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Table of Contents

List of Tables

List of Figures

Executive Summary

This NOAA technical memorandum investigates recent market trends for commercially landed pelagic and highly migratory species in Hawai‘i from 2008 to 2019, focusing on Pacific Island pelagic management unit species (PMUS). We first describe our data sources, followed by an articulation of terminology specific to our report. We then present the species composition, volume, revenue, unit prices, and market share of Hawai‘i pelagic fisheries landings, followed by an analysis of pelagic exports from Hawai‘i. We similarly describe pelagic imports to Hawai‘i. We further analyze the highly migratory species of highest volume and revenue through individual profiles: bigeye tuna, yellowfin tuna, and swordfish. For each, we demonstrate Hawai‘i's contribution to local Hawai‘i and domestic U.S. seafood supply. We then compare Hawai‘i consumption to continental U.S. consumption and total U.S. consumption. Next, we present a summary of landings volume and revenue as well as monthly ex-vessel prices over the 12-year study period. Finally, we discuss each species' exports from Hawai‘i and imports to Hawai‘i in terms of volume, revenue and cost, unit prices, and market share by product form.

To complete these analyses, we query local and domestic landings and trade data from the NOAA NMFS Office of Science and Technology Fisheries One Stop Shop (FOSS) reporting portal, the NOAA NMFS Western Pacific Fisheries Information Network, and the Pacific Island Fisheries Science Center Hawai‘i DAR Commercial Purchases portal. We clean each data set, convert trade volume to live weight using Food and Agricultural Organization of the United Nations (FAO) and NMFS conversion factors, convert product weight expressed in kilograms to pounds, and execute our calculations through various formulas. We display our results in bar charts and tables to visually illustrate market trends while providing nuanced statistics. All of our data analyses use the R coding language in R Studio.

Our findings from available data show that the highest pelagic landings volume and revenue over our study period include bigeye tuna, yellowfin tuna, wahoo, opah, mahimahi, and swordfish. The highest pelagic export volume and revenue were bigeye tuna, yellowfin tuna, skipjack tuna, unspecified squid, and swordfish. Finally, the highest pelagic import volume includes unspecified tuna, bigeye tuna, unspecified squid, mahimahi, and yellowfin tuna. Of these species, bigeye tuna, yellowfin tuna, and swordfish compose the majority of Hawai‘i pelagic landings and revenue from longline fisheries. Based on available data, between 6% and 28% of tuna consumed in Hawai‘i was imported over our study period, with an annual average of 18% of tuna consumption imported. However, these figures do not consider potential domestic shipments from the continental U.S. Indeed, frozen tuna comprises the majority of tuna consumed in Hawai‘i. Much of it originates from foreign sources and is then shipped to Hawai‘i from Los Angeles, California.

While bigeye tuna landings volume and revenue remained relatively consistent over the study period, yellowfin tuna landings volume and revenue increased overall while swordfish experienced a general decrease. The Western and Central Pacific Fisheries Commission bigeye

tuna quota was a key limit to Hawai‘i longline production. High recruitment and increased demand for yellowfin tuna may have also contributed to landings, ex-vessel prices, and increased frozen imports. Similarly, swordfish fishery closures due to sea turtle interaction caps and a decrease in shallow-set longline fishing effort due to rising operating costs may have affected swordfish local landings, ex-vessel prices, and foreign exports.

Over the study period, Hawai‘i contributed between 30% and 47% of national tuna landings and accounted for 49% to 63% of national tuna revenue. Hawai‘i produced between 86% and 95% of national bigeye tuna landings and revenue from 2008 to 2019, respectively. Hawai‘i contributed between 38% and 67% of national yellowfin tuna landings over the study period and accounted for 38% to 76% of national yellowfin tuna revenue. Hawai‘i also provided between 22% and 48% of the nation's swordfish landings and between 20% and 41% of the national swordfish revenue from 2008 to 2019. Our results show that Hawai‘i exports a low share of its pelagic landings, indicating that the primary market is domestic. The majority of pelagic landings seem to be consumed locally, while the relatively lower unit prices of imports and higher unit prices of exports reveal that Hawai‘i is able to maximize its potential earnings from pelagic landings to further support its economy.

Fishing and landings from Hawai‘i commercial pelagic fisheries continue to play an important role in the local culture for Native Hawaiians, Hawai‘i residents, and visitors. Our results demonstrate that Hawai‘i pelagic fisheries provide both a vital source of food and economic support for the Hawaiian Islands, while substantially contributing to the seafood supply and fisheries economy of the United States.

Introduction

Centered in the Pacific Ocean, Hawai‘i enjoys access to a vast range of ocean resources. Geographically remote, marine resources supplement the local food supply. Fish was the main source of protein for Native Hawaiians before colonization and remains a hallmark of Hawaiian heritage and cultural identity. Sharing fish maintains family and social ties (Calhoun et al. 2020), and non-commercial fishing and sharing catch are strong traditions for the local lifestyle and diet. Commercial fishing meanwhile provides fresh, high quality fish to the main Hawaiian Islands and continental U.S., though the higher prices render it more of a local delicacy than a staple.

Hawai‘i commercial fisheries include pelagic, bottomfish, crustacean, nearshore species, and precious coral. Primarily due to catch from Hawai‘i pelagic fisheries, Honolulu consistently ranked in the top 12 U.S. ports for revenue from 2010 to 2019, ranking 9th in 2019 (NMFS 2021). It is the center of the Hawai‘i commercial fishing and seafood industry. This report presents a market analysis of federally managed pelagic commercial fisheries along the Hawaiian Archipelago from 2008 to 2019, with a focus on valuable highly migratory species. We select this study period in order to analyze recent trends and to establish a baseline to compare against the subsequent years impacted by COVID-19.

In this report, we provide summaries of Hawai‘i commercial pelagic landings, ex-vessel prices, local Hawai‘i and domestic U.S. consumption, international trade, and market substitutes, focusing on Pacific Island Region pelagic management unit species (PMUS). Additionally, we present in-depth analyses for bigeye tuna (*Thunnus obesus*), yellowfin tuna (*Thunnus albacares*), and swordfish (*Xiphias gladius*). These species are the primary catch of commercial pelagic fisheries in Hawai‘i and represent the most valuable landings for the deep-set and shallow-set longline fisheries. Bigeye tuna and swordfish are target species for the longline fishery, while yellowfin tuna is secondary catch and popular in local dishes. Similarly, the Hawai‘i small boat troll fishery targets a variety of pelagic species depending on the seasonality, including skipjack tuna (*Katsuwonus pelamis*), marlins (*Makaira mazara* and *Makaira indica*), mahimahi (*Coryphaena* spp.), and wahoo (*Acanthocybium solandri*). A unique feature of Hawai‘i pelagic fisheries is that most non-target catch is retained, resulting in minimal discards.

The pelagic fishery is the largest of Hawai‘i commercial fisheries. From 2008 to 2019, pelagic species accounted for approximately 84% of the total value and 66% of the total volume of the Hawai‘i seafood market[1]. In 2019, the fishery generated 90% of Hawai‘i commercial ex-vessel revenue at $105.6 million (Remington et al. 2020). In 2016, Hawai‘i commercial fisheries generated over $867 million, supported 9,900 jobs, and created $269 million in income (NMFS 2018). Hawai‘i tuna fisheries alone generated $88.5 million in total sales in 2016 (NMFS 2018).

[1] We use Pacific Island Region pelagic management unit species to estimate the pelagic market share.

Hawai‘i residents consume two to three times more seafood per capita than the continental U.S. population, mostly as fresh and frozen finfish (Geslani et al. 2012). Loke et al. (2012) estimate that Hawai‘i residents spent $408 million on seafood in 2005, while visitors spent $256 million on seafood that year. In 2005, approximately 80% of Hawai‘i commercial landings were consumed locally (Loke et al. 2012). Yet, as our report demonstrates, Hawai‘i also relies on imports to fill its consumption demand. We calculate the local and domestic consumption trends of Hawai‘i bigeye tuna, yellowfin tuna, and swordfish landings.

