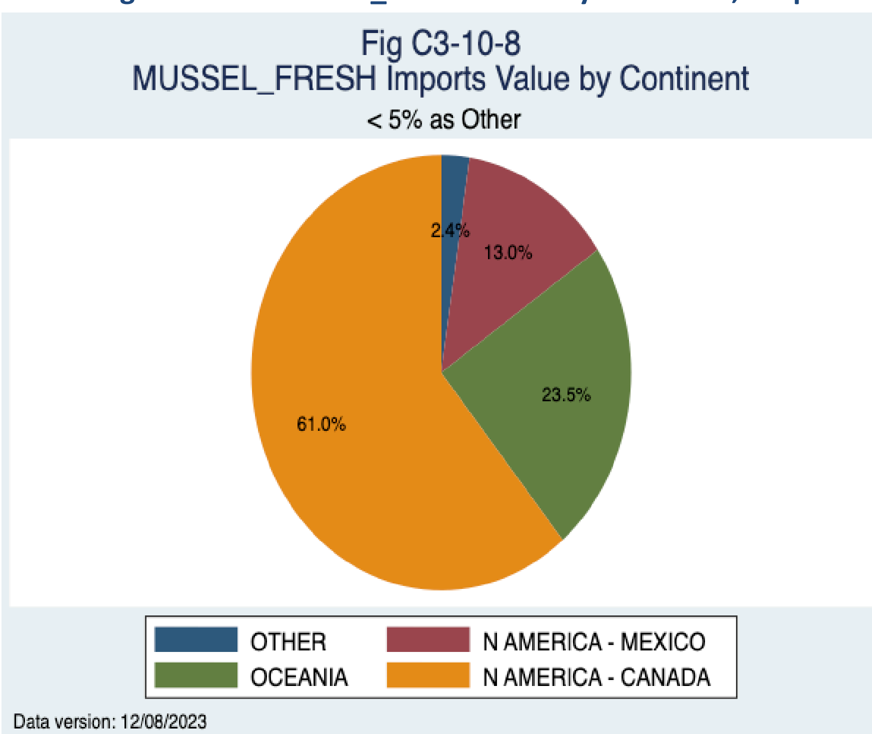


Fig A3-10-9: MUSSEL_FRESH Weight by Continent, Proportion

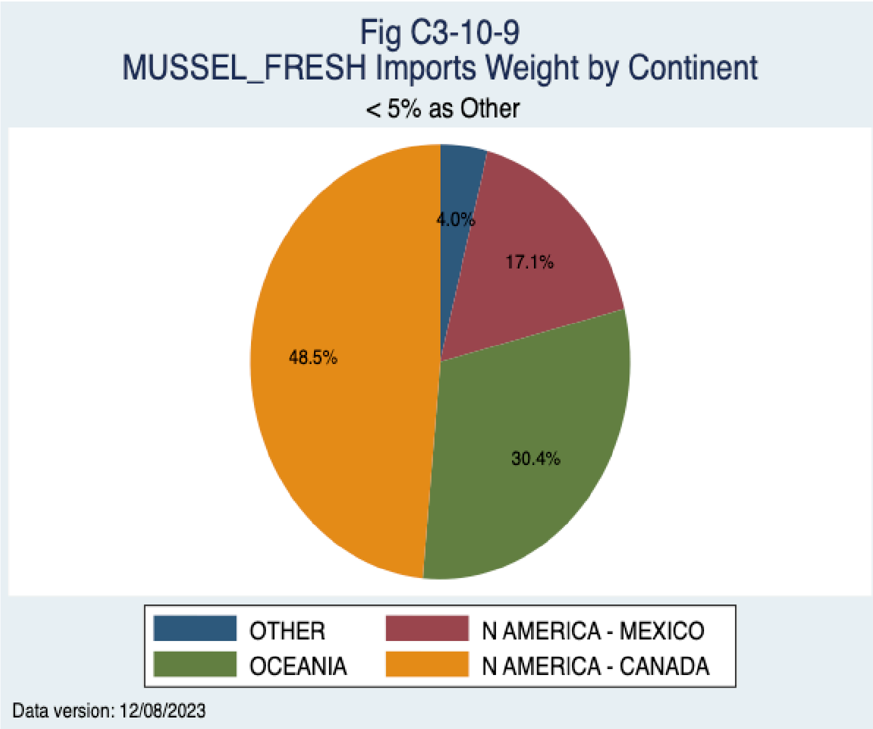


Fig A3-10-10: MUSSEL_FRESH Value by Continent by Year

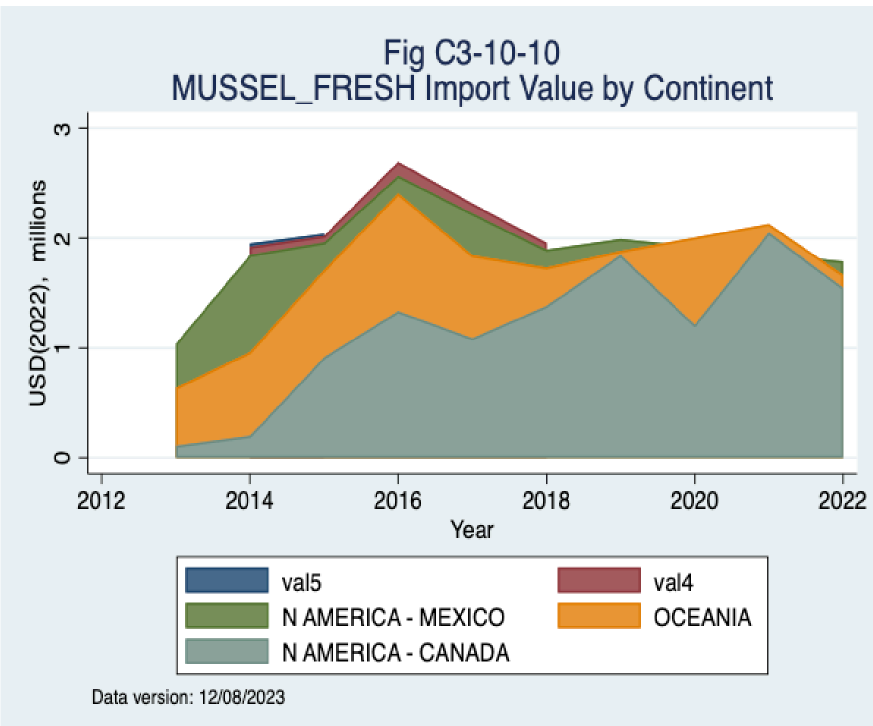


Fig A3-10-11: MUSSEL_FRESH Weight by Continent by Year

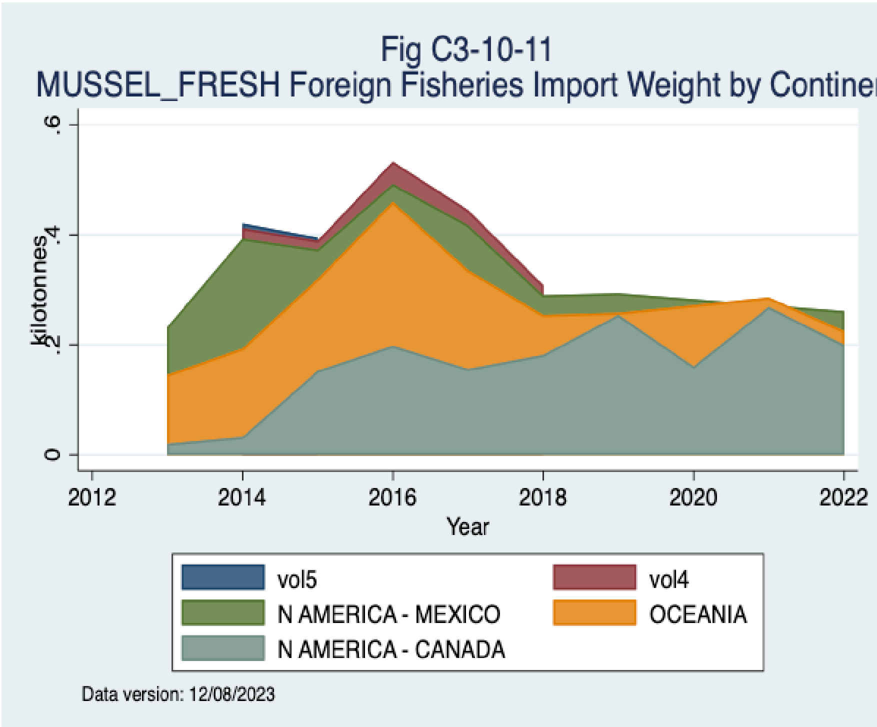


Fig A3-10-12: MUSSEL_FRESH Value by Country, Proportion

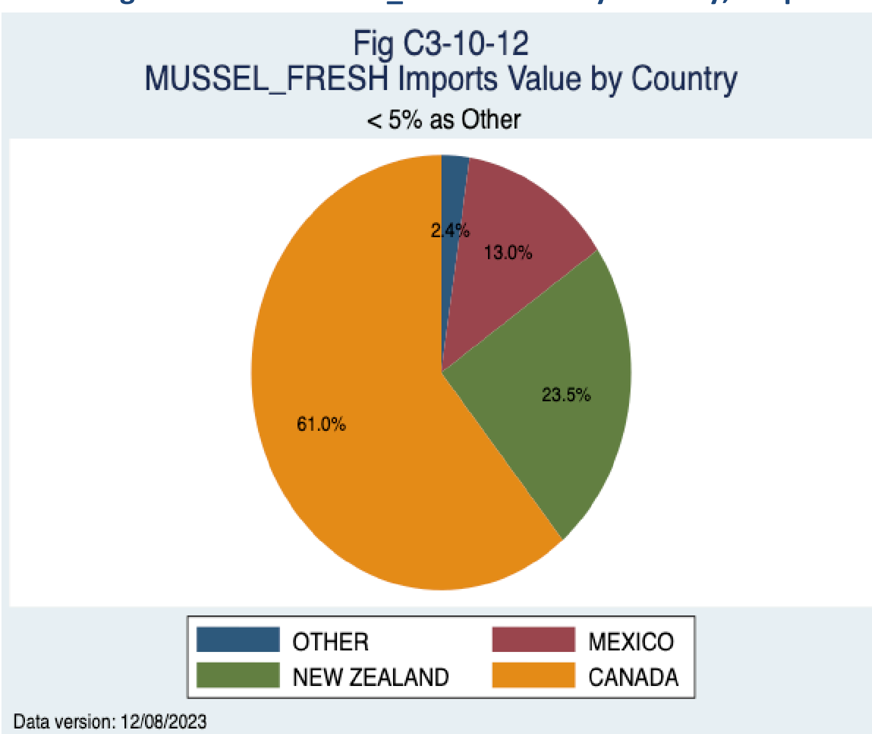


Fig A3-10-13: MUSSEL_FRESH Weight by Country, Proportion

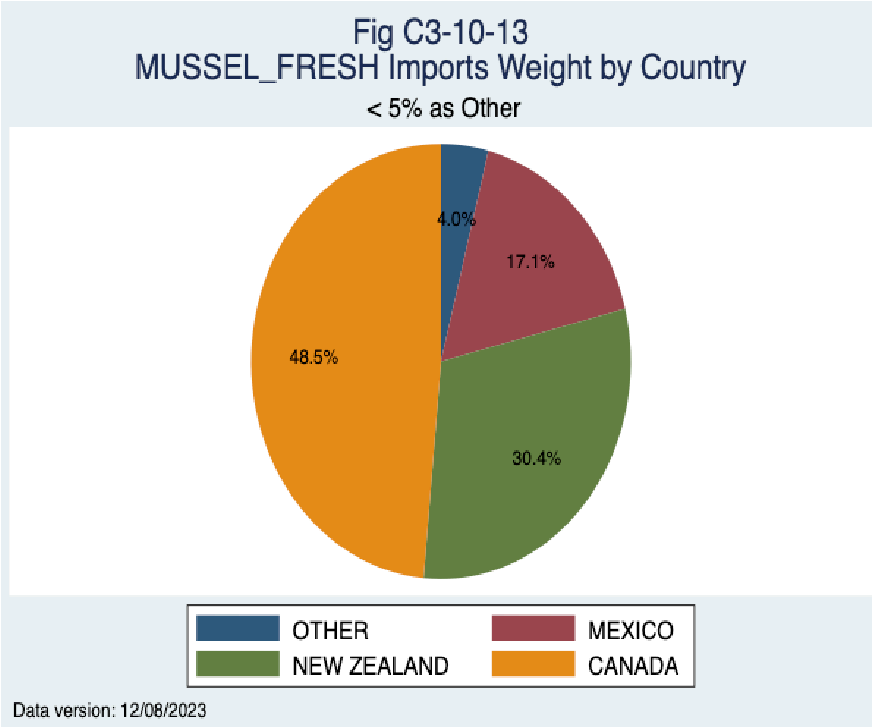


Fig A3-10-14: MUSSEL_FRESH Value by Country by Year

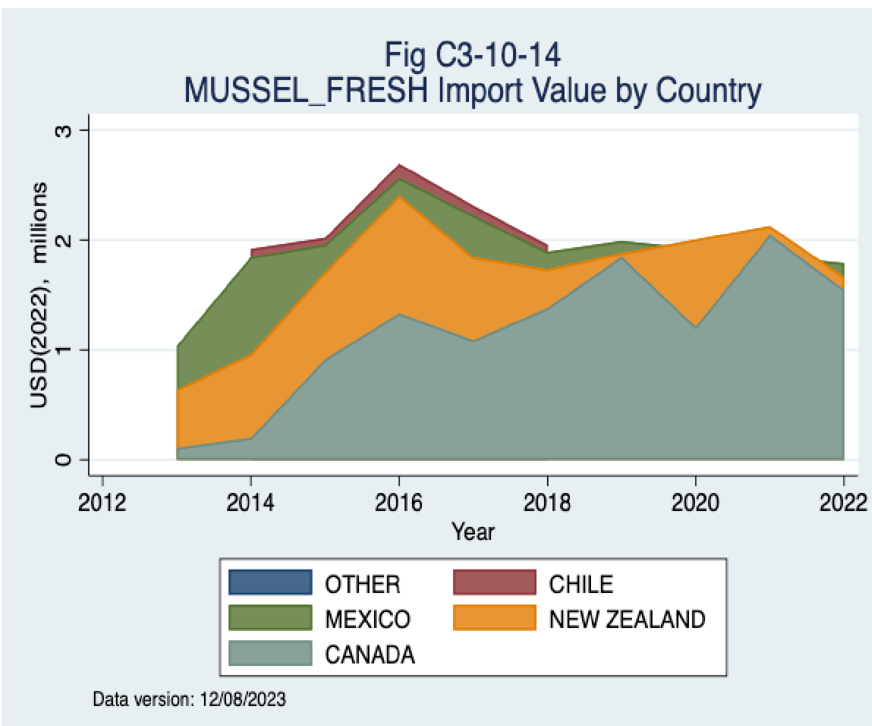
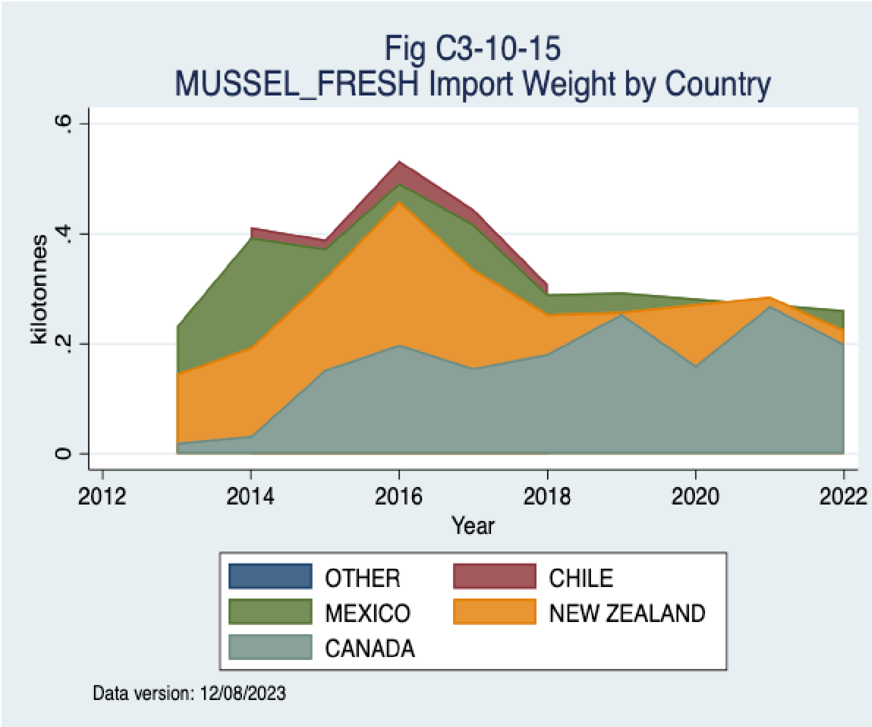


Fig A3-10-15: MUSSEL_FRESH Weight by Country by Year



Figures for MUSSEL_OTHER product group

Fig A3-11-1: MUSSEL_OTHER Weight & Value by Year

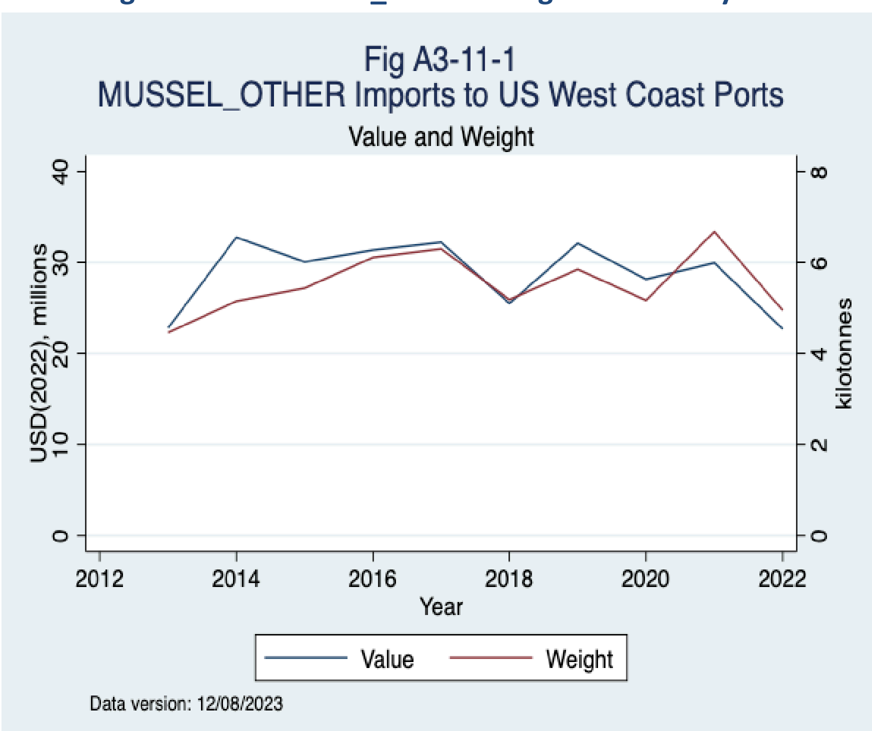


Fig A3-11-2: MUSSEL_OTHER Value & Price by Year

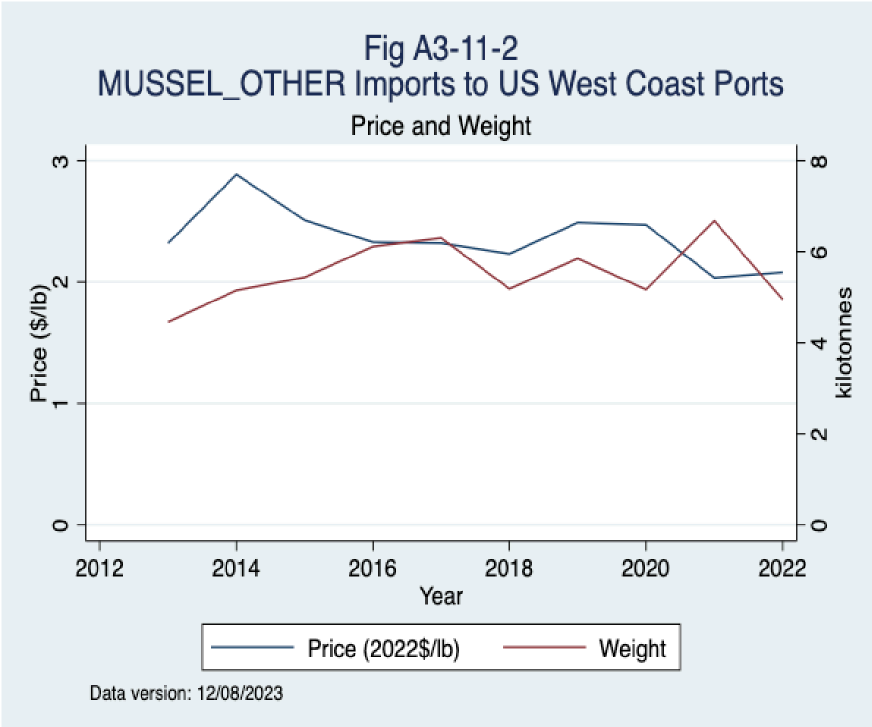


Fig A3-11-3: MUSSEL_OTHER Price Percentiles by Year

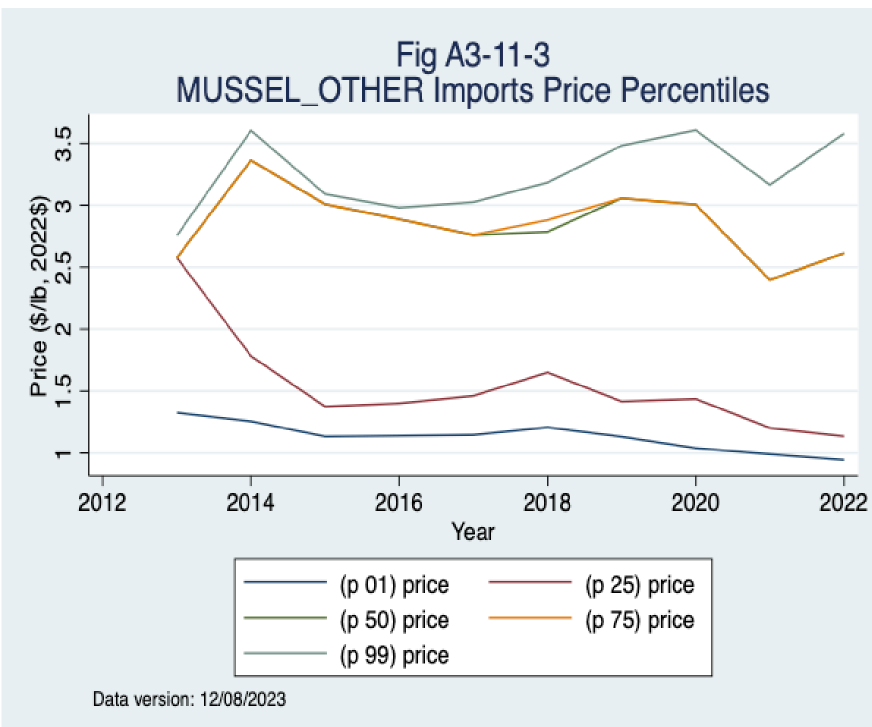


Fig A3-11-4: MUSSEL_OTHER Value by Port, Proportion

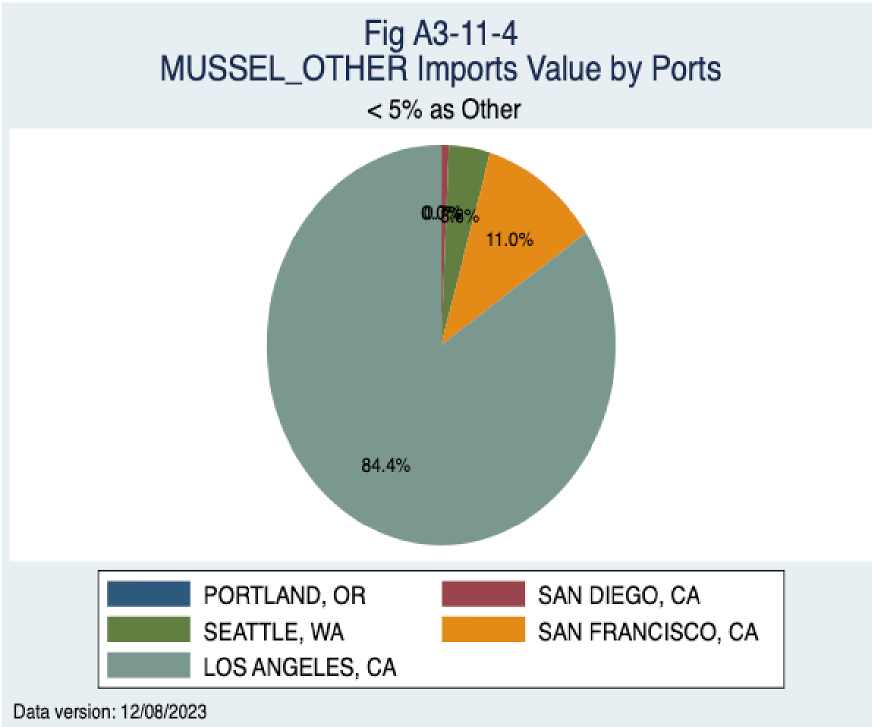


Fig A3-11-5: MUSSEL_OTHER Weight by Port, Proportion

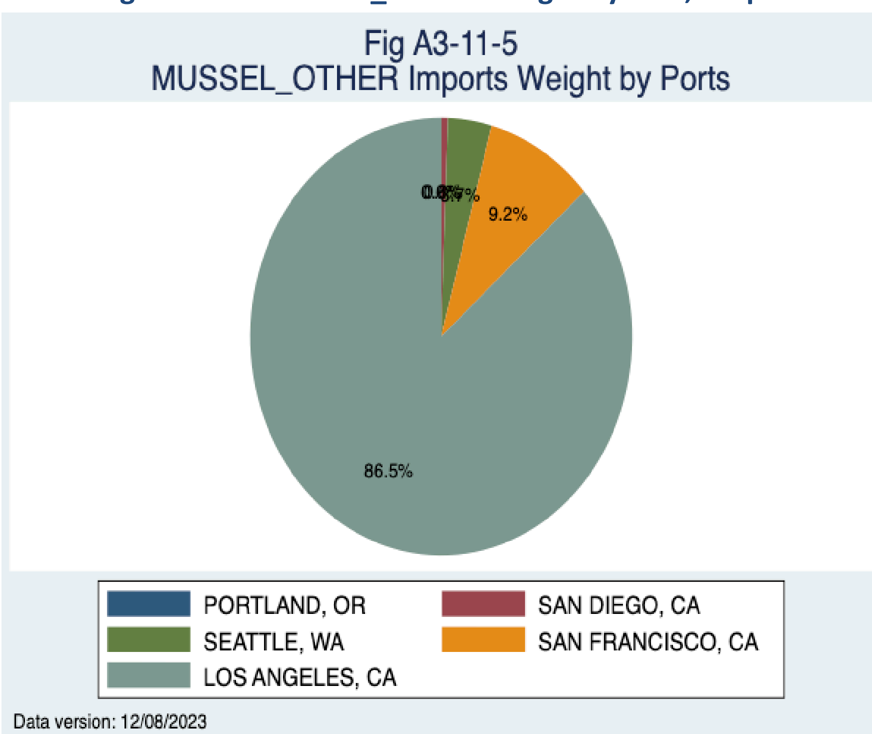


Fig A3-11-6: MUSSEL_OTHER Value by Port by Year

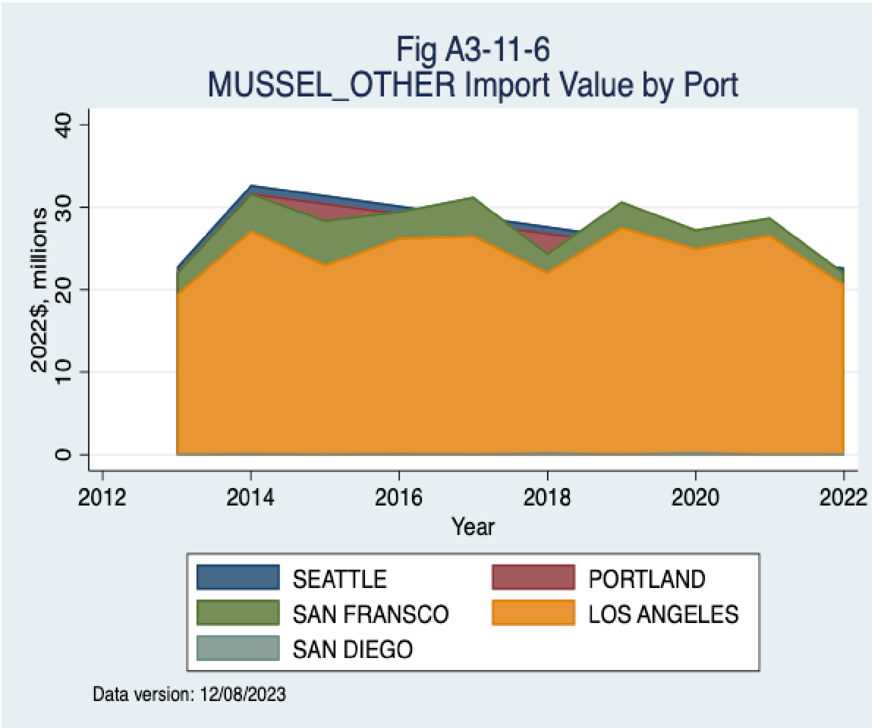


Fig A3-11-7: MUSSEL_OTHER Weight by Port by Year

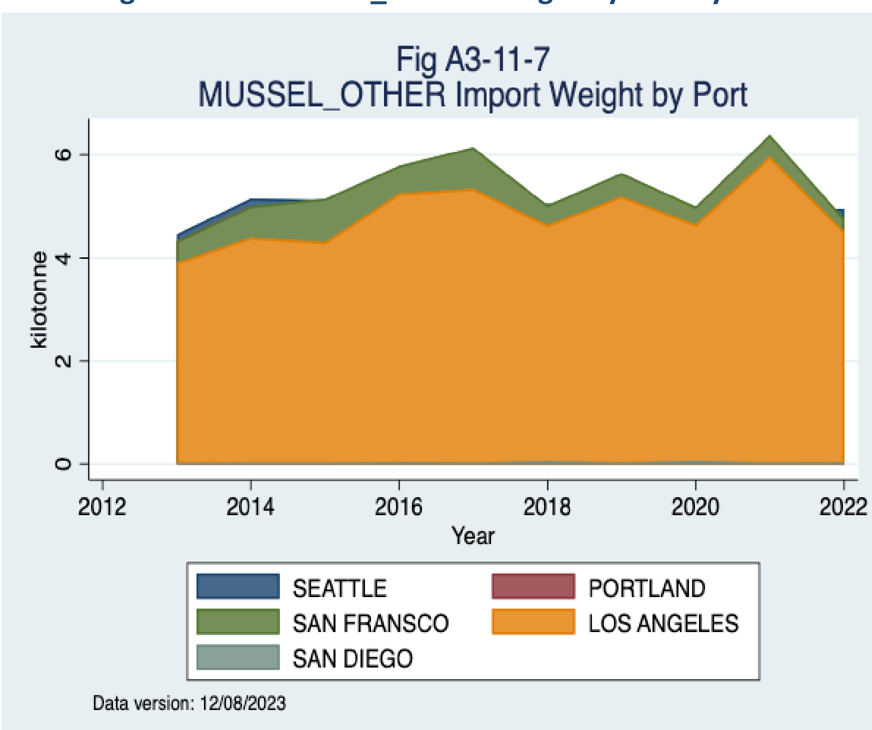


Fig A3-11-8: MUSSEL_OTHER Value by Continent, Proportion

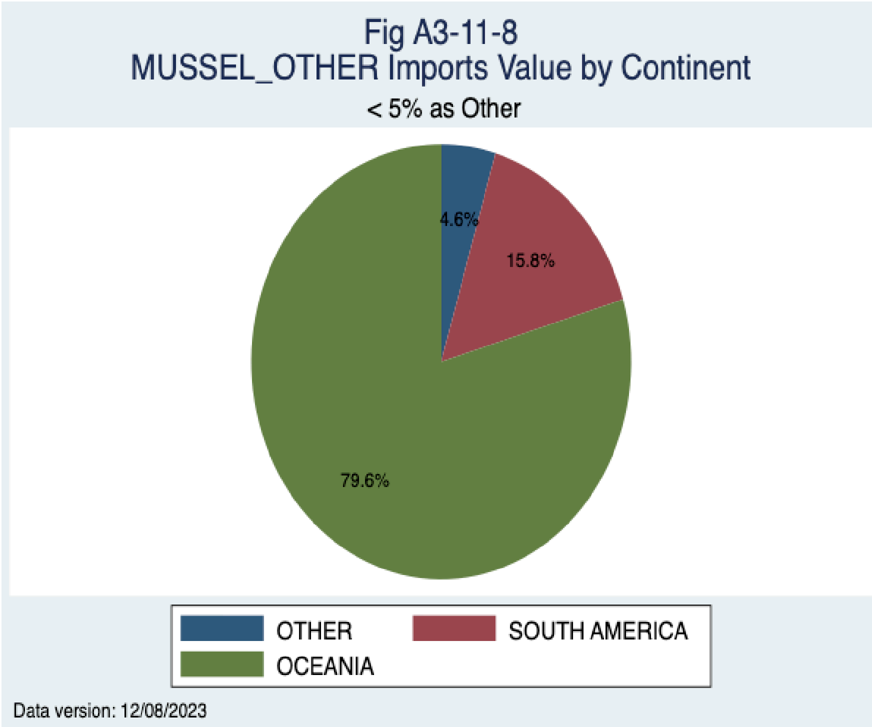


Fig A3-11-9: MUSSEL_OTHER Weight by Continent, Proportion

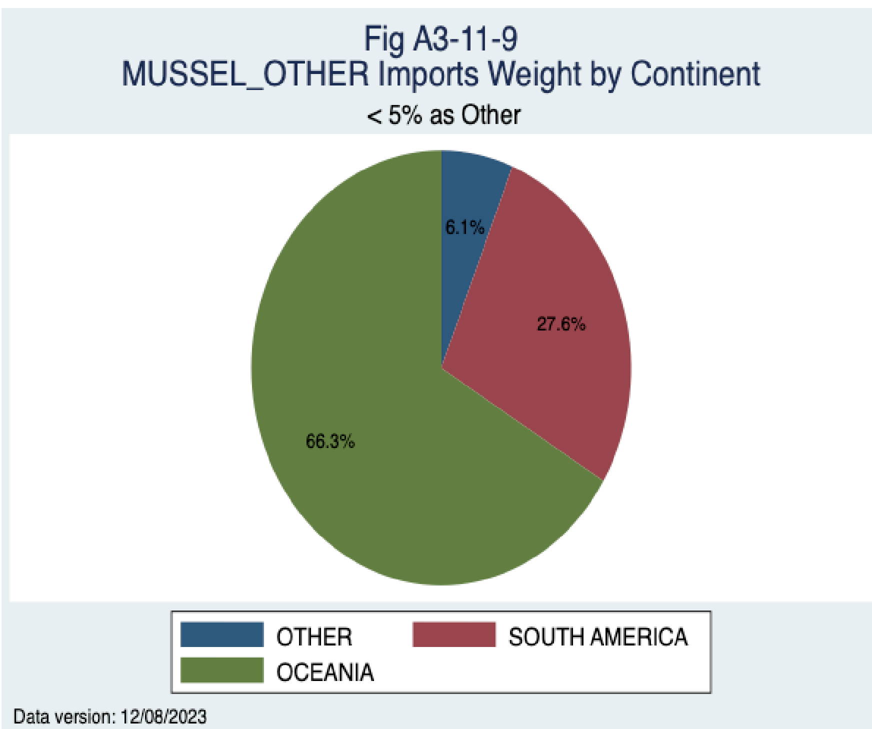


Fig A3-11-10: MUSSEL_OTHER Value by Continent by Year

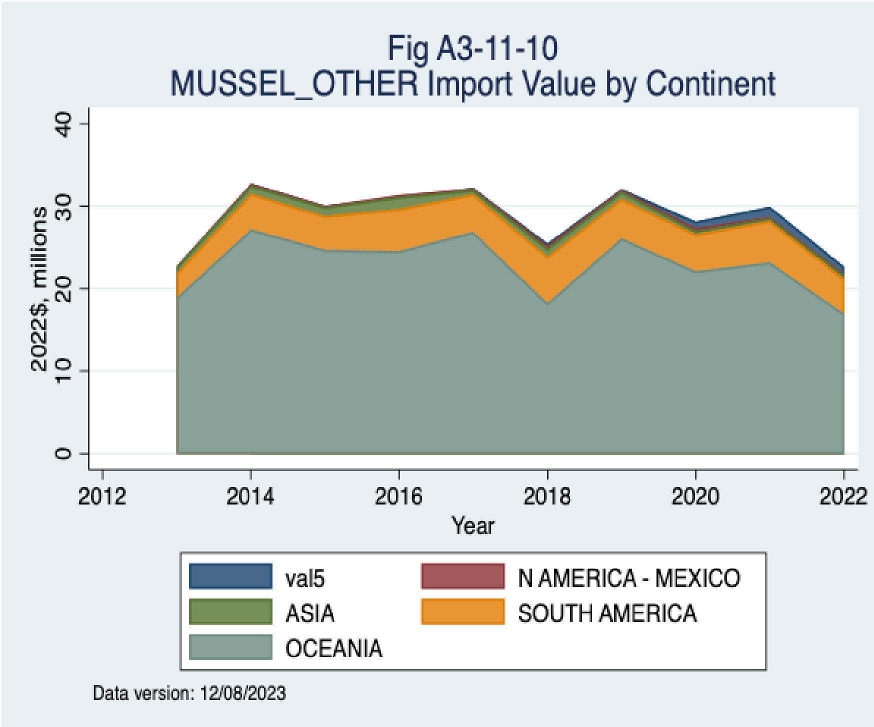


Fig A3-11-11: MUSSEL_OTHER Weight by Continent by Year

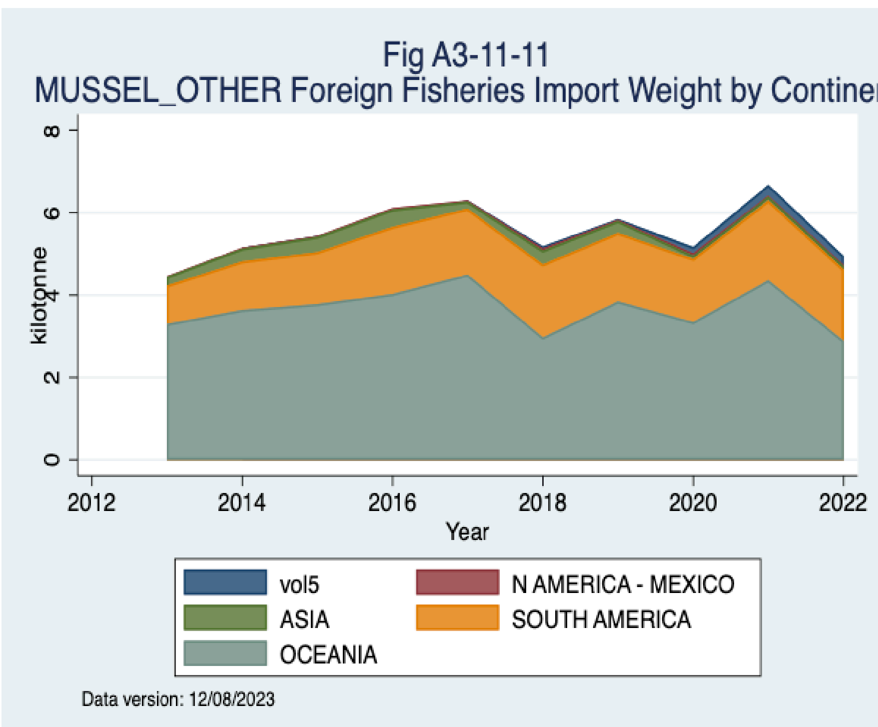


Fig A3-11-12: MUSSEL_OTHER Value by Country, Proportion

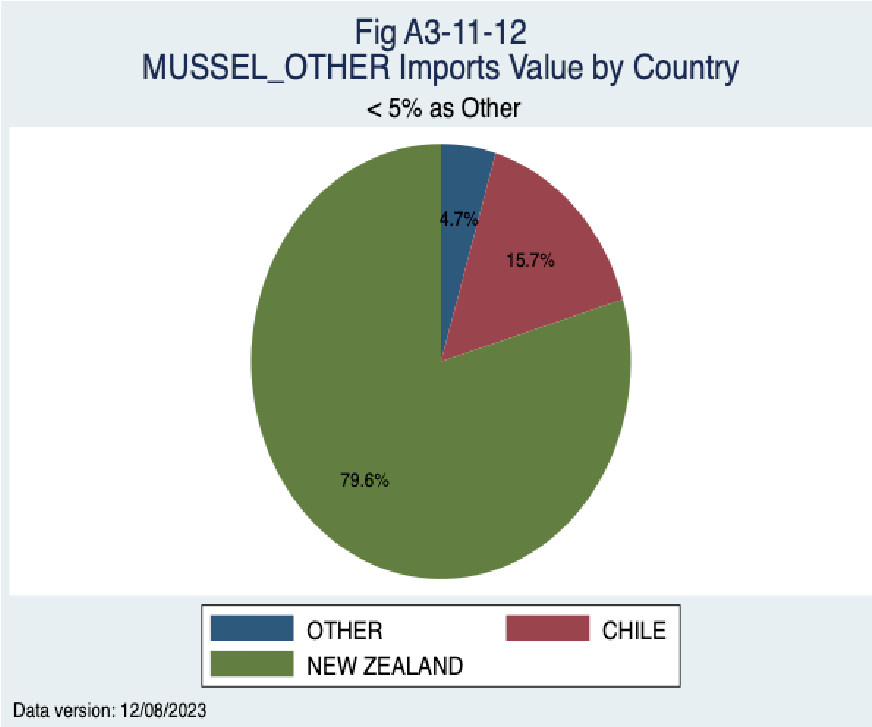


Fig A3-11-13: MUSSEL_OTHER Weight by Country, Proportion

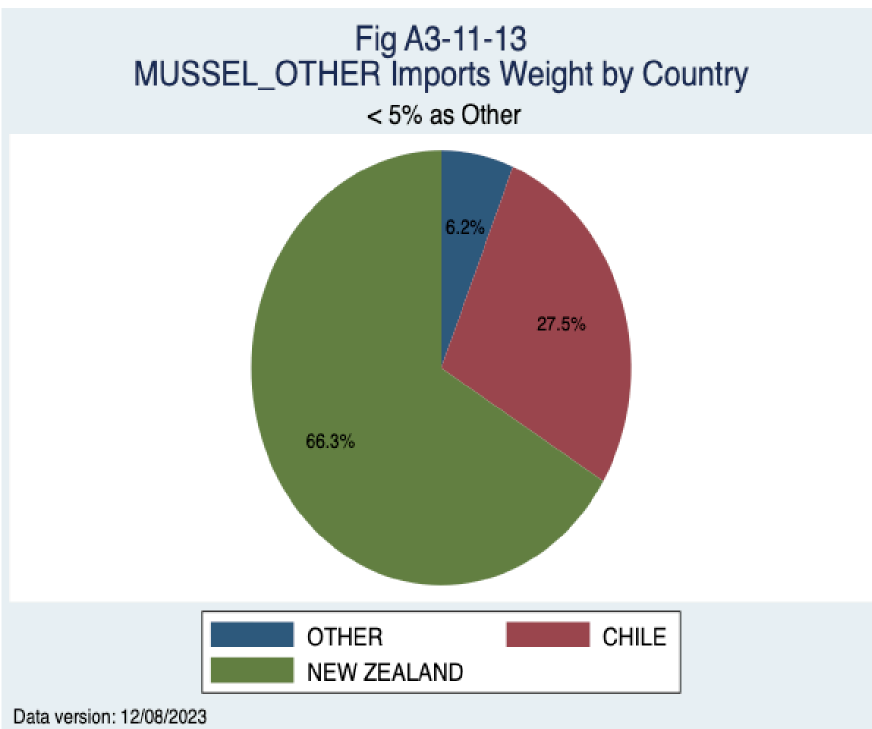


Fig A3-11-14: MUSSEL_OTHER Value by Country by Year

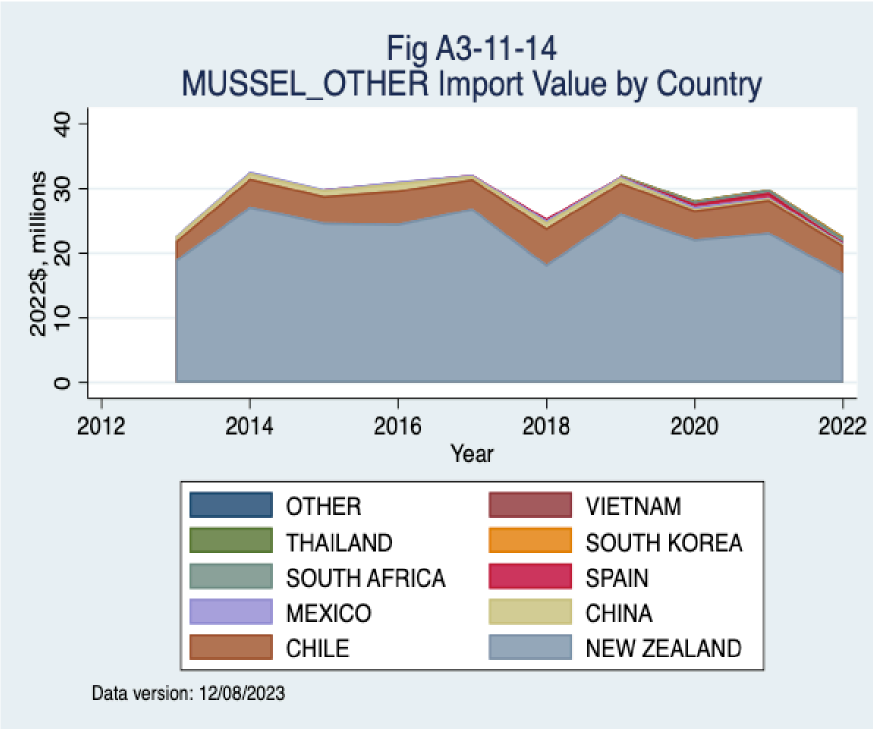
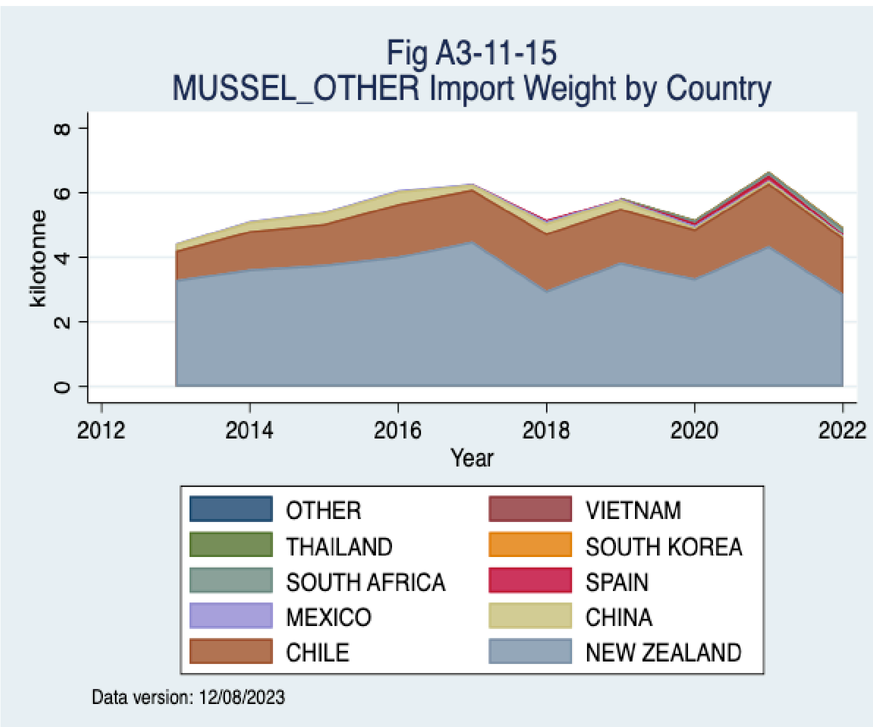