Previous research indicates that a portion of the Hawai‘i seafood market is comprised of domestic shipments of seafood products to the continental U.S. Two studies estimated that from 2000 to 2009, approximately 57% of all seafood consumed in Hawai‘i was imported from foreign sources, while an additional 6% of the Hawai‘i market originated from continental U.S. landings (Loke et al. 2012, Geslani et al. 2012)[2]. Similarly, industry estimates that 80% of Hawai‘i longline catch is sold locally, 18% is shipped to the continental U.S., and less than 2% is exported internationally (Hawaii Longline Association 2020). Loke et al. (2012) also estimate that non-commercial catch in Hawai‘i can account for an additional 22% of the local seafood supply. However, because of the broad estimates provided by these studies and our inability to replicate these values, we reference them but do not incorporate them into our calculations. We focus our analyses instead on commercial seafood sources and consumption. Future studies could benefit from investigating these additional contributions to pelagic fisheries markets and local consumption.

This report is divided into five sections. We first describe our data sources, followed by an articulation of the terminology used throughout this report. The second section summarizes Hawai‘i pelagic fisheries and shows trends in landings. The third section presents Hawai‘i pelagic exports, and the fourth discusses pelagic imports to Hawai‘i. The fifth section provides in-depth analyses of landings, consumption, and trade for the highest pelagic volume and value in Hawai‘i: bigeye tuna, yellowfin tuna, and swordfish. We conclude the report with a discussion of Hawai‘i contribution to U.S. seafood supply and overall economic impact.

Data

We query U.S. commercial landings and international trade data from the NOAA NMFS Office of Science and Technology Fisheries One Stop Shop reporting portal (FOSS) (NMFS 2021).[3] We compile the raw trade data into a database and group the products to represent broader

[2] Geslani et al. (2012) and Loke et al. (2012) aimed to calculate the consumption of seafood in Hawai‘i from 2000 to 2009, providing updated estimates from the last known similar study in 1980 covering 1970 to 1977. They obtained loose estimates of domestic shipments between Hawai‘i and the continental U.S. Using commercial waterborne cargo data from the U.S. Army Corps of Engineers and a survey of dealers, they were able to approximate the percentage of domestic shipments to Hawai‘i that were imports.

[3] For details on how data were queried from FOSS and WPacFIN, see Appendix 2.

product categories based on their disaggregated commodity description. We convert volume from kilograms to pounds.[4]

The data include imports and exports of pelagic fishery products.[5] Imports are calculated as products for consumption and include those of foreign origin entering the U.S. for immediate consumption as well as withdrawals from customs bonded warehouses. Exports include products of both local and domestic origin shipped to non-U.S. markets. The FOSS portal includes re-exports, which are products of foreign origin that have undergone further processing in the U.S. for enhanced value in generally the same form. While the U.S. census classifies them as domestic exports, we exclude them from our calculations because the products are of foreign origin.

Similarly, we remove mail shipments and low value shipments from the data. We analyze data regarding the 50 U.S. states, removing Puerto Rico, the U.S. Virgin Islands, and Pacific Island territories for the purposes of data consistency across our analyses. Of note, the FOSS data exclude domestic shipments within the U.S. (shipments from Hawai‘i to the continental U.S.), thus our results may be conservative representations. Currently, domestic shipment data are not readily available.

In its raw form, the FOSS trade data utilize the Harmonized Tariff Schedule (HTS) classification product naming scheme. We consolidate and re-categorize product forms for ease of reference and create a variable to distinguish among them: fresh, frozen, processed, and combinations of these forms. When the HTS code presents further details about the product form, we include the specific form description, such as gutted or whole. However, several HTS codes are not species-specific. We include unspecified tuna, unspecified squid, and unspecified shark, which are products that cannot be attributed to a specific species and likely contain PMUS. Kawakawa (*Euthynnus affinis*) and sailfish (*Istiophorus platypterus*) appear in an aggregate product form alongside 19 other species and we remove it from our calculations. Similarly, we remove a combined product that includes both cuttlefish and unspecified squid.

We queried Hawai‘i commercial landings data from the NOAA NMFS Western Pacific Fisheries Information Network (WPacFIN) (Western Pacific Fisheries Information Network 2021) and the Pacific Island Fisheries Science Center Hawai‘i DAR (Division of Aquatic Resources) Commercial Purchases portal (Pacific Islands Fisheries Science Center 2021). We only summarize volume sold and ex-vessel price data from the State of Hawai‘i, Division of Aquatic Resources Commercial Marine Dealer’s reports. Similarly, the FOSS landings data notate the volume both caught and sold. Because this report analyzes market trends and calculates unit prices, we report the landings that are sold. For descriptions of species volume caught, please

[4] 1 pound = 0.45359237 kilograms, 1 kilogram = 2.20462 pounds.
[5] Project metadata can be found in the NMFS InPort at https://www.fisheries.noaa.gov/inport/item/65801

refer to the Western Pacific Regional Fishery Management Council pelagic stock assessment and fishery evaluation reports for the years 2008 to 2019 (i.e., Remington et al. 2020).

All comparisons between landings data and trade data use estimated live weight converted from trade volumes. Hawai‘i landings are estimated in whole, wet pounds, while foreign trade has generally undergone varied amounts of processing. We thus specify all import and export volume as estimated live weight when compared to landings[6]. For trade data, we use Food and Agriculture Organization of the United Nations (FAO) conversion factors (FAO 2000, FAO n.d.) and NMFS conversion factors (NMFS n.d.). However, revenue and unit prices remain unchanged to represent the final, value-added prices for exports. Similarly, the unit price reflects the actual unit price[7]. For our calculations of Hawai‘i contribution to U.S. seafood supply, we use FOSS landings data. Most data are public while some state-level data are confidential. The confidential data were not available for our calculations.

All values are expressed in $USD and have been adjusted for inflation to 2019 dollars using the Consumer Price Index (CPI) for Honolulu from the U.S. Bureau of Economic Analysis (see Table A 1 in Appendix A).

Definitions

The following terminology guides the data analyses in this report. These distinctions are reflected in the code for our calculations.

Continental U.S. refers to the contiguous 48 U.S. states and Alaska. It does not include Caribbean or Pacific Island U.S. territories. We use this term to distinguish between the economic activity of Hawai‘i and the remaining 49 states of the U.S. Several data sources do not include data outside the 50 U.S. states, and thus we do not include the consumption and economic contributions of U.S. territories in order to maintain consistency in our analyses.

Imports and *exports* describe trade between Hawai‘i and foreign countries, or between the continental U.S. and foreign countries. The point of reference will be specified.

We calculate *consumption* as:

$$\text{landings} + \text{exports} - \text{imports}$$

Local consumption refers to Hawai‘i commercial pelagic landings and imports that are consumed within Hawai‘i. Similarly, *local landings* refers to Hawai‘i commercial landings of pelagic species. We describe international trade with Hawai‘i as the origin and destination, unless otherwise noted.

[6] See Table 2 in Appendix A for conversion factors.
[7] This is consistent for the summary table for each species profile. For the full list of conversion factors, see Table 2 in Appendix A.

Domestic consumption denotes U.S. commercial pelagic landings and imports that are consumed within the 50 U.S. states. This term is distinguished from consumption figures that only analyze Hawai‘i consumption or continental U.S. consumption. Similarly, *domestic landings* indicates pelagic landings within the 50 U.S. states. Hawai‘i landings and continental U.S. landings are distinguished. Domestic landings, consumption, and trade do not include data from U.S. Caribbean and Pacific Island territories.

Tuna (unspecified) is a species category in the NOAA FOSS data and describes products that are derived from tunas. It is a general product form that is processed rather than a single species product. We find 11 product forms that are *tuna (unspecified)* in FOSS foreign trade data. We include this species category in several aggregate calculations, which we specify throughout our report.

Similarly, *shark (unspecified)* and *squid (unspecified)* appear in the FOSS trade data. Unspecified product forms appear for sharks as fresh, frozen, and dried fins. The same holds for *squid (unspecified)*, for which we identify 6 general product forms. These products are important to include because blue shark (*Prionace glauca*), oceanic whitetip shark (*Carcharhinus longimanus*), shortfin mako shark (*Isurus oxyrinchus*), and thresher sharks (*Alopias* spp.) are PMUS. Neon flying squid (*Ommastrephes bartamii*), diamondback squid (*Thysanoteuthis rhombus*), and purple flying squid (*Sthenoteuthis oualaniensis*) are also PMUS. The FOSS trade data do not specify Hawai‘i shark or squid trade beyond these general product forms. Both unspecified shark and unspecified squid are mostly imported to Hawai‘i.

Among the figures and tables in this report, several import and export quantities are of low volume. We group these data into a category labeled as *Other* to make the quantities visible for display. The countries included in each of the *Other* categories are defined below the respective caption.