Fig A3-11-15: MUSSEL_OTHER Weight by Country by Year



Figures for ABALONE_FRESH product group

Fig A3-12-1: ABALONE_FRESH Weight & Value by Year

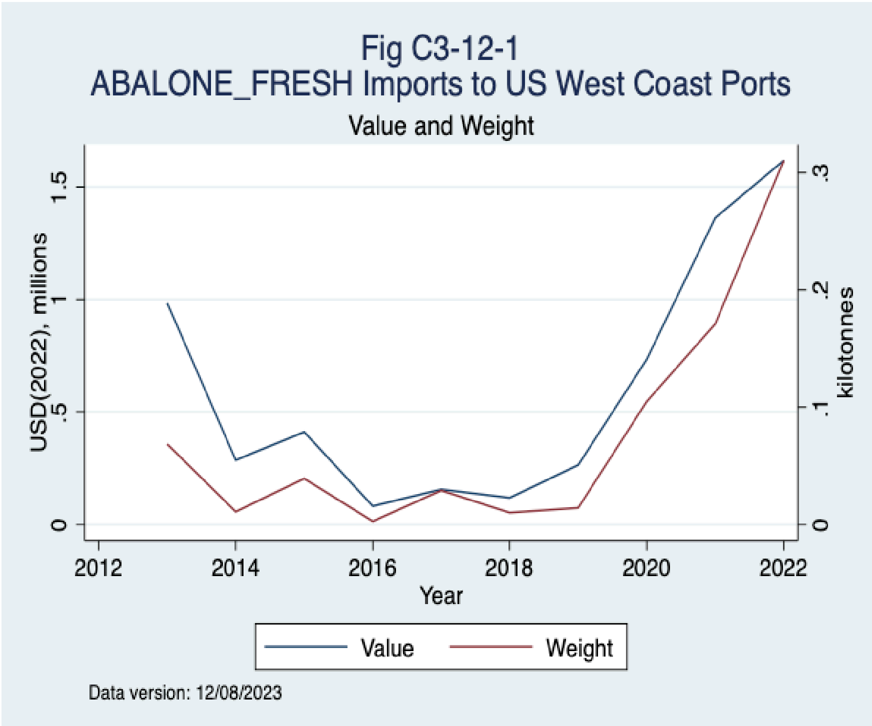


Fig A3-12-2: ABALONE_FRESH Value & Price by Year

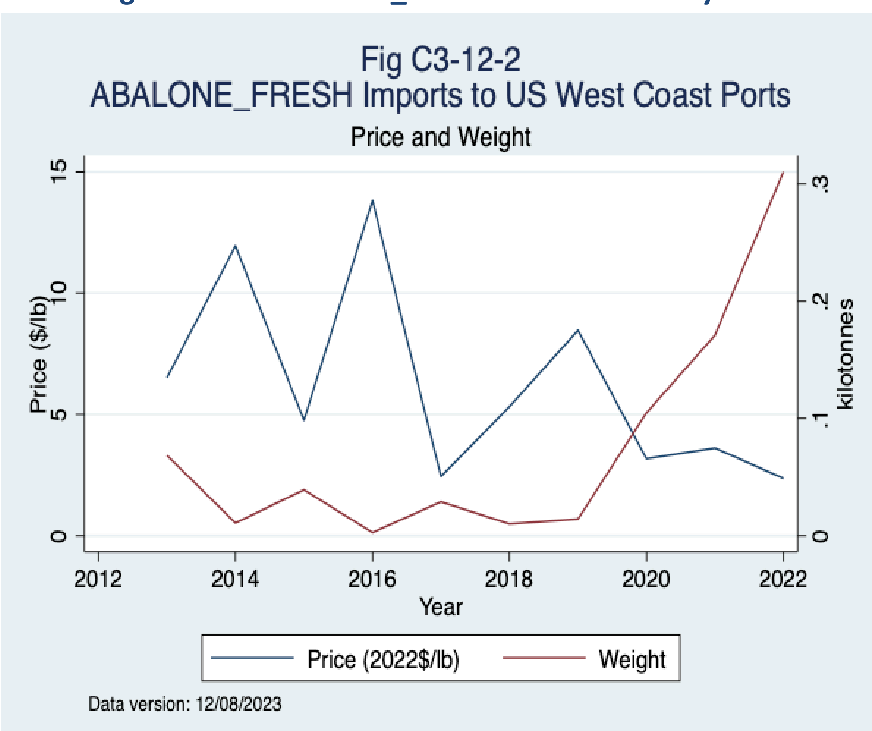


Fig A3-12-3: ABALONE_FRESH Price Percentiles by Year

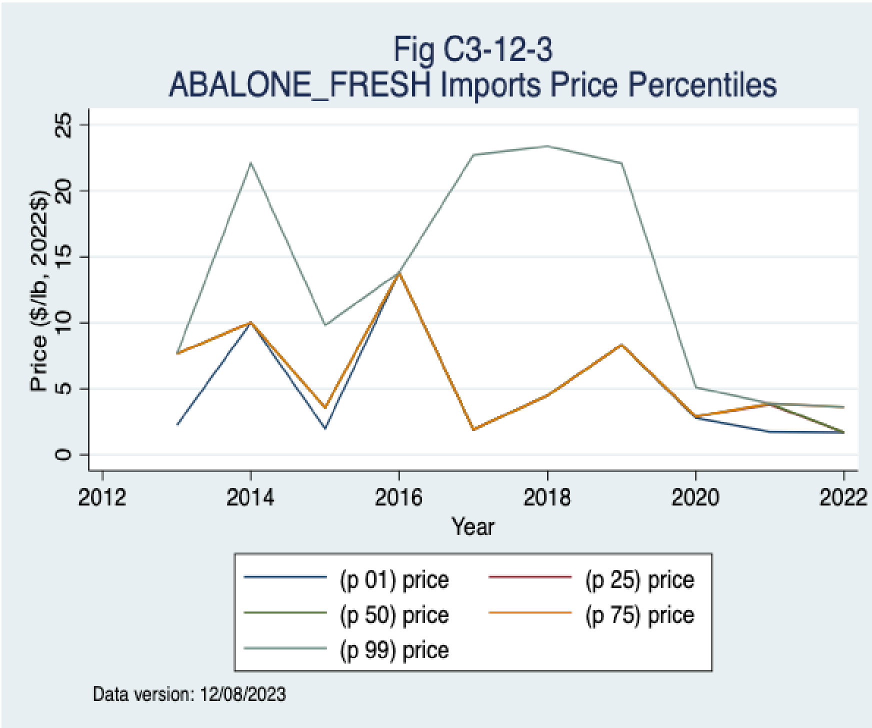


Fig A3-12-4: ABALONE_FRESH Value by Port, Proportion

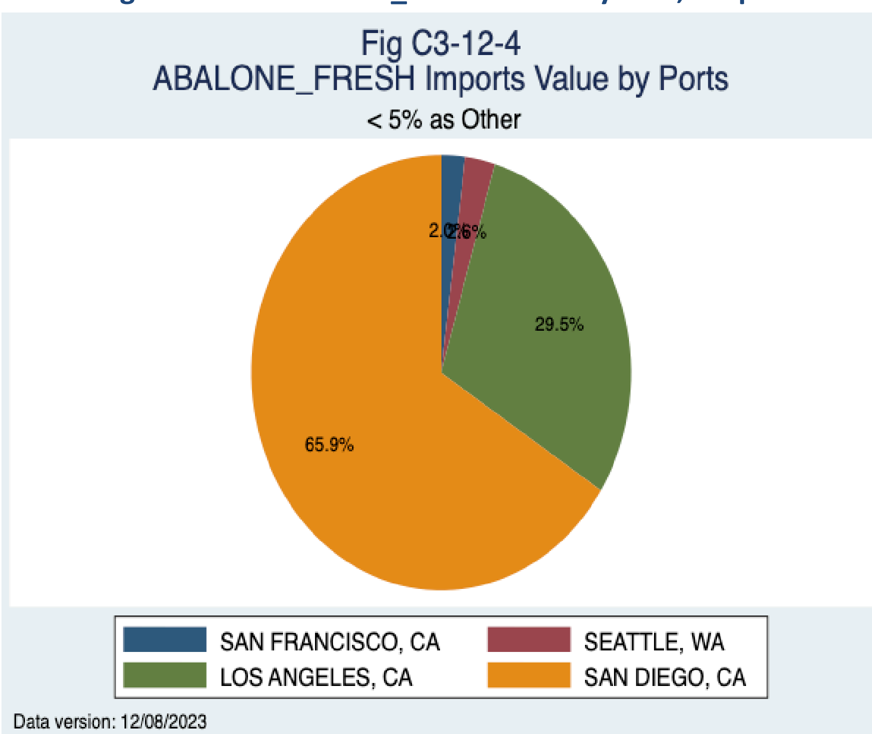


Fig A3-12-5: ABALONE_FRESH Weight by Port, Proportion

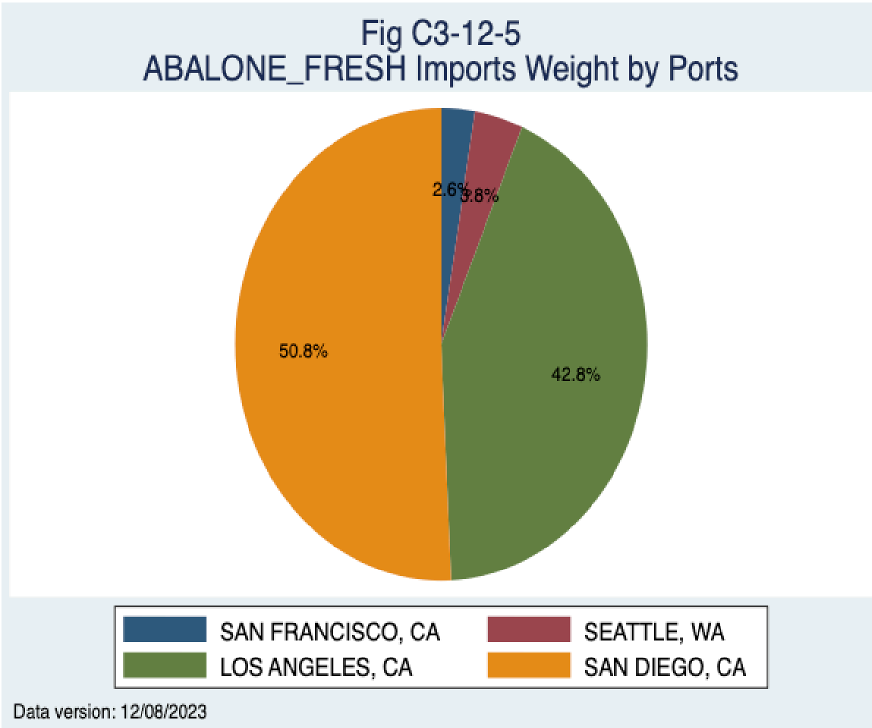


Fig A3-12-6: ABALONE_FRESH Value by Port by Year

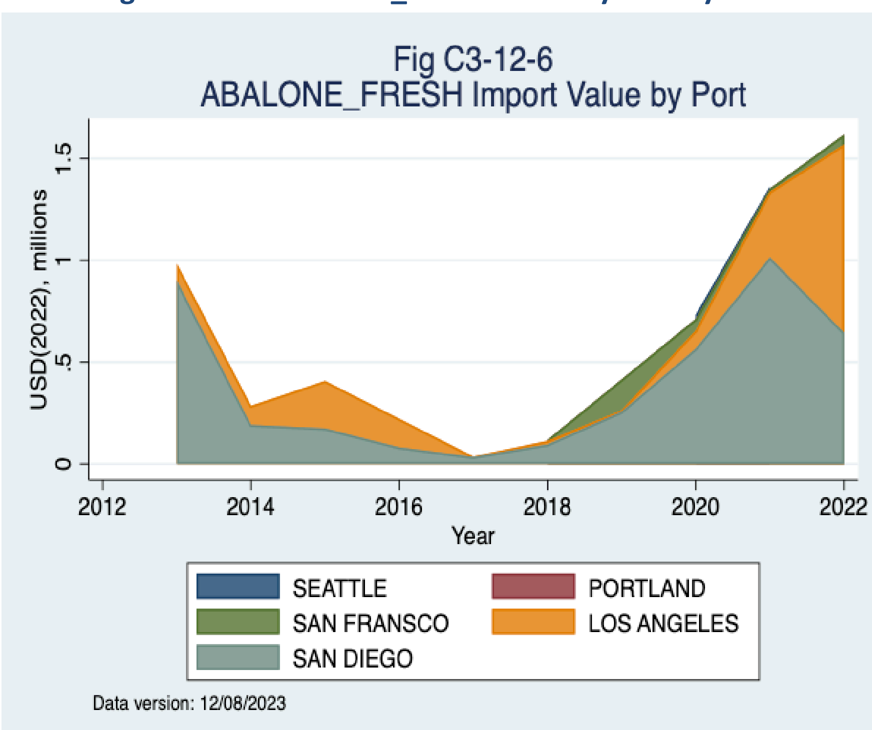


Fig A3-12-7: ABALONE_FRESH Weight by Port by Year

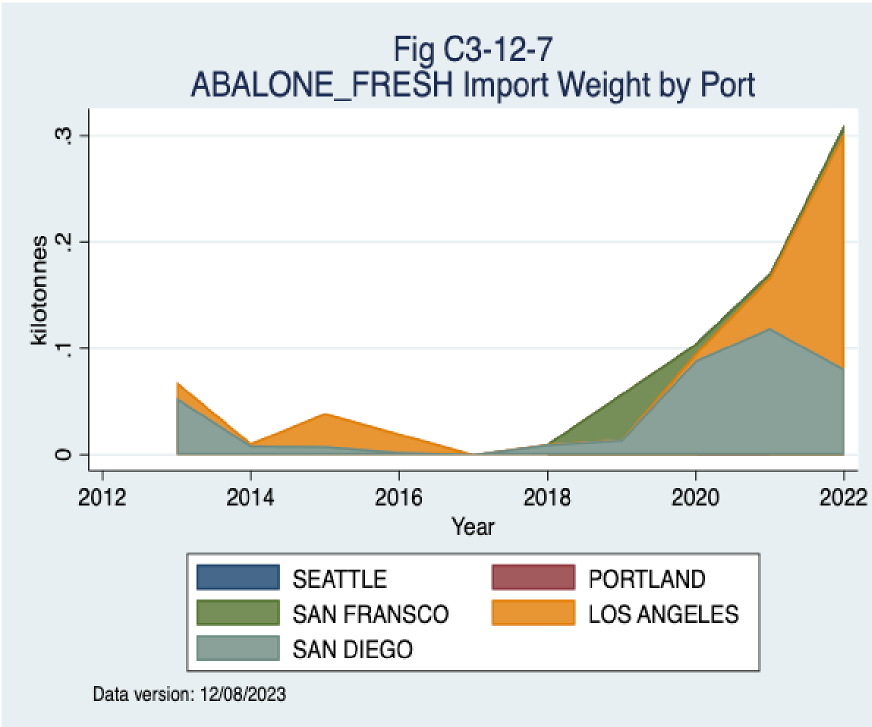


Fig A3-12-8: ABALONE_FRESH Value by Continent, Proportion

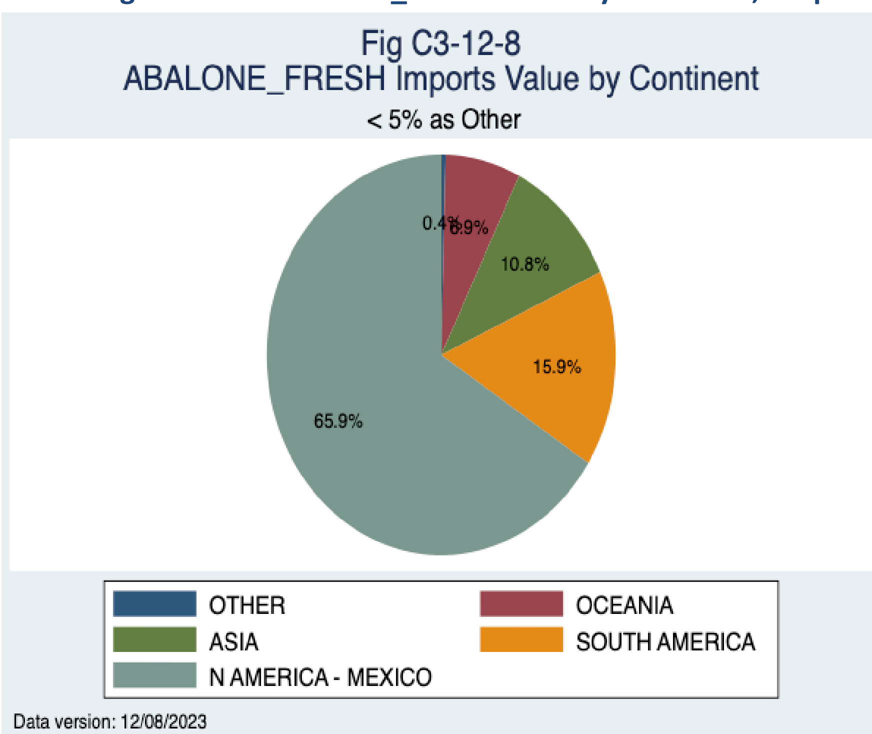


Fig A3-12-9: ABALONE_FRESH Weight by Continent, Proportion

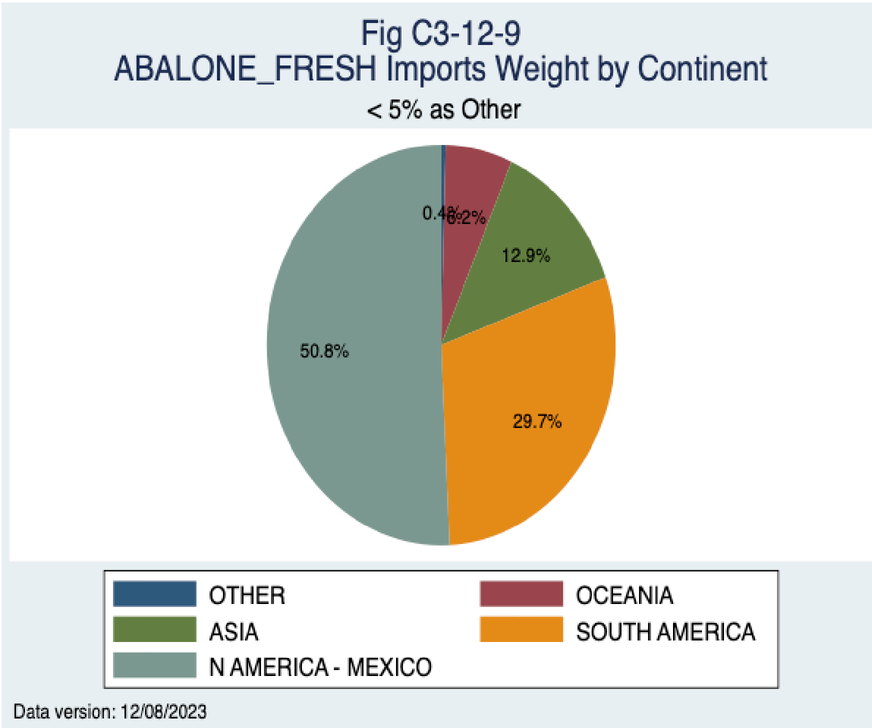


Fig A3-12-10: ABALONE_FRESH Value by Continent by Year

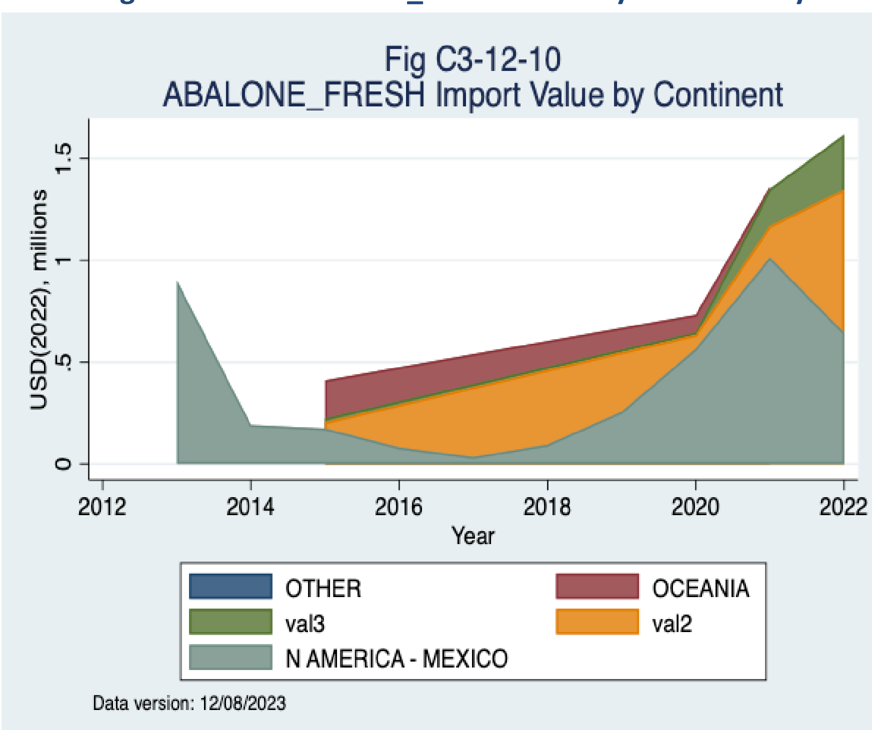


Fig A3-12-11: ABALONE_FRESH Weight by Continent by Year

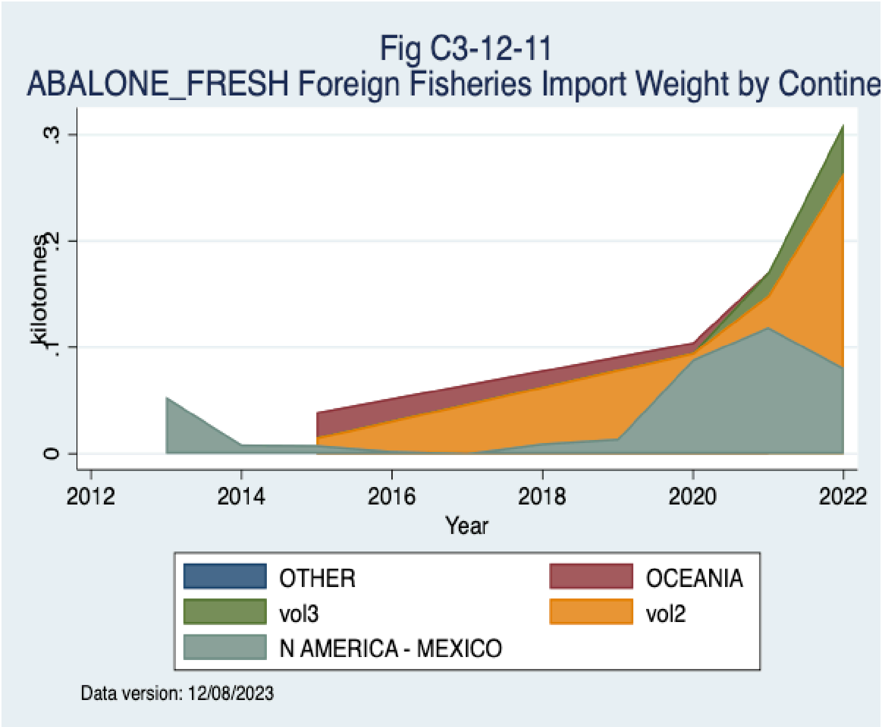


Fig A3-12-12: ABALONE_FRESH Value by Country, Proportion

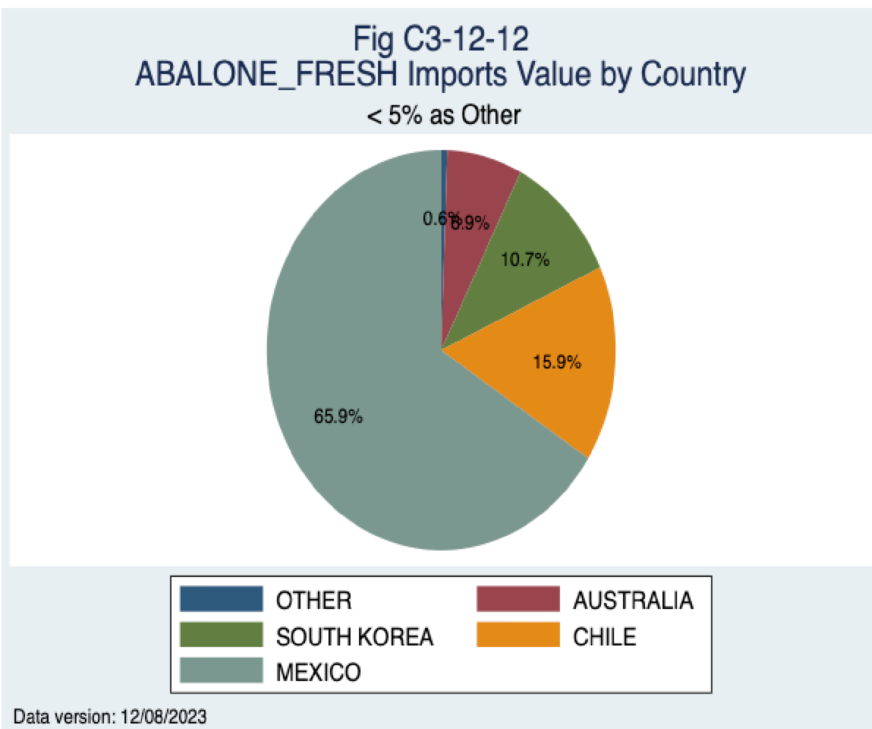


Fig A3-12-13: ABALONE_FRESH Weight by Country, Proportion

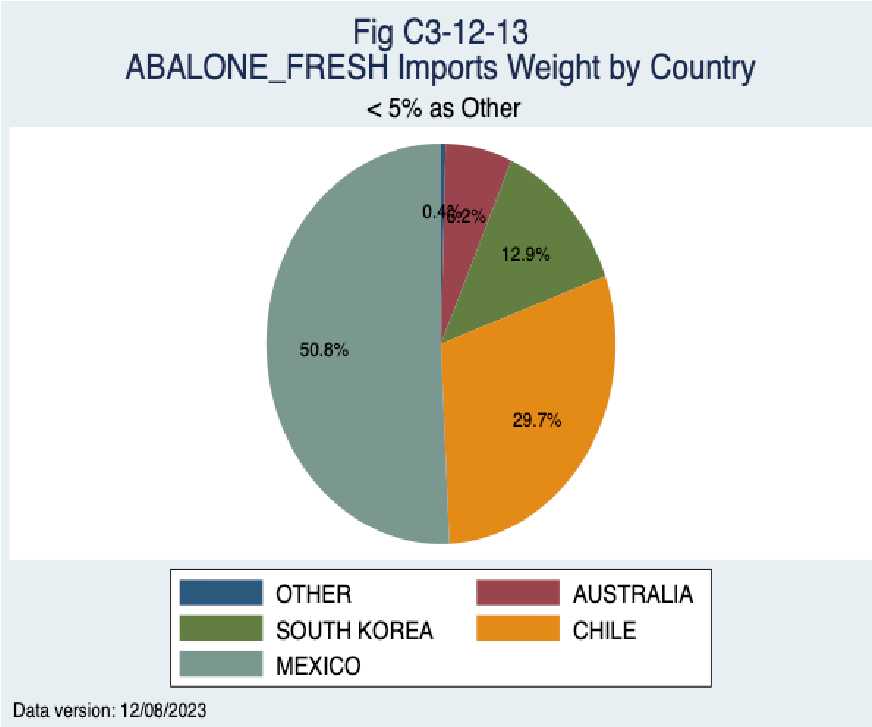


Fig A3-12-14: ABALONE_FRESH Value by Country by Year

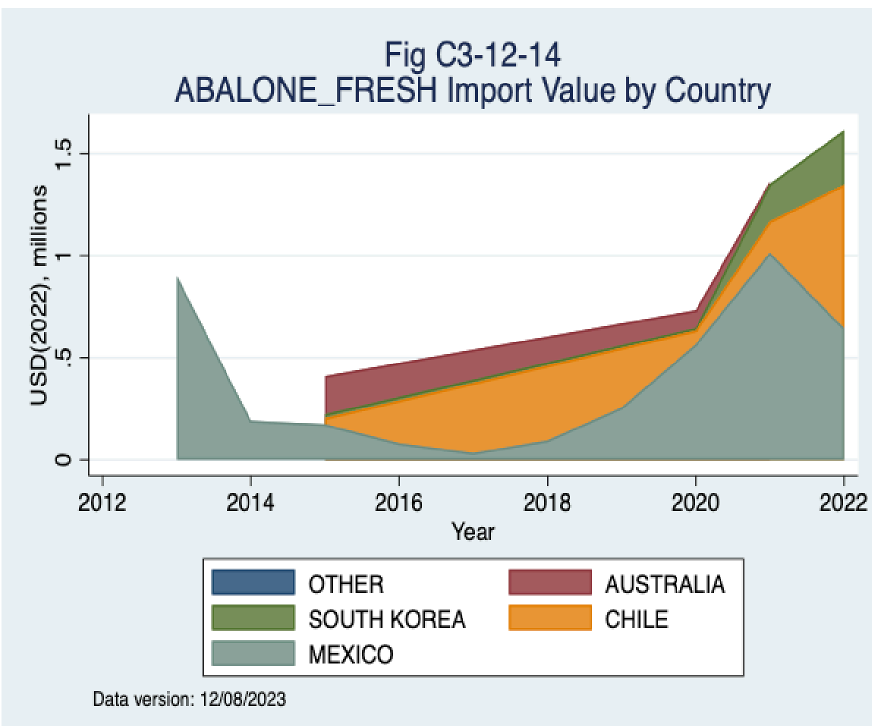
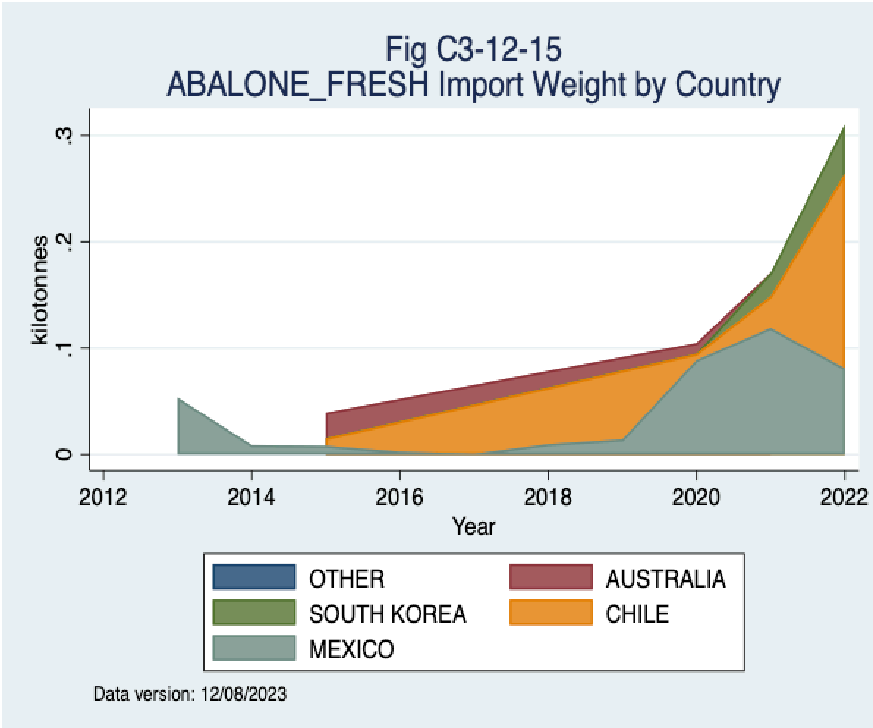