Hawai‘i pelagic landings

Two main fishing fleets harvest pelagic and highly migratory species in Hawai‘i for commercial purposes: the small boat fleet and the longline fleet. The small boat fleet contains a range of vessel types, and the majority sell at least a portion of their catch to cover trip expenses (Chan and Pan 2017). The small boat fishery includes troll, handline, offshore handline, and *aku* boat (pole and line) fisheries (Remington et al. 2020). The longline fleet consists of shallow-set and deep-set fisheries, and included 150 active fishing vessels in 2019 (Remington et al. 2020). The deep-set longline fleet is the largest commercial fishing sector in Hawai‘i and mainly targets bigeye tuna. In 2019, the deep-set longline fishery landed 87% of Hawai‘i commercial pelagic catch and generated 88% of the total revenue (Remington et al. 2020).

The longline fleet is regulated by a limited entry program with a maximum allowance of 164 permits. Permits are renewable and transferable, but no new permits are issued. A small share of the Hawai‘i longline fleet is based on the West Coast of the continental U.S. and sells its landings in California. The landings data in this report exclude the volume sold by the Hawai‘i-permitted longline vessels that land their catch on the continental U.S. West Coast.

The Honolulu fresh fish auction is the main point of market access for fresh pelagic catch in Hawai‘i, and the longline fleet supplies the majority of the fish for auction sale. Locally-owned businesses represent the majority of buyers at the auction (Remington et al. 2020). Figure 1 illustrates the supply chain for pelagic fishery products in Hawai‘i.

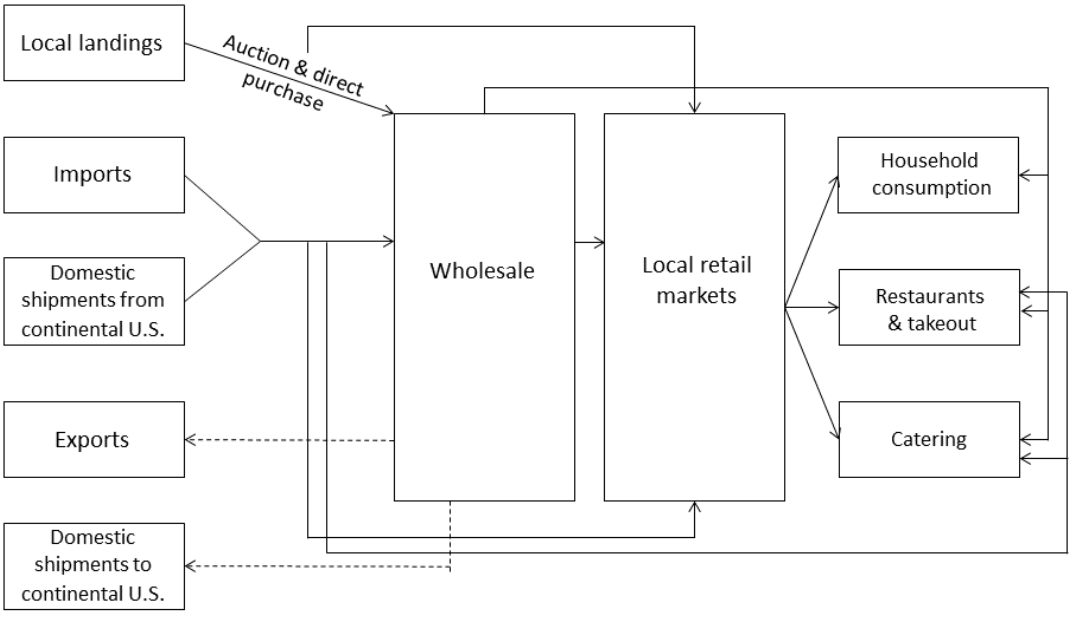

Figure 1. Supply chain of pelagic fishery products in Hawai‘i.

Source: modified after Figure 2 in Loke et al. 2012.

From 2009 to 2015, the total volume sold of pelagic species landed in Hawai‘i steadily increased before reaching a plateau through 2019 (Figure 2). In 2019, approximately 34 million lb of pelagic landings were sold, valued at around $105 million. Bigeye tuna was the highest landed species, followed by yellowfin tuna. Landings of yellowfin tuna generally increased from 2008 to 2018, peaking at about 7.3 million lb in 2018. Swordfish, mahimahi, and opah (*Lampris* spp.) comprised a large share of the remaining landed species, with a decrease in swordfish landings since 2008. Landings of mahimahi decreased slightly from 2015 to 2019, while blue marlin increased over the study period. The "Other" category of species includes the remaining pelagic landings, aggregated to make them visible. The volume landed of these species is detailed in Table 1.

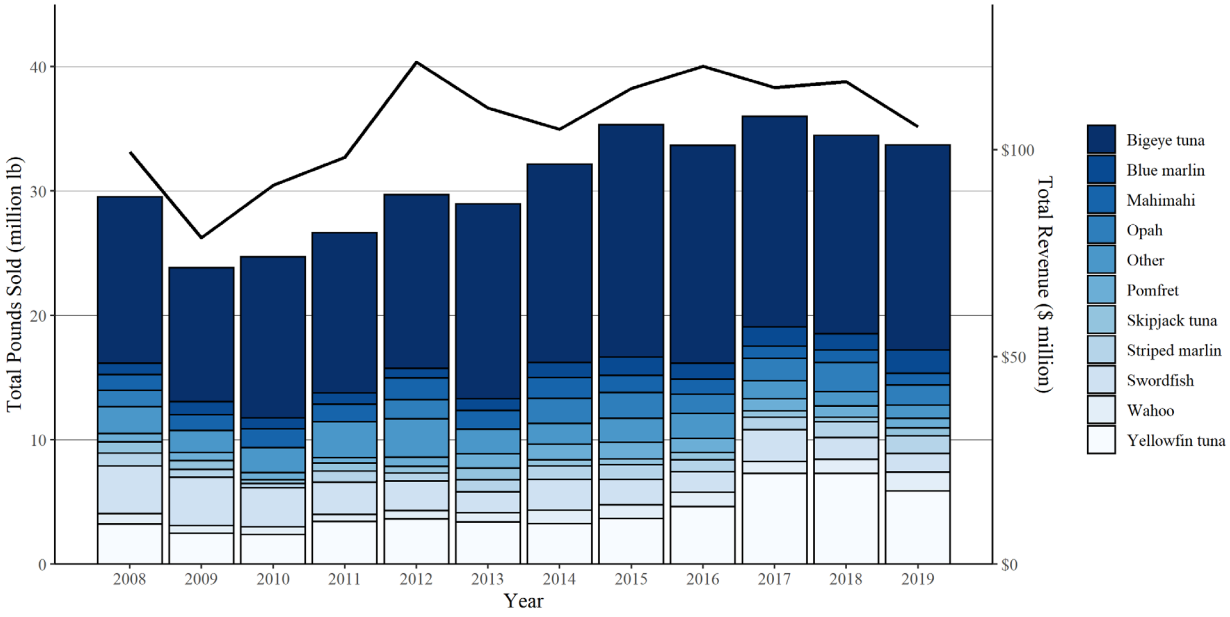

Figure 2. Total volume sold and value of Hawai‘i pelagic landings.

"Other" includes albacore tuna, black marlin/silver marlin, escolar, kawakawa, sailfish, shortbill spearfish, shortfin mako shark, unspecified squid, and unspecified thresher sharks.

Note: While blue shark, bluefin tuna, and oceanic whitetip shark were caught, these species were not sold from 2008 to 2019.

Table 1 summarizes the annual volume of commercial pelagic landings that are sold, by species. Bigeye tuna landings have steadily increased since 2009 and peaked in 2015, then decreased slightly from 2016 to 2019. Yellowfin tuna landings also increased over the study period; 127% from 2008 to 2018. The landings volume of blue marlin and striped marlin (*Tetrapturus audax*) followed a similar increasing trend from 2008 to 2019. Both pomfret (*Taractichthys steindachneri*) and wahoo landings increased significantly from 2012 to 2016, with pomfret increasing by 60% and wahoo increasing by 74%. Aside from wahoo, catch of the majority of species declined overall in the last 4 to 6 years of our study period.

Table 1. Total volume sold (in thousands of lb) of Hawai‘i landings.

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Albacore tuna	803	650	912	1,594	1,927	804	501	661	605	277	220	269
Bigeye tuna	13,384	10,758	12,940	12,860	13,952	15,668	15,928	18,681	17,530	16,977	15,956	16,478
Black marlin, Silver marlin	0	1	0	0	2	4	22	12	18	17	15	13
Blue marlin	922	1,033	870	909	791	935	1,211	1,478	1,282	1,544	1,326	1,888
Blue shark	0	0	0	0	0	0	0	0	0	0	0	0
Bluefin tuna	0	0	0	0	0	0	0	0	0	0	0	0
Escolar	491	545	576	632	602	579	532	483	440	319	303	267
Kawakawa	2	5	2	2	4	5	13	18	6	7	5	6
Mahimahi	1,250	1,283	1,504	1,423	1,741	1,511	1,685	1,383	1,188	957	1,006	943
Oceanic whitetip shark	0	0	0	0	0	0	0	0	0	0	0	0
Opah	1,314	0	0	0	1,549	0	2,004	2,067	1,556	1,812	2,327	1,614
Pomfret	672	627	589	428	731	1,143	1,243	1,362	1,166	981	929	781
Sailfish	11	22	32	18	19	12	34	37	37	38	29	47
Shortbill spearfish	508	260	271	469	365	475	500	603	774	690	485	461
Shortfin mako shark	250	234	184	131	124	98	91	94	113	90	92	0
Skipjack tuna	911	712	298	638	536	929	498	478	552	493	368	645
Squid (unspecified)	1	3	6	3	4	3	3	1	1	1	0	2
Striped marlin	1,024	646	339	910	656	980	1,075	1,161	1,000	1,020	1,257	1,407
Swordfish	3,835	3,882	3,150	2,592	2,382	1,674	2,480	2,046	1,640	2,560	1,745	1,491
Thresher sharks (unspecified)	89	62	40	44	31	11	13	9	4	4	0	0
Wahoo	850	604	599	568	656	742	1,056	1,105	1,143	960	1,143	1,523
Yellowfin tuna	3,205	2,485	2,371	3,409	3,622	3,391	3,259	3,654	4,611	7,283	7,278	5,861

Bigeye and yellowfin tunas composed the largest share of Hawai‘i commercial pelagic landings, constituting approximately 66% of total volume and 80% of total revenue in 2019 (Figure 3). They are often marketed as ‘ahi throughout Hawai‘i (Hospital and Beavers 2014), and so this Hawaiian name refers to both species in our report. Bigeye tuna accounted for 49% of the volume sold and 60% of the revenue in 2019. Yellowfin tuna followed, totaling to 17% of the volume sold and 20% of the revenue (Figure 3).

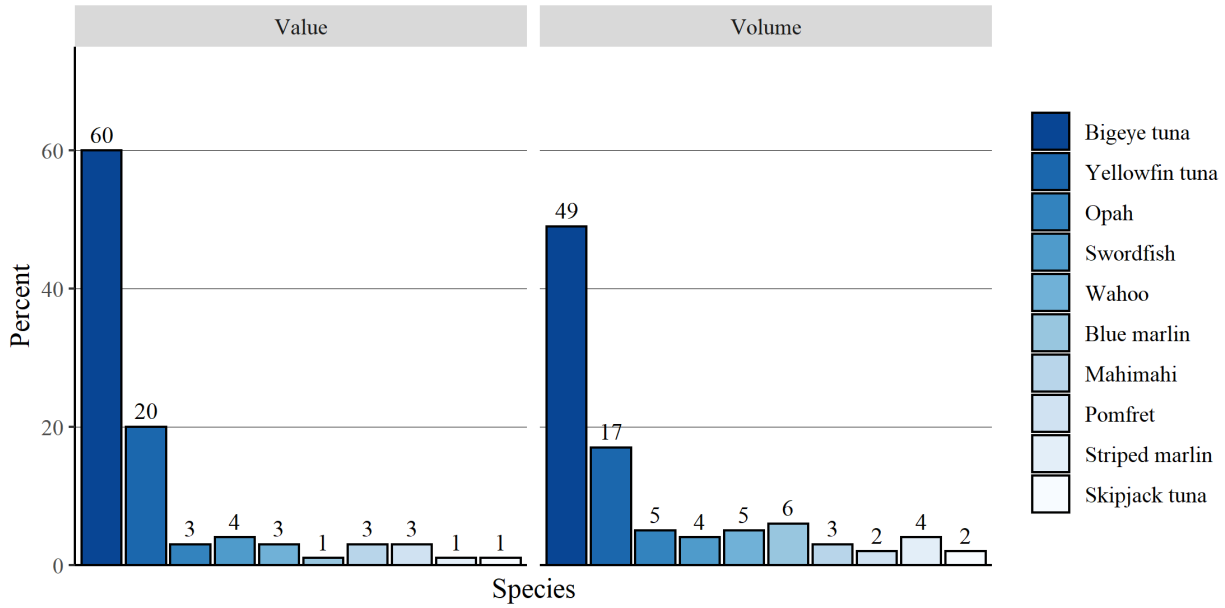

Figure 3. Share of top Hawai‘i landings sold, 2019.

Distinguishable by a barrel-like body and wide eyes, bigeye tuna is valued for its high fat content and delicate flesh. Yellowfin tuna has a slimmer build and is characterized by its long, bright yellow dorsal and anal fins. Throughout Hawai‘i, ‘ahi is in high demand during the winter holiday season and particularly expensive for New Year celebrations and into the beginning of the following year (late November through mid-February). ‘Ahi is typically enjoyed raw in Hawai‘i as sashimi or *poke*, which is seasoned, raw, cubed fish often served over rice.

‘Ahi poke in grocery stores is made predominantly with imported frozen, carbon monoxide treated raw tuna. Frozen, carbon monoxide treated raw tuna is known as tasteless smoke and commonly labelled as “previously frozen”. The process is used to preserve or alter the red color in tuna. Previously frozen ‘ahi is typically imported yellowfin tuna and is sold at a lower price than its fresh counterpart (Hospital and Beavers 2014). It is the most common market substitute for local fresh ‘ahi (Hospital and Beavers 2014). On average, fresh, locally sourced poke can be more than twice as expensive as frozen imported ‘ahi poke.

Pelagic exports from Hawai‘i

Table 2 shows the total annual PMUS volume sold and value of Hawai‘i landings and exports: bigeye tuna, yellowfin tuna, skipjack tuna, albacore tuna (*Thunnus alalunga*), swordfish, bluefin tuna, unspecified shark, unspecified squid, and unspecified tuna. Both fresh and frozen export forms are included. The trade data include several species of bluefin tuna (*Thunnus thynnus*, *Thunnus maccoyii*, and *Thunnus orientalis*) either as a single species or as a combination of multiple species. We aggregate these as "bluefin tuna" for ease of analysis and because they are of low volume. Of the bluefin tuna species, only northern bluefin tuna (*Thunnus thynnus*) is a PMUS.

With the exception of 2012, the overall unit price for exports from Hawai‘i was several dollars per pound higher than the estimated unit price of local landings (Table 2). A small share of pelagic landings are exported from Hawai‘i. From 2008 to 2011 and from 2013 to 2019, less than 2% of commercial pelagic landings in Hawai‘i were exported annually. In 2015, and from 2017 to 2019, annual pelagic exports decreased markedly.

Table 2. Total Hawai‘i landings sold and exports of PMUS.

	Hawai‘i Landings			Exports from Hawai‘i				
Year	Volume (lb)	Revenue ($)	Unit Value ($/lb)	Export Volume (lb)	Export Revenue ($)	Export Unit Value ($/lb)	Share of Volume Exported (%)	Share of Value Exported (%)
2008	29,523,225	99,482,072	3.37	427,752	1,745,668	4.08	1.4	1.8
2009	23,813,211	78,696,476	3.30	369,074	3,010,792	8.16	1.5	3.8
2010	24,684,198	91,429,231	3.70	281,802	2,366,551	8.40	1.1	2.6
2011	26,631,008	98,162,308	3.69	494,941	3,352,510	6.77	1.9	3.4
2012	29,691,207	121,171,878	4.08	1,383,183	4,538,001	3.28	4.7	3.7
2013	28,963,539	110,084,668	3.80	412,563	2,058,243	4.99	1.4	1.9
2014	32,147,192	104,888,031	3.26	178,136	865,445	4.86	0.6	0.8
2015	35,331,620	114,787,048	3.25	62,634	235,349	3.76	0.2	0.2
2016	33,666,780	120,083,054	3.57	116,305	598,868	5.15	0.3	0.5
2017	36,028,486	115,004,548	3.19	58,971	319,542	5.42	0.2	0.3
2018	34,485,798	116,386,904	3.37	20,042	141,581	7.06	0.1	0.1
2019	33,695,848	105,498,999	3.13	22,569	112,820	5.00	0.1	0.1

Species landed and sold include albacore tuna, bigeye tuna, black marlin/silver marlin, blue marlin, bluefin tuna, escolar, kawakawa, mahimahi, opah, pomfret, sailfish, shortbill spearfish, shortfin mako shark, skipjack tuna, striped marlin, swordfish, thresher sharks, unspecified squid, wahoo, and yellowfin tuna. Species exported include albacore tuna, bigeye tuna, bluefin tuna, skipjack tuna, swordfish, unspecified shark, unspecified squid, unspecified tuna, and yellowfin tuna.