Fig A3-12-15: ABALONE_FRESH Weight by Country by Year



Figures for ABALONE_OTHER product group

Fig A3-13-1: ABALONE_OTHER Weight & Value by Year

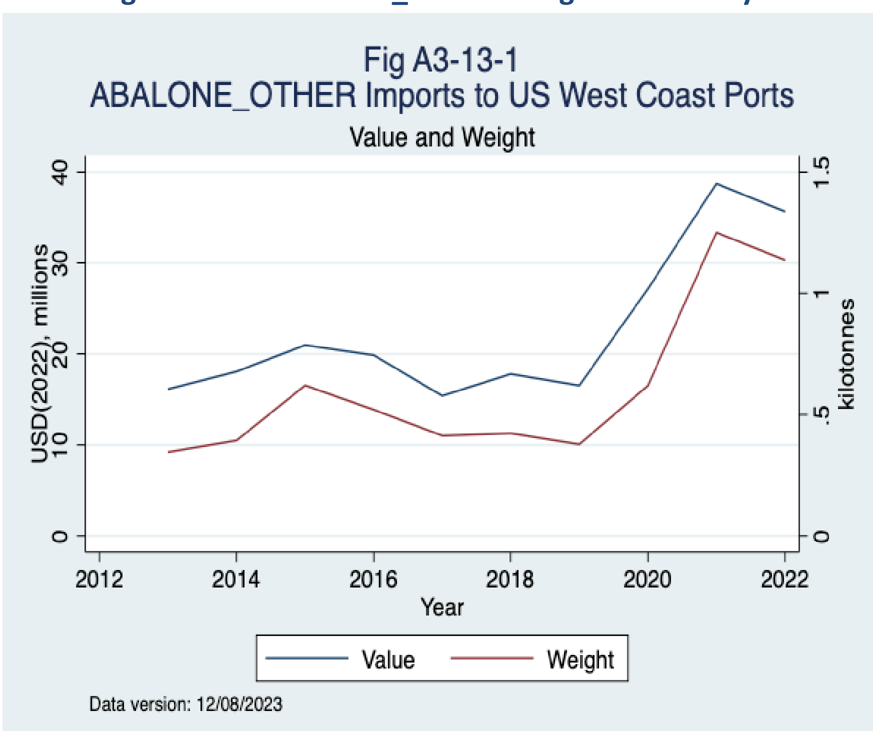


Fig A3-13-2: ABALONE_OTHER Value & Price by Year

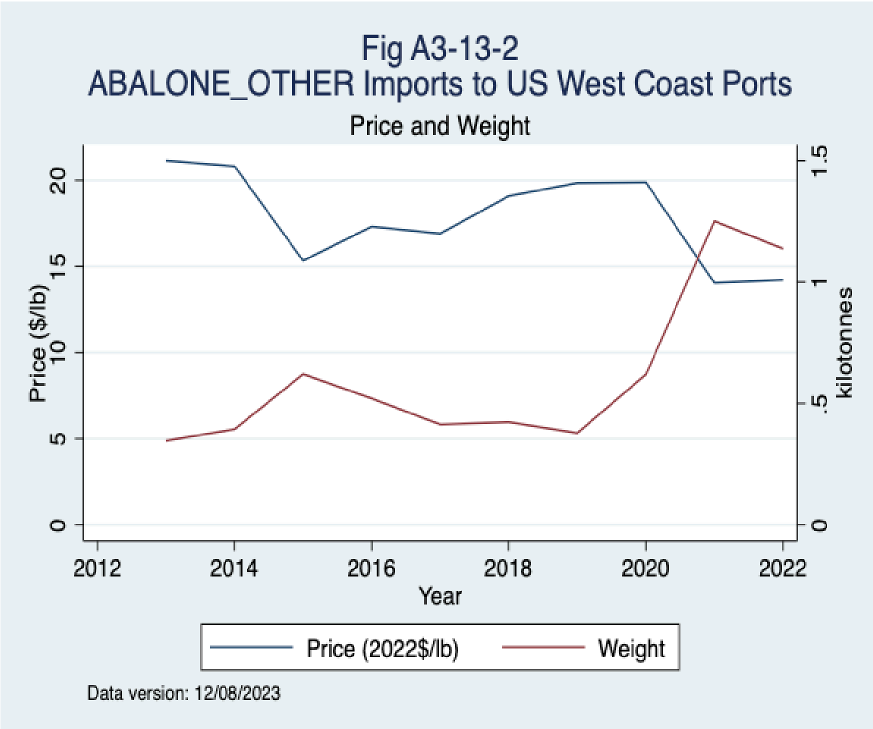


Fig A3-13-3: ABALONE_OTHER Price Percentiles by Year

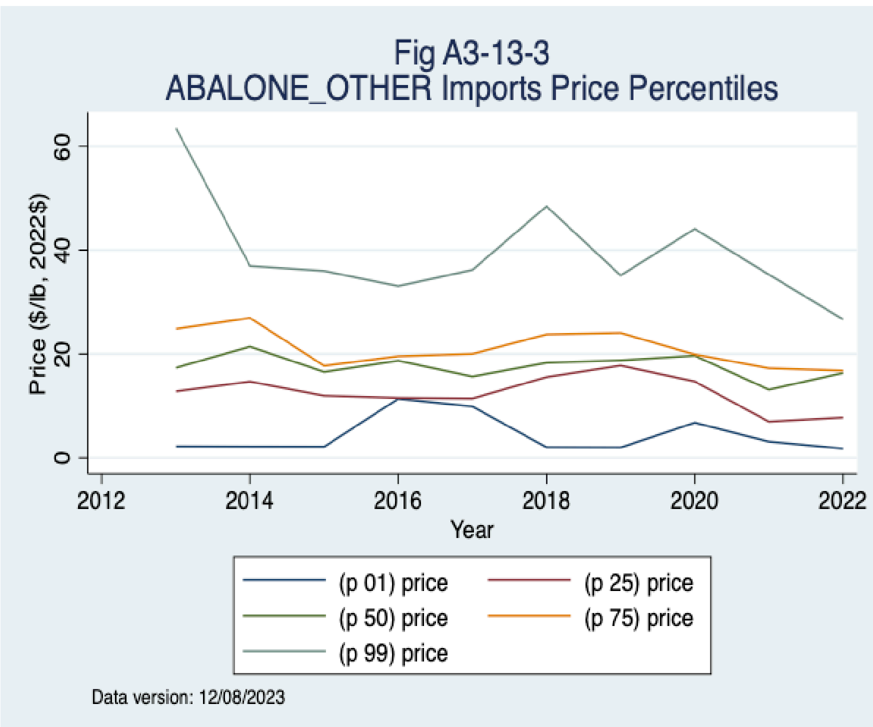


Fig A3-13-4: ABALONE_OTHER Value by Port, Proportion

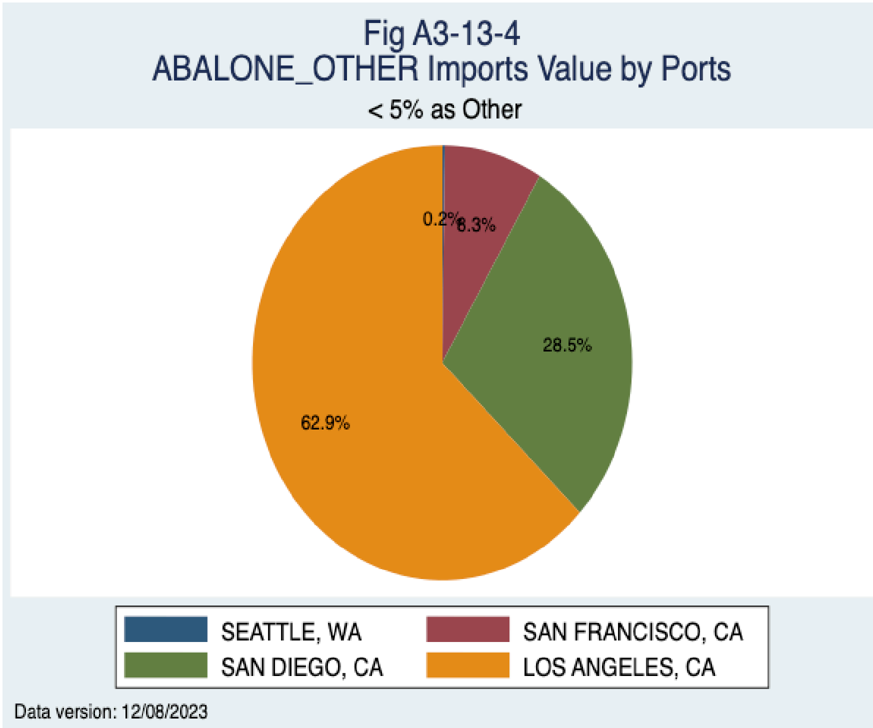


Fig A3-13-5: ABALONE_OTHER Weight by Port, Proportion

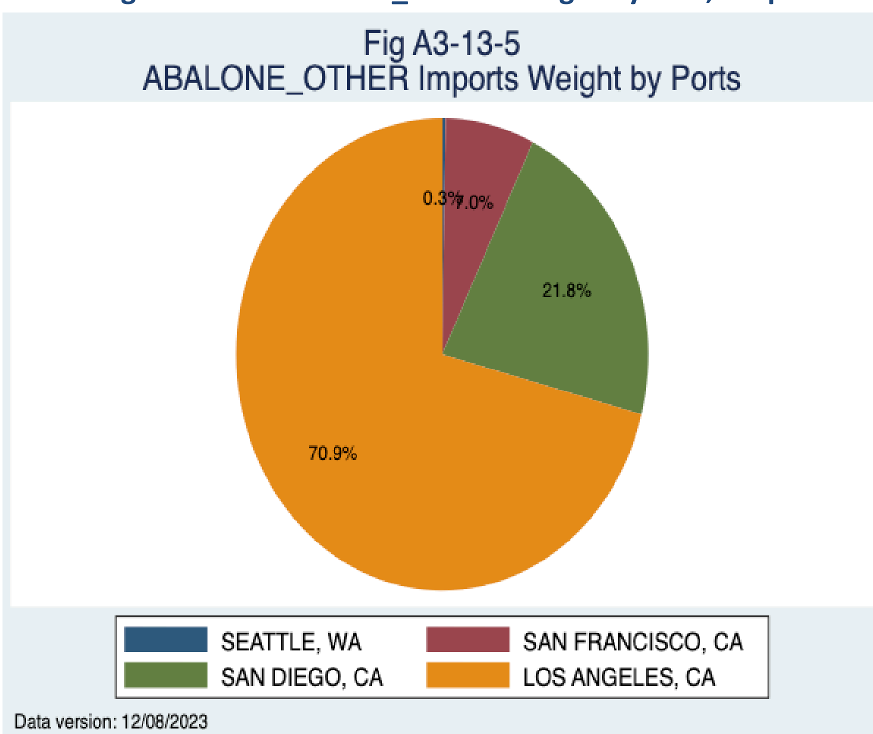


Fig A3-13-6: ABALONE_OTHER Value by Port by Year

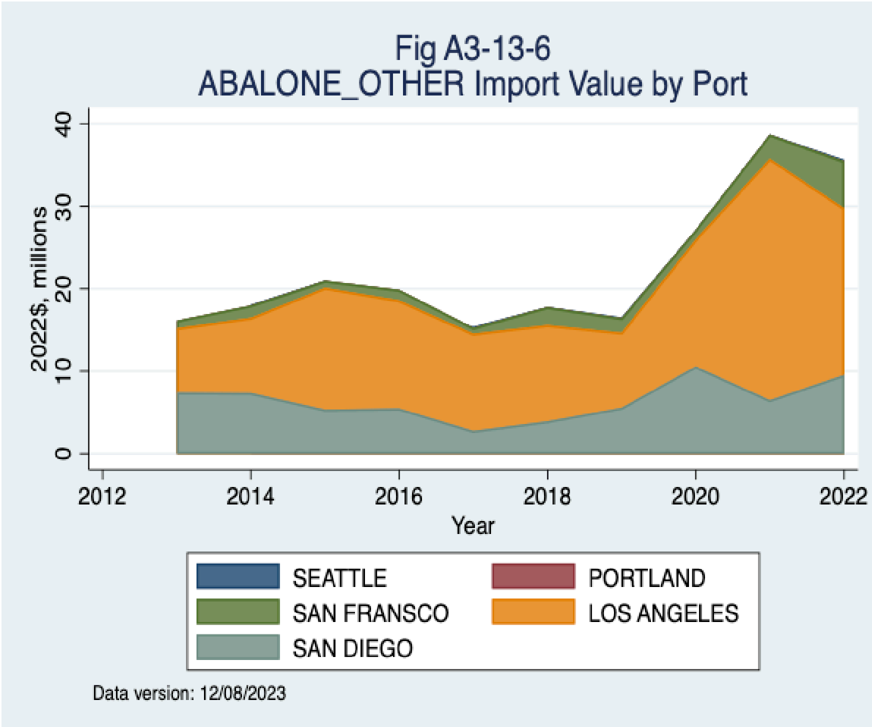


Fig A3-13-7: ABALONE_OTHER Weight by Port by Year

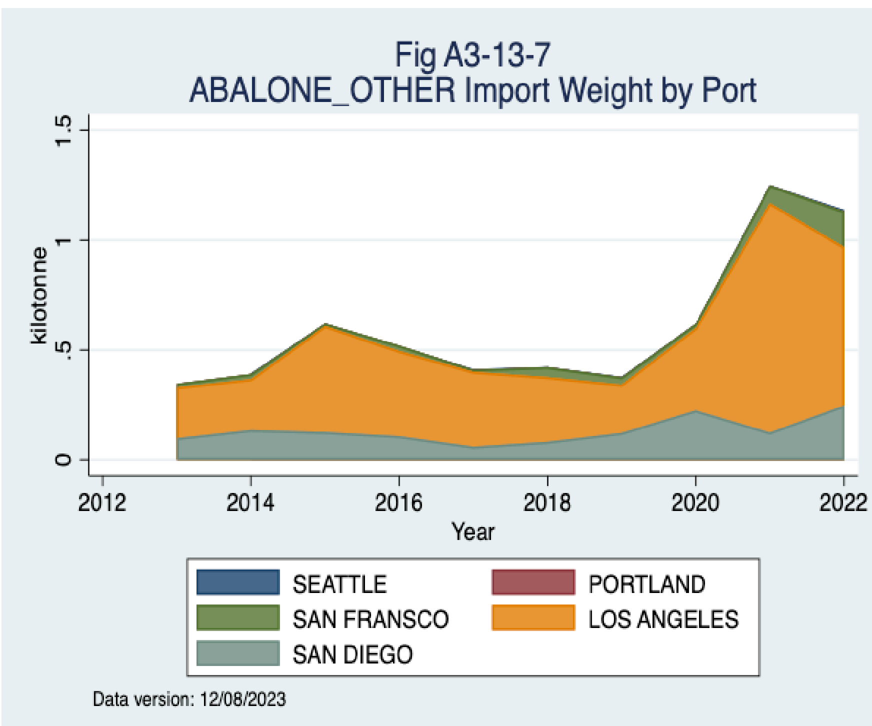


Fig A3-13-8: ABALONE_OTHER Value by Continent, Proportion

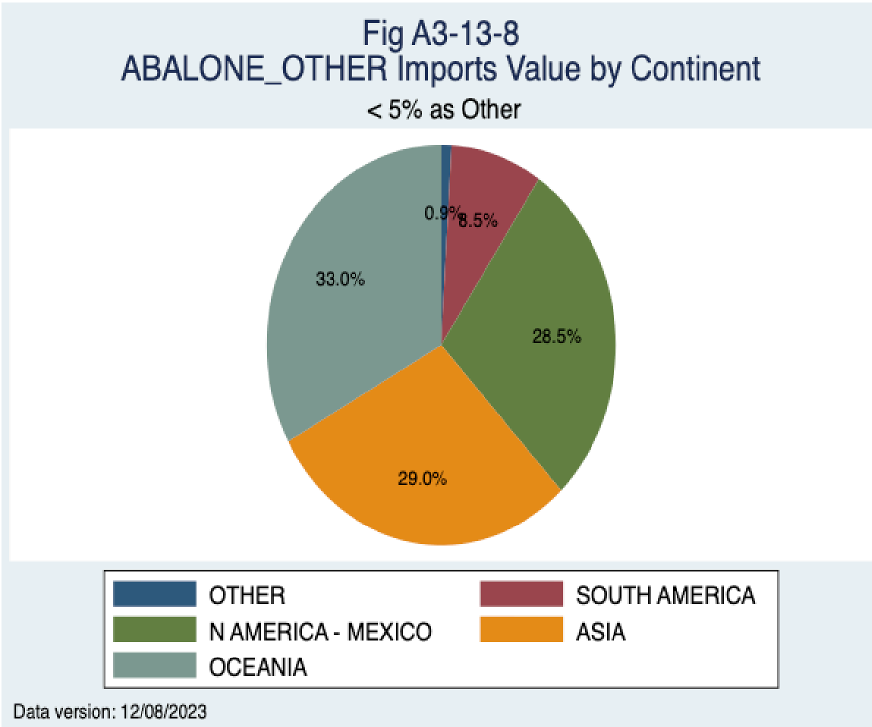


Fig A3-13-9: ABALONE_OTHER Weight by Continent, Proportion

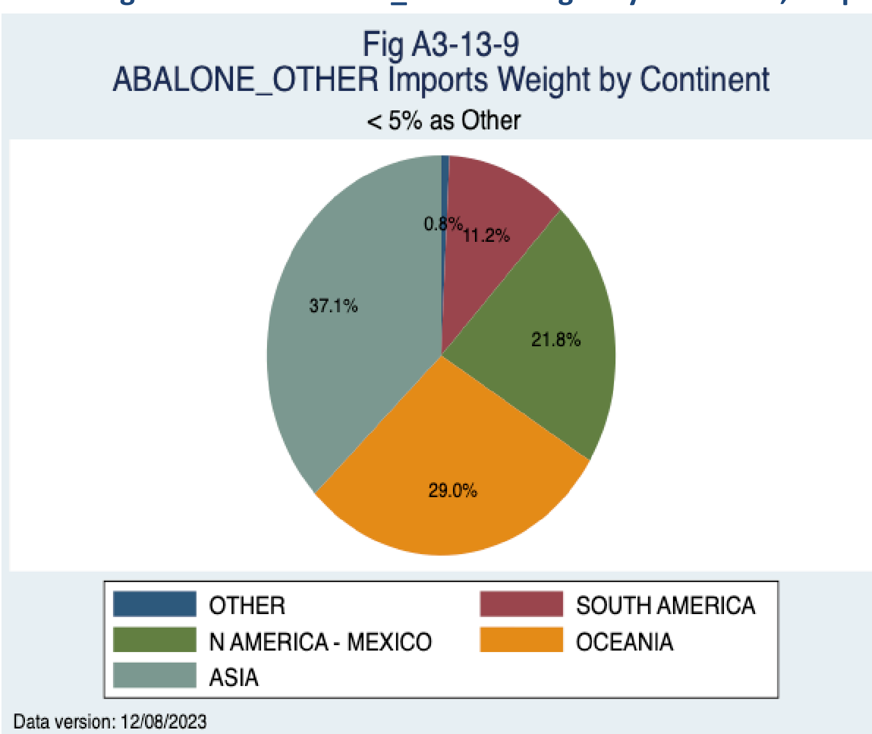


Fig A3-13-10: ABALONE_OTHER Value by Continent by Year

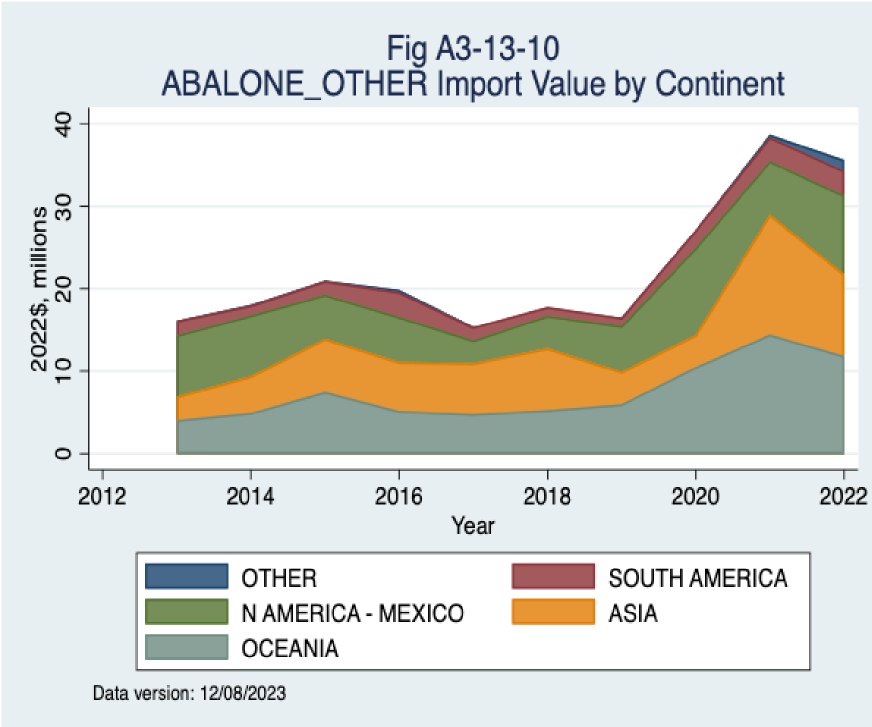


Fig A3-13-11: ABALONE_OTHER Weight by Continent by Year

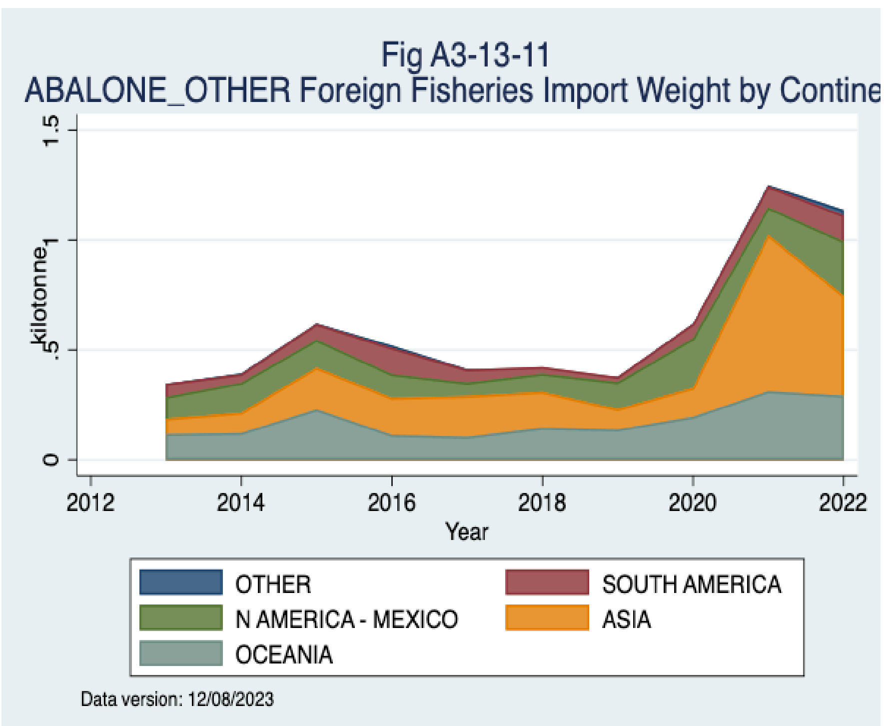


Fig A3-13-12: ABALONE_OTHER Value by Country, Proportion

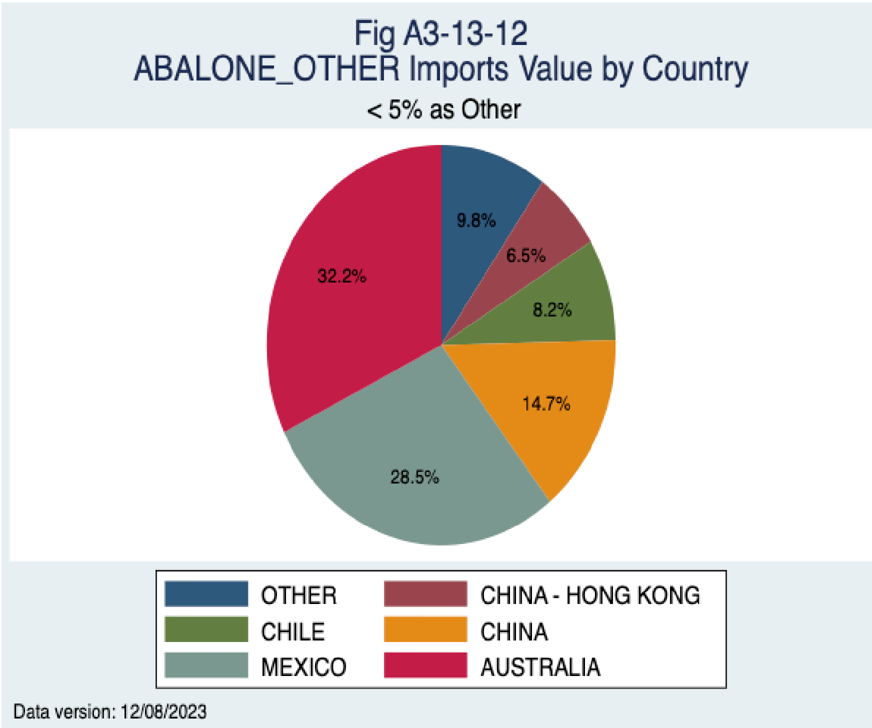


Fig A3-13-13: ABALONE_OTHER Weight by Country, Proportion

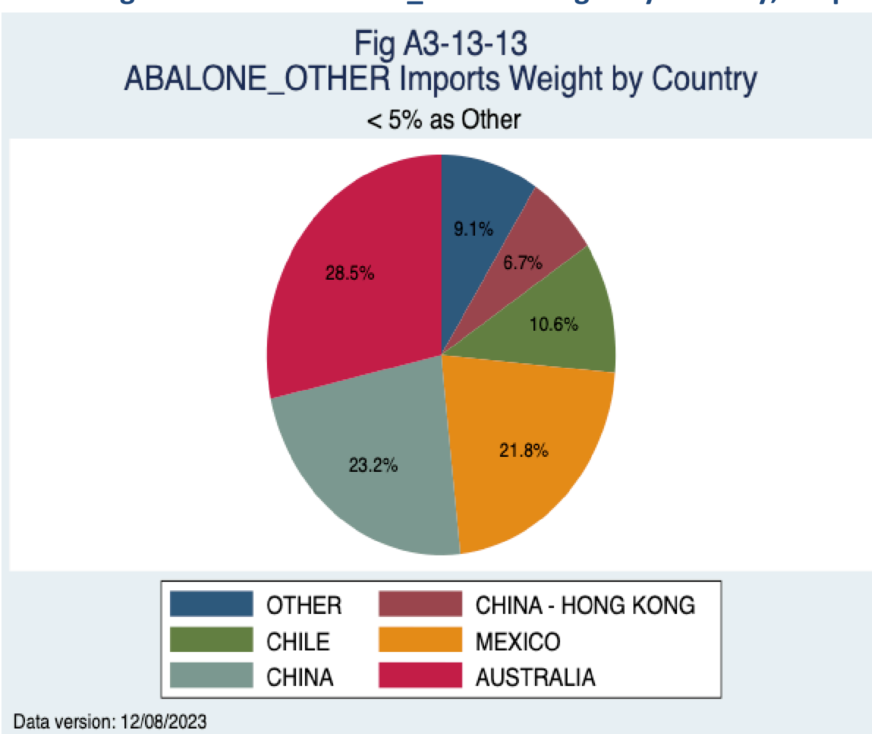


Fig A3-13-14: ABALONE_OTHER Value by Country by Year

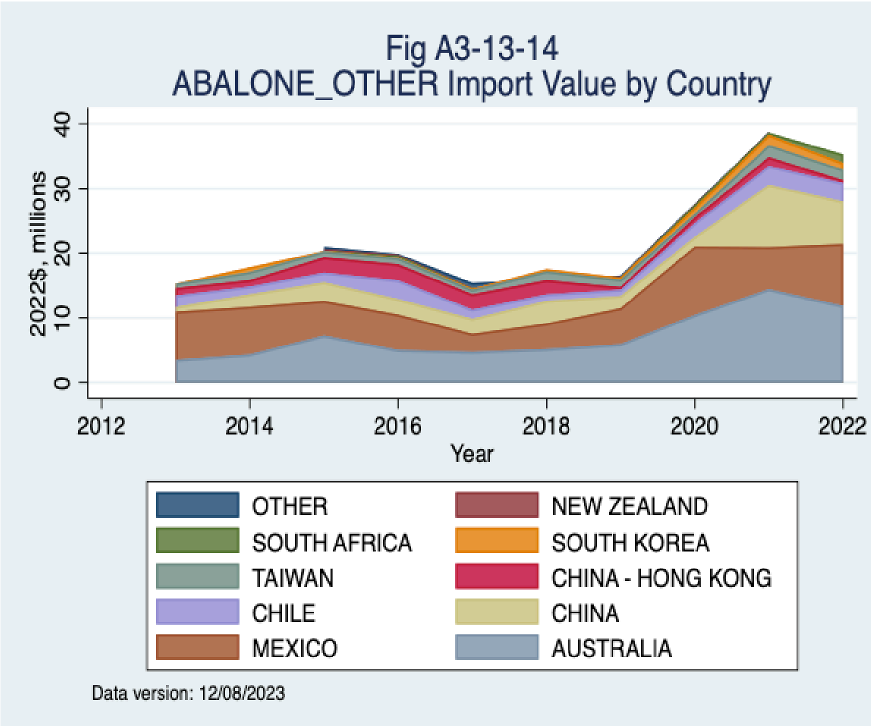
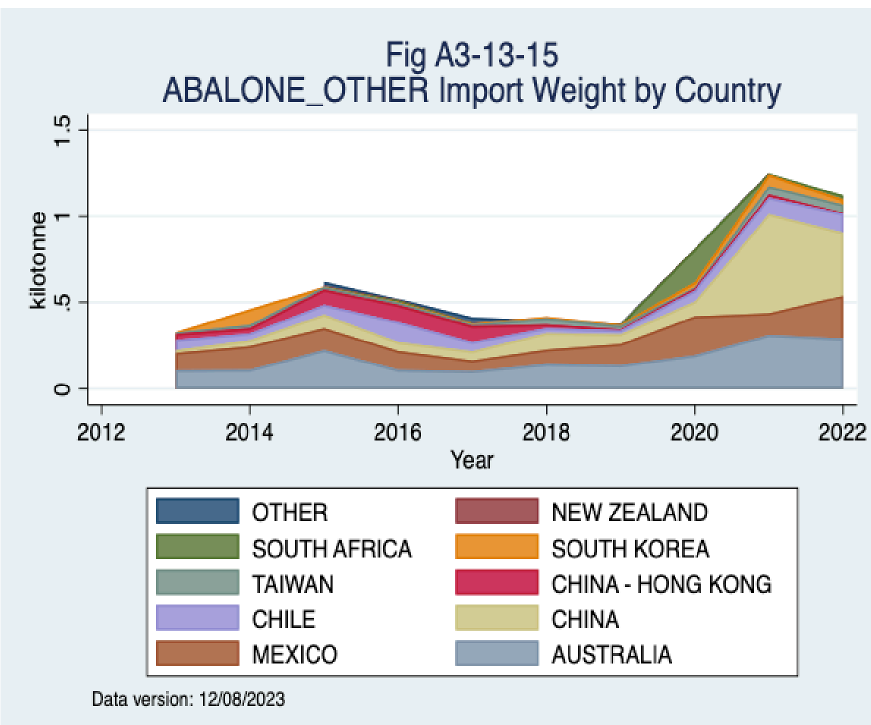