Figure 4 displays exports of PMUS from Hawai‘i, which include bigeye tuna, yellowfin tuna, skipjack tuna, albacore tuna, swordfish, bluefin tuna, unspecified shark, unspecified squid, and unspecified tuna. Figure 4 shows an overall decrease in pelagic exports since 2008, though exports sharply increased in 2012 to nearly 1.4 million lb. Bigeye and yellowfin tuna were the main pelagic exports from 2008 to 2019. Bigeye tuna accounted for the majority of export volume while yellowfin tuna generated the highest export unit value (Table 3). The average unit

value of pelagic exports dropped to its lowest point in 2012, having declined from a high of $8.40/lb in 2010 to $3.28/lb in 2012 (Table 2).

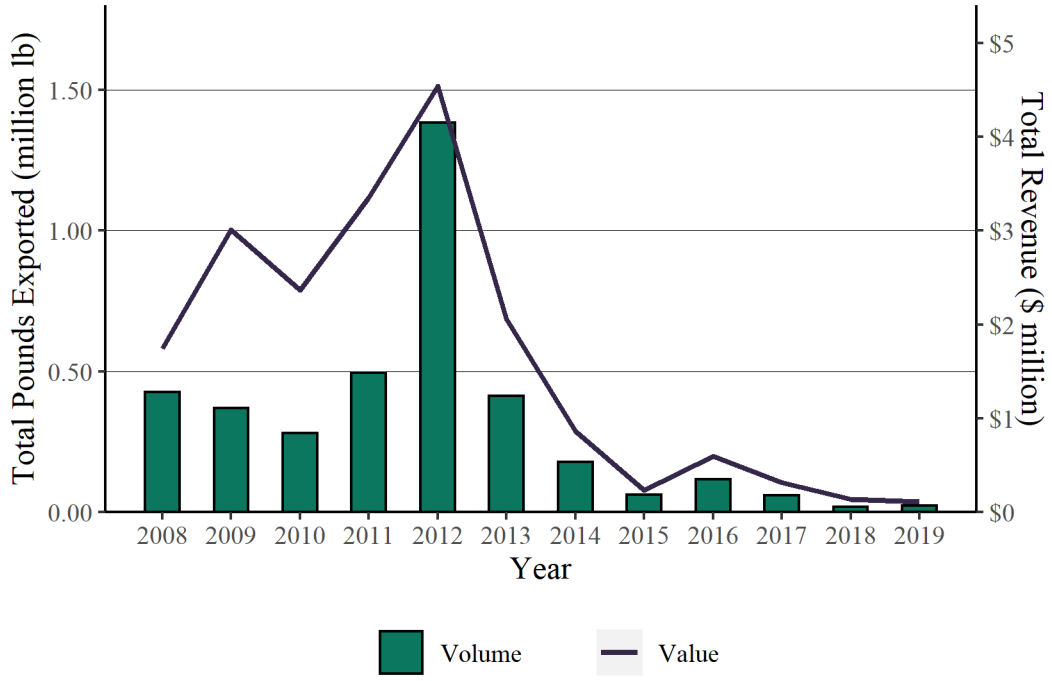

Figure 4. Total PMUS exports from Hawai‘i.

Species include albacore tuna, bigeye tuna, bluefin tuna, skipjack tuna, swordfish, unspecified shark, unspecified squid, unspecified tuna, and yellowfin tuna.

Table 3 shows Hawai‘i average landings sold, revenue, and exports from Hawai‘i from 2008 to 2019. We highlight the PMUS that were landed, sold, and exported. On average, Hawai‘i exported approximately 1.3% of its bigeye tuna landings from 2008 to 2019. Skipjack tuna had the highest export share of landings and revenue at 4.6% and 11.6%, respectively, with an average export unit value of $4.18/lb. The average unit value for yellowfin tuna exports from 2008 to 2019 was much higher than the average local landings unit value, at $8.61/lb and $3.50/lb, respectively. The tables below show that Hawai‘i exports a low share of its PMUS landings, indicating that the main markets remain within the U.S. The exception is unspecified squid, exports of which exceeded Hawai‘i landings even without conversion factors applied. The export volume may thus include domestic shipments from the continental U.S. or other sources.

Table 3. Average annual Hawai‘i landings sold and exports of PMUS, 2008–2019.

	Hawai‘i Landings			Exports from Hawai‘i				
Species	Volume (lb)	Revenue ($)	Unit Value ($/lb)	Export Volume (lb)	Export Revenue ($)	Export Unit Value ($/lb)	Share of Volume Exported (%)	Share of Value Exported (%)
Albacore tuna	768,489	1,572,090	2.05	1,034	7,513	7.27	0.1	0.5
Bigeye tuna	15,092,603	66,297,441	4.39	201,371	943,018	4.68	1.3	1.4
Skipjack tuna	588,228	970,222	1.65	26,886	112,362	4.18	4.6	11.6
Squid (unspecified)	2,407	7,998	3.32	19,518	23,836	1.22	810.9	298.0
Swordfish	1,473,863	3,821,419	2.59	7,966	26,073	3.27	0.5	0.7
Yellowfin tuna	4,202,348	14,691,111	3.50	53,762	463,054	8.61	1.3	3.2

Table 4 details pelagic export volume from Hawai‘i from 2008 to 2019. The majority of pelagic exports were bigeye tuna and yellowfin tuna. With the exception of 2012, bigeye tuna experienced an overall decrease in exports over the study period, with a sharp decrease from 2015 to 2017 coinciding with bigeye tuna fishery closures (Table 10). Yellowfin tuna exports decreased in the last five years of the study period as well, however to a smaller degree in comparison with those of bigeye tuna. Hawai‘i exported small quantities of skipjack tuna, albacore tuna, unspecified squid, and swordfish over the study period.

Table 4. Total PMUS export volume from Hawai‘i (lb).

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Albacore tuna	0	0	0	0	0	0	0	0	0	0	0	1,034
Bigeye tuna	154,769	171,701	203,452	286,271	1,099,927	296,660	98,515	22,911	44,983	12,588	10,937	13,739
Bluefin tuna	2,511	5,025	0	0	0	1,422	0	0	0	0	0	0
Shark (unspecified)	120,492	51,822	0	0	0	0	0	0	0	0	0	0
Skipjack tuna	22,267	74,730	6,067	0	0	0	0	0	0	4,482	0	0
Squid (unspecified)	0	0	0	0	0	0	4,463	26,904	41,375	10,714	0	0
Swordfish	21,552	376	0	0	0	0	0	1,971	0	0	0	0
Tuna (unspecified)	67,622	10,935	33,012	120,875	103,946	19,544	16,940	0	0	0	0	1,674
Yellowfin tuna	38,539	54,485	39,271	87,795	179,310	94,938	58,217	16,233	29,948	31,187	9,105	6,122

Table 5 displays the export destinations for Hawai‘i pelagic landings in terms of average export volume and revenue from 2008 to 2019. On average, Japan was consistently the top export destination for tunas. Together, Japan and Canada imported approximately 92% of Hawai‘i bigeye tuna exports from 2008 to 2019. An average of 64% of yellowfin tuna exports from Hawai‘i were sold to Japan, accounting for nearly 84% of the average yellowfin export value. Japan was also the main export destination for skipjack tuna, importing an average of 86% of skipjack export volume from Hawai‘i and 96% of the skipjack exports revenue. Unspecified shark was only exported from 2008 to 2009, the majority imported by Australia. Unspecified tuna exports from Hawai‘i remained consistently high from 2008 to 2014, with no exports from

2015 to 2018 and less than 1,700 lb of exports to Palau in 2019. The total average export volume and revenue for these top Hawai‘i pelagic landings are shown at the bottom of Table 5.