Fig A3-13-15: ABALONE_OTHER Weight by Country by Year



Figures for SCALLOP_FRESH product group

Fig A3-14-1: SCALLOP_FRESH Weight & Value by Year

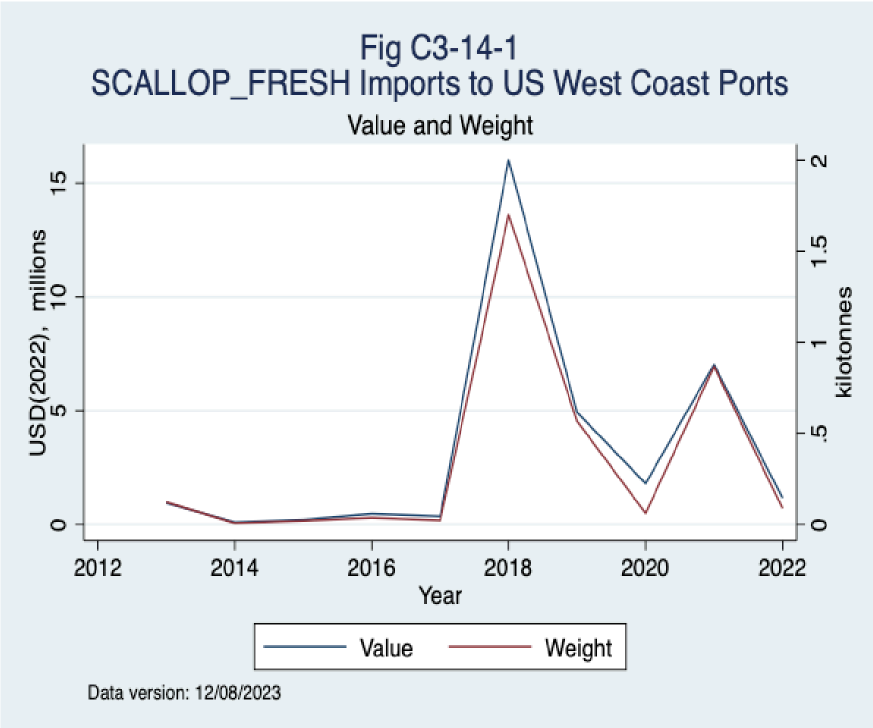


Fig A3-14-2: SCALLOP_FRESH Value & Price by Year

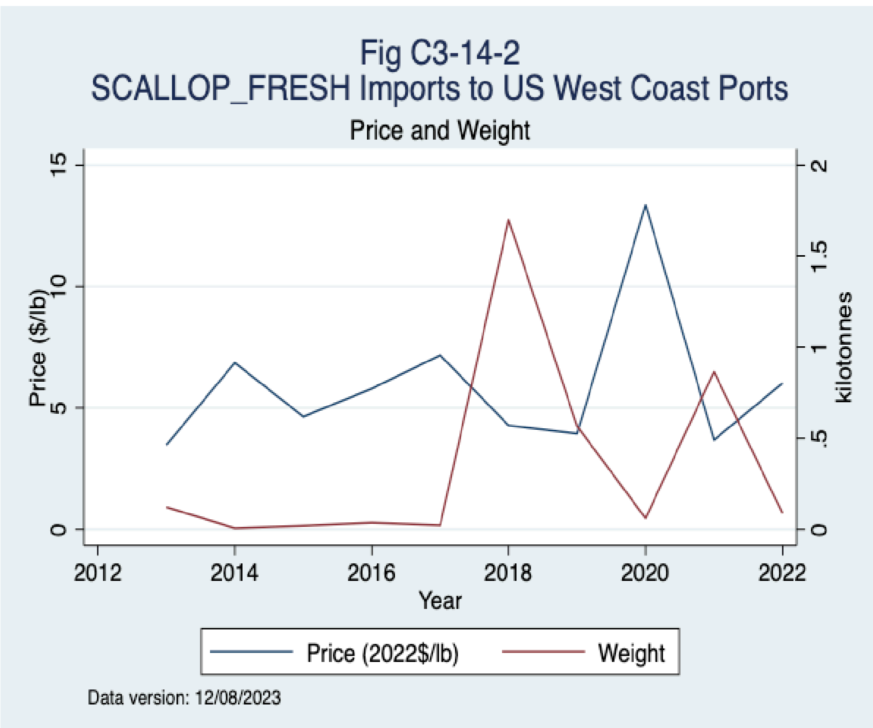


Fig A3-14-3: SCALLOP_FRESH Price Percentiles by Year

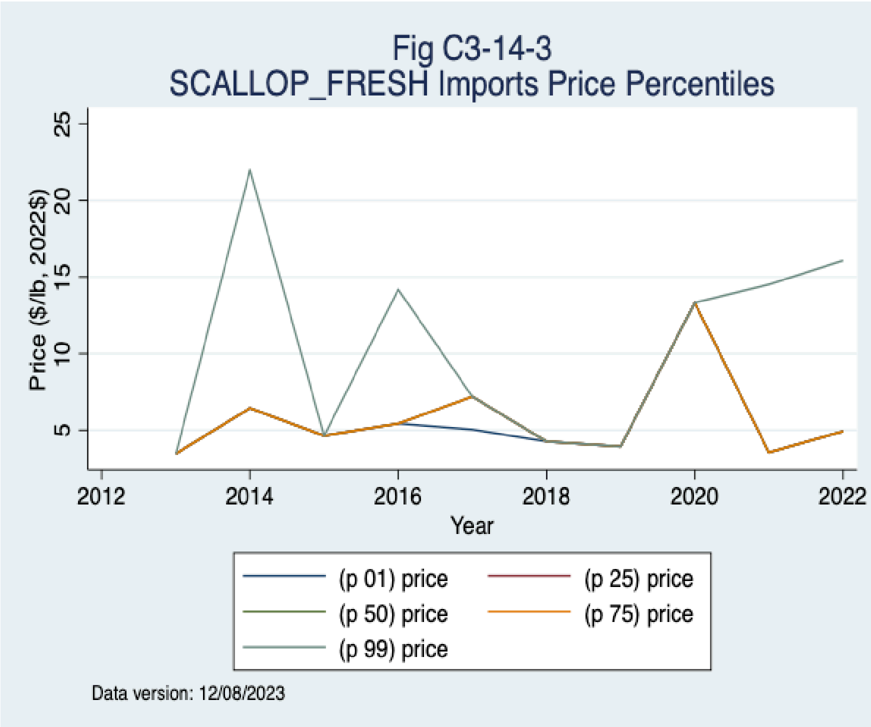


Fig A3-14-4: SCALLOP_FRESH Value by Port, Proportion

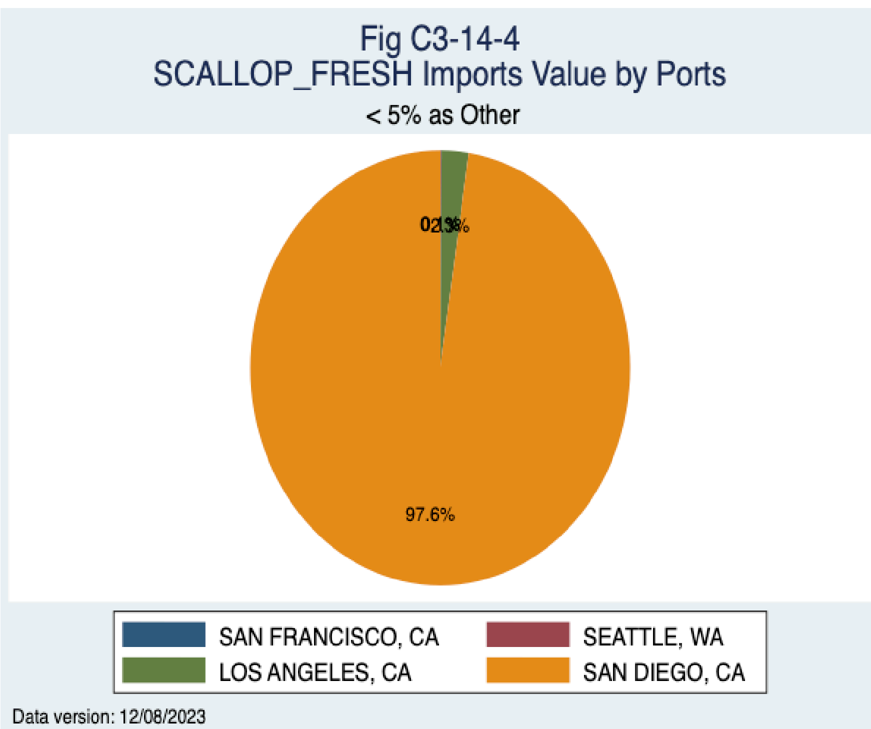


Fig A3-14-5: SCALLOP_FRESH Weight by Port, Proportion

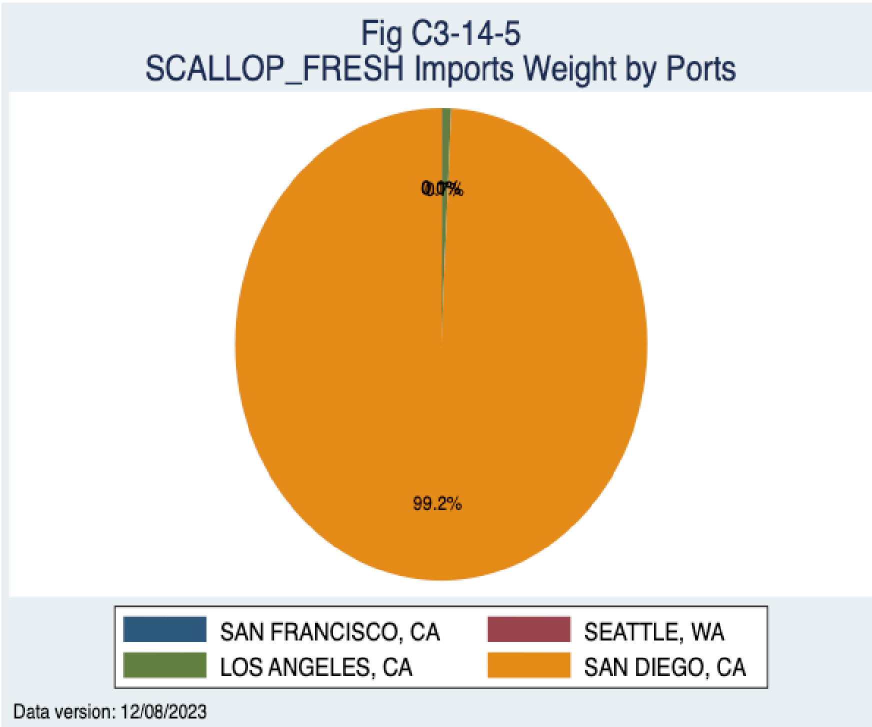


Fig A3-14-6: SCALLOP_FRESH Value by Port by Year

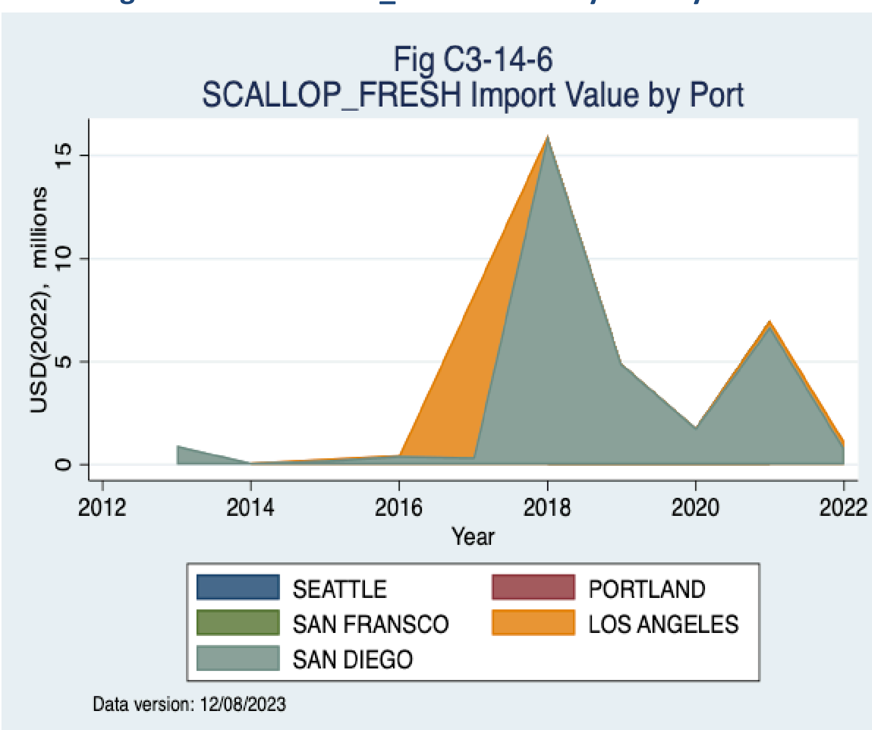


Fig A3-14-7: SCALLOP_FRESH Weight by Port by Year

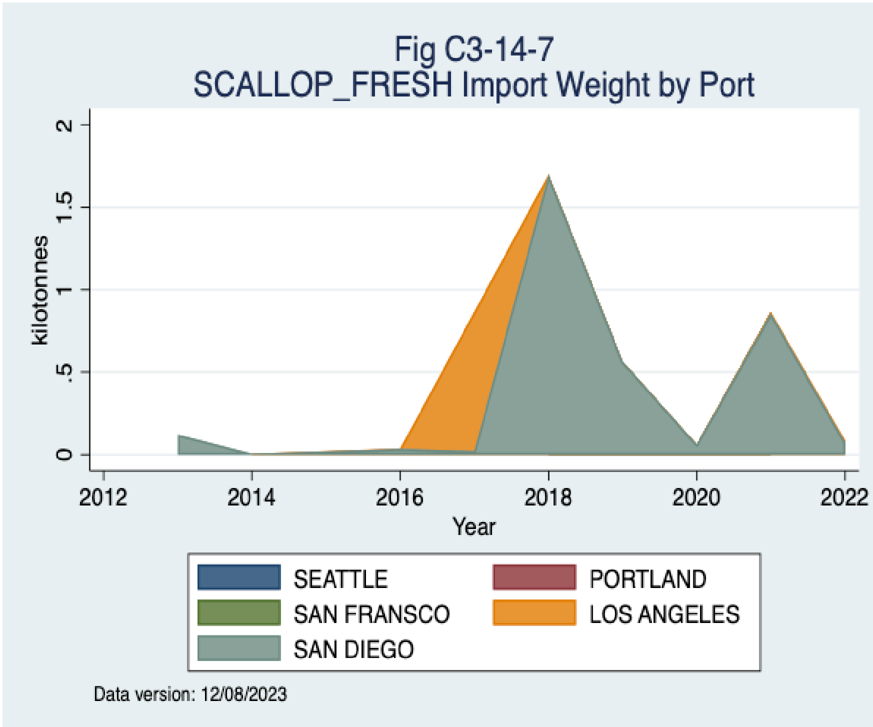


Fig A3-14-8: SCALLOP_FRESH Value by Continent, Proportion

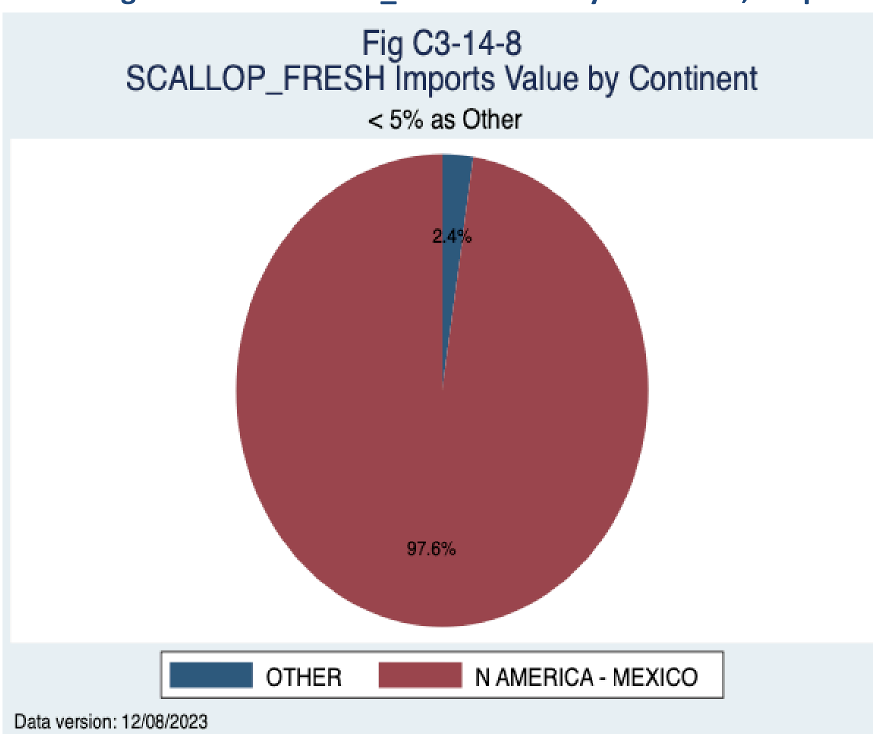


Fig A3-14-9: SCALLOP_FRESH Weight by Continent, Proportion

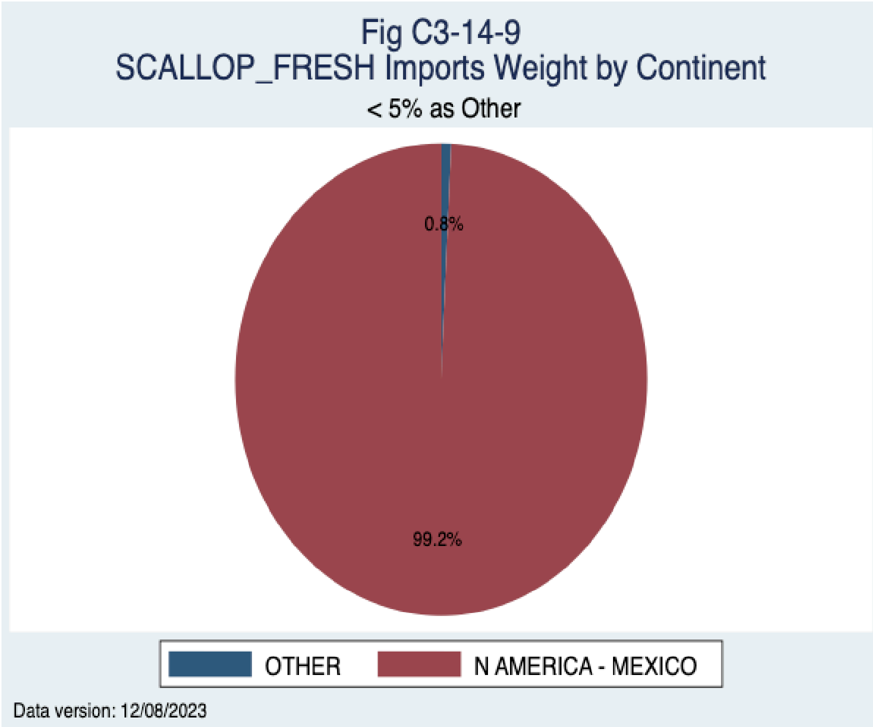


Fig A3-14-10: SCALLOP_FRESH Value by Continent by Year

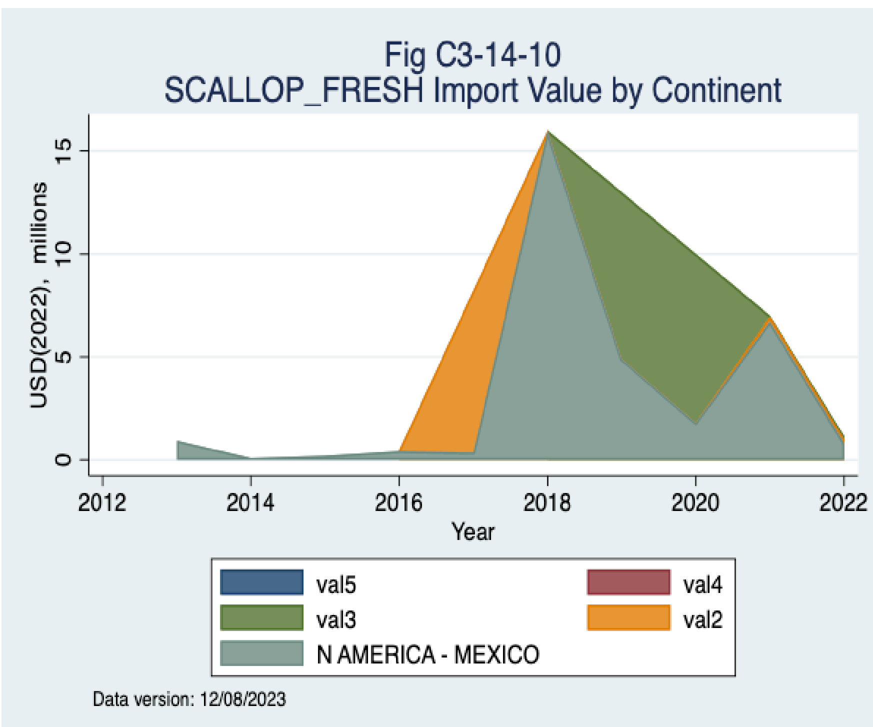


Fig A3-14-11: SCALLOP_FRESH Weight by Continent by Year

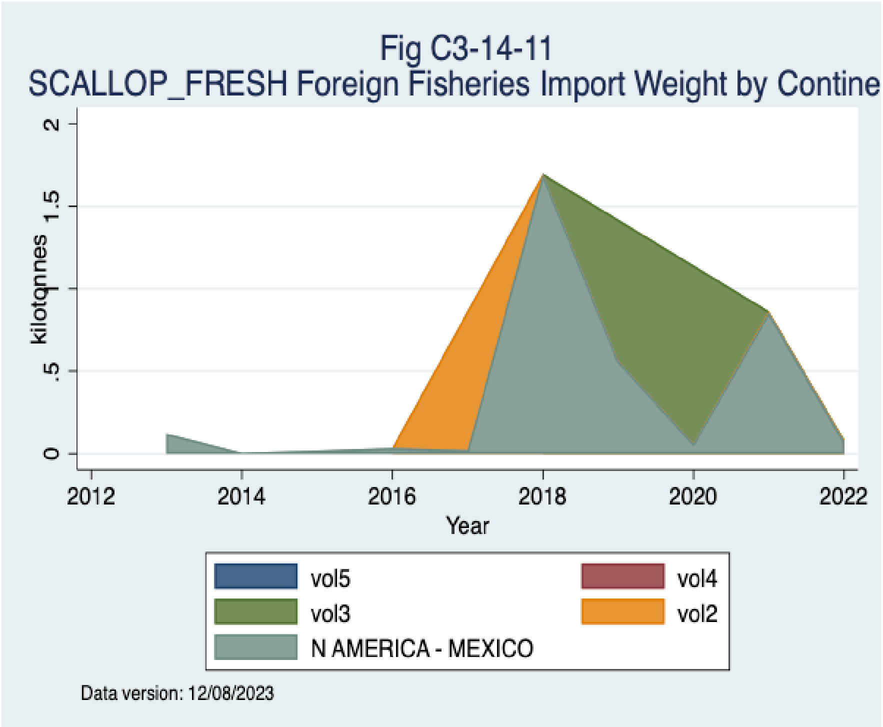


Fig A3-14-12: SCALLOP_FRESH Value by Country, Proportion

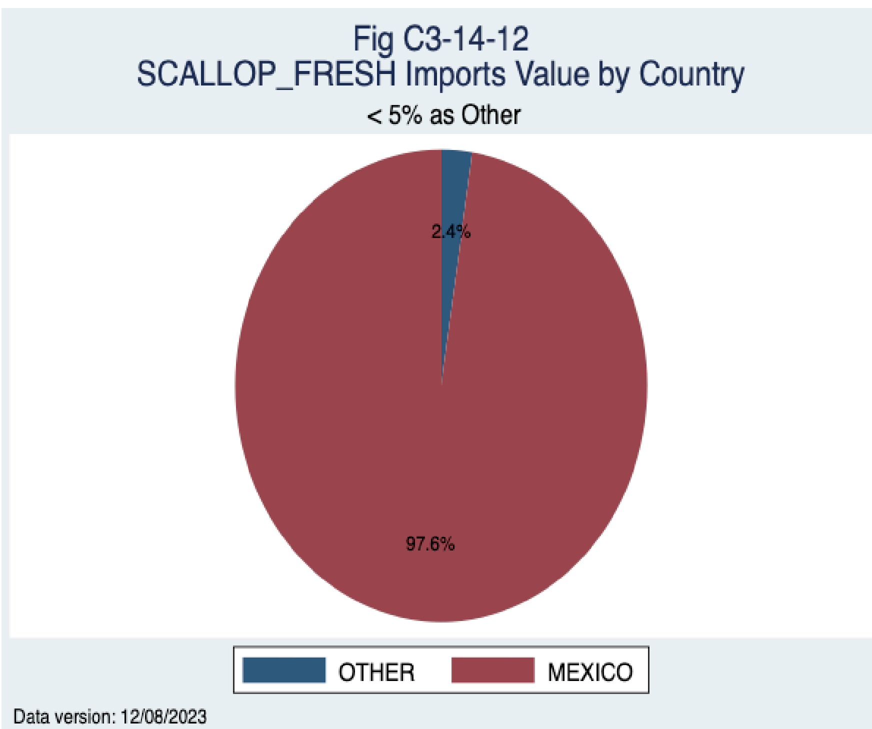


Fig A3-14-13: SCALLOP_FRESH Weight by Country, Proportion

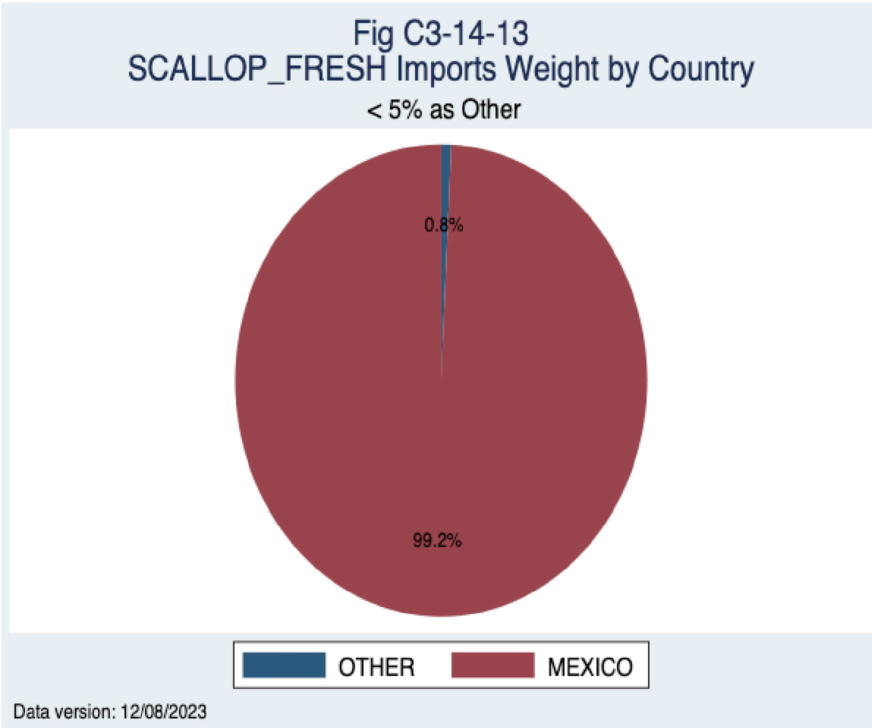


Fig A3-14-14: SCALLOP_FRESH Value by Country by Year

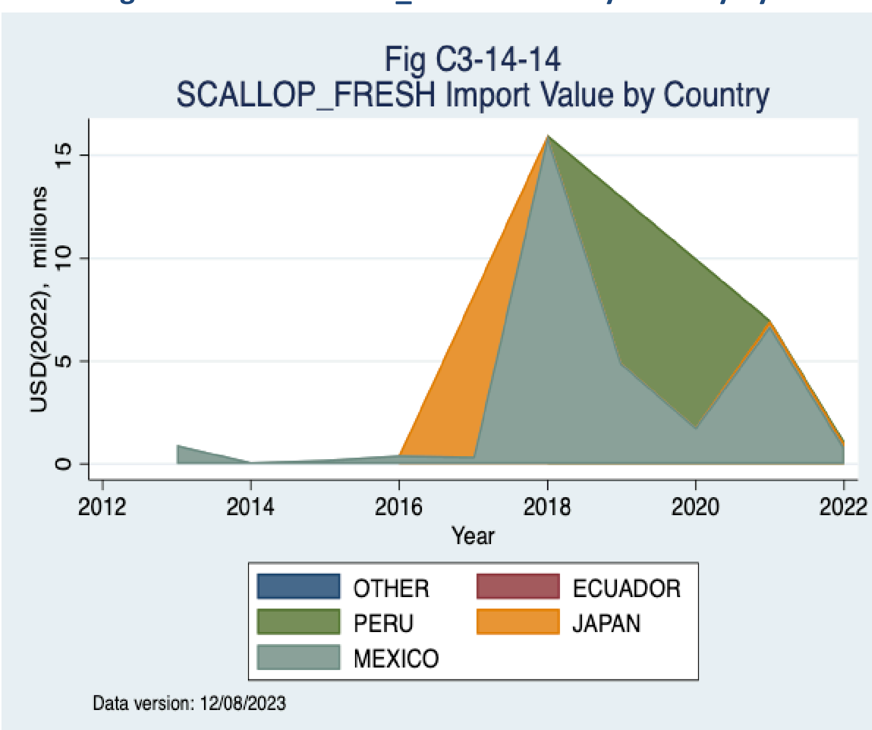
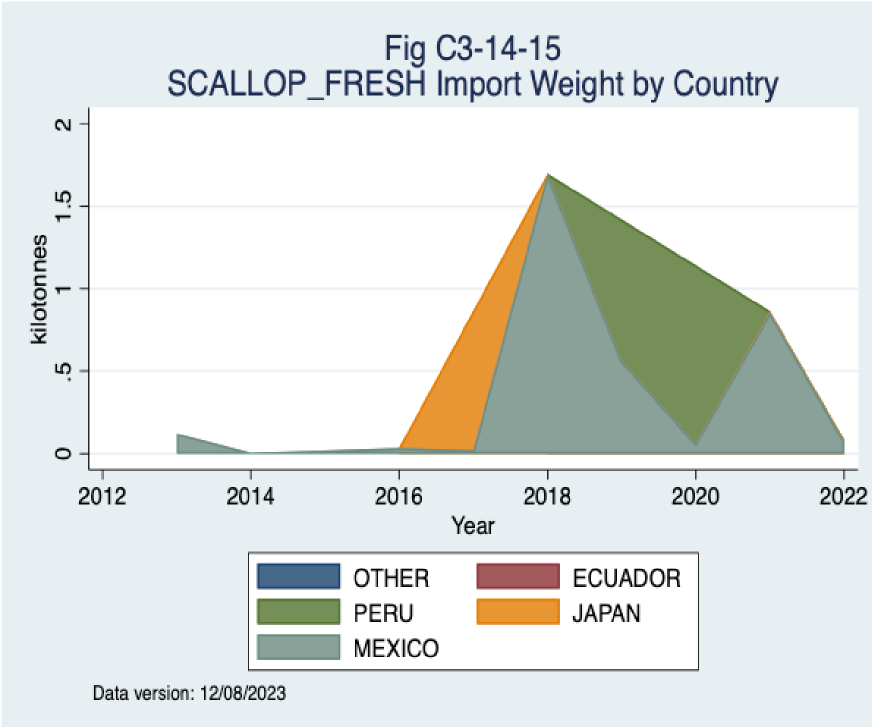


Fig A3-14-15: SCALLOP_FRESH Weight by Country by Year



Figures for SCALLOP_OTHER product group

Fig A3-15-1: SCALLOP_OTHER Weight & Value by Year

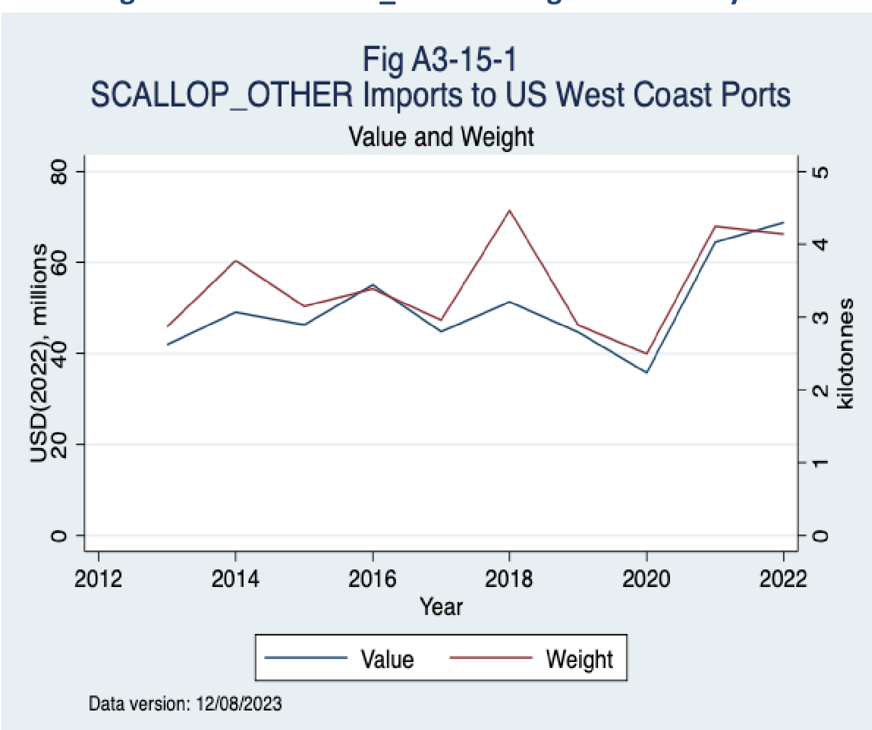


Fig A3-15-2: SCALLOP_OTHER Value & Price by Year

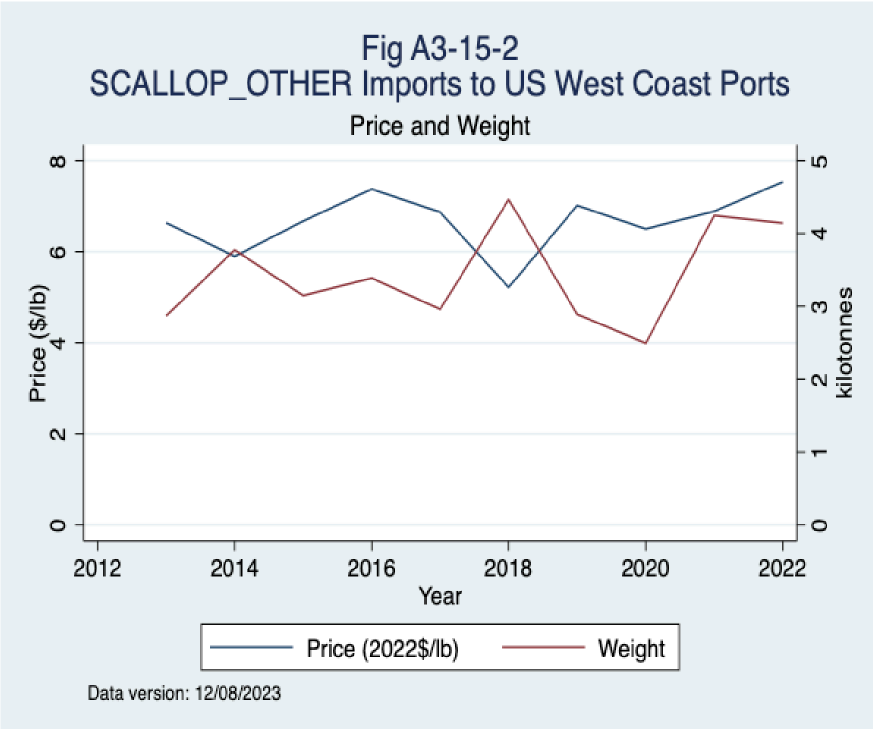


Fig A3-15-3: SCALLOP_OTHER Price Percentiles by Year

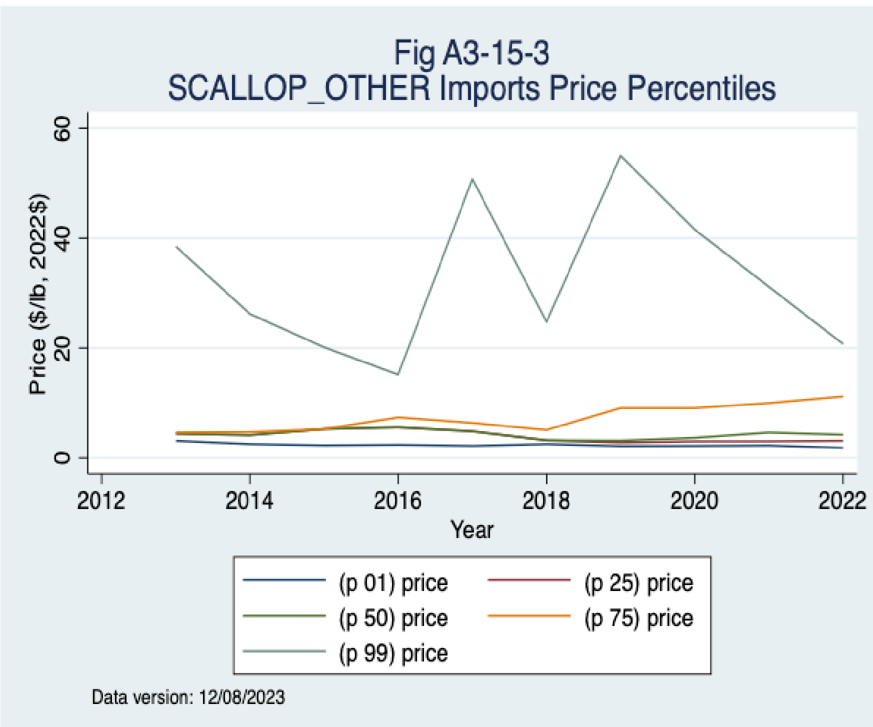


Fig A3-15-4: SCALLOP_OTHER Value by Port, Proportion

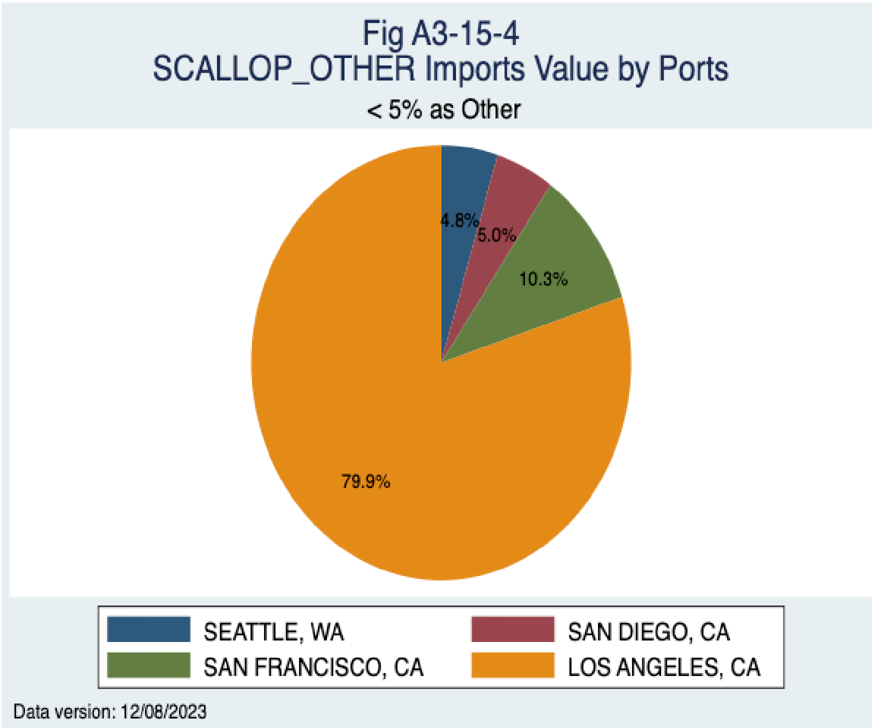


Fig A3-15-5: SCALLOP_OTHER Weight by Port, Proportion

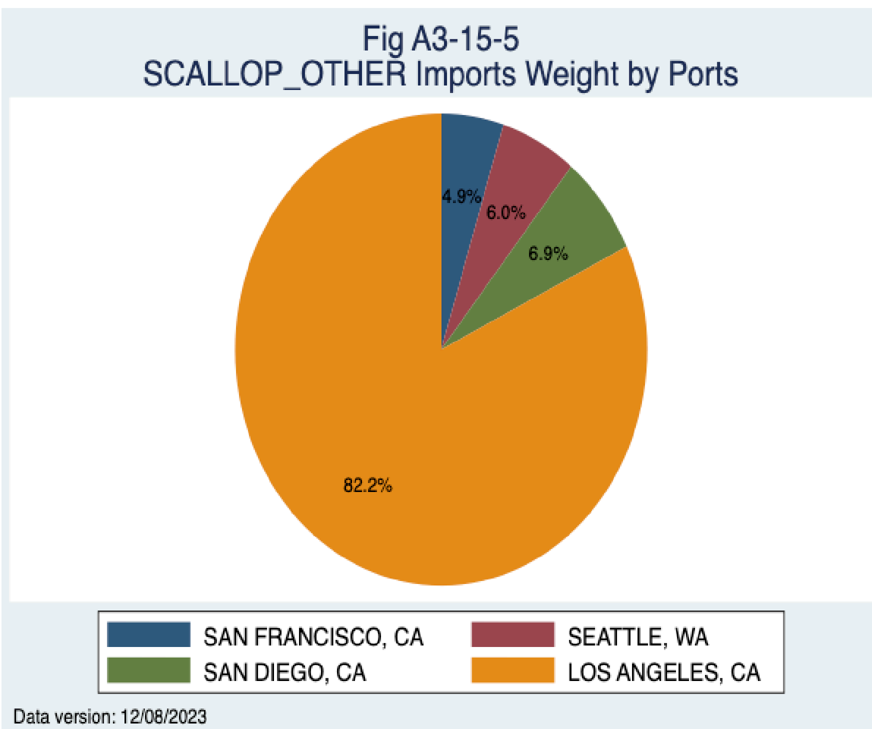


Fig A3-15-6: SCALLOP_OTHER Value by Port by Year

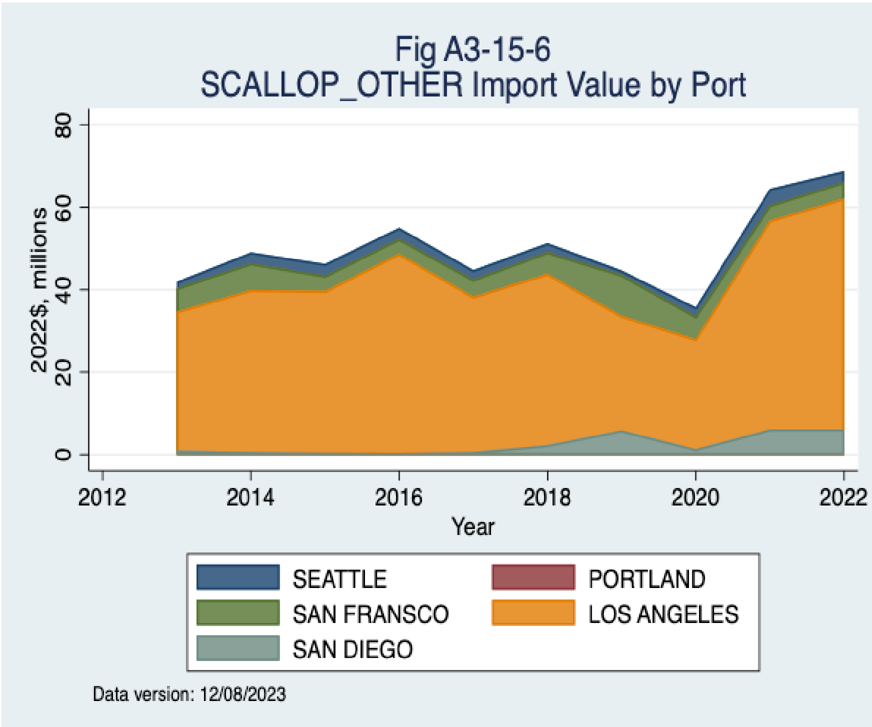


Fig A3-15-7: SCALLOP_OTHER Weight by Port by Year

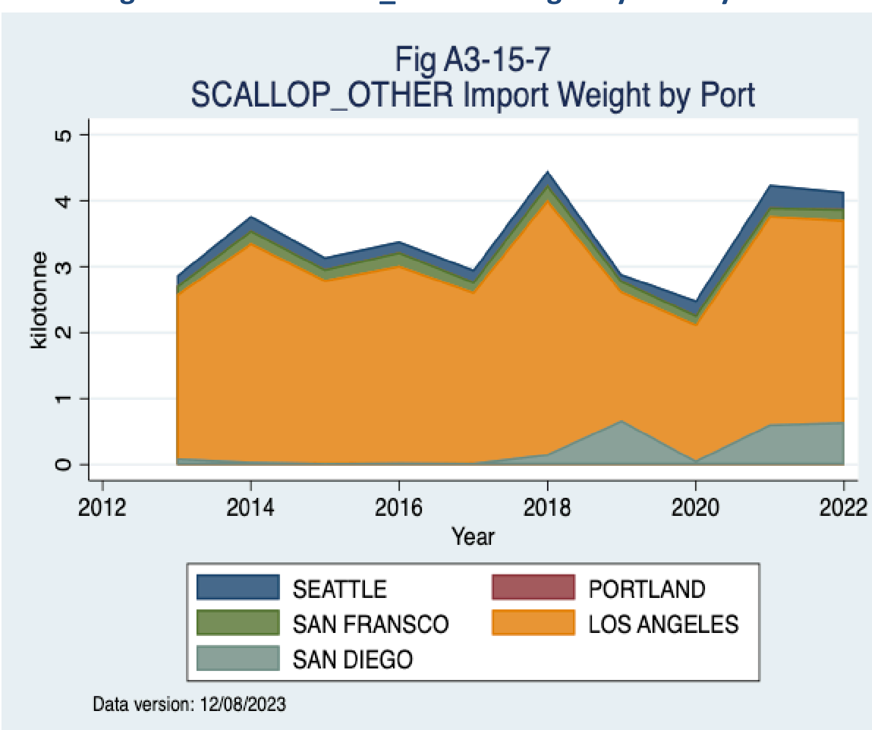


Fig A3-15-8: SCALLOP_OTHER Value by Continent, Proportion

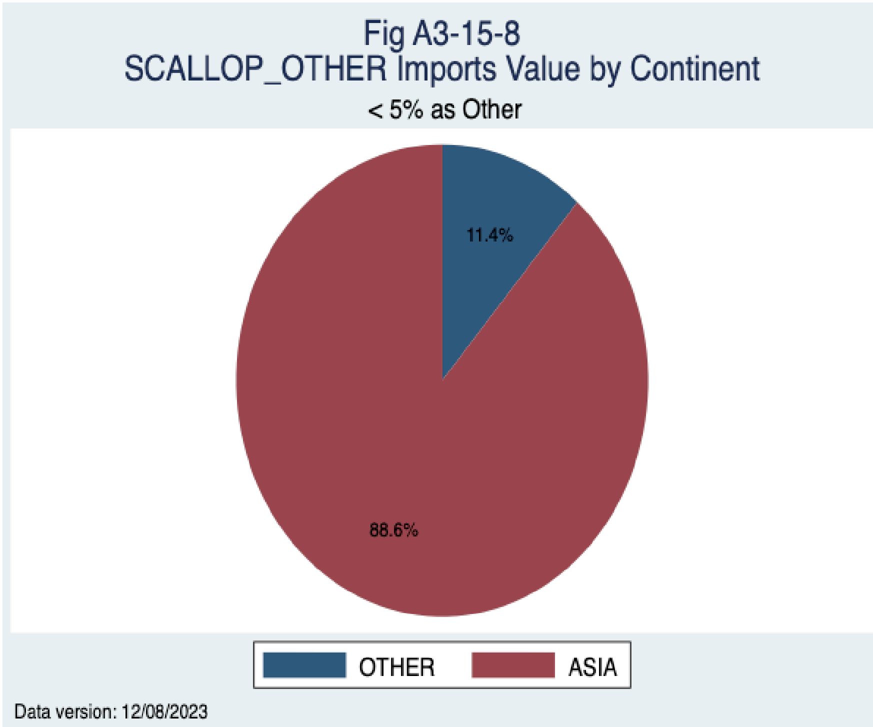


Fig A3-15-9: SCALLOP_OTHER Weight by Continent, Proportion

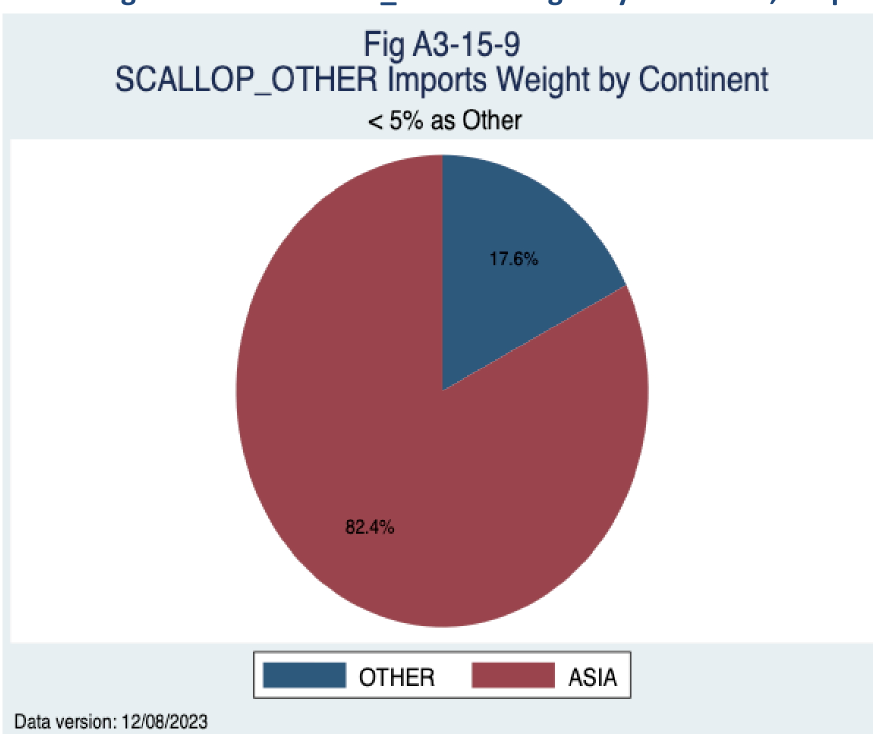


Fig A3-15-10: SCALLOP_OTHER Value by Continent by Year

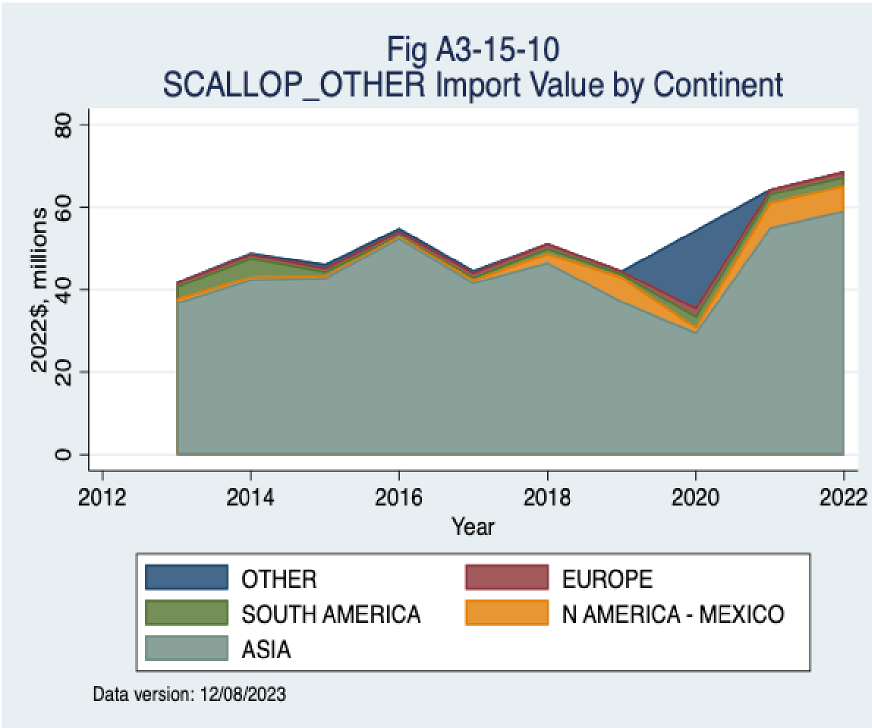


Fig A3-15-11: SCALLOP_OTHER Weight by Continent by Year

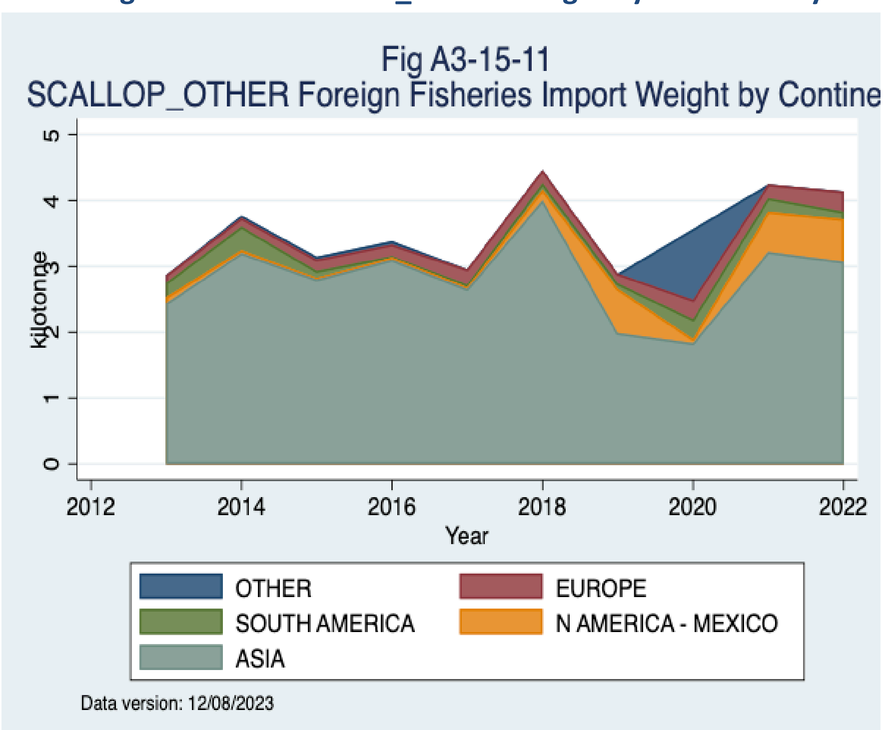


Fig A3-15-12: SCALLOP_OTHER Value by Country, Proportion

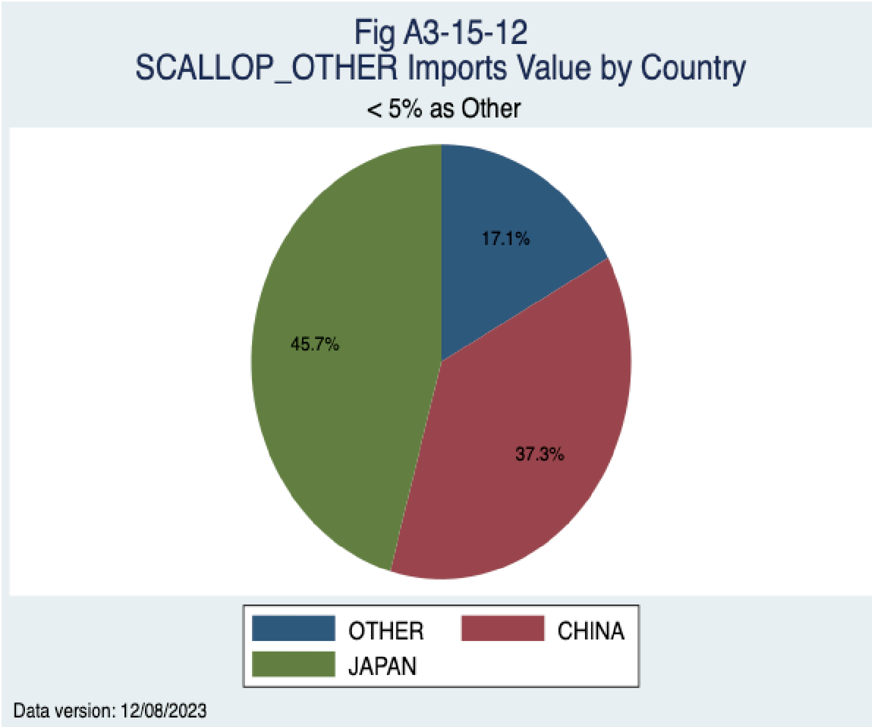


Fig A3-15-13: SCALLOP_OTHER Weight by Country, Proportion

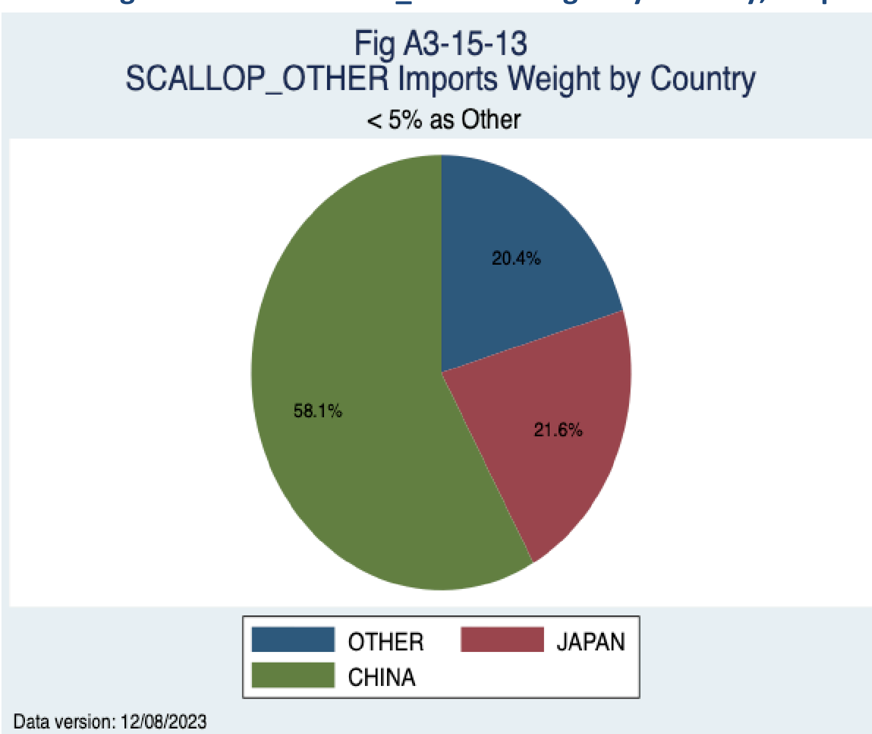


Fig A3-15-14: SCALLOP_OTHER Value by Country by Year

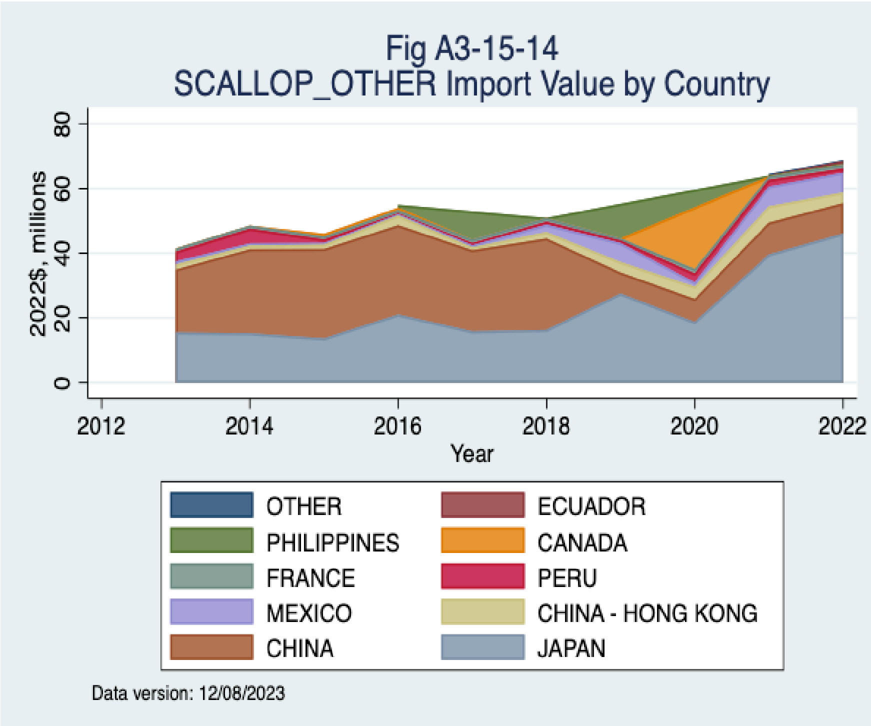
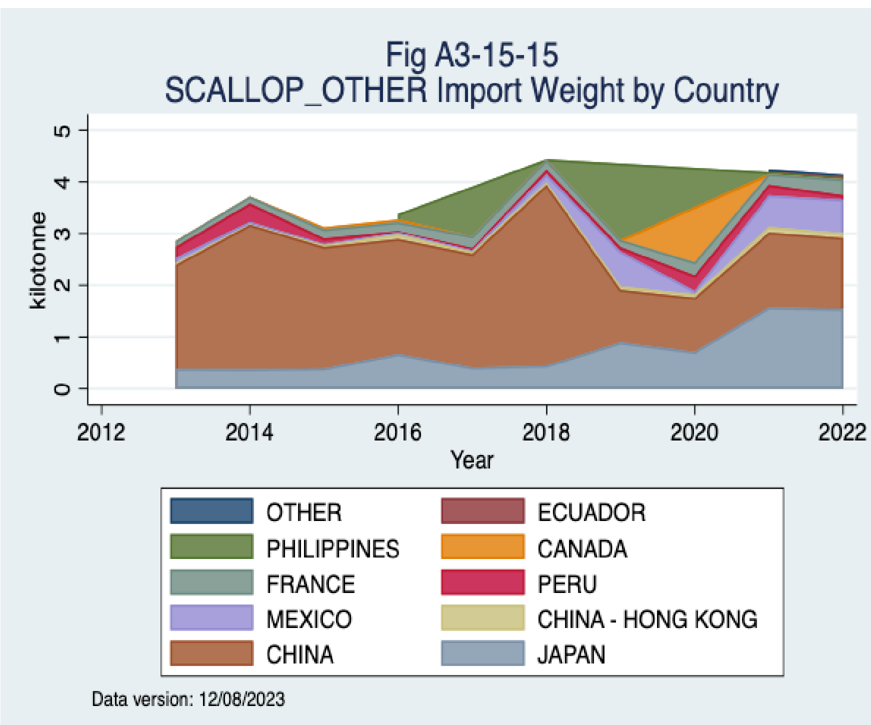


Fig A3-15-15: SCALLOP_OTHER Weight by Country by Year



Figures for SEAWEED_EDIBLE product group

Fig A3-16-1: SEAWEED_EDIBLE Weight & Value by Year

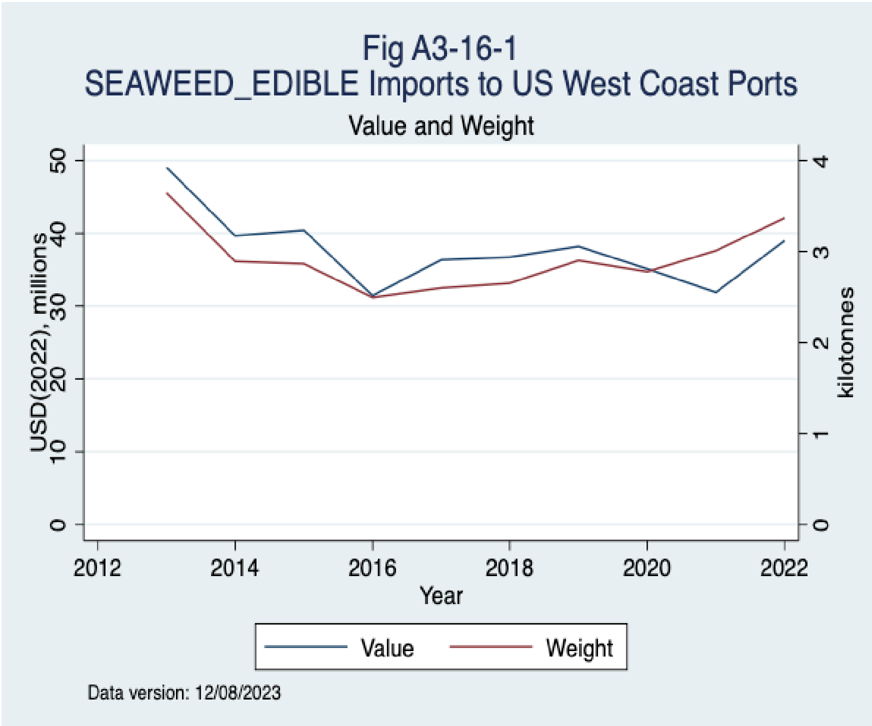


Fig A3-16-2: SEAWEED_EDIBLE Value & Price by Year

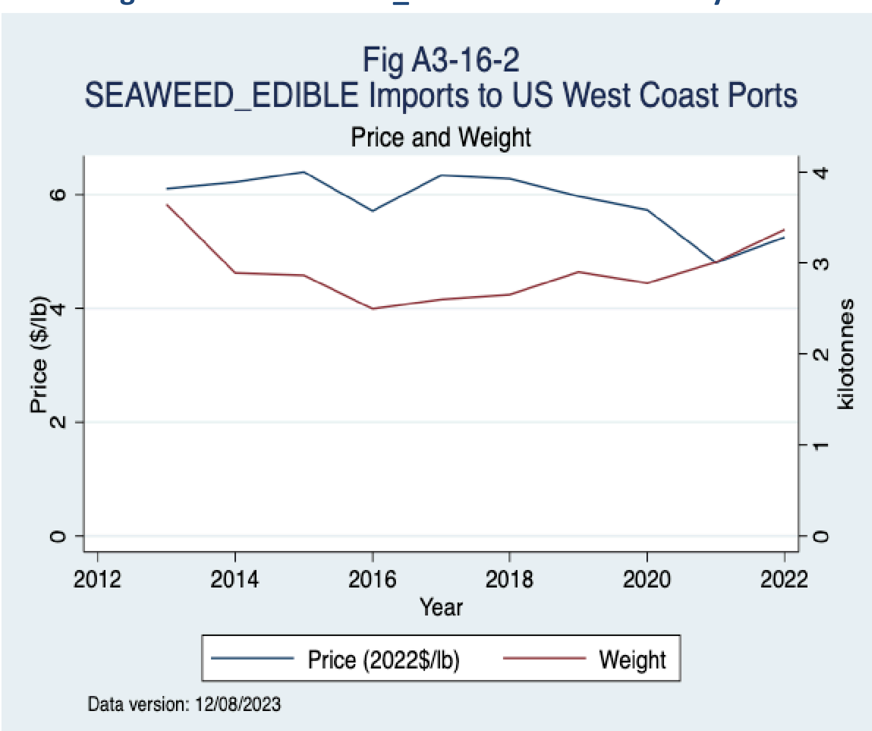


Fig A3-16-3: SEAWEED_EDIBLE Price Percentiles by Year

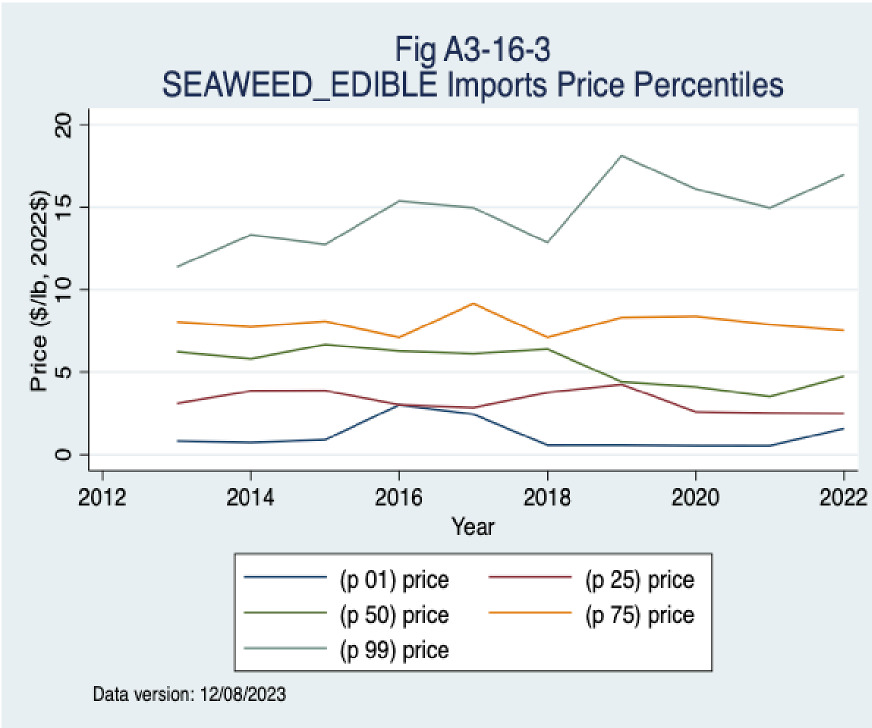


Fig A3-16-4: SEAWEED_EDIBLE Value by Port, Proportion

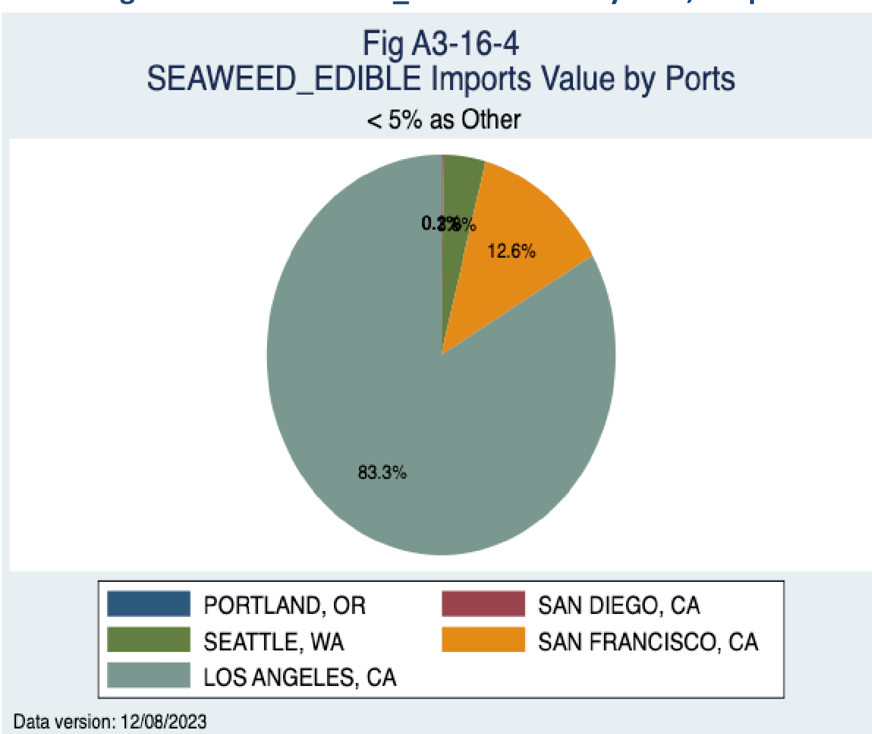


Fig A3-16-5: SEAWEED_EDIBLE Weight by Port, Proportion

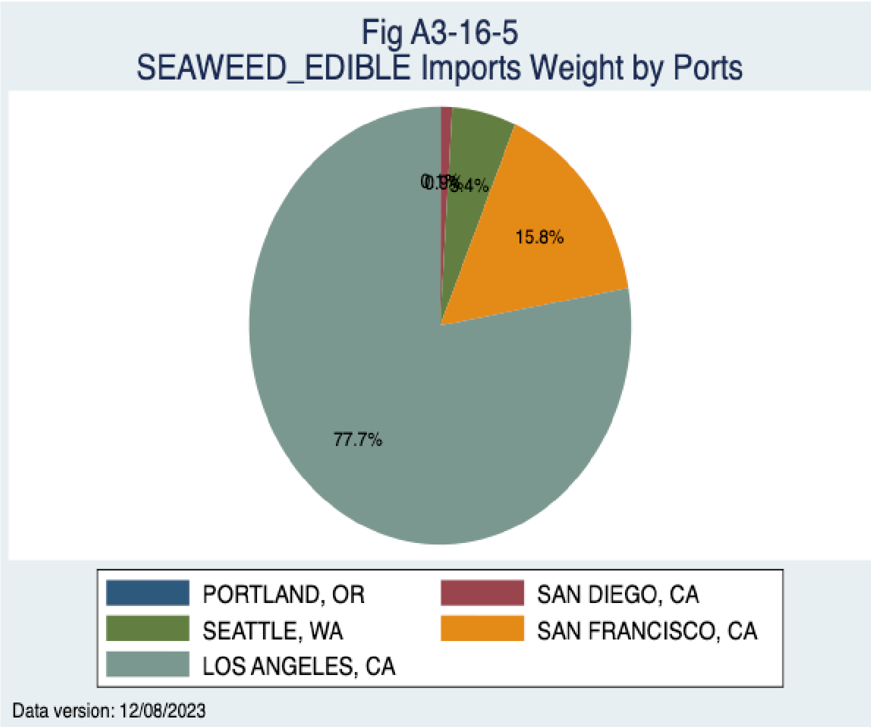


Fig A3-16-6: SEAWEED_EDIBLE Value by Port by Year

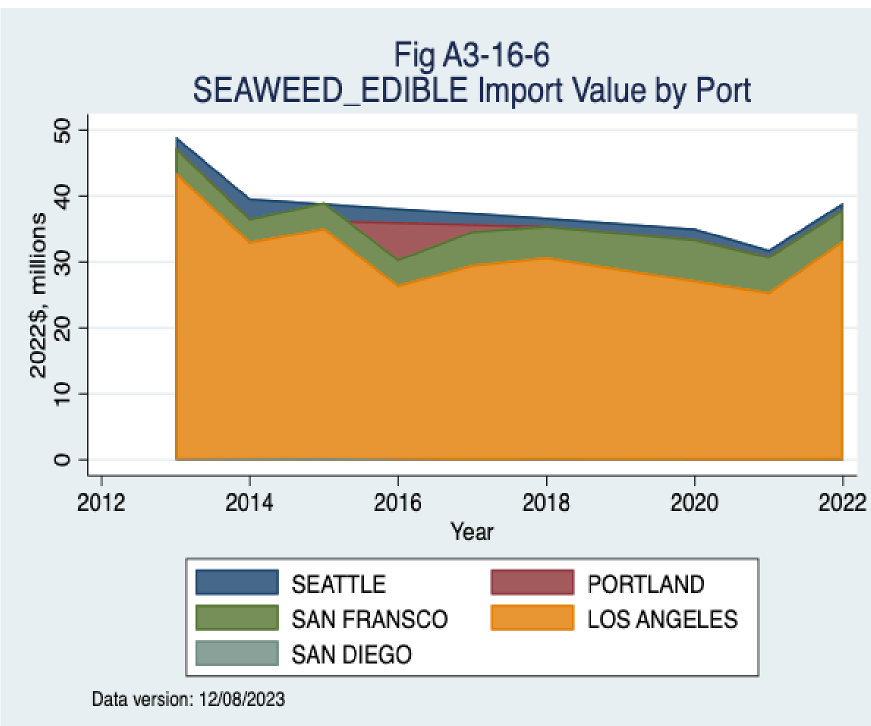


Fig A3-16-7: SEAWEED_EDIBLE Weight by Port by Year

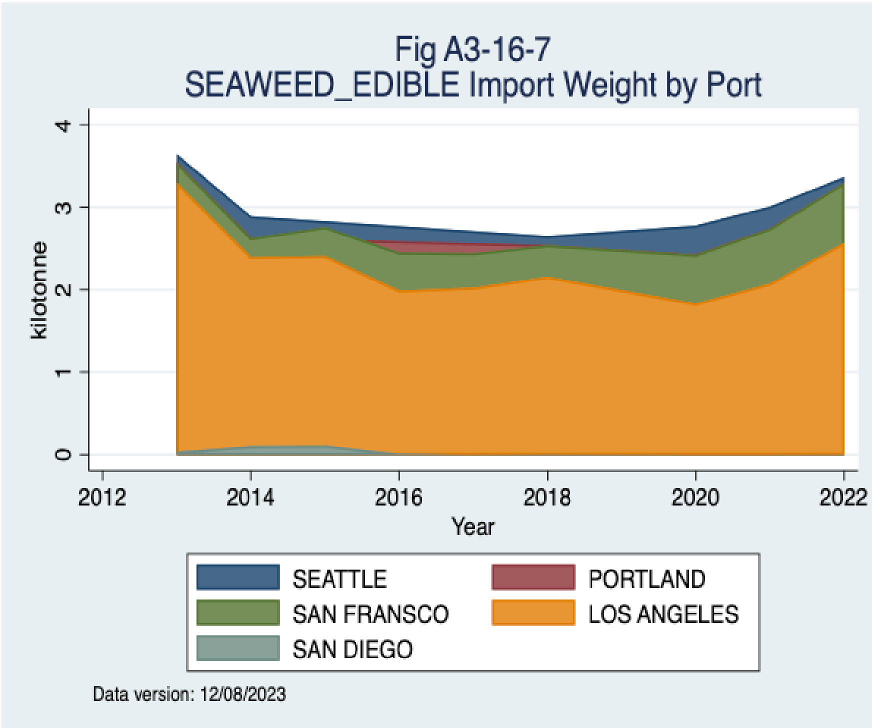


Fig A3-16-8: SEAWEED_EDIBLE Value by Continent, Proportion

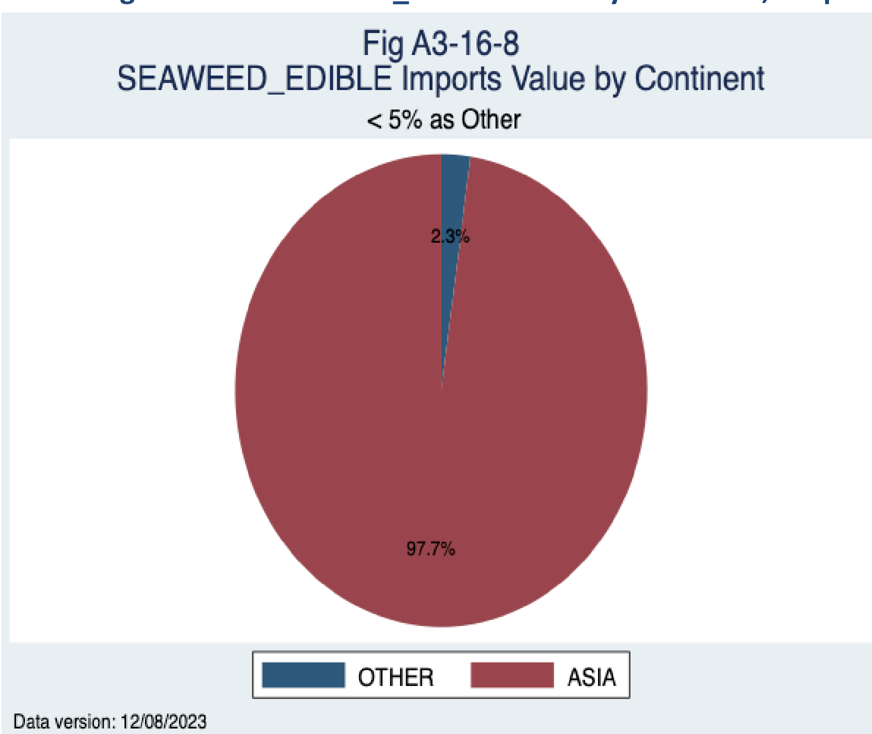


Fig A3-16-9: SEAWEED_EDIBLE Weight by Continent, Proportion

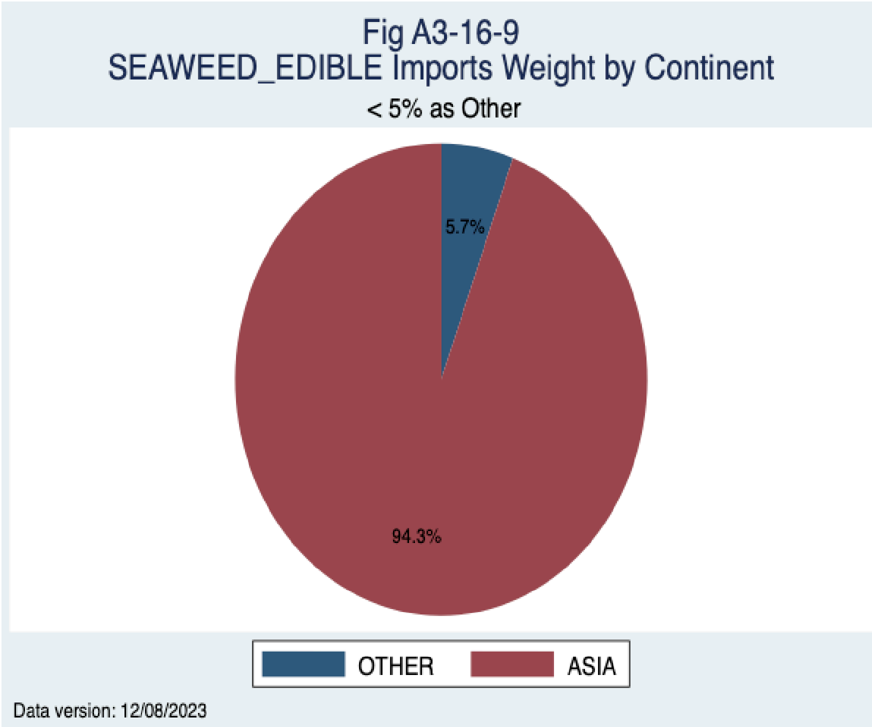


Fig A3-16-10: SEAWEED_EDIBLE Value by Continent by Year

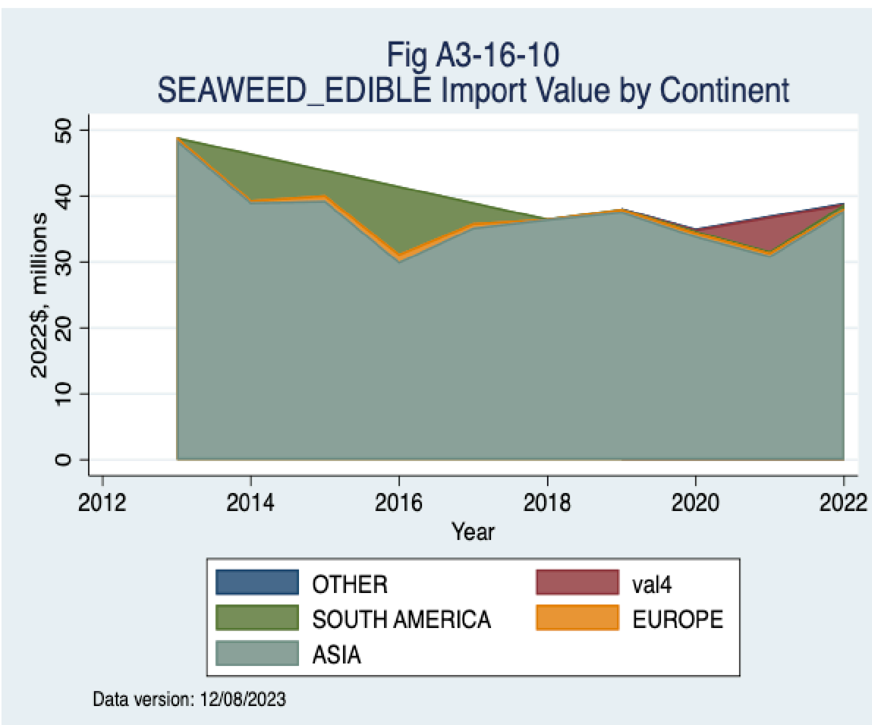


Fig A3-16-11: SEAWEED_EDIBLE Weight by Continent by Year

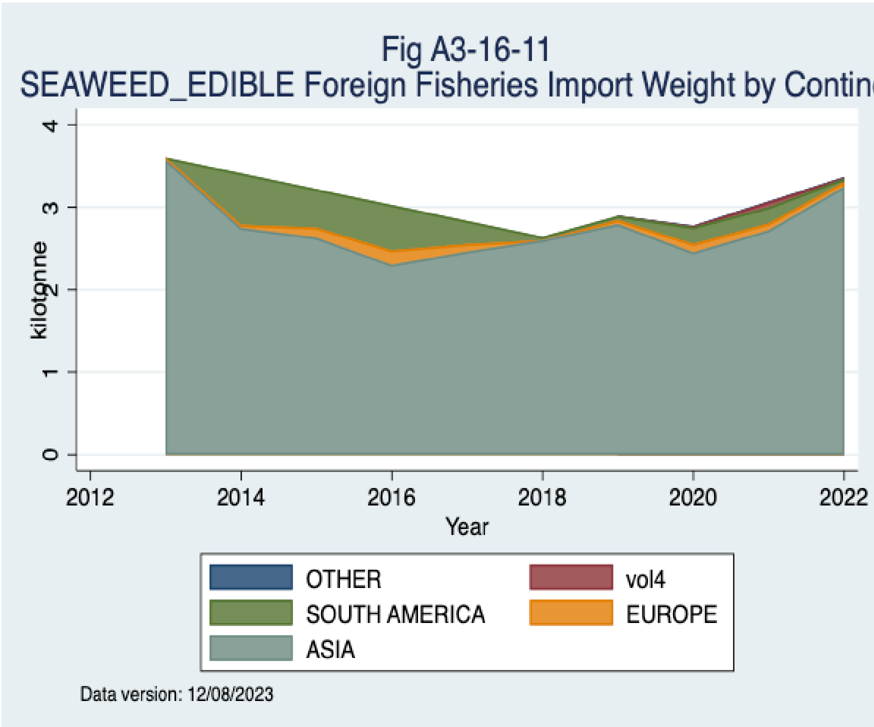


Fig A3-16-12: SEAWEED_EDIBLE Value by Country, Proportion

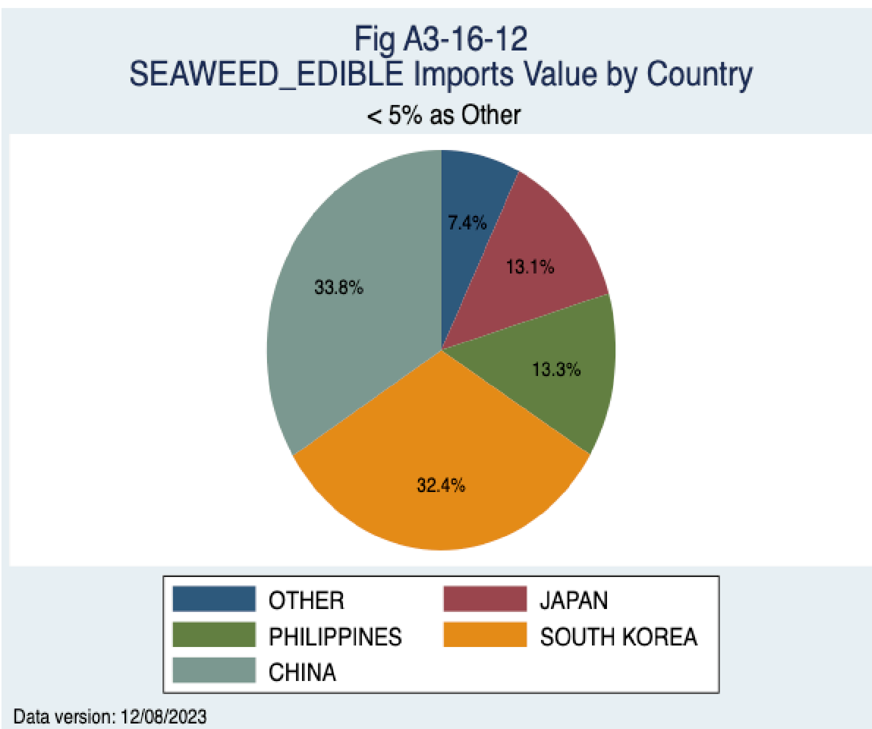


Fig A3-16-13: SEAWEED_EDIBLE Weight by Country, Proportion

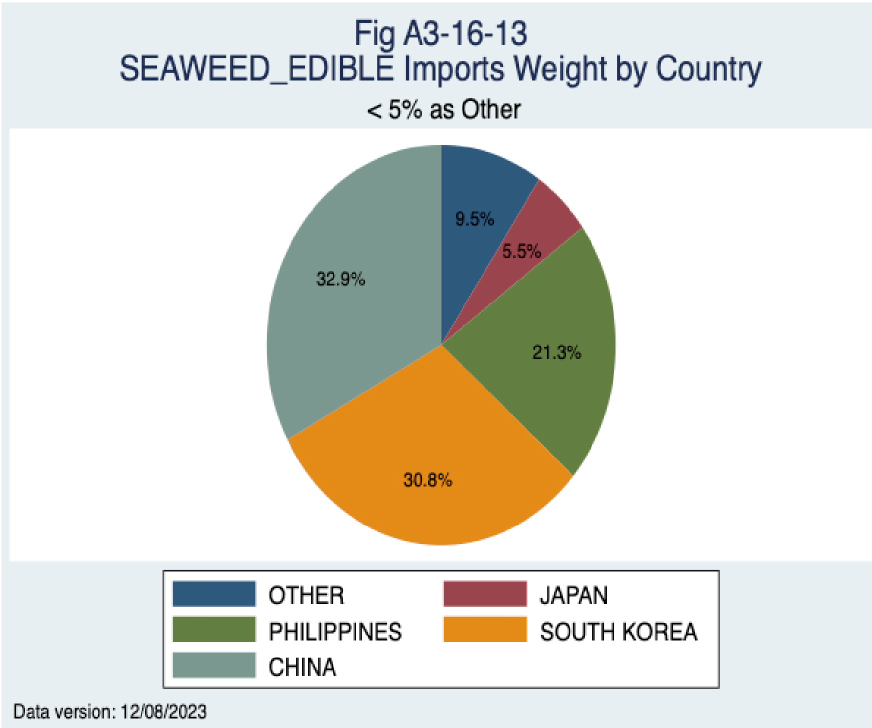


Fig A3-16-14: SEAWEED_EDIBLE Value by Country by Year

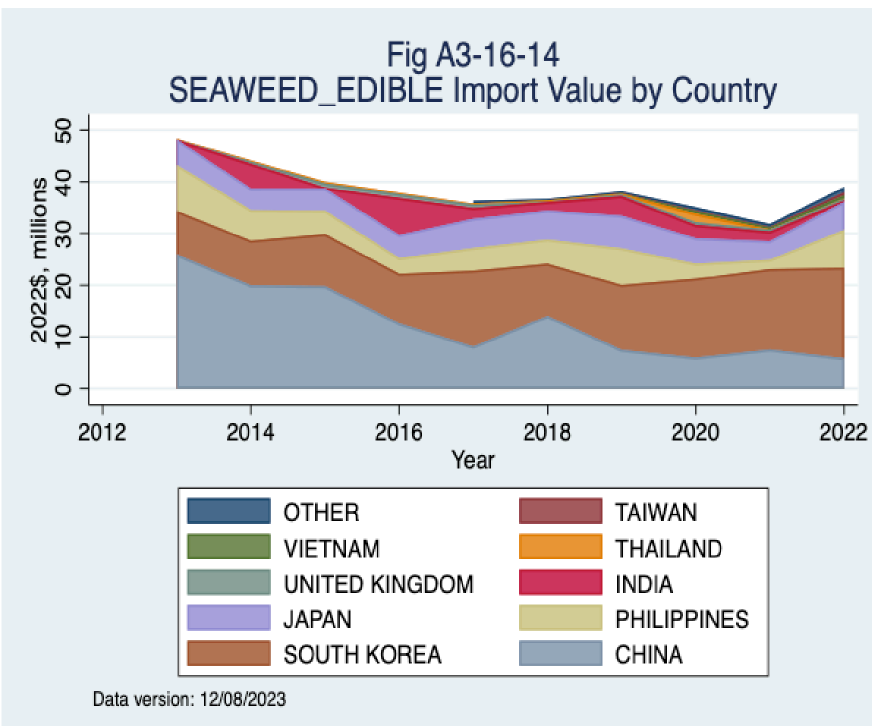
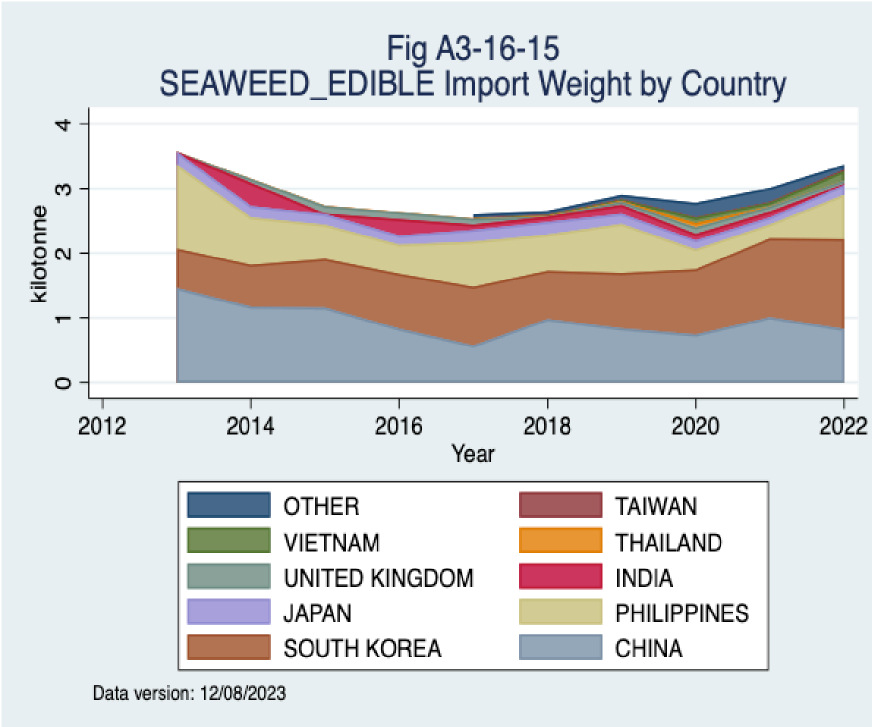