Table 5. Average annual exports from Hawai‘i of PMUS, 2008–2019.

Species	Country	Export Volume (lb)	Export Revenue ($)	Unit Value ($/lb)	Export Share Volume (%)	Export Share Value (%)
Albacore tuna	Canada	1,034	7,513	7.27	100.0	100.0
Bigeye tuna	Japan	120,661	569,198	4.72	50.9	52.7
	Canada	96,883	458,536	4.73	40.9	42.5
	China - Hong Kong	11,198	32,978	2.94	4.7	3.1
	South Korea	8,283	18,615	2.25	3.5	1.7
Bluefin tuna	Canada	2,986	6,099	2.04	100.0	100.0
Skipjack tuna	Japan	32,451	146,140	4.50	86.4	96.4
	Australia	5,096	5,513	1.08	13.6	3.6
Squid (unspecified)	Palau	19,518	23,836	1.22	100.0	100.0
Swordfish	Canada	7,966	26,073	3.27	100.0	100.0
Shark (unspecified)	Australia	120,492	95,644	0.79	69.9	10.5
	China - Hong Kong	51,822	813,411	15.70	30.1	89.5
Tuna (unspecified)	Philippines	67,205	53,735	0.80	54.6	27.7
	Canada	41,908	120,130	2.87	34.0	62.0
	China - Hong Kong	10,199	12,016	1.18	8.3	6.2
	South Korea	2,116	4,373	2.07	1.7	2.3
	Palau	1,674	3,600	2.15	1.4	1.9
Yellowfin tuna	Japan	48,178	435,721	9.04	63.5	83.7
	South Korea	19,452	17,172	0.88	25.7	3.3
	Canada	7,959	61,734	7.76	10.5	11.9
	Malaysia	238	5,746	24.14	0.3	1.1
	Totals	**677,319**	**2,917,783**	**4.31**		

Pelagic imports to Hawai‘i

Hawai‘i depends on imports to fill its consumption demand, as shown throughout this report from available data. Table 6 compares Hawai‘i pelagic landings sold and pelagic imports, showing that the share of pelagic imports increased overall during the twelve-year study period. The unit price for imports to Hawai‘i was slightly lower than the estimated unit price of local landings (Table 6). From 2010 to 2011, pelagic import volume decreased significantly, from 15% in 2010 to 8.8% in 2011. The highest share of imports to Hawai‘i occurred in 2019, when pelagic imports accounted for 25.2% of the import volume. Landings volume remained relatively consistent from 2008 to 2019, with a slight decrease from 2009 to 2011, and an increase in 2017.

Table 6. Total Hawai‘i landings sold and imports of PMUS.

	Hawai‘i Landings			Imports to Hawai‘i				
Year	Volume (lb)	Revenue ($)	Unit Value ($/lb)	Import Volume (lb)	Import Value ($)	Import Unit Value ($/lb)	Share of Volume Imported (%)	Share of Value Imported (%)
2008	29,523,225	99,482,072	3.37	4,406,301	8,999,686	2.04	13.0	8.3
2009	23,813,211	78,696,476	3.30	5,805,739	11,506,606	1.98	19.6	12.8
2010	24,684,198	91,429,231	3.70	4,348,862	8,981,452	2.07	15.0	8.9
2011	26,631,008	98,162,308	3.69	2,557,367	6,459,414	2.53	8.8	6.2
2012	29,691,207	121,171,878	4.08	3,475,784	6,993,499	2.01	10.5	5.5
2013	28,963,539	110,084,668	3.80	5,799,369	17,137,752	2.96	16.7	13.5
2014	32,147,192	104,888,031	3.26	8,543,362	21,149,119	2.48	21.0	16.8
2015	35,331,620	114,787,048	3.25	9,800,684	24,364,014	2.49	21.7	17.5
2016	33,666,780	120,083,054	3.57	9,396,322	22,747,619	2.42	21.8	15.9
2017	36,028,486	115,004,548	3.19	7,972,640	19,755,318	2.48	18.1	14.7
2018	34,485,798	116,386,904	3.37	8,836,208	23,705,556	2.68	20.4	16.9
2019	33,695,848	105,498,999	3.13	11,341,096	31,185,372	2.75	25.2	22.8

Species landed and sold include albacore tuna, bigeye tuna, black marlin/silver marlin, blue marlin, bluefin tuna, escolar, kawakawa, mahimahi, opah, pomfret, sailfish, shortbill spearfish, shortfin mako shark, skipjack tuna, striped marlin, swordfish, thresher sharks, unspecified squid, wahoo, and yellowfin tuna. Species imported include albacore tuna, bigeye tuna, bluefin tuna, mahimahi, skipjack tuna, swordfish, unspecified shark, unspecified squid, unspecified tuna, and yellowfin tuna.

Table 7 shows the average volume and value of Hawai‘i landings sold and pelagic imports to Hawai‘i over the study period. Here, we highlight PMUS that were landed, sold, and imported. Small quantities of bigeye tuna are imported to Hawai‘i; the average share of bigeye tuna imports by volume and value were 4.8% and 1.5%, respectively. The average unit value of imported bigeye tuna to Hawai‘i from 2008 to 2019 was $1.28/lb, just over 70% lower than locally landed bigeye prices. Yellowfin tuna imports had nearly twice the import market share in comparison to bigeye tuna from 2008 to 2019, with an average of 8.2% in import volume annually.

Table 7. Average annual Hawai‘i landings sold and imports of PMUS, 2008–2019.

	Hawai‘i Landings			Imports to Hawai‘i				
Species	Volume (lb)	Revenue ($)	Unit Value ($/lb)	Import Volume (lb)	Import Value ($)	Import Unit Value ($/lb)	Share of Volume Imported (%)	Share of Value Imported (%)
Albacore tuna	768,489	1,572,090	2.05	16,266	45,624	2.80	2.1	2.8
Bigeye tuna	15,092,603	66,297,441	4.39	759,813	975,577	1.28	4.8	1.5
Mahimahi	1,322,887	4,345,271	3.28	762,350	2,134,421	2.80	36.6	32.9
Skipjack tuna	588,228	970,222	1.65	26,303	22,228	0.85	4.3	2.2
Squid (unspecified)	2,407	7,998	3.32	1,038,403	2,499,611	2.41	99.8	99.7
Swordfish	1,473,863	3,821,419	2.59	14,810	52,391	3.54	1.0	1.4
Yellowfin tuna	4,202,348	14,691,111	3.50	377,110	1,519,006	4.03	8.2	9.4

Figure 5 displays the total pelagic imports to Hawai‘i by year, with a focus on the species of highest import volume and value. These species include bigeye tuna, yellowfin tuna, skipjack tuna, albacore tuna, mahimahi, swordfish, and unspecified tuna. There is a general increase in pelagic imports starting in 2013 and peaking in 2019. The overall increase in imports could be due to higher demand for pelagic species by tourists and residents.

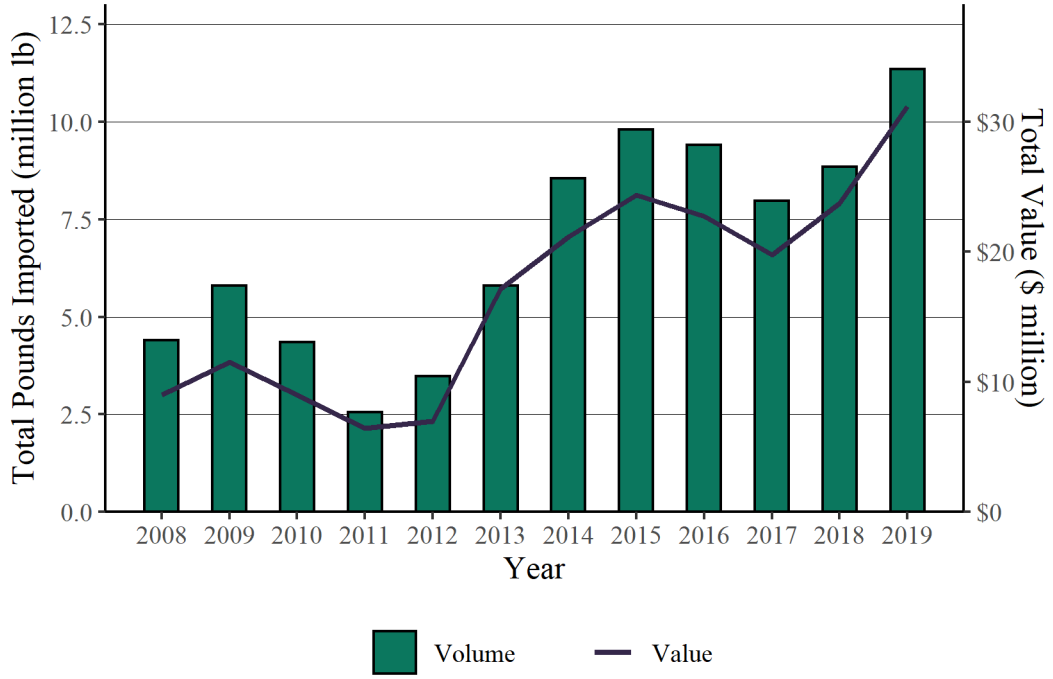

Figure 5. Total PMUS imports to Hawai‘i.