Fig A3-16-15: SEAWEED_EDIBLE Weight by Country by Year



Figures for SEAWEED product group

Fig A3-17-1: SEAWEED Weight & Value by Year

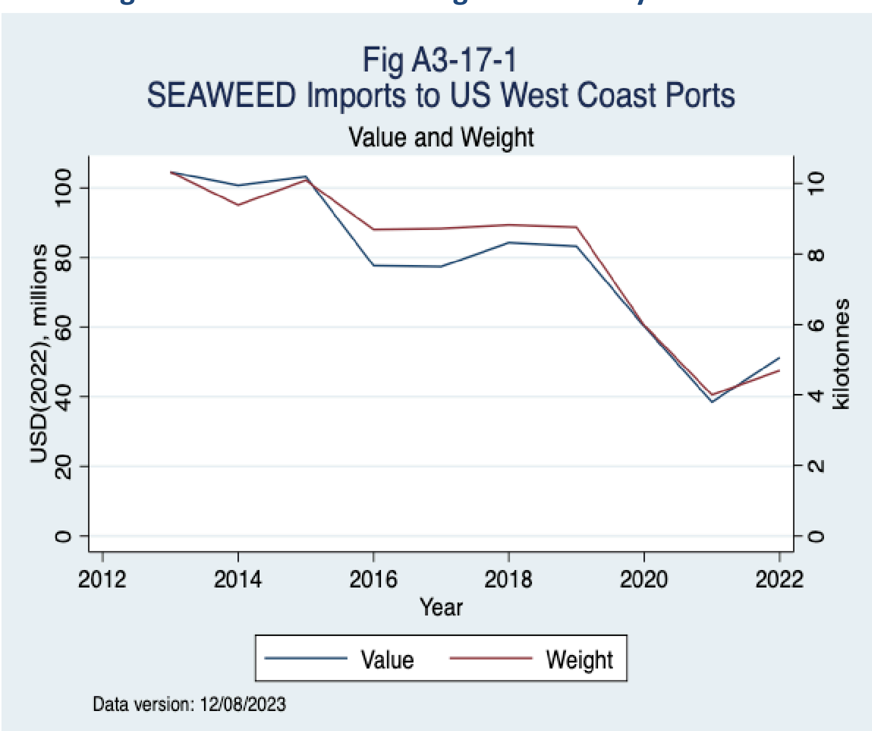


Fig A3-17-2: SEAWEED Value & Price by Year

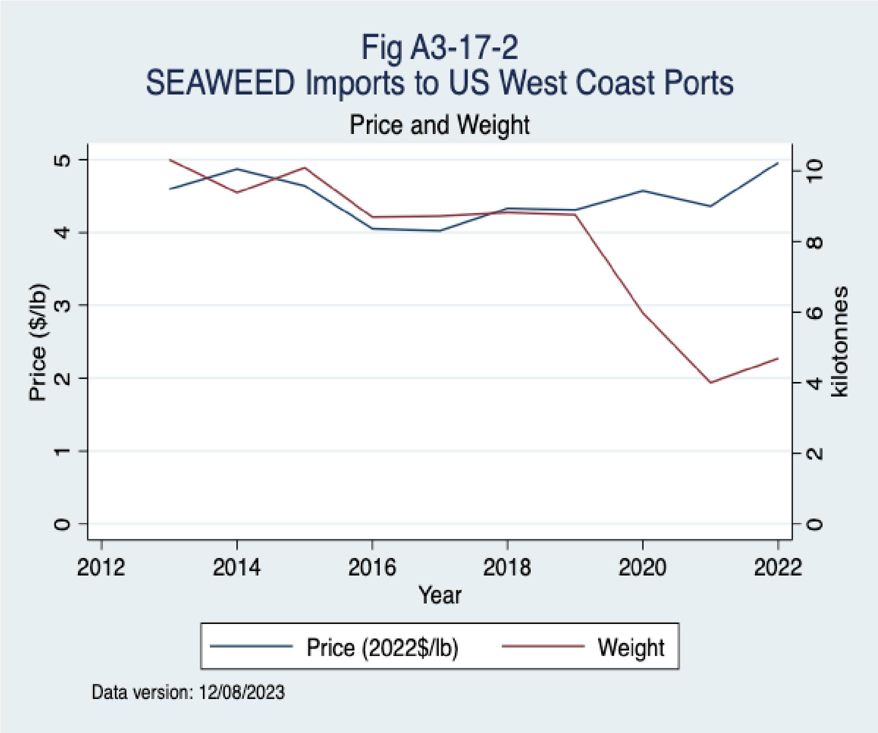


Fig A3-17-3: SEAWEED Price Percentiles by Year

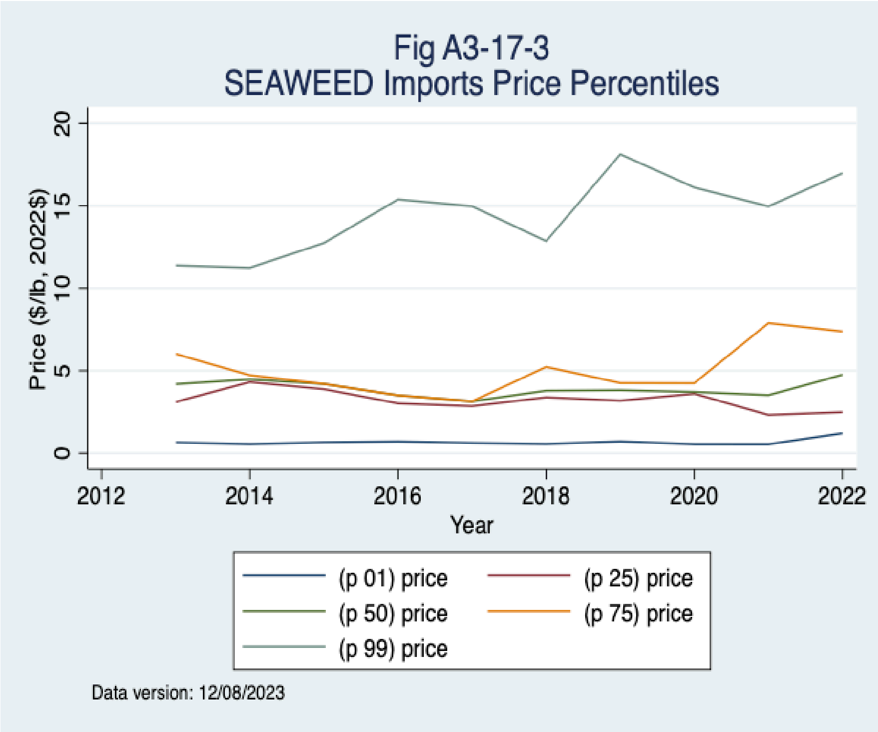


Fig A3-17-4: SEAWEED Value by Port, Proportion

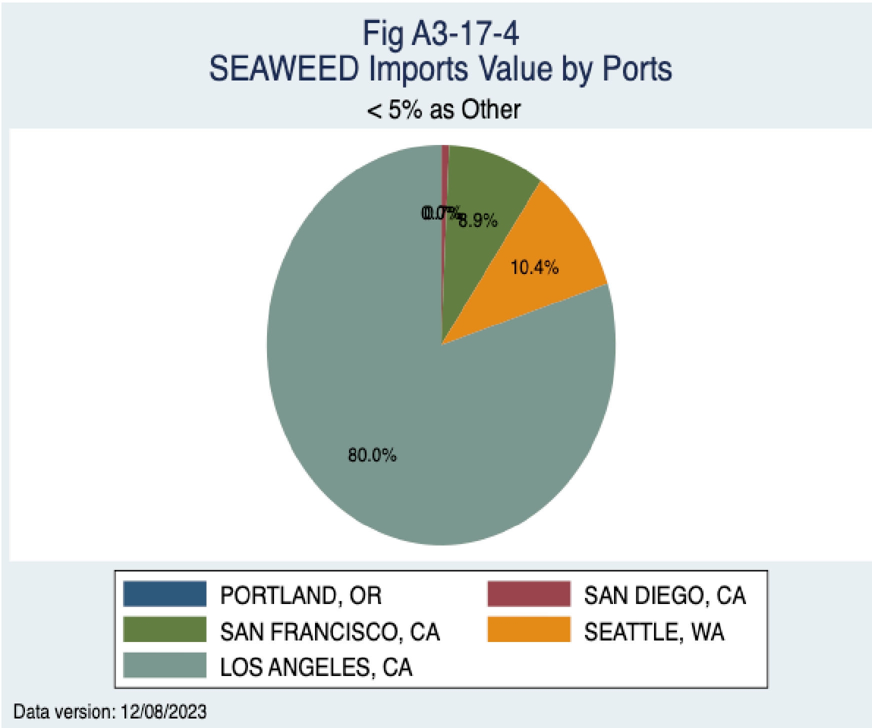


Fig A3-17-5: SEAWEED Weight by Port, Proportion

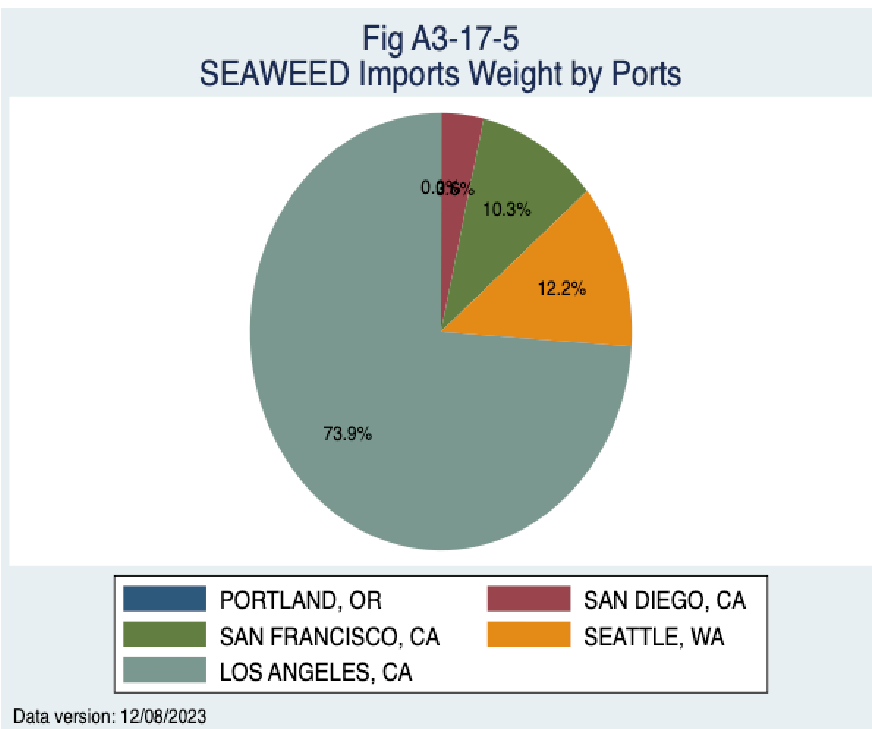


Fig A3-17-6: SEAWEED Value by Port by Year

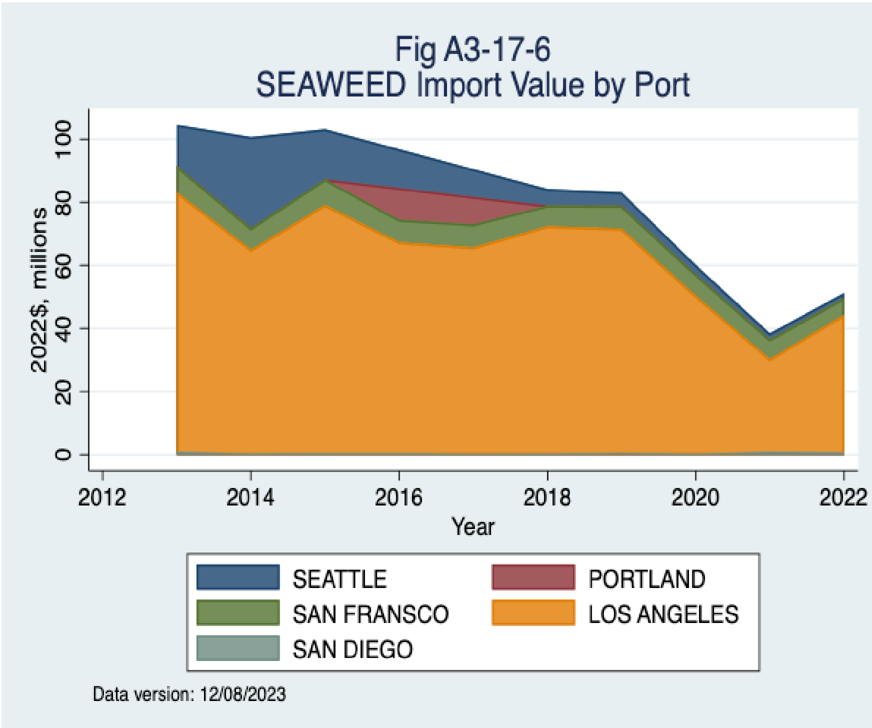


Fig A3-17-7: SEAWEED Weight by Port by Year

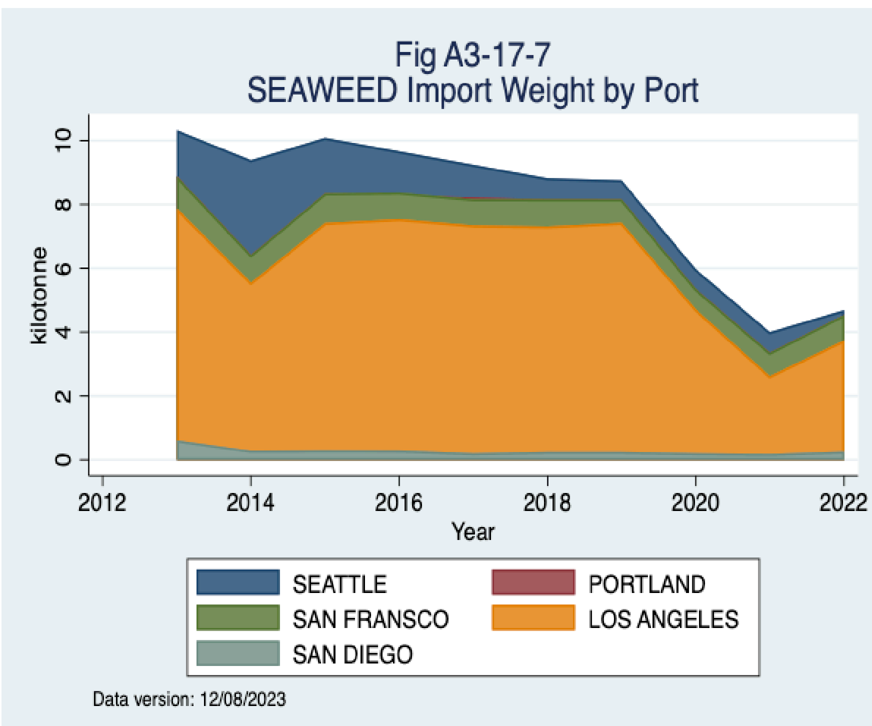


Fig A3-17-8: SEAWEED Value by Continent, Proportion

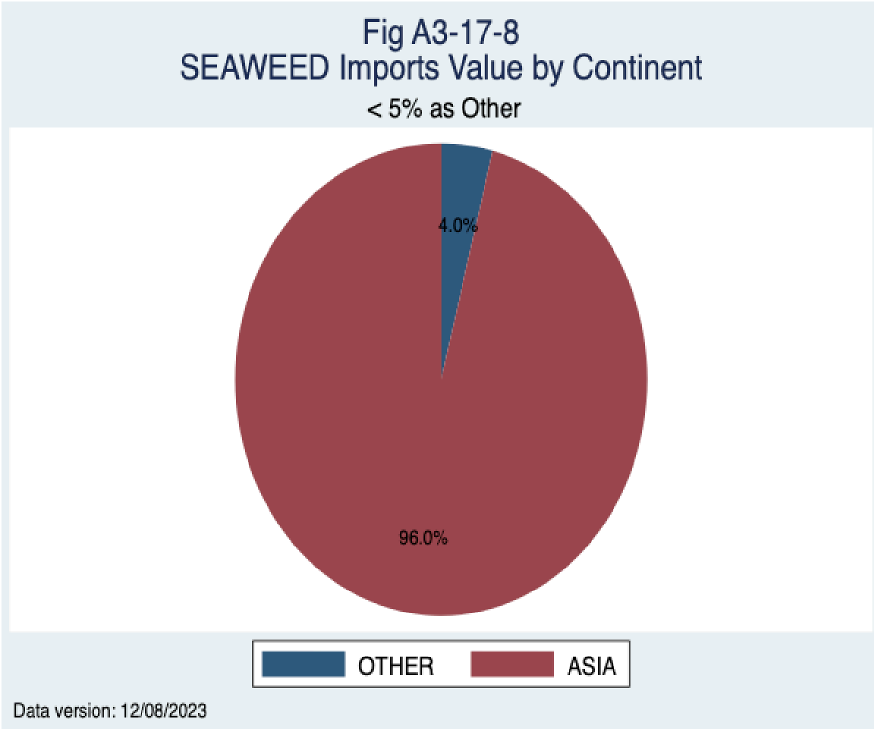


Fig A3-17-9: SEAWEED Weight by Continent, Proportion

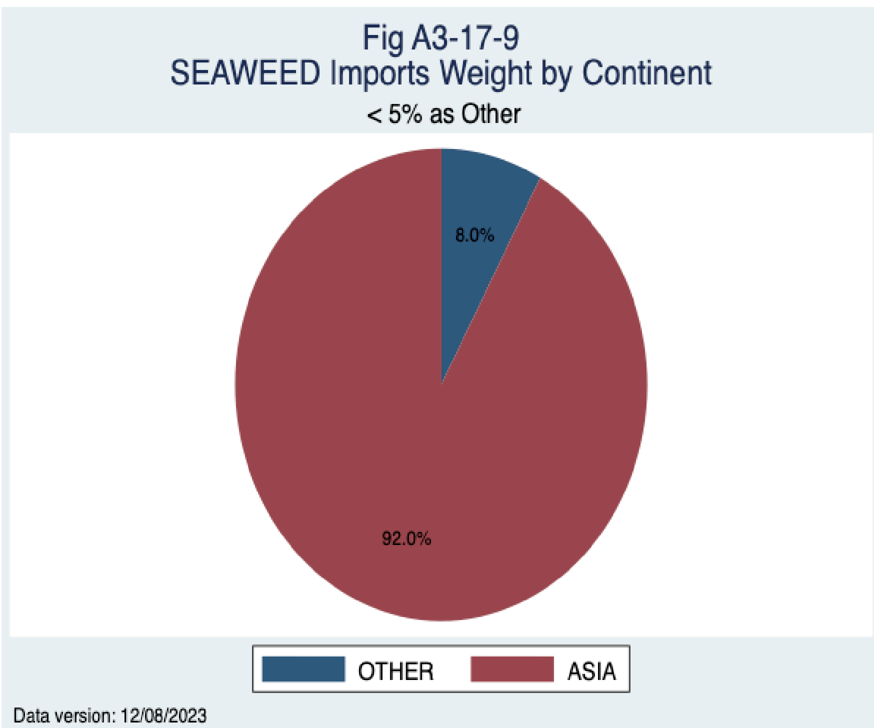


Fig A3-17-10: SEAWEED Value by Continent by Year

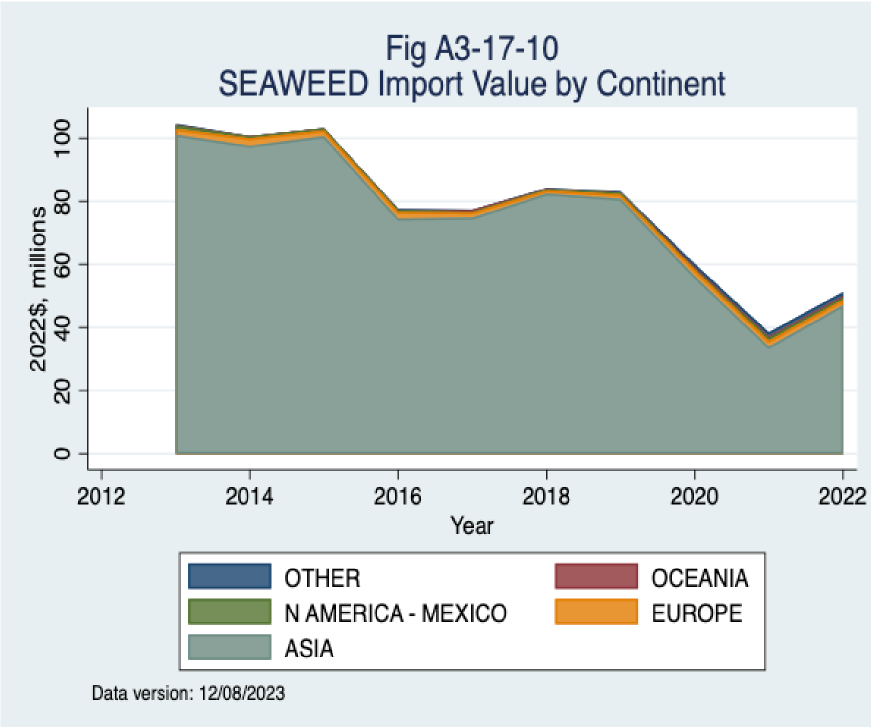


Fig A3-17-11: SEAWEED Weight by Continent by Year

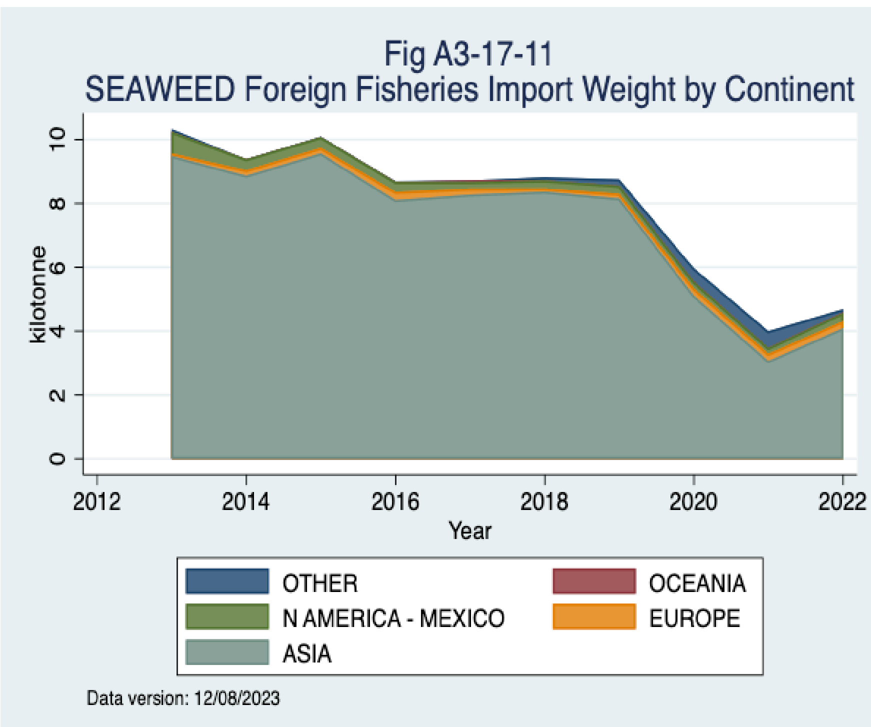


Fig A3-17-12: SEAWEED Value by Country, Proportion

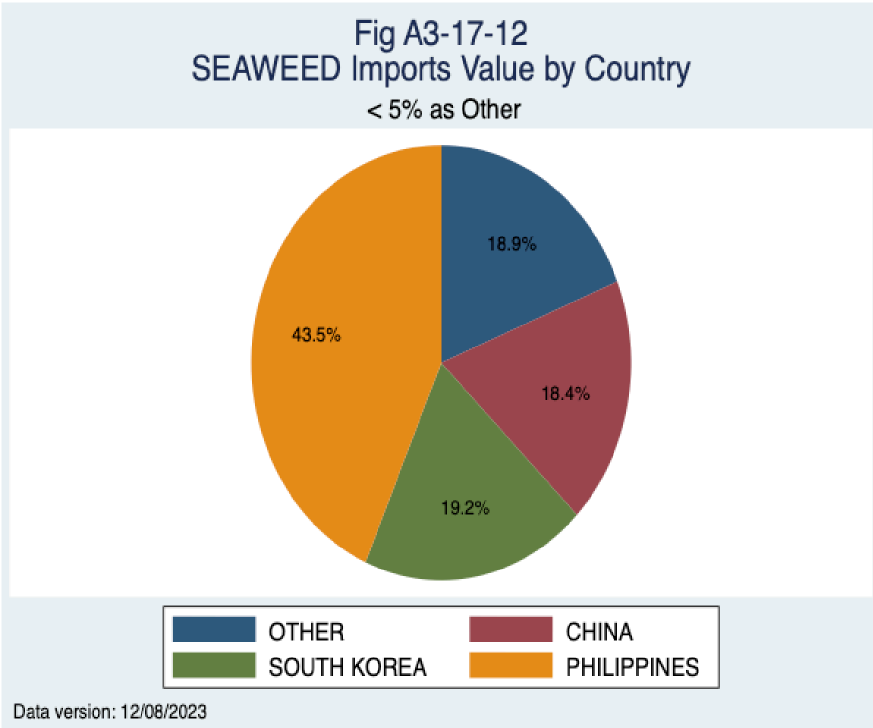


Fig A3-17-13: SEAWEED Weight by Country, Proportion

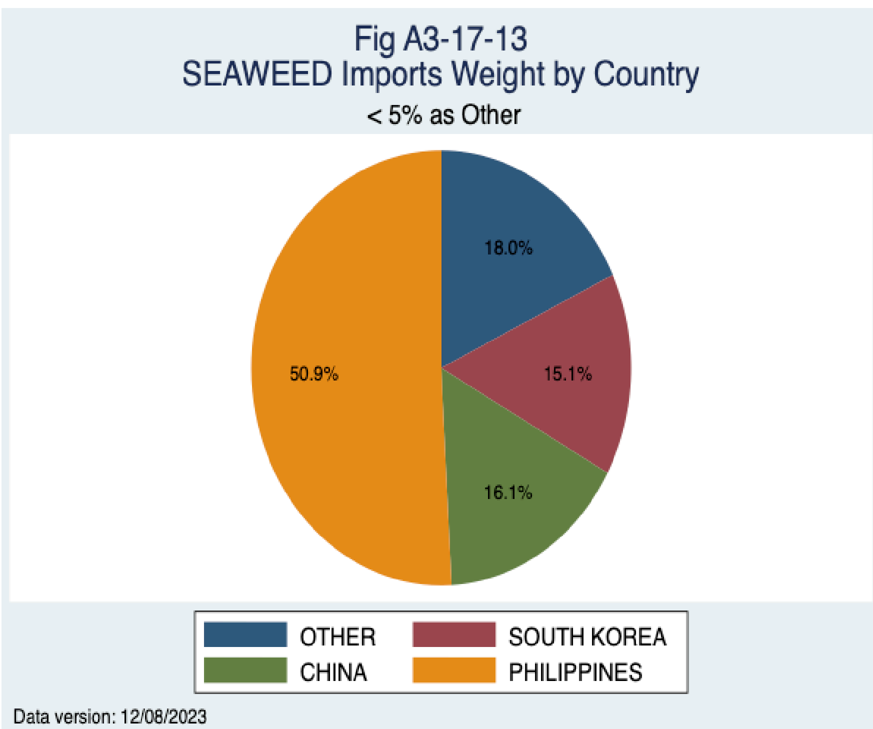


Fig A3-17-14: SEAWEED Value by Country by Year

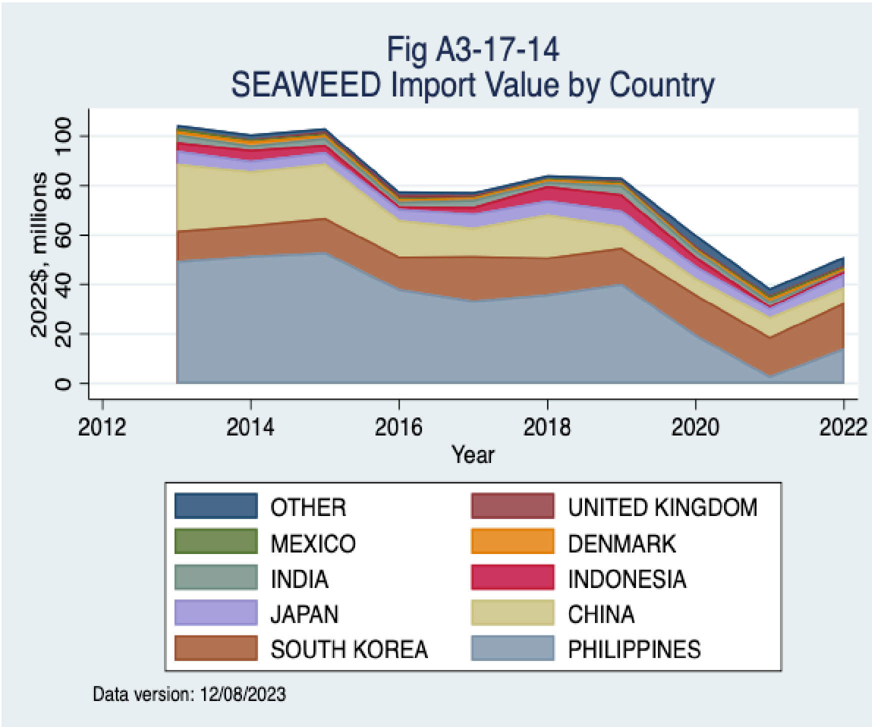
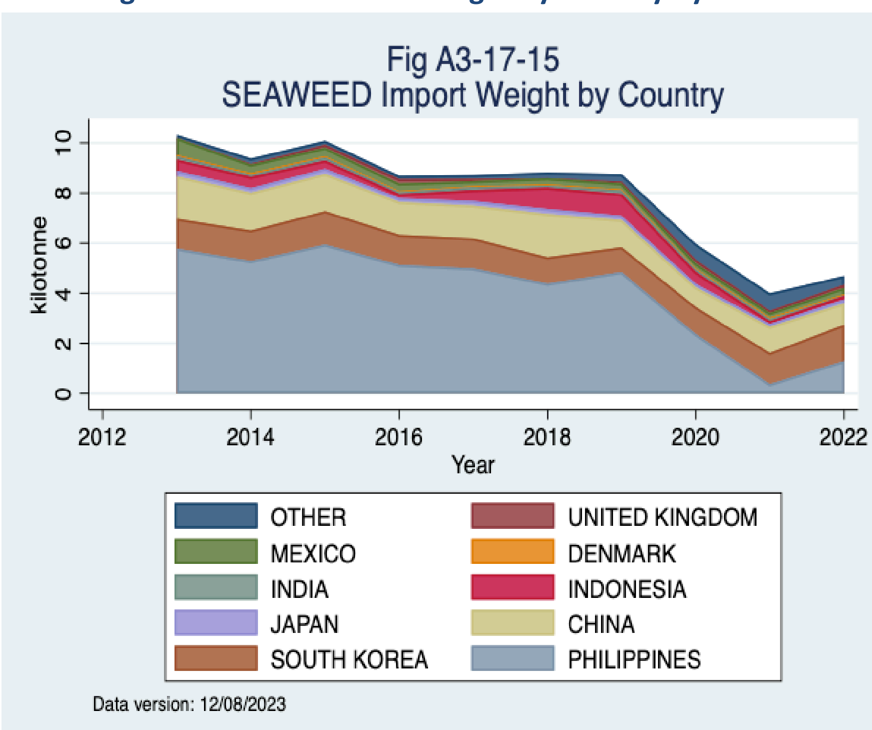


Fig A3-17-15: SEAWEED Weight by Country by Year



Figures for AGAR product group

Fig A3-18-1: AGAR Weight & Value by Year

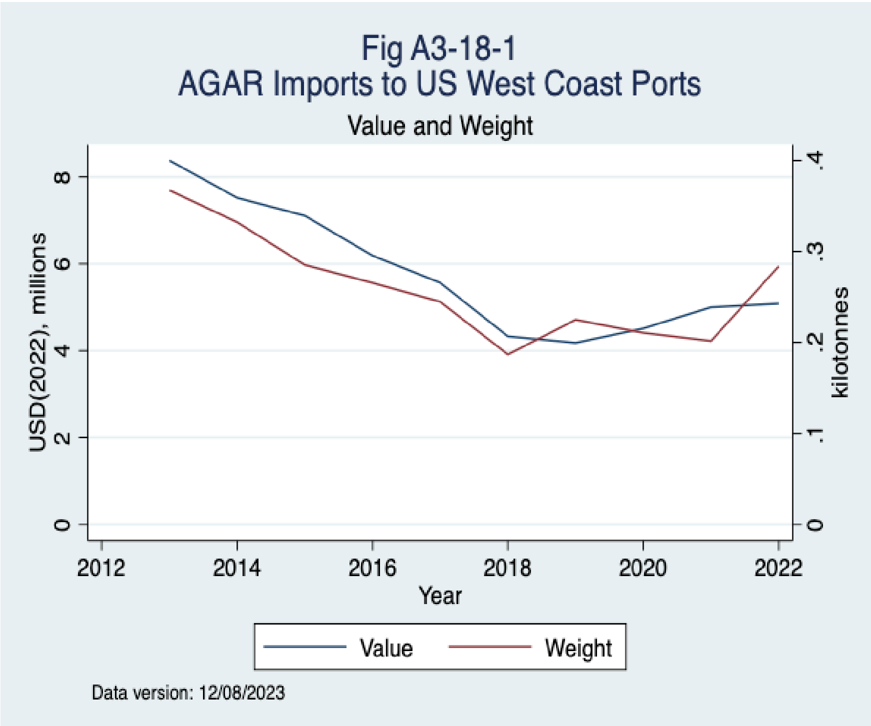


Fig A3-18-2: AGAR Value & Price by Year

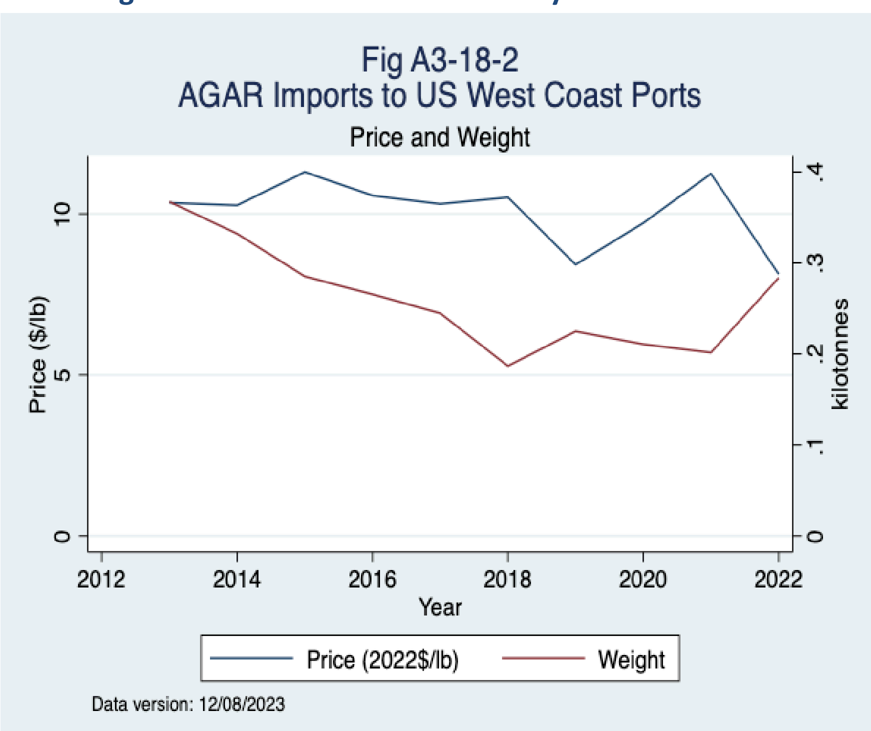


Fig A3-18-3: AGAR Price Percentiles by Year

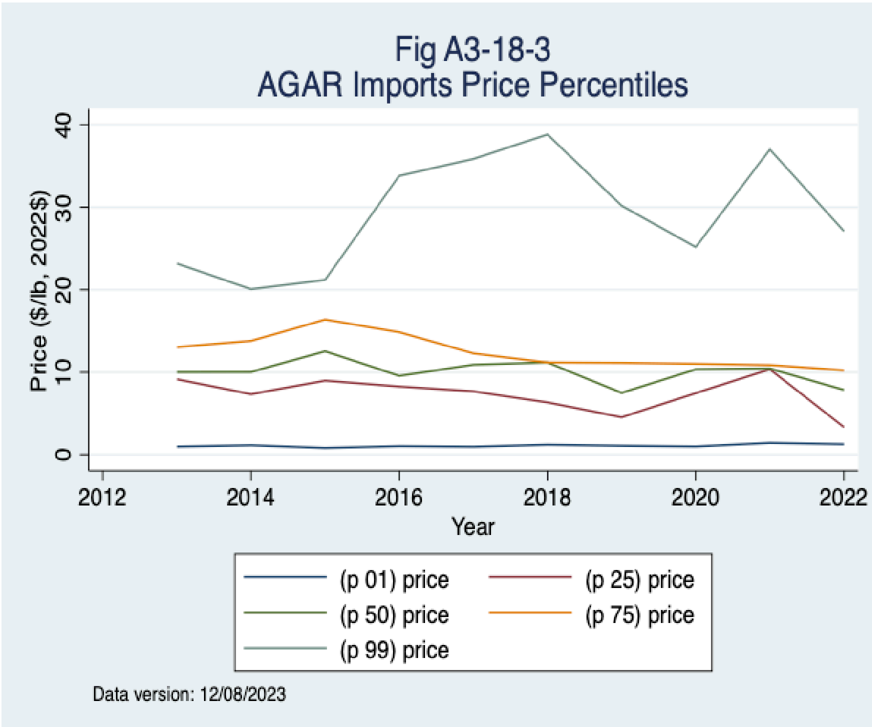


Fig A3-18-4: AGAR Value by Port, Proportion

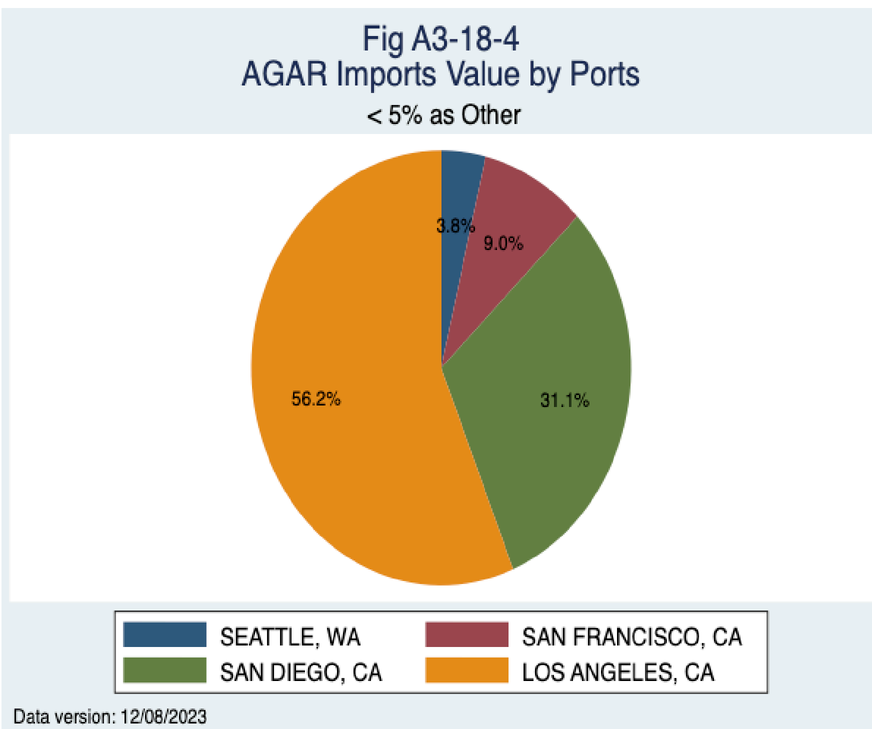


Fig A3-18-5: AGAR Weight by Port, Proportion

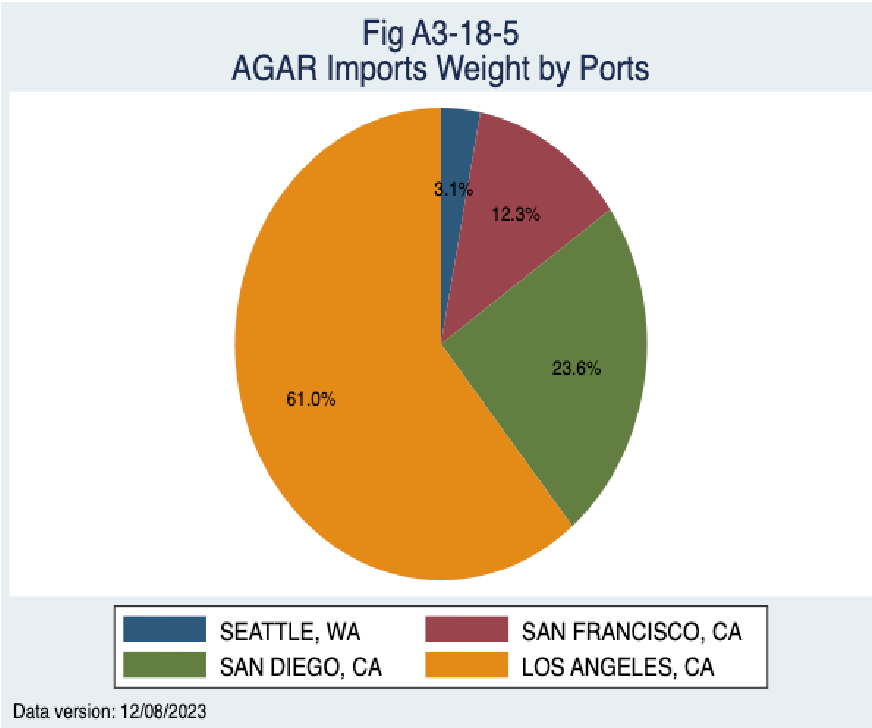


Fig A3-18-6: AGAR Value by Port by Year

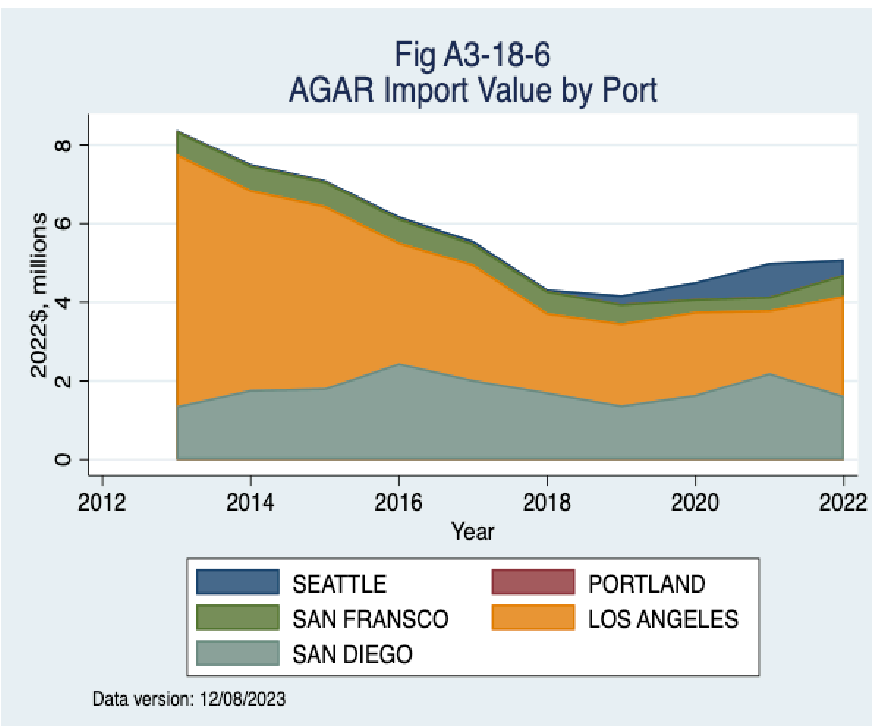


Fig A3-18-7: AGAR Weight by Port by Year

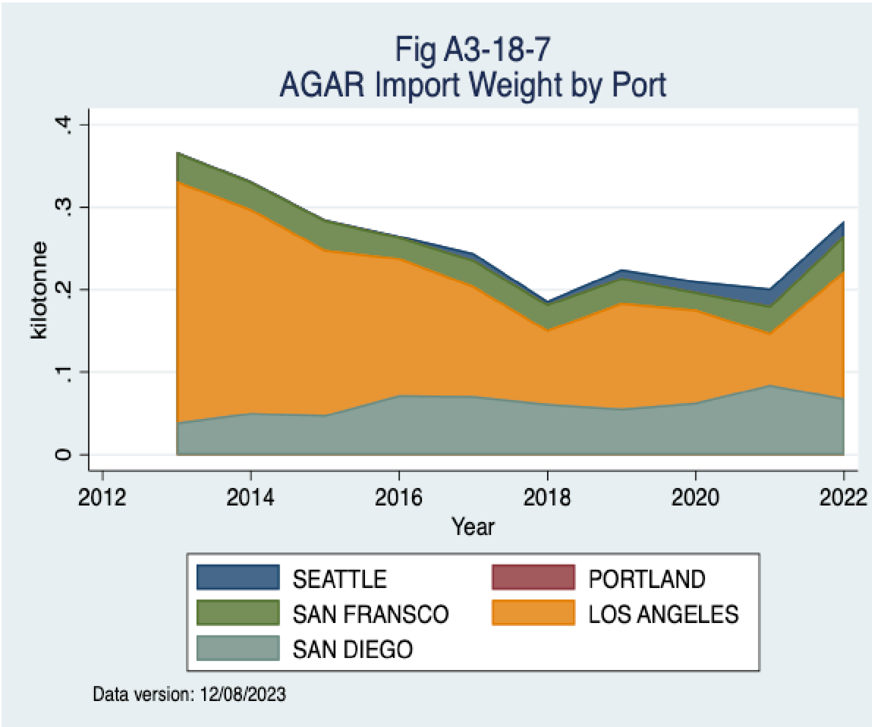


Fig A3-18-8: AGAR Value by Continent, Proportion

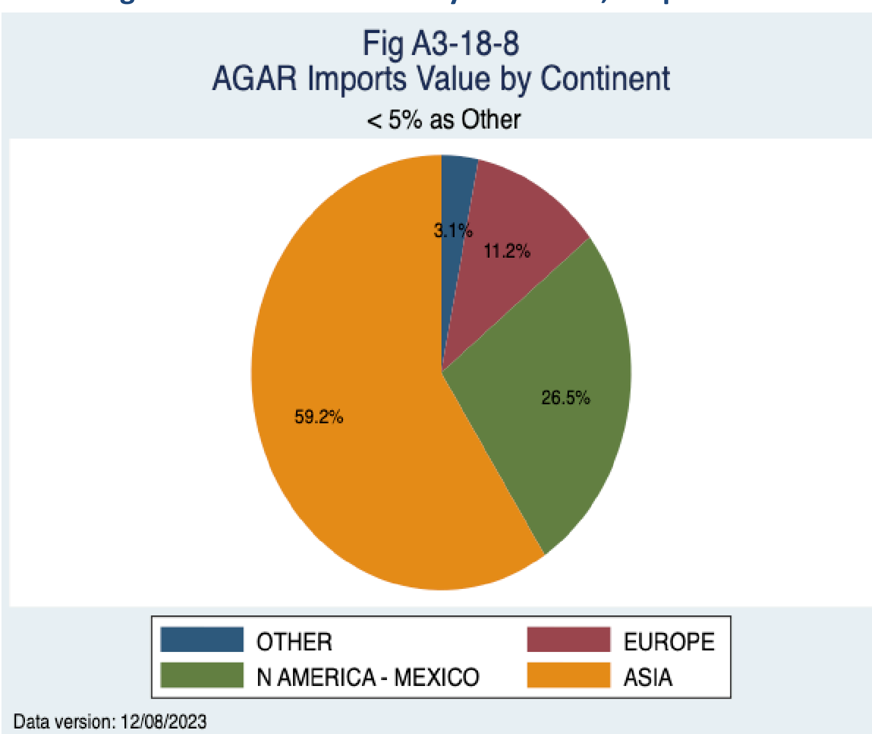


Fig A3-18-9: AGAR Weight by Continent, Proportion

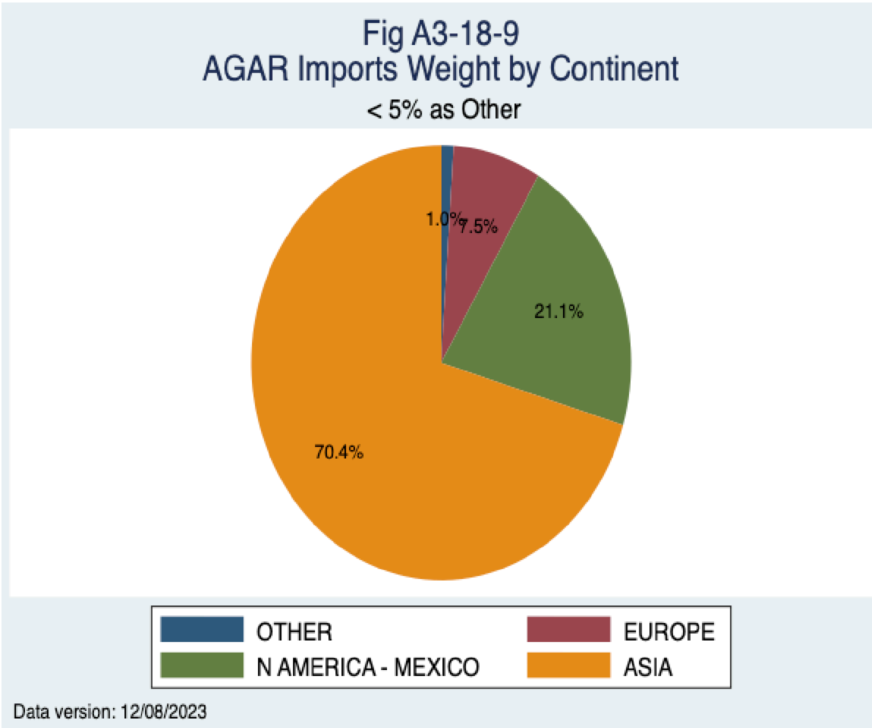


Fig A3-18-10: AGAR Value by Continent by Year

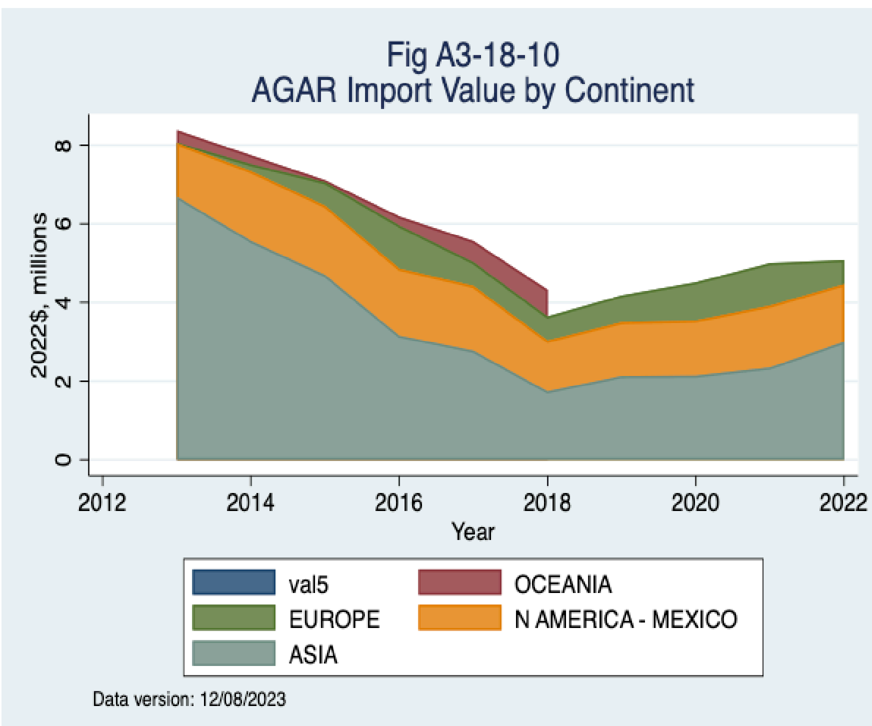


Fig A3-18-11: AGAR Weight by Continent by Year

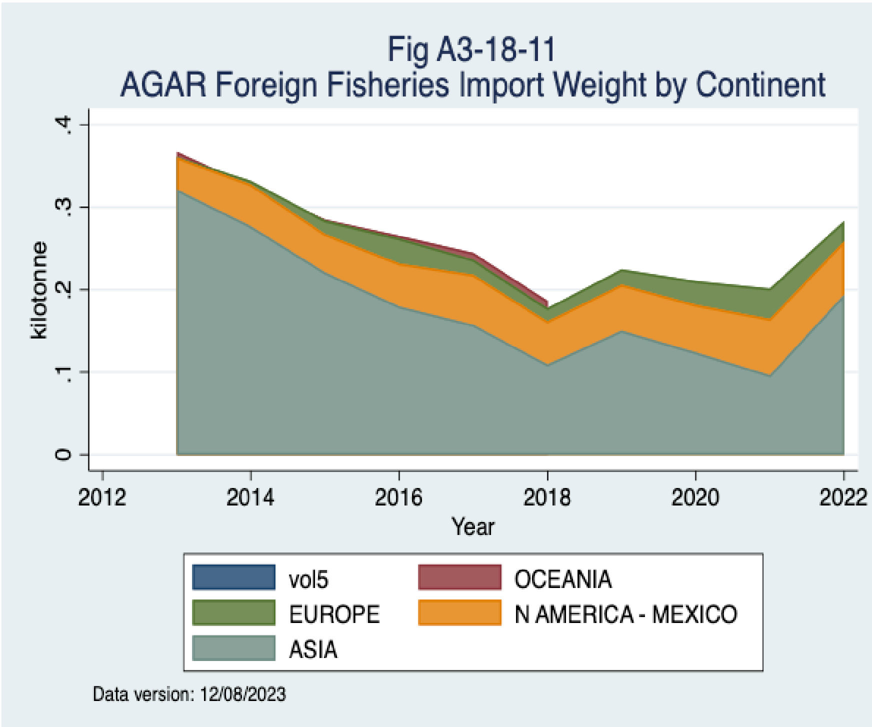


Fig A3-18-12: AGAR Value by Country, Proportion

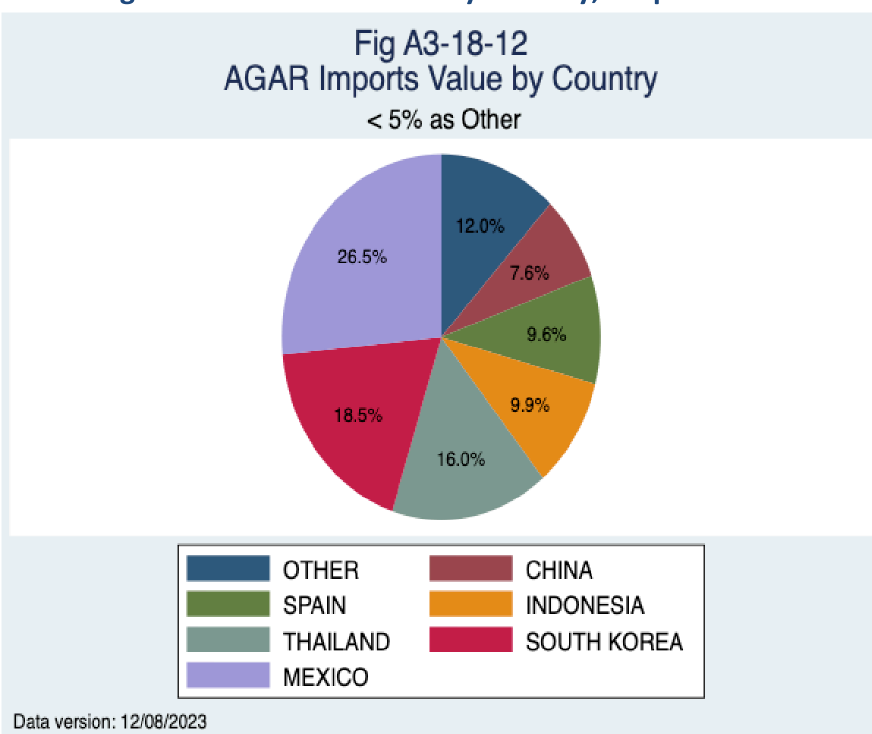


Fig A3-18-13: AGAR Weight by Country, Proportion

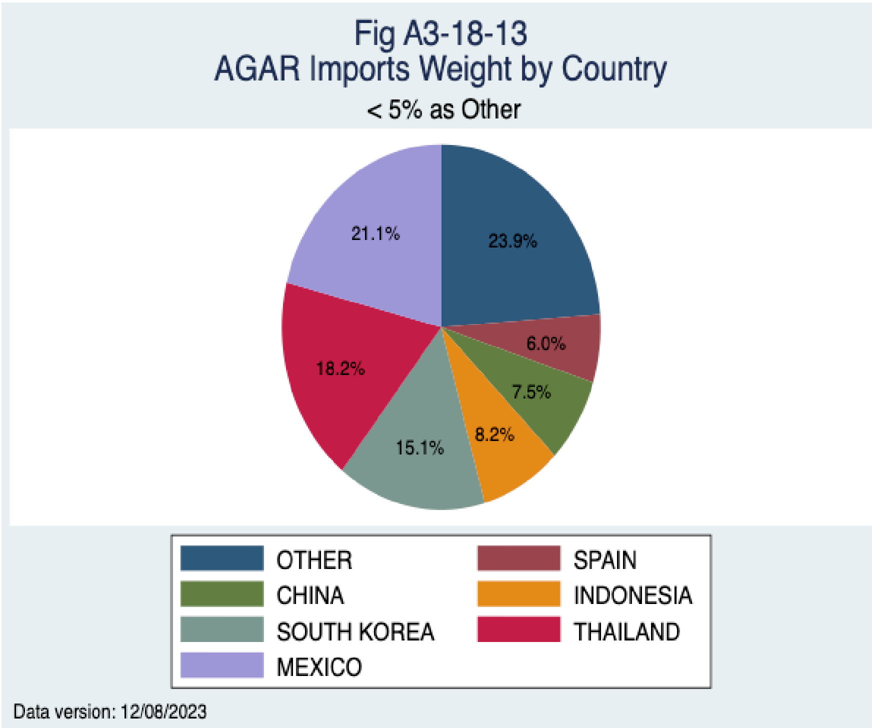


Fig A3-18-14: AGAR Value by Country by Year

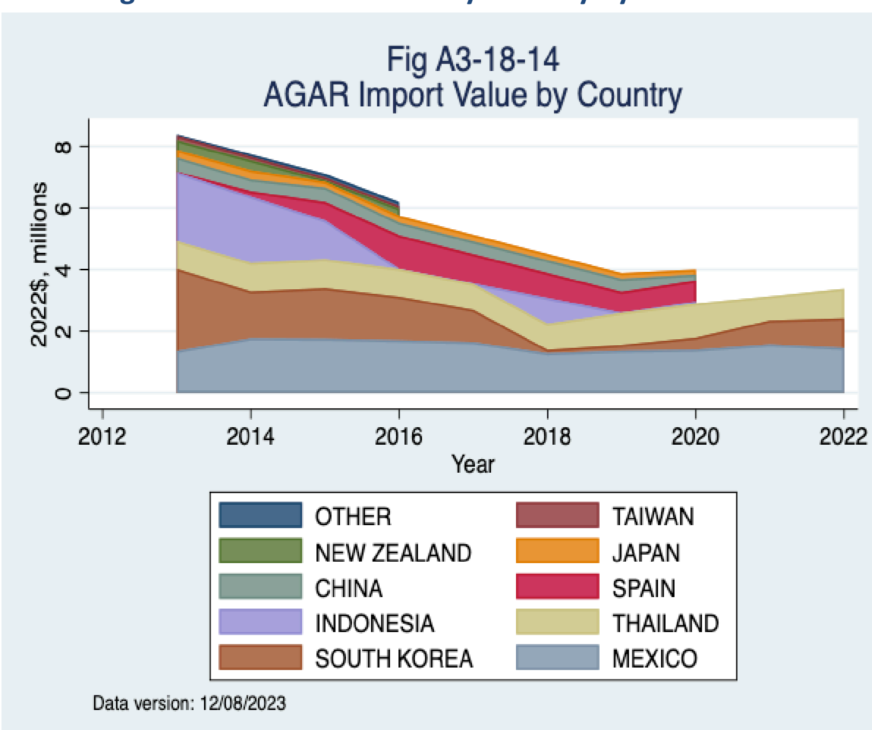
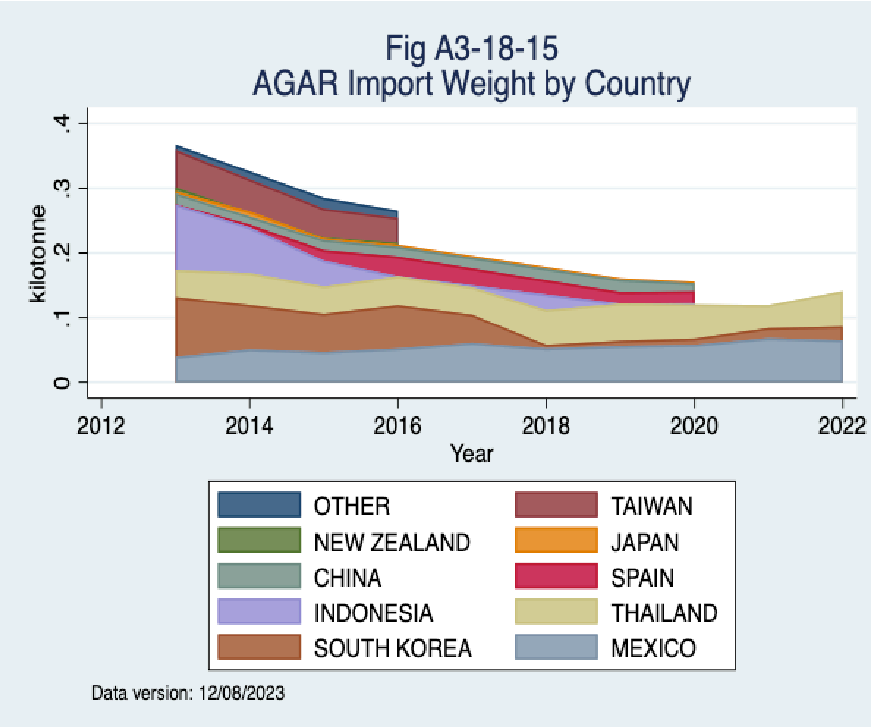


Fig A3-18-15: AGAR Weight by Country by Year



APPENDIX 4. IMPORT TABLES (LINK)

Tables for ALL product group

Table A4-1-1 ALL Value, Volume, Price by Year

Year	Value (2022$)	Weight (kg)	Price (2022$ / lb)
2013	7,266,468,716	868,406,597	3.79
2014	7,890,079,228	881,740,129	4.06
2015	7,041,891,113	886,937,370	3.60
2016	7,200,794,091	894,586,868	3.65
2017	7,737,833,335	901,097,425	3.89
2018	7,891,852,364	928,448,655	3.85
2019	7,319,230,111	863,510,350	3.84
2020	6,902,930,732	845,079,908	3.70
2021	7,731,075,419	888,233,729	3.95
2022	7,563,940,284	864,973,230	3.97

Table A4-1-2 ALL Value, Volume, Price by Port: 2013-2022

US Customs District	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SAN DIEGO, CA	2,259,896,999	364,353,300	2.81
LOS ANGELES, CA	51,430,266,800	6,248,771,614	3.73
SAN FRANCISCO, CA	4,279,264,760	602,843,410	3.22
PORTLAND, OR	52,755,492	8,525,838	2.81
SEATTLE, WA	16,523,911,342	1,598,520,099	4.69

Table A4-1-3 ALL Value, Volume, Price by Continent: 2013-2022

Continent	Value (2022$)	Weight (kg)	Price (2022$ / lb)
AFRICA	717,811,396	98,746,248	3.30
ASIA	45,082,480,290	5,811,091,833	3.52
CARIBBEAN	17,008,574	794,495	9.71
CENTRAL AMERICA	514,755,148	61,346,108	3.81
EUROPE	9,038,363,973	548,011,867	7.48
N AMERICA - CANADA	6,662,421,583	797,407,477	3.79
N AMERICA - MEXICO	1,608,130,508	277,744,513	2.63
OCEANIA	2,263,856,207	260,987,283	3.93
SOUTH AMERICA	8,641,267,713	966,884,437	4.05

Table A4-1-4 ALL Value, Volume, Price by Country: 2013-2022

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
ALBANIA	10,530	470	10.16
ANTIGUA & BARBUDA	269,604	11,793	10.37
ARGENTINA	696,132,314	65,495,142	4.82
ARMENIA	2,024,721	166,999	5.50
AUSTRALIA	437,355,947	21,159,089	9.37
BAHAMAS	11,587,993	277,737	18.92
BAHRAIN	2,085,562	372,208	2.54
BANGLADESH	181,668,874	10,622,054	7.76
BELARUS	2,481,027	439,917	2.56
BELGIUM	840,158	25,091	15.19
BELIZE	6,785,086	474,706	6.48
BERMUDA	2,828,432	92,936	13.80
BOLIVIA	405,066	80,000	2.30
BRAZIL	31,313,637	6,875,287	2.07
BRUNEI	1,002,209	87,417	5.20
BULGARIA	5,697,331	70,526	36.64
BURMA	183,392,016	9,878,063	8.42
BURUNDI	5,096	318	7.27
CAMBODIA	192,549	13,445	6.49
CAMEROON	2,591	653	1.80
CANADA	6,662,421,583	797,407,477	3.79
CAPE VERDE	2,556,160	292,966	3.96
CHILE	3,499,886,931	323,626,893	4.90
CHINA	10,197,884,067	1,765,102,635	2.62
CHINA - HONG KONG	240,955,661	56,795,204	1.92
CHINA - MACAO	30,415	1,621	8.51
COCOS IS.	49,655	21,792	1.03
COLOMBIA	96,696,573	13,195,058	3.32
CONGO (KINSHASA)	5,712	747	3.47
COOK IS.	619,524	95,706	2.94
COSTA RICA	88,570,662	12,554,316	3.20
CROATIA	1,724,598	134,960	5.80
CYPRUS	11,387,104	1,086,256	4.75
DENMARK	143,815,001	12,752,178	5.11
DOMINICAN REPUBLIC	64,794	136,078	0.22
ECUADOR	3,594,465,275	464,674,546	3.51
EGYPT	35,246,209	6,657,262	2.40
EL SALVADOR	5,921,332	541,584	4.96
ESTONIA	40,577	26,857	0.69
FALKLAND IS.	22,557,739	945,955	10.81

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
FAROE IS.	348,129,377	33,950,444	4.65
FED STATES OF MICRON	1,544,063	94,420	7.42
FIJI	887,903,868	128,384,019	3.14
FINLAND	58,012	136	193.45
FRANCE	54,469,778	7,645,008	3.23
FRENCH POLYNESIA	106,462,630	9,419,791	5.13
GEORGIA	87,913	519	76.82
GERMANY	147,671,812	11,094,661	6.04
GHANA	361,874	86,518	1.90
GIBRALTAR	5,691,691	254,727	10.13
GREECE	72,683,663	4,641,464	7.10
GREENLAND	11,490,227	863,394	6.04
GRENADA	25,344	681	16.88
GUATEMALA	40,351,330	4,090,637	4.47
GUINEA	90,308	6,376	6.42
GUYANA	9,071,837	2,191,443	1.88
HAITI	382,146	12,794	13.55
HONDURAS	157,137,097	16,974,827	4.20
HUNGARY	53,916	271	90.23
ICELAND	175,399,719	16,617,329	4.79
INDIA	5,935,139,115	561,313,259	4.80
INDONESIA	7,857,311,019	724,645,389	4.92
IRAN	214,164	45,121	2.15
IRELAND	8,154,339	1,125,569	3.29
ISRAEL	7,099,317	339,699	9.48
ITALY	19,387,547	1,526,021	5.76
IVORY COAST	36,976	1,938	8.65
JAMAICA	981,498	22,798	19.52
JAPAN	2,003,088,542	136,123,336	6.67
JORDAN	105,505	4,070	11.76
KENYA	46,621	9,181	2.30
KIRIBATI	16,945,696	1,310,743	5.86
KYRGYZSTAN	137,200	18,525	3.36
LATVIA	10,906,666	2,505,934	1.97
LIBERIA	13,001	1,030	5.72
LITHUANIA	22,822,140	2,698,434	3.84
MADAGASCAR	462,506	3,109	67.47
MALAYSIA	399,972,961	45,094,456	4.02
MALDIVE IS.	82,787,308	6,177,390	6.08
MALTA	1,240,508	96,000	5.86
MARSHALL IS.	18,262,103	1,957,740	4.23

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
MAURITANIA	6,103,204	882,145	3.14
MAURITIUS	366,751,853	51,934,720	3.20
MEXICO	1,608,130,508	277,744,513	2.63
MOLDOVA	525,767	805	296.20
MOROCCO	97,076,665	20,020,500	2.20
MOZAMBIQUE	159,298	41,603	1.74
NAMIBIA	1,285,477	143,644	4.06
NETHERLANDS	263,404,554	16,129,619	7.41
NEW CALEDONIA	7,023,959	350,374	9.09
NEW ZEALAND	747,224,838	92,156,803	3.68
NICARAGUA	102,615,539	10,306,769	4.52
NIGERIA	229,048	17,625	5.89
NIUE	155,978	17,268	4.10
NORFOLK IS.	294,187	20,108	6.64
NORWAY	2,128,095,545	183,254,063	5.27
OMAN	9,288,546	1,694,600	2.49
PAKISTAN	50,660,483	2,512,436	9.14
PALAU	368,745	60,869	2.75
PANAMA	113,374,102	16,403,269	3.13
PAPUA NEW GUINEA	15,219,355	1,223,280	5.64
PERU	609,470,173	77,811,115	3.55
PHILIPPINES	1,622,611,517	224,333,260	3.28
POLAND	53,739,597	6,631,857	3.67
PORTUGAL	17,529,400	2,385,760	3.33
REUNION	47,946,893	1,787,380	12.17
ROMANIA	264,202	31,160	3.85
RUSSIAN FEDERATION	4,892,598,222	182,381,009	12.17
SAUDI ARABIA	14,205,052	1,662,896	3.87
SENEGAL	66,517,941	11,065,052	2.73
SEYCHELLES	7,066,370	459,160	6.98
SIERRA LEONE	11,769	1,202	4.44
SINGAPORE	126,410,415	15,263,921	3.76
SOLOMON IS.	10,274,139	2,136,000	2.18
SOMALIA	5,161	510	4.59
SOUTH AFRICA	48,090,369	3,092,080	7.05
SOUTH KOREA	1,121,551,098	129,629,506	3.92
SPAIN	197,492,466	16,284,573	5.50
SRI LANKA	106,381,572	7,449,061	6.48
ST. HELENA	27,371,610	1,073,504	11.56
ST. LUCIA	149,516	5,112	13.26
SURINAME	12,844,061	1,624,306	3.59

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SWEDEN	577,695	35,299	7.42
SWITZERLAND	156,106	50,253	1.41
SYRIA	13,719	3,281	1.90
TAIWAN	1,242,507,084	240,014,709	2.35
TANZANIA	41,796	7,868	2.41
THAILAND	7,392,316,710	974,903,145	3.44
TOGO	24,348	2,275	4.85
TOKELAU IS.	78,435	2,602	13.67
TONGA	6,566,279	802,974	3.71
TRINIDAD & TOBAGO	631,601	217,132	1.32
TUNISIA	10,267,339	1,153,426	4.04
TURKEY	105,924,759	11,138,558	4.31
TURKS & CAICOS IS.	87,645	17,434	2.28
UGANDA	19,251	2,456	3.55
UKRAINE	21,499,086	838,570	11.63
UNITED ARAB EMIRATES	15,539,862	1,548,339	4.55
UNITED KINGDOM	312,400,853	31,294,694	4.53
URUGUAY	13,965,661	975,821	6.49
VANUATU	4,362,155	1,451,191	1.36
VENEZUELA	54,458,446	9,388,871	2.63
VIETNAM	6,285,815,112	895,275,269	3.18
WESTERN SAMOA	3,144,652	322,514	4.42
ZAMBIA	15,952	1,000	7.23

Tables for PROXY_FRESH product group

Table A4-2-1 PROXY_FRESH Value, Volume, Price by Year

Year	Value (2022$)	Weight (kg)	Price (2022$ / lb)
2013	150,235,131	13,039,444	5.23
2014	147,788,096	13,342,427	5.02
2015	149,052,783	14,173,326	4.77
2016	142,210,996	13,796,751	4.68
2017	151,355,890	14,204,682	4.83
2018	173,417,901	15,725,522	5.00
2019	175,938,554	15,574,825	5.12
2020	126,642,228	11,420,833	5.03
2021	202,732,829	17,990,286	5.11
2022	235,882,732	19,169,053	5.58

Table A4-2-2 PROXY_FRESH Value, Volume, Price by Port: 2013-2022

US Customs District	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SAN DIEGO, CA	396,658,889	37,979,090	4.74
LOS ANGELES, CA	846,723,192	74,303,253	5.17
SAN FRANCISCO, CA	216,118,014	16,913,282	5.80
PORTLAND, OR	291,087	25,573	5.16
SEATTLE, WA	195,465,957	19,215,951	4.61

Table A4-2-3 PROXY_FRESH Value, Volume, Price by Continent: 2013-2022

Continent	Value (2022$)	Weight (kg)	Price (2022$ / lb)
AFRICA	20,283,902	1,306,488	7.04
ASIA	674,522,151	51,169,770	5.98
CARIBBEAN	164,430	5,698	13.09
CENTRAL AMERICA	22,237,000	2,165,491	4.66
EUROPE	146,750,604	13,813,696	4.82
N AMERICA - CANADA	131,963,657	12,785,246	4.68
N AMERICA - MEXICO	397,862,087	38,158,253	4.73
OCEANIA	250,198,168	27,356,308	4.15
SOUTH AMERICA	11,275,140	1,676,199	3.05

Table A4-2-4 PROXY_FRESH Value, Volume, Price by Country: 2013-2022

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
AUSTRALIA	54,119,674	3,961,603	6.20
BRAZIL	540,691	59,255	4.14
CANADA	131,963,657	12,785,246	4.68
CHILE	2,605,647	872,788	1.35
CHINA	127,893,629	9,595,615	6.05
CHINA - HONG KONG	573,517	71,555	3.64
COOK IS.	73,189	24,776	1.34
COSTA RICA	5,483,707	448,338	5.55
CROATIA	36,352	1,375	11.99
CYPRUS	7,026,305	634,471	5.02
DENMARK	3,658	349	4.75
DOMINICAN REPUBLIC	3,478	319	4.94
ECUADOR	7,613,335	718,223	4.81
FED STATES OF MICRON	438,644	47,275	4.21
FIJI	68,949,796	11,014,196	2.84
FRANCE	566,188	33,535	7.66
FRENCH POLYNESIA	97,060,572	8,508,089	5.17
GERMANY	16,793	2,202	3.46
GREECE	22,934,370	2,648,594	3.93
GRENADA	25,344	681	16.88

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
INDIA	12,370,743	513,061	10.94
INDONESIA	6,607,586	672,706	4.46
IRELAND	146,672	5,296	12.56
ITALY	462,139	28,126	7.45
JAPAN	60,724,410	1,927,114	14.29
KIRIBATI	2,781,590	251,338	5.02
LIBERIA	13,001	1,030	5.73
MALDIVE IS.	56,477,745	3,719,595	6.89
MALTA	70,960	3,049	10.56
MARSHALL IS.	4,561,283	422,672	4.89
MAURITIUS	254,962	26,305	4.40
MEXICO	397,862,087	38,158,253	4.73
MOZAMBIQUE	60,587	16,741	1.64
NETHERLANDS	1,062,089	56,276	8.56
NEW ZEALAND	15,875,201	2,222,420	3.24
NORWAY	91,726	8,937	4.66
OMAN	2,819,329	212,351	6.02
PALAU	185,931	54,274	1.55
PANAMA	16,753,293	1,717,153	4.43
PERU	443,776	20,000	10.06
PHILIPPINES	170,731,040	16,931,232	4.57
PORTUGAL	570,005	16,669	15.51
RUSSIAN FEDERATION	51,503	615	37.99
SENEGAL	22,034	1,283	7.79
SEYCHELLES	6,024,938	380,467	7.18
SINGAPORE	765,207	64,406	5.39
SOLOMON IS.	1,592,005	286,013	2.52
SOUTH AFRICA	13,238,867	855,875	7.02
SOUTH KOREA	131,802,414	10,112,137	5.91
SPAIN	43,329,417	2,114,164	9.30
SRI LANKA	56,268,312	3,709,056	6.88
ST. LUCIA	135,609	4,698	13.09
SWEDEN	3,742	349	4.86
TAIWAN	4,160,992	421,471	4.48
THAILAND	12,392,753	865,876	6.49
TOKELAU IS.	78,435	2,602	13.67
TONGA	1,285,653	216,333	2.70
TUNISIA	669,513	24,787	12.25
TURKEY	64,824,289	7,454,584	3.94
UNITED KINGDOM	5,554,397	805,105	3.13
URUGUAY	71,691	5,933	5.48

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
VANUATU	60,353	22,933	1.19
VIETNAM	30,934,474	2,353,595	5.96
WESTERN SAMOA	3,135,840	321,784	4.42

Table A4-2-5 PROXY_FRESH Value, Volume, Price by Product: 2013-2022

Product Name	Value (2022$)	Weight (kg)	Price (2022$ / lb)
ABALONE LIVE/FRESH	6,012,591	760,399	3.59
BASS FRESH	33,679,316	3,205,550	4.77
MUSSELS LIVE/FRESH FARMED	14,799,791	2,353,588	2.85
MUSSELS LIVE/FRESH WILD	4,353,808	990,904	1.99
OYSTERS LIVE/FRESH FARMED	203,867,296	30,673,414	3.01
OYSTERS LIVE/FRESH WILD	8,117,776	879,674	4.19
SCALLOPS LIVE/FRESH	32,967,584	3,485,666	4.29
SEA BASS (DICENTRARCHUS SPP.) FRESH	105,768,962	12,083,239	3.97
SEA BASS (DICENTRARCHUS SPP.) FRESH NOT > 6.8KG	153,816	25,599	2.73
SEAWEED AND OTHER ALGAE FIT FOR HUMAN CONSUMPTION	377,847,128	29,203,177	5.87
TUNA ALBACORE FRESH	38,343,393	6,859,090	2.54
TUNA BIGEYE FRESH	103,704,512	8,471,763	5.55
TUNA BLUEFIN ATLANTIC, PACIFIC FRESH	296,164,116	12,832,250	10.47
TUNA BLUEFIN SOUTHERN FRESH	4,432,254	354,903	5.66
TUNA NSPF FRESH	8,370,715	792,356	4.79
TUNA SKIPJACK FRESH	151,203	38,232	1.79
TUNA YELLOWFIN FRESH	416,522,878	35,427,345	5.33

Tables for PROXY_OTHER product group

Table A4-3-1 PROXY_OTHER Value, Volume, Price by Year

Year	Value (2022$)	Weight (kg)	Price (2022$ / lb)
2013	1,059,664,628	140,919,488	3.41
2014	912,516,860	133,558,943	3.10
2015	892,070,265	125,908,093	3.21
2016	841,415,828	118,590,777	3.22
2017	890,709,628	121,977,385	3.31
2018	1,021,283,624	136,821,650	3.39
2019	1,007,102,890	133,792,767	3.41
2020	965,022,076	140,342,587	3.12
2021	863,935,080	112,431,103	3.49
2022	998,299,131	121,443,062	3.73

Table A4-3-2 PROXY_OTHER Value, Volume, Price by Port: 2013-2022

US Customs District	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SAN DIEGO, CA	369,849,896	50,962,134	3.29
LOS ANGELES, CA	7,770,807,910	1,067,050,300	3.30
SAN FRANCISCO, CA	567,688,232	73,969,623	3.48
PORTLAND, OR	14,787,903	4,745,924	1.41
SEATTLE, WA	728,886,071	89,057,874	3.71

Table A4-3-3 PROXY_OTHER Value, Volume, Price by Continent: 2013-2022

Continent	Value (2022$)	Weight (kg)	Price (2022$ / lb)
AFRICA	426,428,236	61,612,075	3.14
ASIA	6,952,794,375	938,965,412	3.36
CARIBBEAN	17,273	558	14.04
CENTRAL AMERICA	27,247,508	6,318,421	1.96
EUROPE	43,388,285	4,971,752	3.96
N AMERICA - CANADA	220,998,284	18,835,594	5.32
N AMERICA - MEXICO	186,408,769	23,838,623	3.55
OCEANIA	1,146,126,754	156,512,894	3.32
SOUTH AMERICA	448,610,528	74,730,526	2.72

Table A4-3-4 PROXY_OTHER Value, Volume, Price by Country: 2013-2022

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
ARGENTINA	4,032,221	978,266	1.87
AUSTRALIA	75,507,737	1,783,672	19.20
BELGIUM	3,085	10	139.95
BELIZE	145,976	10,600	6.25
BOLIVIA	405,066	80,000	2.30
BRAZIL	375,830	48,318	3.53
BURMA	4,515	493	4.15
CANADA	220,998,284	18,835,594	5.32
CAPE VERDE	870,747	106,246	3.72
CHILE	64,634,057	15,905,364	1.84
CHINA	861,343,900	122,998,685	3.18
CHINA - HONG KONG	53,260,501	2,669,824	9.05
COLOMBIA	58,431,037	8,146,154	3.25
COSTA RICA	22,834,938	5,609,192	1.85
CROATIA	1,442,753	87,715	7.46
DENMARK	9,598,172	490,990	8.87
DOMINICAN REPUBLIC	3,365	144	10.60
ECUADOR	288,383,648	45,590,751	2.87
EL SALVADOR	1,936,492	235,791	3.73

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
FED STATES OF MICRON	581,603	37,321	7.07
FIJI	801,588,760	113,835,668	3.19
FRANCE	10,785,878	1,954,379	2.50
FRENCH POLYNESIA	117,749	11,607	4.60
GERMANY	28,339	3,396	3.79
GUATEMALA	20,017	22,500	0.40
ICELAND	366,153	5,103	32.55
INDIA	10,806,259	488,074	10.04
INDONESIA	1,138,201,516	108,446,354	4.76
IRAN	214,164	45,121	2.15
IRELAND	545,709	124,677	1.99
ISRAEL	182,520	11,363	7.29
ITALY	1,988,764	297,274	3.03
IVORY COAST	36,976	1,938	8.65
JAPAN	348,276,148	15,107,780	10.46
KIRIBATI	9,899,933	853,377	5.26
MALAYSIA	4,216,530	540,006	3.54
MALDIVE IS.	19,841,337	2,069,300	4.35
MALTA	1,169,548	92,951	5.71
MARSHALL IS.	12,295,053	1,425,696	3.91
MAURITANIA	11,250	90	56.70
MAURITIUS	362,457,967	51,620,148	3.18
MEXICO	186,408,769	23,838,623	3.55
MOROCCO	3,783	68	25.24
NETHERLANDS	106,037	10,055	4.78
NEW ZEALAND	233,418,526	36,908,766	2.87
NORWAY	971,586	226,169	1.95
OMAN	399,841	60,515	3.00
PANAMA	2,310,085	440,338	2.38
PAPUA NEW GUINEA	7,038,922	952,727	3.35
PERU	20,737,904	2,571,536	3.66
PHILIPPINES	864,404,223	106,969,504	3.67
PORTUGAL	991,336	145,887	3.08
SENEGAL	58,821,203	9,401,013	2.84
SEYCHELLES	258,787	25,791	4.55
SINGAPORE	5,106,385	473,123	4.90
SOLOMON IS.	5,678,472	704,060	3.66
SOUTH AFRICA	3,717,270	451,165	3.74
SOUTH KOREA	204,881,601	24,094,045	3.86
SPAIN	10,189,217	798,779	5.79
SRI LANKA	24,352,158	1,911,279	5.78

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
ST. LUCIA	13,907	414	15.24
SURINAME	11,610,765	1,410,137	3.73
TAIWAN	103,996,668	8,282,549	5.70
THAILAND	2,184,458,228	394,969,557	2.51
TUNISIA	250,253	5,616	20.21
TURKEY	4,618,094	590,032	3.55
UNITED KINGDOM	583,612	144,335	1.83
VIETNAM	1,128,847,882	149,827,840	3.42

Table A4-3-5 PROXY_OTHER Value, Volume, Price by Product: 2013-2022

Product Name	Value (2022$)	Weight (kg)	Price (2022$ / lb)
ABALONE DRIED/SALTED/BRINE	17,062,965	404,708	19.12
ABALONE FROZEN	49,507,529	1,223,842	18.35
ABALONE FROZEN/DRIED/SALTED/BRINE	43,873,484	1,219,822	16.31
ABALONE PREPARED/PRESERVED	114,409,440	2,961,127	17.53
ABALONE PRODUCTS PREPARED DINNERS	1,439,151	292,369	2.23
AGAR AGAR	57,866,802	2,602,551	10.09
MUSSELS DRIED/SALTED/BRINE	20,191,277	3,406,626	2.69
MUSSELS FROZEN	119,938,493	21,025,671	2.59
MUSSELS FROZEN/DRIED/SALTED/BRINE	100,367,182	16,386,800	2.78
MUSSELS NSPF PREPARED/PRESERVED	43,091,852	13,351,769	1.46
MUSSELS PRODUCTS PREPARED DINNERS	4,040,621	1,113,276	1.65
OYSTERS CANNED	49,611,262	7,472,865	3.01
OYSTERS CANNED SMOKED	136,371,714	16,213,689	3.82
OYSTERS DRIED/SALTED/BRINE FARMED	6,852,233	597,558	5.20
OYSTERS DRIED/SALTED/BRINE WILD	4,582,997	574,417	3.62
OYSTERS FROZEN FARMED	36,415,429	4,862,933	3.40
OYSTERS FROZEN WILD	12,849,829	1,668,878	3.49
OYSTERS FROZEN/DRIED/SALTED/BRINE FARMED	43,022,676	4,788,494	4.08
OYSTERS FROZEN/DRIED/SALTED/BRINE WILD	6,463,352	1,048,600	2.80
OYSTERS PRODUCTS PREPARED DINNERS	1,209,467	260,394	2.11
SCALLOPS DRIED/SALTED/BRINE	105,328,735	3,964,627	12.05
SCALLOPS FROZEN	178,827,752	14,657,903	5.53
SCALLOPS FROZEN/DRIED/SALTED/BRINE	183,332,312	12,235,495	6.80
SCALLOPS PREPARED/PRESERVED	23,946,722	1,519,109	7.15
SCALLOPS PRODUCTS PREPARED DINNERS	10,723,417	1,995,946	2.44
SEA BASS (DICENTRARCHUS SPP.) FROZEN	14,119,498	2,793,338	2.29
SEAWEED AND OTHER ALGAE	93,994,561	15,472,585	2.76

Product Name	Value (2022$)	Weight (kg)	Price (2022$ / lb)
THICKENERS DERIVED FROM SEAWEED CARAGEENAN	308,952,569	34,772,813	4.03
TUNA ALBACORE FROZEN	43,669,531	10,020,625	1.98
TUNA ALBACORE IN ATC (FOIL OR FLEXIBLE) NOT IN OIL IN QUOTA	2,253,479	571,590	1.79
TUNA ALBACORE IN ATC (FOIL OR FLEXIBLE) NOT IN OIL OVER QUOTA	75,897,403	9,705,542	3.55
TUNA ALBACORE IN ATC (OTHER) IN OIL	14,170,940	2,427,406	2.65
TUNA ALBACORE IN ATC (OTHER) NOT IN OIL IN QUOTA	24,489,180	4,473,000	2.48
TUNA ALBACORE IN ATC (OTHER) NOT IN OIL OVER QUOTA	628,036,567	86,978,109	3.28
TUNA BIGEYE FROZEN	2,385,851	352,984	3.07
TUNA BLUEFIN ATLANTIC FROZEN	13,124,491	243,932	24.41
TUNA BLUEFIN PACIFIC FROZEN	1,712,866	267,153	2.91
TUNA BLUEFIN SOUTHERN FROZEN	3,981,337	95,153	18.98
TUNA NSPF FILLET FROZEN	2,228,001,840	166,223,070	6.08
TUNA NSPF FROZEN	1,385,867	448,589	1.40
TUNA NSPF IN ATC (FOIL OR FLEXIBLE) IN OIL	19,688,036	2,897,385	3.08
TUNA NSPF IN ATC (FOIL OR FLEXIBLE) NOT IN OIL IN QUOTA	7,035,265	1,329,611	2.40
TUNA NSPF IN ATC (FOIL OR FLEXIBLE) NOT IN OIL OVER QUOTA	708,137,583	112,604,500	2.85
TUNA NSPF IN ATC (OTHER) IN OIL	98,294,134	20,751,379	2.15
TUNA NSPF IN ATC (OTHER) NOT IN OIL IN QUOTA	30,370,592	7,388,717	1.86
TUNA NSPF IN ATC (OTHER) NOT IN OIL OVER QUOTA	1,310,072,379	296,539,684	2.00
TUNA NSPF MEAT FROZEN > 6.8KG	52,271,589	7,608,511	3.12
TUNA NSPF NOT IN A.T.C. NOT IN OIL > 6.8KG	2,164,521,351	344,771,795	2.85
TUNA NSPF NOT IN A.T.C. NOT IN OIL NOT > 6.8KG	11,783,934	891,135	6.00
TUNA SKIPJACK FROZEN	2,001,873	991,957	0.92
TUNA YELLOWFIN EVISCERATED HEAD-OFF FROZEN	185,941,497	15,479,911	5.45
TUNA YELLOWFIN EVISCERATED HEAD-ON FROZEN	131,321	36,408	1.64
TUNA YELLOWFIN WHOLE FROZEN	954,395	296,281	1.46
TUNA (THUNNUS)/SKIPJACK/BONITO MEAT FROZEN > 6.8 kg	33,313,393	3,503,223	4.31

Tables for TUNA_FRESH product group

Table A4-4-1 TUNA_FRESH Value, Volume, Price by Year

Year	Value (2022$)	Weight (kg)	Price (2022$ / lb)
2013	77,220,433	6,429,332	5.45
2014	77,619,867	6,369,246	5.53
2015	78,075,187	6,858,899	5.16
2016	78,732,227	6,771,884	5.27
2017	78,953,535	6,767,326	5.29
2018	85,700,392	6,533,465	5.95
2019	88,583,630	6,513,993	6.17
2020	56,449,452	3,682,547	6.95
2021	110,293,856	6,844,788	7.31
2022	136,060,493	8,004,459	7.71

Table A4-4-2 TUNA_FRESH Value, Volume, Price by Port: 2013-2022

US Customs District	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SAN DIEGO, CA	246,948,764	11,398,332	9.83
LOS ANGELES, CA	412,751,847	37,332,546	5.01
SAN FRANCISCO, CA	155,164,592	11,054,223	6.37
SEATTLE, WA	52,823,869	4,990,838	4.80

Table A4-4-3 TUNA_FRESH Value, Volume, Price by Continent: 2013-2022

Continent	Value (2022$)	Weight (kg)	Price (2022$ / lb)
AFRICA	20,012,961	1,276,261	7.11
ASIA	294,738,293	22,402,847	5.97
CENTRAL AMERICA	22,208,725	2,161,211	4.66
EUROPE	40,427,944	1,392,111	13.17
N AMERICA - CANADA	264,119	39,573	3.03
N AMERICA - MEXICO	248,188,107	11,578,134	9.72
OCEANIA	235,818,593	25,326,627	4.22
SOUTH AMERICA	6,030,330	599,175	4.57

Table A4-4-4 TUNA_FRESH Value, Volume, Price by Country: 2013-2022

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
AUSTRALIA	53,254,067	3,896,476	6.20
BRAZIL	536,722	58,555	4.16
CANADA	264,119	39,573	3.03
CHILE	10,677	768	6.31
CHINA	25,281	2,041	5.62
CHINA - HONG KONG	23,053	2,409	4.34

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
COOK IS.	73,189	24,776	1.34
COSTA RICA	5,483,707	448,338	5.55
CROATIA	36,352	1,375	11.99
ECUADOR	5,279,552	527,274	4.54
FED STATES OF MICRON	438,644	47,275	4.21
FIJI	68,949,796	11,014,196	2.84
FRANCE	131,636	5,754	10.38
FRENCH POLYNESIA	97,060,572	8,508,089	5.17
GREECE	94,873	2,743	15.69
INDIA	87,715	5,555	7.16
INDONESIA	6,607,586	672,706	4.46
ITALY	5,386	260	9.40
JAPAN	10,414,069	262,199	18.02
KIRIBATI	2,781,590	251,338	5.02
LIBERIA	13,001	1,030	5.73
MALDIVE IS.	56,477,745	3,719,595	6.89
MALTA	68,460	2,963	10.48
MARSHALL IS.	4,561,283	422,672	4.89
MAURITIUS	17,427	859	9.20
MEXICO	248,188,107	11,578,134	9.72
MOZAMBIQUE	60,587	16,741	1.64
NEW ZEALAND	2,397,422	269,503	4.04
NORWAY	31,363	1,564	9.10
OMAN	2,819,329	212,351	6.02
PALAU	185,931	54,274	1.55
PANAMA	16,725,018	1,712,873	4.43
PERU	203,379	12,578	7.33
PHILIPPINES	120,355,621	10,700,731	5.10
PORTUGAL	567,542	16,541	15.56
SENEGAL	22,034	1,283	7.79
SEYCHELLES	6,024,938	380,467	7.18
SINGAPORE	765,207	64,406	5.39
SOLOMON IS.	1,592,005	286,013	2.52
SOUTH AFRICA	13,213,855	852,614	7.03
SOUTH KOREA	2,782	38	33.21
SPAIN	34,151,558	1,135,228	13.65
SRI LANKA	56,268,312	3,709,056	6.88
TAIWAN	2,520,122	268,708	4.25
THAILAND	9,185,313	759,025	5.49
TOKELAU IS.	78,435	2,602	13.67
TONGA	1,249,465	204,696	2.77

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
TUNISIA	661,118	23,267	12.89
TURKEY	5,340,775	225,683	10.73
VANUATU	60,353	22,933	1.19
VIETNAM	29,186,157	2,024,027	6.54
WESTERN SAMOA	3,135,840	321,784	4.42

Table A4-4-5 TUNA_FRESH Value, Volume, Price by Product: 2013-2022

Product Name	Value (2022$)	Weight (kg)	Price (2022$ / lb)
TUNA ALBACORE FRESH	38,343,393	6,859,090	2.54
TUNA BIGEYE FRESH	103,704,512	8,471,763	5.55
TUNA BLUEFIN ATLANTIC, PACIFIC FRESH	296,164,116	12,832,250	10.47
TUNA BLUEFIN SOUTHERN FRESH	4,432,254	354,903	5.66
TUNA NSPF FRESH	8,370,715	792,356	4.79
TUNA SKIPJACK FRESH	151,203	38,232	1.79
TUNA YELLOWFIN FRESH	416,522,878	35,427,345	5.33

Tables for TUNA_OTHER product group

Table A4-5-1 TUNA_OTHER Value, Volume, Price by Year

Year	Value (2022$)	Weight (kg)	Price (2022$ / lb)
2013	882,735,172	122,666,801	3.26
2014	714,959,207	113,944,983	2.85
2015	691,433,643	104,937,982	2.99
2016	648,019,698	97,416,018	3.02
2017	720,560,919	101,544,191	3.22
2018	839,532,166	115,826,459	3.29
2019	835,280,897	114,689,532	3.30
2020	820,361,936	125,504,395	2.96
2021	689,633,135	95,035,009	3.29
2022	821,109,919	105,332,280	3.54