Species include albacore tuna, bigeye tuna, bluefin tuna, mahimahi, skipjack tuna, swordfish, unspecified shark, unspecified squid, unspecified tuna, and yellowfin tuna.

Table 8 articulates the total pelagic import volume to Hawai‘i, by species and year. Unspecified tuna composed the highest import volume over the study period, increasing by 615% from 2008 to 2019. While we cannot directly compare locally landed and imported unspecified tuna, squid,

and shark because Hawai‘i landings data are species specific, we include the general product categories to capture the scale of imports to Hawai‘i. The average import volume of unspecified tuna was greater than that of all other tuna species combined from 2008 to 2019. Mahimahi was the second highest import volume in 2019, followed closely by unspecified squid (Table 8). Bigeye tuna imports peaked from 2012 to 2015 before decreasing to its lowest import volume in 2018 and 2019.

Table 8. Total PMUS import volume to Hawai‘i (in thousands of lb).

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Albacore tuna	3	43	47	22	14	19	30	9	2	2	1	3
Bigeye tuna	547	697	428	309	1,373	1,189	1,494	1,184	853	508	283	253
Bluefin tuna	0	56	4	3	6	3	10	13	14	8	17	23
Mahimahi	879	895	1,161	459	410	430	766	729	535	725	967	1,192
Shark (unspecified)	490	368	25	0	0	0	0	0	0	0	0	0
Skipjack tuna	2	2	0	0	2	2	29	29	32	0	114	0
Squid (unspecified)	1,053	903	846	934	965	925	1,086	1,351	1,133	1,177	1,046	1,042
Swordfish	28	12	22	15	10	25	2	2	3	9	37	11
Tuna (unspecified)	1,199	2,468	1,603	632	620	2,233	4,483	5,802	6,438	5,105	6,253	8,574
Yellowfin tuna	205	363	213	183	75	974	645	683	388	438	117	242

Table 9 displays the annual import share of the top Hawai‘i pelagic landings from 2008 to 2019. Unspecified tuna had the highest import share across most years; imports composed over 75% of the total PMUS imports to Hawai‘i in 2019. In 2013, the import share of yellowfin tuna sharply increased to nearly 17% from about 2% in 2012. Unspecified squid, bigeye tuna, and mahimahi joined unspecified tuna as the highest PMUS import shares over the study period, while albacore tuna, bluefin tuna, unspecified shark, swordfish, and skipjack tuna were consistently among the lowest.

Table 9. Share of PMUS imports to Hawai‘i (%).

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Albacore tuna	0.1	0.7	1.1	0.9	0.4	0.3	0.3	0.1	0.0	0.0	0.0	0.0
Bigeye tuna	12.4	12.0	9.8	12.1	39.5	20.5	17.5	12.1	9.1	6.4	3.2	2.2
Bluefin tuna	0.0	1.0	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.2
Mahimahi	20.0	15.4	26.7	17.9	11.8	7.4	9.0	7.4	5.7	9.1	10.9	10.5
Shark (unspecified)	11.1	6.3	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Skipjack tuna	0.0	0.0	0.0	0.0	0.1	0.0	0.3	0.3	0.3	0.0	1.3	0.0
Squid (unspecified)	23.9	15.5	19.4	36.5	27.8	15.9	12.7	13.8	12.1	14.8	11.8	9.2
Swordfish	0.6	0.2	0.5	0.6	0.3	0.4	0.0	0.0	0.0	0.1	0.4	0.1
Tuna (unspecified)	27.2	42.5	36.9	24.7	17.8	38.5	52.5	59.2	68.5	64.0	70.8	75.6
Yellowfin tuna	4.7	6.2	4.9	7.2	2.2	16.8	7.5	7.0	4.1	5.5	1.3	2.1

Figures 6 and 7 show the total fresh and frozen pelagic imports to Hawai‘i from 2008 to 2019. Over most years, bigeye tuna accounted for the largest share of fresh imports to Hawai‘i, followed by mahimahi and yellowfin tuna (Figure 6). Fresh imports of mahimahi steadily increased from 2010 to 2019, accounting for about 69% of all fresh imports in 2019. Fresh yellowfin tuna imports decreased from about 257,000 lb in 2013 to approximately 70,000 lb in 2018 before increasing to about 242,000 lb in 2019 (Figure 6). Unspecified tuna, mahimahi, and yellowfin tuna accounted for the highest frozen pelagic import volume to Hawai‘i over the study

period; unspecified tuna comprised the majority (Figure 7). Indeed, Hawai‘i is one of the major market channels for frozen tuna imports.

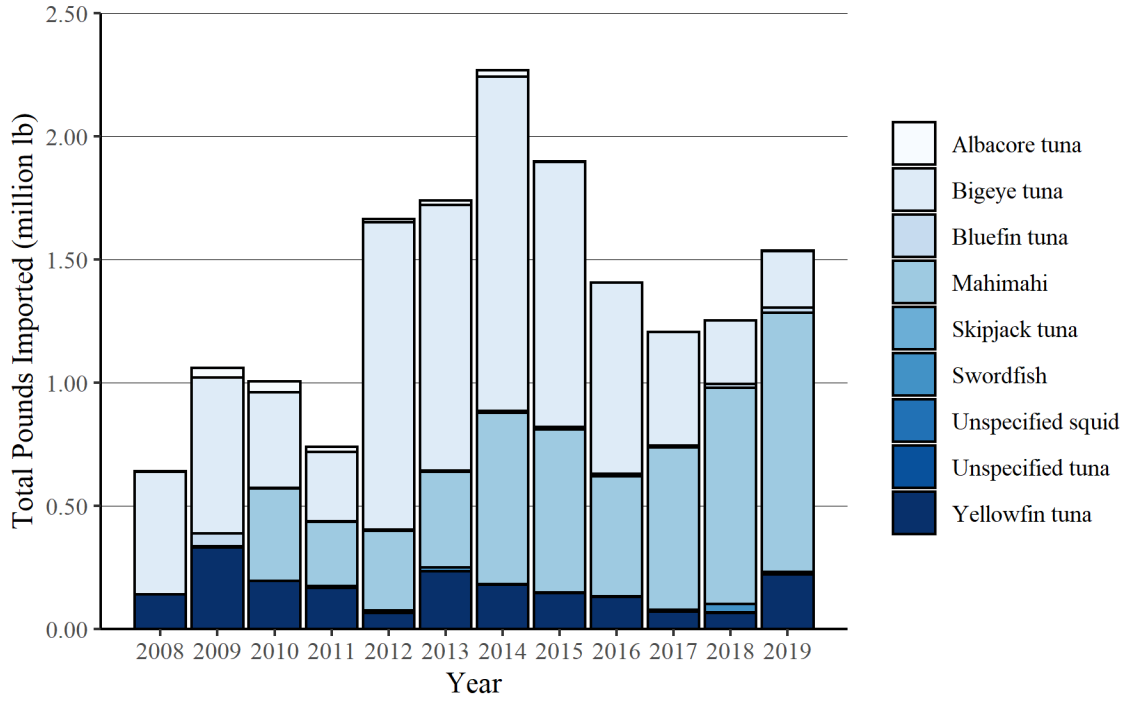

Figure 6. Total fresh import volume to Hawai‘i.