Table A4-5-2 TUNA_OTHER Value, Volume, Price by Port: 2013-2022

US Customs District	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SAN DIEGO, CA	253,745,949	43,362,363	2.65
LOS ANGELES, CA	6,386,322,802	916,554,835	3.16
SAN FRANCISCO, CA	418,227,528	59,874,762	3.17
PORTLAND, OR	14,732,572	4,739,895	1.41
SEATTLE, WA	590,597,842	72,365,795	3.70

Table A4-5-3 TUNA_OTHER Value, Volume, Price by Continent: 2013-2022

Continent	Value (2022$)	Weight (kg)	Price (2022$ / lb)
AFRICA	422,788,243	61,184,126	3.13
ASIA	5,729,649,250	821,579,639	3.16
CENTRAL AMERICA	27,247,508	6,318,421	1.96
EUROPE	7,484,773	820,514	4.14
N AMERICA - CANADA	205,594,716	16,733,732	5.57
N AMERICA - MEXICO	72,434,863	16,128,120	2.04
OCEANIA	838,024,597	117,975,502	3.22
SOUTH AMERICA	360,402,743	56,157,596	2.91

Table A4-5-4 TUNA_OTHER Value, Volume, Price by Country: 2013-2022

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
AUSTRALIA	529,641	22,756	10.56
BELIZE	145,976	10,600	6.25
BRAZIL	102,134	13,291	3.49
CANADA	205,594,716	16,733,732	5.57
CAPE VERDE	870,747	106,246	3.72
CHINA	474,740,017	78,101,520	2.76
COLOMBIA	58,431,037	8,146,154	3.25
COSTA RICA	22,834,938	5,609,192	1.85
CROATIA	1,442,753	87,715	7.46
ECUADOR	287,400,582	45,559,569	2.86
EL SALVADOR	1,936,492	235,791	3.73
FED STATES OF MICRON	581,603	37,321	7.07
FIJI	801,545,164	113,826,107	3.19
FRANCE	14,229	742	8.70
FRENCH POLYNESIA	117,749	11,607	4.60
GERMANY	28,339	3,396	3.79
GUATEMALA	20,017	22,500	0.40
INDIA	559,043	54,564	4.65
INDONESIA	1,098,990,584	103,934,533	4.80
IRAN	214,164	45,121	2.15
ISRAEL	76,259	8,363	4.14
ITALY	688,785	121,581	2.57
IVORY COAST	36,976	1,938	8.65
JAPAN	100,236,997	6,192,163	7.34
KIRIBATI	9,899,933	853,377	5.26
MALAYSIA	1,968,352	216,541	4.12
MALDIVE IS.	19,841,337	2,069,300	4.35
MALTA	1,169,548	92,951	5.71
MARSHALL IS.	12,295,053	1,425,696	3.91

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
MAURITIUS	362,457,967	51,620,148	3.18
MEXICO	72,434,863	16,128,120	2.04
MOROCCO	3,783	68	25.24
NEW ZEALAND	338,060	141,851	1.08
OMAN	399,841	60,515	3.00
PANAMA	2,310,085	440,338	2.38
PAPUA NEW GUINEA	7,038,922	952,727	3.35
PERU	2,960,225	1,037,299	1.29
PHILIPPINES	573,669,847	72,567,445	3.59
PORTUGAL	884,968	143,898	2.79
SENEGAL	58,801,866	9,400,731	2.84
SEYCHELLES	258,787	25,791	4.55
SINGAPORE	4,706,289	453,307	4.71
SOLOMON IS.	5,678,472	704,060	3.66
SOUTH AFRICA	107,864	23,588	2.07
SOUTH KOREA	45,161,143	5,693,787	3.60
SPAIN	1,955,821	246,412	3.60
SRI LANKA	24,352,158	1,911,279	5.78
SURINAME	11,508,765	1,401,283	3.73
TAIWAN	84,554,007	6,338,384	6.05
THAILAND	2,173,074,773	394,310,016	2.50
TUNISIA	250,253	5,616	20.21
TURKEY	1,300,329	123,819	4.76
VIETNAM	1,127,104,439	149,622,801	3.42

Table A4-5-5 TUNA_OTHER Value, Volume, Price by Product: 2013-2022

Product Name	Value (2022$)	Weight (kg)	Price (2022$ / lb)
TUNA ALBACORE FROZEN	43,669,531	10,020,625	1.98
TUNA ALBACORE IN ATC (FOIL OR FLEXIBLE) NOT IN OIL IN QUOTA	2,253,479	571,590	1.79
TUNA ALBACORE IN ATC (FOIL OR FLEXIBLE) NOT IN OIL OVER QUOTA	75,897,403	9,705,542	3.55
TUNA ALBACORE IN ATC (OTHER) IN OIL	14,170,940	2,427,406	2.65
TUNA ALBACORE IN ATC (OTHER) NOT IN OIL IN QUOTA	24,489,180	4,473,000	2.48
TUNA ALBACORE IN ATC (OTHER) NOT IN OIL OVER QUOTA	628,036,567	86,978,109	3.28
TUNA BIGEYE FROZEN	2,385,851	352,984	3.07
TUNA BLUEFIN ATLANTIC FROZEN	13,124,491	243,932	24.41
TUNA BLUEFIN PACIFIC FROZEN	1,712,866	267,153	2.91
TUNA BLUEFIN SOUTHERN FROZEN	3,981,337	95,153	18.98

Product Name	Value (2022$)	Weight (kg)	Price (2022$ / lb)
TUNA NSPF FILLET FROZEN	2,228,001,840	166,223,070	6.08
TUNA NSPF FROZEN	1,385,867	448,589	1.40
TUNA NSPF IN ATC (FOIL OR FLEXIBLE) IN OIL	19,688,036	2,897,385	3.08
TUNA NSPF IN ATC (FOIL OR FLEXIBLE) NOT IN OIL IN QUOTA	7,035,265	1,329,611	2.40
TUNA NSPF IN ATC (FOIL OR FLEXIBLE) NOT IN OIL OVER QUOTA	708,137,583	112,604,500	2.85
TUNA NSPF IN ATC (OTHER) IN OIL	98,294,134	20,751,379	2.15
TUNA NSPF IN ATC (OTHER) NOT IN OIL IN QUOTA	30,370,592	7,388,717	1.86
TUNA NSPF IN ATC (OTHER) NOT IN OIL OVER QUOTA	1,310,072,379	296,539,684	2.00
TUNA NSPF MEAT FROZEN > 6.8KG	52,271,589	7,608,511	3.12
TUNA NSPF NOT IN A.T.C. NOT IN OIL > 6.8KG	2,164,521,351	344,771,795	2.85
TUNA NSPF NOT IN A.T.C. NOT IN OIL NOT > 6.8KG	11,783,934	891,135	6.00
TUNA SKIPJACK FROZEN	2,001,873	991,957	0.92
TUNA YELLOWFIN EVISCERATED HEAD-OFF FROZEN	185,941,497	15,479,911	5.45
TUNA YELLOWFIN EVISCERATED HEAD-ON FROZEN	131,321	36,408	1.64
TUNA YELLOWFIN WHOLE FROZEN	954,395	296,281	1.46
TUNA (THUNNUS)/SKIPJACK/BONITO MEAT FROZEN > 6.8 kg	33,313,393	3,503,223	4.31

Tables for BASS_FRESH product group

Table A4-6-1 BASS_FRESH Value, Volume, Price by Year

Year	Value (2022$)	Weight (kg)	Price (2022$ / lb)
2013	7,193,894	630,578	5.17
2014	9,099,908	785,470	5.26
2015	8,510,401	860,743	4.48
2016	8,852,650	964,619	4.16
2017	9,894,196	1,143,036	3.93
2018	13,937,388	1,569,976	4.03
2019	20,117,114	2,273,380	4.01
2020	15,827,157	1,774,073	4.05
2021	21,711,605	2,503,000	3.93
2022	24,457,779	2,809,513	3.95

Table A4-6-2 BASS_FRESH Value, Volume, Price by Port: 2013-2022

US Customs District	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SAN DIEGO, CA	34,561,636	3,303,770	4.75
LOS ANGELES, CA	94,948,824	11,011,398	3.91
SAN FRANCISCO, CA	9,873,497	961,381	4.66
SEATTLE, WA	218,137	37,839	2.61

Table A4-6-3 BASS_FRESH Value, Volume, Price by Continent: 2013-2022

Continent	Value (2022$)	Weight (kg)	Price (2022$ / lb)
AFRICA	245,929	26,966	4.14
ASIA	469,694	43,732	4.87
CARIBBEAN	3,478	319	4.94
CENTRAL AMERICA	28,275	4,280	3.00
EUROPE	101,073,317	11,670,156	3.93
N AMERICA - MEXICO	34,567,426	3,304,387	4.75
OCEANIA	802,258	67,003	5.43
SOUTH AMERICA	2,411,717	197,545	5.54

Table A4-6-4 BASS_FRESH Value, Volume, Price by Country: 2013-2022

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
CHILE	4,514	672	3.05
CYPRUS	7,026,305	634,471	5.02
DOMINICAN REPUBLIC	3,478	319	4.94
ECUADOR	2,296,193	189,716	5.49
GREECE	22,839,497	2,645,851	3.92
ITALY	456,754	27,866	7.43
JAPAN	255,666	2,722	42.60
MAURITIUS	237,535	25,446	4.23
MEXICO	34,567,426	3,304,387	4.75
NETHERLANDS	1,062,089	56,276	8.56
NEW ZEALAND	802,258	67,003	5.43
NORWAY	60,363	7,373	3.71
PANAMA	28,275	4,280	3.00
PERU	39,319	1,224	14.57
PORTUGAL	2,463	128	8.73
SPAIN	9,097,826	978,372	4.22
TAIWAN	214,028	41,010	2.37
TUNISIA	8,394	1,520	2.50
TURKEY	59,483,514	7,228,901	3.73
UNITED KINGDOM	1,044,506	90,918	5.21
URUGUAY	71,691	5,933	5.48

Table A4-6-5 BASS_FRESH Value, Volume, Price by Product: 2013-2022

Product Name	Value (2022$)	Weight (kg)	Price (2022$ / lb)
BASS FRESH	33,679,316	3,205,550	4.77
SEA BASS (DICENTRARCHUS SPP.) FRESH	105,768,962	12,083,239	3.97
SEA BASS (DICENTRARCHUS SPP.) FRESH NOT > 6.8KG	153,816	25,599	2.73

Tables for BASS_OTHER product group

Table A4-7-1 BASS_OTHER Value, Volume, Price by Year

Year	Value (2022$)	Weight (kg)	Price (2022$ / lb)
2013	407,339	103,259	1.79
2014	228,859	44,073	2.36
2015	1,535,412	316,506	2.20
2016	2,535,770	533,410	2.16
2017	3,233,139	785,270	1.87
2018	569,723	97,043	2.66
2019	1,826,608	289,625	2.86
2020	1,093,972	200,353	2.48
2021	1,455,578	212,016	3.11
2022	1,233,097	211,783	2.64

Table A4-7-2 BASS_OTHER Value, Volume, Price by Port: 2013-2022

US Customs District	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SAN DIEGO, CA	9,989	5,626	0.81
SAN FRANCISCO, CA	4,731,929	1,131,163	1.90
LOS ANGELES, CA	9,247,432	1,612,112	2.60
SEATTLE, WA	130,148	44,437	1.33

Table A4-7-3 BASS_OTHER Value, Volume, Price by Continent: 2013-2022

Continent	Value (2022$)	Weight (kg)	Price (2022$ / lb)
ASIA	6,858,951	1,351,543	2.30
EUROPE	3,313,133	466,109	3.22
N AMERICA - MEXICO	9,989	5,626	0.81
SOUTH AMERICA	3,937,425	970,060	1.84

Table A4-7-4 BASS_OTHER Value, Volume, Price by Country: 2013-2022

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
ARGENTINA	3,937,425	970,060	1.84
BURMA	4,515	493	4.15
CHINA	447,621	94,331	2.15
JAPAN	6,723	410	7.44
MEXICO	9,989	5,626	0.81
TAIWAN	6,366,953	1,243,909	2.32
TURKEY	3,313,133	466,109	3.22
VIETNAM	33,139	12,400	1.21

Table A4-7-5 BASS_OTHER Value, Volume, Price by Product: 2013-2022

Product Name	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SEA BASS (DICENTRARCHUS SPP.) FROZEN	14,119,498	2,793,338	2.29

Tables for OYSTER_FRESH product group

Table A4-8-1 OYSTER_FRESH Value, Volume, Price by Year

Year	Value (2022$)	Weight (kg)	Price (2022$ / lb)
2013	13,814,587	1,913,792	3.27
2014	19,072,185	2,858,202	3.03
2015	19,393,756	3,135,439	2.81
2016	19,933,012	2,992,048	3.02
2017	23,327,799	3,197,827	3.31
2018	18,967,338	2,952,869	2.91
2019	21,865,366	3,012,298	3.29
2020	15,482,275	2,850,765	2.46
2021	28,330,494	4,310,949	2.98
2022	31,798,260	4,328,899	3.33

Table A4-8-2 OYSTER_FRESH Value, Volume, Price by Port: 2013-2022

US Customs District	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SAN DIEGO, CA	75,859,364	18,590,705	1.85
LOS ANGELES, CA	17,389,665	1,906,872	4.14
SAN FRANCISCO, CA	2,978,712	207,643	6.51
SEATTLE, WA	115,757,332	10,847,868	4.84

Table A4-8-3 OYSTER_FRESH Value, Volume, Price by Continent: 2013-2022

Continent	Value (2022$)	Weight (kg)	Price (2022$ / lb)
ASIA	8,838,759	1,043,939	3.84
EUROPE	7,555	454	7.55
N AMERICA - CANADA	119,525,950	11,093,065	4.89
N AMERICA - MEXICO	75,859,364	18,590,705	1.85
OCEANIA	7,753,444	824,925	4.26

Table A4-8-4 OYSTER_FRESH Value, Volume, Price by Country: 2013-2022

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
CANADA	119,525,950	11,093,065	4.89
CHINA - HONG KONG	13,310	2,944	2.05
FRANCE	7,555	454	7.55
JAPAN	121,711	21,695	2.54
MEXICO	75,859,364	18,590,705	1.85
NEW ZEALAND	7,753,444	824,925	4.26
SOUTH KOREA	8,703,739	1,019,300	3.87

Table A4-8-5 OYSTER_FRESH Value, Volume, Price by Product: 2013-2022

Product Name	Value (2022$)	Weight (kg)	Price (2022$ / lb)
OYSTERS LIVE/FRESH FARMED	203,867,296	30,673,414	3.01
OYSTERS LIVE/FRESH WILD	8,117,776	879,674	4.19

Tables for OYSTER_OTHER product group

Table A4-9-1 OYSTER_OTHER Value, Volume, Price by Year

Year	Value (2022$)	Weight (kg)	Price (2022$ / lb)
2013	31,739,050	3,428,480	4.20
2014	28,865,593	3,426,174	3.82
2015	31,895,252	3,941,652	3.67
2016	32,172,934	4,161,112	3.51
2017	27,927,766	3,612,949	3.51
2018	34,718,712	4,471,634	3.52
2019	27,491,470	3,616,738	3.45
2020	22,948,034	2,948,039	3.53
2021	28,130,927	3,817,100	3.34
2022	31,489,220	4,063,950	3.51

Table A4-9-2 OYSTER_OTHER Value, Volume, Price by Port: 2013-2022

US Customs District	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SAN DIEGO, CA	1,879,776	395,669	2.15
LOS ANGELES, CA	246,670,678	30,854,061	3.63
SAN FRANCISCO, CA	15,104,583	1,907,130	3.59
SEATTLE, WA	33,723,922	4,330,968	3.53

Table A4-9-3 OYSTER_OTHER Value, Volume, Price by Continent: 2013-2022

Continent	Value (2022$)	Weight (kg)	Price (2022$ / lb)
ASIA	283,169,777	35,678,534	3.60
EUROPE	566,755	137,051	1.88
N AMERICA - CANADA	11,545,028	1,249,866	4.19
N AMERICA - MEXICO	1,879,776	395,669	2.15
OCEANIA	217,623	26,708	3.70

Table A4-9-4 OYSTER_OTHER Value, Volume, Price by Country: 2013-2022

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
CANADA	11,545,028	1,249,866	4.19
CHINA	139,186,923	17,871,526	3.53
CHINA - HONG KONG	12,886,077	1,612,339	3.63
ITALY	566,755	137,051	1.88
JAPAN	14,486,635	1,344,543	4.89
MALAYSIA	248,150	37,650	2.99
MEXICO	1,879,776	395,669	2.15
NEW ZEALAND	217,623	26,708	3.70
SOUTH KOREA	116,108,028	14,783,966	3.56
TAIWAN	18,663	2,006	4.22
THAILAND	130,539	12,031	4.92
VIETNAM	104,762	14,473	3.28

Table A4-9-5 OYSTER_OTHER Value, Volume, Price by Product: 2013-2022

Product Name	Value (2022$)	Weight (kg)	Price (2022$ / lb)
OYSTERS CANNED	49,611,262	7,472,865	3.01
OYSTERS CANNED SMOKED	136,371,714	16,213,689	3.82
OYSTERS DRIED/SALTED/BRINE FARMED	6,852,233	597,558	5.20
OYSTERS DRIED/SALTED/BRINE WILD	4,582,997	574,417	3.62
OYSTERS FROZEN FARMED	36,415,429	4,862,933	3.40
OYSTERS FROZEN WILD	12,849,829	1,668,878	3.49
OYSTERS FROZEN/DRIED/SALTED/BRINE FARMED	43,022,676	4,788,494	4.08
OYSTERS FROZEN/DRIED/SALTED/BRINE WILD	6,463,352	1,048,600	2.80
OYSTERS PRODUCTS PREPARED DINNERS	1,209,467	260,394	2.11

Tables for MUSSEL_FRESH product group

Table A4-10-1 MUSSEL_FRESH Value, Volume, Price by Year

Year	Value (2022$)	Weight (kg)	Price (2022$ / lb)
2013	1,038,467	231,946	2.03
2014	1,951,829	420,832	2.10
2015	2,040,668	394,743	2.34
2016	2,695,061	533,220	2.29
2017	2,314,043	445,108	2.36
2018	1,957,453	308,341	2.88
2019	1,992,884	293,600	3.08
2020	1,242,251	169,424	3.33
2021	2,129,359	286,079	3.38
2022	1,791,584	261,199	3.11

Table A4-10-2 MUSSEL_FRESH Value, Volume, Price by Port: 2013-2022

US Customs District	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SAN DIEGO, CA	2,495,436	570,886	1.98
LOS ANGELES, CA	4,411,324	996,523	2.01
SAN FRANCISCO, CA	203,965	48,576	1.90
SEATTLE, WA	12,042,875	1,728,507	3.16

Table A4-10-3 MUSSEL_FRESH Value, Volume, Price by Continent: 2013-2022

Continent	Value (2022$)	Weight (kg)	Price (2022$ / lb)
ASIA	50,816	13,857	1.66
N AMERICA - CANADA	11,692,876	1,623,370	3.27
N AMERICA - MEXICO	2,495,436	570,886	1.98
OCEANIA	4,505,605	1,015,666	2.01
SOUTH AMERICA	408,866	120,713	1.54

Table A4-10-4 MUSSEL_FRESH Value, Volume, Price by Country: 2013-2022

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
CANADA	11,692,876	1,623,370	3.27
CHILE	408,866	120,713	1.54
JAPAN	31,328	8,510	1.67
MEXICO	2,495,436	570,886	1.98
NEW ZEALAND	4,505,605	1,015,666	2.01
VIETNAM	19,489	5,347	1.65

Table A4-10-5 MUSSEL_FRESH Value, Volume, Price by Product: 2013-2022

Product Name	Value (2022$)	Weight (kg)	Price (2022$ / lb)
MUSSELS LIVE/FRESH FARMED	14,799,791	2,353,588	2.85
MUSSELS LIVE/FRESH WILD	4,353,808	990,904	1.99

Tables for MUSSEL_OTHER product group

Table A4-11-1 MUSSEL_OTHER Value, Volume, Price by Year

Year	Value (2022$)	Weight (kg)	Price (2022$ / lb)
2013	22,800,967	4,458,532	2.32
2014	32,759,010	5,149,752	2.89
2015	30,067,902	5,436,361	2.51
2016	31,368,567	6,112,097	2.33
2017	32,222,721	6,298,946	2.32
2018	25,502,054	5,183,866	2.23
2019	32,102,456	5,849,094	2.49
2020	28,151,726	5,168,698	2.47
2021	29,955,264	6,676,608	2.04
2022	22,698,757	4,950,188	2.08

Table A4-11-2 MUSSEL_OTHER Value, Volume, Price by Port: 2013-2022

US Customs District	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SAN DIEGO, CA	2,001,787	310,766	2.92
SAN FRANCISCO, CA	31,703,614	5,084,854	2.83
LOS ANGELES, CA	242,901,730	47,841,596	2.30
PORTLAND, OR	51,378	5,829	4.00
SEATTLE, WA	10,970,916	2,041,097	2.44

Table A4-11-3 MUSSEL_OTHER Value, Volume, Price by Continent: 2013-2022

Continent	Value (2022$)	Weight (kg)	Price (2022$ / lb)
AFRICA	1,576,383	383,493	1.86
ASIA	7,945,908	2,370,911	1.52
EUROPE	1,764,694	320,256	2.50
N AMERICA - CANADA	4,043	713	2.57
N AMERICA - MEXICO	2,001,787	310,766	2.92
OCEANIA	229,025,008	36,655,041	2.83
SOUTH AMERICA	45,311,602	15,242,962	1.35

Table A4-11-4 MUSSEL_OTHER Value, Volume, Price by Country: 2013-2022

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
CANADA	4,043	713	2.57
CHILE	45,254,158	15,224,836	1.35
CHINA	6,413,783	2,147,405	1.35
FIJI	43,596	9,561	2.07
ITALY	45,367	3,492	5.89
MEXICO	2,001,787	310,766	2.92
NEW ZEALAND	228,981,412	36,645,480	2.83
PERU	57,444	18,126	1.44
PORTUGAL	15,284	1,431	4.84
SOUTH AFRICA	1,576,383	383,493	1.86
SOUTH KOREA	756,793	89,551	3.83
SPAIN	1,704,043	315,333	2.45
THAILAND	640,460	98,138	2.96
VIETNAM	134,873	35,817	1.71

Table A4-11-5 MUSSEL_OTHER Value, Volume, Price by Product: 2013-2022

Product Name	Value (2022$)	Weight (kg)	Price (2022$ / lb)
MUSSELS DRIED/SALTED/BRINE	20,191,277	3,406,626	2.69
MUSSELS FROZEN	119,938,493	21,025,671	2.59
MUSSELS FROZEN/DRIED/SALTED/BRINE	100,367,182	16,386,800	2.78
MUSSELS NSPF PREPARED/PRESERVED	43,091,852	13,351,769	1.46
MUSSELS PRODUCTS PREPARED DINNERS	4,040,621	1,113,276	1.65

Tables for ABALONE_FRESH product group

Table A4-12-1 ABALONE_FRESH Value, Volume, Price by Year

Year	Value (2022$)	Weight (kg)	Price (2022$ / lb)
2013	983,586	68,486	6.51
2014	285,922	10,858	11.94
2015	411,027	39,150	4.76
2016	81,692	2,683	13.81
2017	155,770	28,951	2.44
2018	118,005	10,065	5.32
2019	264,143	14,161	8.46
2020	733,232	104,783	3.17
2021	1,361,940	170,934	3.61
2022	1,617,274	310,328	2.36

Table A4-12-2 ABALONE_FRESH Value, Volume, Price by Port: 2013-2022

US Customs District	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SAN DIEGO, CA	3,962,748	386,025	4.66
LOS ANGELES, CA	1,774,827	325,616	2.47
SAN FRANCISCO, CA	121,429	19,908	2.77
SEATTLE, WA	153,586	28,850	2.41

Table A4-12-3 ABALONE_FRESH Value, Volume, Price by Continent: 2013-2022

Continent	Value (2022$)	Weight (kg)	Price (2022$ / lb)
AFRICA	25,012	3,261	3.48
ASIA	652,063	98,169	3.01
N AMERICA - MEXICO	3,962,748	386,025	4.66
OCEANIA	417,300	46,898	4.04
SOUTH AMERICA	955,468	226,046	1.92

Table A4-12-4 ABALONE_FRESH Value, Volume, Price by Country: 2013-2022

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
AUSTRALIA	417,300	46,898	4.04
CHILE	955,468	226,046	1.92
JAPAN	9,344	54	78.49
MEXICO	3,962,748	386,025	4.66
SOUTH AFRICA	25,012	3,261	3.48
SOUTH KOREA	642,719	98,115	2.97

Table A4-12-5 ABALONE_FRESH Value, Volume, Price by Product: 2013-2022

Product Name	Value (2022$)	Weight (kg)	Price (2022$ / lb)
ABALONE LIVE/FRESH	6,012,591	760,399	3.59

Tables for ABALONE_OTHER product group

Table A4-13-1 ABALONE_OTHER Value, Volume, Price by Year

Year	Value (2022$)	Weight (kg)	Price (2022$ / lb)
2013	16,132,762	346,064	21.15
2014	18,071,996	393,785	20.82
2015	20,973,267	620,312	15.34
2016	19,870,021	520,511	17.32
2017	15,403,927	413,307	16.91
2018	17,802,879	423,134	19.08
2019	16,532,166	377,881	19.84
2020	27,136,857	619,068	19.88
2021	38,715,031	1,250,540	14.04
2022	35,653,663	1,137,266	14.22

Table A4-13-2 ABALONE_OTHER Value, Volume, Price by Port: 2013-2022

US Customs District	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SAN DIEGO, CA	64,511,617	1,332,398	21.96
LOS ANGELES, CA	142,357,438	4,327,362	14.92
SAN FRANCISCO, CA	18,863,543	425,135	20.13
SEATTLE, WA	559,972	16,973	14.96

Table A4-13-3 ABALONE_OTHER Value, Volume, Price by Continent: 2013-2022

Continent	Value (2022$)	Weight (kg)	Price (2022$ / lb)
AFRICA	2,058,495	43,696	21.37
ASIA	65,733,013	2,265,638	13.16
N AMERICA - CANADA	89,823	2,900	14.05
N AMERICA - MEXICO	64,523,675	1,332,842	21.96
OCEANIA	74,664,979	1,772,275	19.11
SOUTH AMERICA	19,222,585	684,517	12.74

Table A4-13-4 ABALONE_OTHER Value, Volume, Price by Country: 2013-2022

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
AUSTRALIA	72,806,169	1,739,574	18.98
CANADA	89,823	2,900	14.05
CHILE	18,644,025	648,802	13.03
CHINA	33,285,214	1,416,834	10.66
CHINA - HONG KONG	14,747,611	409,018	16.35
ECUADOR	76,581	2,985	11.64
INDONESIA	772,509	26,353	13.30
JAPAN	951,252	30,924	13.95
MALAYSIA	12,324	1,088	5.14
MAURITANIA	11,250	90	56.70
MEXICO	64,523,675	1,332,842	21.96
NEW ZEALAND	1,858,810	32,701	25.78
PERU	399,979	23,876	7.60
SENEGAL	19,337	282	31.10
SINGAPORE	133,984	1,468	41.40
SOUTH AFRICA	2,027,908	43,324	21.23
SOUTH KOREA	4,504,063	154,698	13.21
SURINAME	102,000	8,854	5.23
TAIWAN	11,138,007	221,077	22.85
VIETNAM	188,048	4,178	20.42

Table A4-13-5 ABALONE_OTHER Value, Volume, Price by Product: 2013-2022

Product Name	Value (2022$)	Weight (kg)	Price (2022$ / lb)
ABALONE DRIED/SALTED/BRINE	17,062,965	404,708	19.12
ABALONE FROZEN	49,507,529	1,223,842	18.35
ABALONE FROZEN/DRIED/SALTED/BRINE	43,873,484	1,219,822	16.31
ABALONE PREPARED/PRESERVED	114,409,440	2,961,127	17.53
ABALONE PRODUCTS PREPARED DINNERS	1,439,151	292,369	2.23

Tables for SCALLOP_FRESH product group

Table A4-14-1 SCALLOP_FRESH Value, Volume, Price by Year

Year	Value (2022$)	Weight (kg)	Price (2022$ / lb)
2013	932,337	121,756	3.47
2014	97,938	6,476	6.86
2015	203,459	19,888	4.64
2016	467,522	36,593	5.80
2017	356,221	22,536	7.17
2018	16,010,384	1,698,404	4.28
2019	4,922,954	566,396	3.94
2020	1,794,217	60,931	13.36
2021	7,021,309	865,232	3.68
2022	1,161,243	87,454	6.02

Table A4-14-2 SCALLOP_FRESH Value, Volume, Price by Port: 2013-2022

US Customs District	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SAN DIEGO, CA	32,171,980	3,458,396	4.22
LOS ANGELES, CA	751,342	24,833	13.72
SAN FRANCISCO, CA	20,261	288	31.91
SEATTLE, WA	24,001	2,149	5.07

Table A4-14-3 SCALLOP_FRESH Value, Volume, Price by Continent: 2013-2022

Continent	Value (2022$)	Weight (kg)	Price (2022$ / lb)
ASIA	530,692	17,539	13.72
EUROPE	11,281	416	12.30
N AMERICA - CANADA	24,001	2,149	5.07
N AMERICA - MEXICO	32,171,980	3,458,396	4.22
SOUTH AMERICA	229,630	7,166	14.54

Table A4-14-4 SCALLOP_FRESH Value, Volume, Price by Country: 2013-2022

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
CANADA	24,001	2,149	5.07
ECUADOR	32,040	1,068	13.61
JAPAN	530,692	17,539	13.72
MEXICO	32,171,980	3,458,396	4.22
PERU	197,590	6,098	14.70
UNITED KINGDOM	11,281	416	12.30

Table A4-14-5 SCALLOP_FRESH Value, Volume, Price by Product: 2013-2022

Product Name	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SCALLOPS LIVE/FRESH	32,967,584	3,485,666	4.29

Tables for SCALLOP_OTHER product group

Table A4-15-1 SCALLOP_OTHER Value, Volume, Price by Year

Year	Value (2022$)	Weight (kg)	Price (2022$ / lb)
2013	41,957,032	2,868,892	6.63
2014	49,066,201	3,773,924	5.90
2015	46,293,338	3,147,727	6.67
2016	55,051,955	3,386,551	7.37
2017	44,785,794	2,958,785	6.87
2018	51,340,913	4,464,812	5.22
2019	44,686,807	2,890,258	7.01
2020	35,747,972	2,494,555	6.50
2021	64,457,173	4,246,141	6.89
2022	68,771,753	4,141,435	7.53

Table A4-15-2 SCALLOP_OTHER Value, Volume, Price by Port: 2013-2022

US Customs District	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SAN DIEGO, CA	24,943,244	2,382,907	4.75
SAN FRANCISCO, CA	51,862,719	1,677,680	14.02
LOS ANGELES, CA	401,231,613	28,255,911	6.44
SEATTLE, WA	24,121,362	2,056,582	5.32

Table A4-15-3 SCALLOP_OTHER Value, Volume, Price by Continent: 2013-2022

Continent	Value (2022$)	Weight (kg)	Price (2022$ / lb)
ASIA	445,010,745	28,328,560	7.13
EUROPE	11,059,068	1,981,578	2.53
N AMERICA - CANADA	1,748,844	102,854	7.71
N AMERICA - MEXICO	24,943,244	2,382,907	4.75
OCEANIA	795,225	41,353	8.72
SOUTH AMERICA	18,601,811	1,535,828	5.49

Table A4-15-4 SCALLOP_OTHER Value, Volume, Price by Country: 2013-2022

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
AUSTRALIA	494,422	4,321	51.90
CANADA	1,748,844	102,854	7.71
CHILE	383,286	15,876	10.95
CHINA	187,065,443	19,961,845	4.25
CHINA - HONG KONG	25,384,448	614,634	18.73
ECUADOR	906,485	28,197	14.58
FRANCE	10,420,241	1,941,416	2.43
INDONESIA	158,505	1,600	44.94
JAPAN	229,292,965	7,411,539	14.03
MALAYSIA	29,018	5,975	2.20
MEXICO	24,943,244	2,382,907	4.75
NEW ZEALAND	300,803	37,032	3.68
PERU	17,312,040	1,491,755	5.26
PHILIPPINES	1,415,311	180,397	3.56
SINGAPORE	259,159	16,409	7.16
SOUTH KOREA	83,191	8,272	4.56
SPAIN	638,826	40,162	7.21
TAIWAN	442,800	10,642	18.87
THAILAND	314,846	33,554	4.26
VIETNAM	565,057	83,693	3.06

Table A4-15-5 SCALLOP_OTHER Value, Volume, Price by Product: 2013-2022

Product Name	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SCALLOPS DRIED/SALTED/BRINE	105,328,735	3,964,627	12.05
SCALLOPS FROZEN	178,827,752	14,657,903	5.53
SCALLOPS FROZEN/DRIED/SALTED/BRINE	183,332,312	12,235,495	6.80
SCALLOPS PREPARED/PRESERVED	23,946,722	1,519,109	7.15
SCALLOPS PRODUCTS PREPARED DINNERS	10,723,417	1,995,946	2.44

Tables for SEAWEED_EDIBLE product group

Table A4-16-1 SEAWEED_EDIBLE Value, Volume, Price by Year

Year	Value (2022$)	Weight (kg)	Price (2022$ / lb)
2013	49,051,828	3,643,554	6.11
2014	39,660,446	2,891,343	6.22
2015	40,418,285	2,864,464	6.40
2016	31,448,830	2,495,704	5.72
2017	36,354,325	2,599,898	6.34
2018	36,726,941	2,652,402	6.28
2019	38,192,463	2,900,997	5.97
2020	35,113,644	2,778,310	5.73
2021	31,884,267	3,009,304	4.81
2022	38,996,099	3,367,201	5.25

Table A4-16-2 SEAWEED_EDIBLE Value, Volume, Price by Port: 2013-2022

US Customs District	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SAN DIEGO, CA	658,961	270,976	1.10
LOS ANGELES, CA	314,695,364	22,705,465	6.29
SAN FRANCISCO, CA	47,755,558	4,621,263	4.69
PORTLAND, OR	291,087	25,573	5.16
SEATTLE, WA	14,446,158	1,579,900	4.15

Table A4-16-3 SEAWEED_EDIBLE Value, Volume, Price by Continent: 2013-2022

Continent	Value (2022$)	Weight (kg)	Price (2022$ / lb)
ASIA	369,241,835	27,549,687	6.08
CARIBBEAN	160,952	5,379	13.57
EUROPE	5,230,508	750,559	3.16
N AMERICA - CANADA	456,711	27,089	7.65
N AMERICA - MEXICO	617,026	269,720	1.04
OCEANIA	900,967	75,189	5.44
SOUTH AMERICA	1,239,130	525,554	1.07

Table A4-16-4 SEAWEED_EDIBLE Value, Volume, Price by Country: 2013-2022

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
AUSTRALIA	448,307	18,229	11.16
BRAZIL	3,969	700	2.57
CANADA	456,711	27,089	7.65
CHILE	1,226,123	524,589	1.06
CHINA	127,868,348	9,593,574	6.05
CHINA - HONG KONG	537,154	66,202	3.68
DENMARK	3,658	349	4.75
ECUADOR	5,550	165	15.26
FRANCE	426,998	27,327	7.09
GERMANY	16,793	2,202	3.46
GRENADA	25,344	681	16.88
INDIA	12,283,028	507,506	10.98
IRELAND	146,672	5,296	12.56
JAPAN	49,361,601	1,614,395	13.87
MALTA	2,500	86	13.19
MEXICO	617,026	269,720	1.04
NEW ZEALAND	416,472	45,323	4.17
PERU	3,488	100	15.82
PHILIPPINES	50,375,418	6,230,501	3.67
RUSSIAN FEDERATION	51,503	615	37.99
SOUTH KOREA	122,453,175	8,994,684	6.18
SPAIN	80,033	564	64.37
ST. LUCIA	135,609	4,698	13.09
SWEDEN	3,742	349	4.86
TAIWAN	1,426,842	111,753	5.79
THAILAND	3,207,440	106,851	13.62
TONGA	36,188	11,637	1.41
UNITED KINGDOM	4,498,610	713,771	2.86
VIETNAM	1,728,829	324,221	2.42

Table A4-16-5 SEAWEED_EDIBLE Value, Volume, Price by Product: 2013-2022

Product Name	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SEAWEED AND OTHER ALGAE FIT FOR HUMAN CONSUMPTION	377,847,128	29,203,177	5.87

Tables for SEAWEED product group

Table A4-17-1 SEAWEED Value, Volume, Price by Year

Year	Value (2022$)	Weight (kg)	Price (2022$ / lb)
2013	104,565,635	10,323,730	4.59
2014	100,707,142	9,385,446	4.87
2015	103,182,044	10,086,784	4.64
2016	77,656,882	8,691,246	4.05
2017	77,365,343	8,719,081	4.02
2018	84,213,756	8,820,329	4.33
2019	83,195,312	8,755,722	4.31
2020	60,182,227	5,975,171	4.57
2021	38,471,944	4,001,389	4.36
2022	51,253,972	4,689,677	4.96

Table A4-17-2 SEAWEED Value, Volume, Price by Port: 2013-2022

US Customs District	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SAN DIEGO, CA	5,426,452	2,828,034	0.87
LOS ANGELES, CA	624,260,564	58,722,294	4.82
SAN FRANCISCO, CA	69,758,359	8,170,172	3.87
PORTLAND, OR	295,041	25,773	5.19
SEATTLE, WA	81,053,843	9,702,302	3.79

Table A4-17-3 SEAWEED Value, Volume, Price by Continent: 2013-2022

Continent	Value (2022$)	Weight (kg)	Price (2022$ / lb)
AFRICA	5,114	760	3.05
ASIA	749,424,303	73,108,727	4.65
CARIBBEAN	178,225	5,937	13.62
EUROPE	17,975,063	1,801,710	4.53
N AMERICA - CANADA	2,472,542	772,618	1.45
N AMERICA - MEXICO	5,884,904	3,003,786	0.89
OCEANIA	2,493,511	90,335	12.52
SOUTH AMERICA	2,360,596	664,702	1.61

Table A4-17-4 SEAWEED Value, Volume, Price by Country: 2013-2022

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
ARGENTINA	94,796	8,206	5.24
AUSTRALIA	2,040,851	33,375	27.74
BELGIUM	3,085	10	139.95
BOLIVIA	405,066	80,000	2.30
BRAZIL	277,664	35,727	3.53
CANADA	2,472,542	772,618	1.45
CHILE	1,565,816	540,024	1.32
CHINA	143,700,064	12,803,360	5.09
CHINA - HONG KONG	589,015	73,683	3.63
DENMARK	9,471,373	491,164	8.75
DOMINICAN REPUBLIC	3,365	144	10.60
ECUADOR	5,550	165	15.26
FRANCE	700,882	36,663	8.67
GERMANY	16,793	2,202	3.46
GRENADA	25,344	681	16.88
ICELAND	366,153	5,103	32.55
INDIA	22,530,245	941,016	10.86
INDONESIA	32,568,519	4,270,068	3.46
IRELAND	692,381	129,973	2.42
ISRAEL	106,261	3,000	16.07
JAPAN	50,602,150	1,711,133	13.41
MALAYSIA	1,943,668	274,545	3.21
MALTA	2,500	86	13.19
MEXICO	5,884,904	3,003,786	0.89
NETHERLANDS	106,037	10,055	4.78
NEW ZEALAND	416,472	45,323	4.17
NORWAY	971,586	226,169	1.95
PERU	11,704	580	9.15
PHILIPPINES	339,351,912	40,414,328	3.81
PORTUGAL	91,085	558	74.04
RUSSIAN FEDERATION	51,503	615	37.99
SINGAPORE	3,380	499	3.07
SOUTH AFRICA	5,114	760	3.05
SOUTH KOREA	150,019,644	11,966,329	5.69
SPAIN	413,880	40,564	4.63
ST. LUCIA	149,516	5,112	13.27
SWEDEN	3,742	349	4.86
TAIWAN	1,825,684	160,096	5.17
THAILAND	4,259,052	148,184	13.04
TONGA	36,188	11,637	1.41

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
TURKEY	4,631	104	20.20
UNITED KINGDOM	5,079,431	858,095	2.69
VIETNAM	1,924,711	342,486	2.55

Table A4-17-5 SEAWEED Value, Volume, Price by Product: 2013-2022

Product Name	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SEAWEED AND OTHER ALGAE	93,994,561	15,472,585	2.76
SEAWEED AND OTHER ALGAE FIT FOR HUMAN CONSUMPTION	377,847,128	29,203,177	5.87
THICKENERS DERIVED FROM SEAWEED CARAGEENAN	308,952,569	34,772,813	4.03

Tables for AGAR product group

Table A4-18-1 AGAR Value, Volume, Price by Year

Year	Value (2022$)	Weight (kg)	Price (2022$ / lb)
2013	8,378,498	367,284	10.35
2014	7,519,298	332,149	10.27
2015	7,107,692	285,233	11.30
2016	6,188,830	265,536	10.57
2017	5,564,344	244,754	10.31
2018	4,330,364	186,775	10.52
2019	4,179,637	224,914	8.43
2020	4,512,995	210,618	9.72
2021	5,000,295	201,604	11.25
2022	5,084,849	283,684	8.13

Table A4-18-2 AGAR Value, Volume, Price by Port: 2013-2022

US Customs District	Value (2022$)	Weight (kg)	Price (2022$ / lb)
SAN DIEGO, CA	17,990,043	615,347	13.26
LOS ANGELES, CA	32,511,018	1,587,594	9.29
SAN FRANCISCO, CA	5,191,516	319,990	7.36
SEATTLE, WA	2,174,225	79,620	12.39

Table A4-18-3 AGAR Value, Volume, Price by Continent: 2013-2022

Continent	Value (2022$)	Weight (kg)	Price (2022$ / lb)
ASIA	34,244,263	1,831,547	8.48
EUROPE	6,455,307	195,093	15.01
N AMERICA - MEXICO	15,347,559	548,627	12.69
OCEANIA	1,806,778	26,869	30.50
SOUTH AMERICA	12,894	415	14.09

Table A4-18-4 AGAR Value, Volume, Price by Country: 2013-2022

Country	Value (2022$)	Weight (kg)	Price (2022$ / lb)
AUSTRALIA	84,961	1,875	20.55
CHILE	12,894	415	14.09
CHINA	4,373,183	195,438	10.15
CHINA - HONG KONG	190,505	26,352	3.28
DENMARK	130,457	175	338.14
FRANCE	77,523	2,885	12.19
INDONESIA	5,711,398	213,800	12.12
ITALY	687,857	35,150	8.88
JAPAN	2,061,026	31,463	29.71
MALAYSIA	15,018	4,207	1.62
MEXICO	15,347,559	548,627	12.69
NEW ZEALAND	1,721,818	24,994	31.25
PHILIPPINES	342,572	37,835	4.11
SINGAPORE	3,573	1,440	1.13
SOUTH KOREA	10,701,914	392,126	12.38
SPAIN	5,556,680	156,872	16.07
TAIWAN	1,077,395	418,188	1.17
THAILAND	9,245,998	474,485	8.84
UNITED KINGDOM	2,791	11	115.08
VIETNAM	521,682	36,213	6.53

Table A4-18-5 AGAR Value, Volume, Price by Product: 2013-2022

Product Name	Value (2022$)	Weight (kg)	Price (2022$ / lb)
AGAR AGAR	57,866,802	2,602,551	10.09