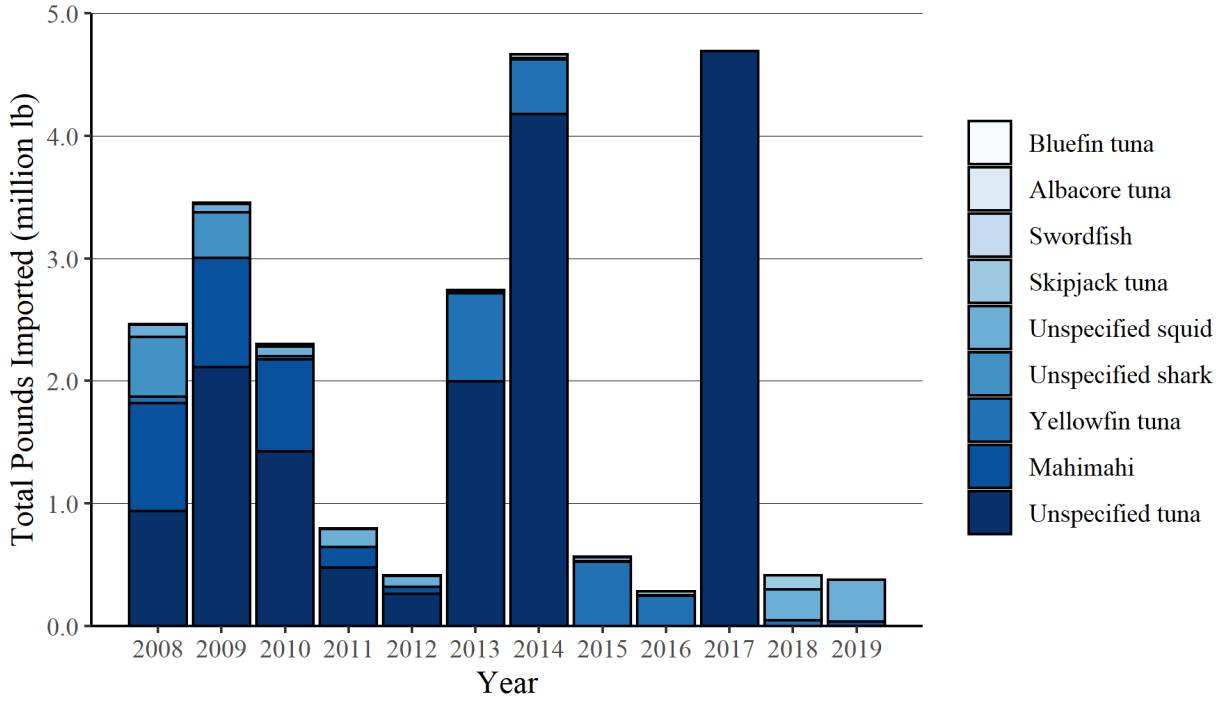

Figure 7. Total frozen import volume to Hawai‘i.

Species profiles

This section contains a series of profiles describing the consumption trends, landings, and trade for bigeye tuna, yellowfin tuna, and swordfish. These highly migratory species were selected for further analysis because they are the primary species of commercial pelagic catch in Hawai‘i and represent the most valuable landings for the deep-set and shallow-set longline fisheries. Bigeye tuna and swordfish are target species, and yellowfin tuna is popular in local dishes.

The first part of each species profile analyzes local and domestic consumption trends. The second presents a landings summary and average monthly ex-vessel prices. The third shows export destinations, while the fourth summarizes import origins. These trade sections describe varying product forms, volume traded, revenues, unit prices, and market substitutes where applicable.

Bigeye Tuna

Overall, Hawai’i accounted for 86% of U.S. bigeye tuna landings and 86% of domestic bigeye revenue in 2019. Hawai‘i contributed between 86% and 95% of domestic bigeye tuna landings while the islands' share of national bigeye revenue ranged between 86% and 95% from 2008 to 2019. From 2008 to 2019, bigeye tuna landed in Hawai‘i continued to be of high market value and low volume. Because of its high fat content, restaurants and grocery stores favor it for sashimi and poke. Bigeye tuna is predominately targeted by the deep-set longline fishery and by offshore handline fishers. It is the predominant catch of offshore handline vessels, though the individual tuna size is smaller on average and fishery catch volume is lower than in the longline fishery.

The Inter-American Tropical Tuna Commission (IATTC) was the first regional fishery management organization to set bigeye tuna catch limits for longline vessels in the Pacific Ocean in 2004 (IATTC 2004), followed by the Western and Central Pacific Fisheries Commission (WCPFC) in 2005 (WCPFC 2005). The IATTC resolution applied to four of its Parties, while the WCPFC conservation and management measure applied to all Commission Members. In 2009, an annual quota system was introduced for bigeye tuna caught throughout the Pacific, negotiated multilaterally among member and cooperating non-member nations of the IATTC and the WCPFC. Table 10 presents a summary of the WCPFC area closures during the study years. In addition to the United States, five WCPFC Members are subject to the WCPFC bigeye tuna quota: China, Indonesia, Japan, Republic of Korea, and Chinese Taipei (Ayers et al. 2018). Forecasted closure dates are set during the year using logbook data and catch trends for both the WCPFC and the IATTC.

Table 10. Timeline of Western and Central Pacific Fisheries Commission (WCPFC) bigeye tuna catch limits and fishery closures.

Year	WCPFC catch limit (mt)	Forecasted fishery closure date	Date the fishery reopened	Total days with closure in effect	Percentage of the year with closure in effect
2008	None	-	-	0	0%
2009	3,763	December 27	January 1, 2010	4	1%
2010	3,763	November 22	January 1, 2011	40	11%
2011	3,763	November 17	-	0	0%
2012	3,763	November 27	-	0	0%
2013	3,763	December 13	-	0	0%
2014	3,763	November 8	-	0	0%
2015	3,502	August 5	October 9	83	23%
2016	3,554	July 22	September 9	113	31%
2017	3,138	September 1	October 10	39	11%
2018	3,554	-	-	0	0%
2019	3,554	July 27	August 1	4	1%

Sources: Ayers et al. 2018, Wallace 2019.

During closures in the WCPFC convention area, most Hawai‘i longline vessels are prohibited from landing bigeye tuna, with three exceptions. First, vessels less than 24 meters in size are permitted to fish for bigeye tuna in the IATTC Convention area 500 miles east of Honolulu. Second, catch can be attributed to unused quota belonging to the U.S. Pacific Island territories (American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands) through the Consolidated and Further Continuing Appropriations Act [8] passed in 2010[9] (Ayers et al. 2018). Third, American Samoa and Hawai‘i longline dual permit holders may target bigeye tuna under their American Samoa permit during closures and when fishing outside of the U.S. exclusive economic zone (EEZ). During WCPFC closures, the market price for bigeye tuna rises. Vessels that qualify for the above exemptions are able to secure revenues during closures.

There have been six closures in the WCPFC convention area since 2009, each varying in length. Richmond et al. (2015) monitored the effects of the 2010 40-day closure. It occurred over the winter holiday season when ‘ahi is in high demand. They found that supply and quality of bigeye landings had decreased, while longliners had traveled further to fish in rougher waters. Prices for fresh, local ‘ahi also increased during this time, and some dealers purchased imported ‘ahi to meet the demand (Richmond et al. 2015). From 2011 to 2014, there were no closures due to territory attribution agreements. During the 2015 to 2016 season, the bigeye market may have been impacted by the second most active Pacific hurricane season on record (Ayers et al. 2018), which set dangerous conditions for tuna longliners.

[8] Attributed quota is purchased from U.S. Pacific Island territories through a negotiation process, and the owners of this quota are permitted to fish within the WCPFC Convention area, but outside of the Hawai‘i exclusive economic zone.

[9] In 2014, this Act was superseded by Amendment 7 to the Pelagics Ecosystem Management Plan (79 FR 64097).

When calculated as averages across the years of our study period, these possible closure impacts appear minimal. Hawai‘i landed an annual average of about 15 million lb of bigeye tuna from 2008 to 2019 (Table 11). Hawai‘i exported an average of approximately 319,000 lb of bigeye tuna and imported an average of around 760,000 lb annually. For both Hawai‘i and the continental U.S., the unit price of fresh bigeye tuna is higher than frozen bigeye tuna. On average, Hawai‘i annual exports of fresh bigeye sold for $2.27/lb higher than fresh bigeye tuna exports from the continental U.S. Hawai‘i export prices were 80% higher than continental U.S. export prices.

Table 11. Average annual supply and value of bigeye tuna, 2008–2019.

	Form	Volume (lb)	Value ($)	Unit Price ($/lb)
Hawai‘i Landings	Fresh	15,092,603	66,297,441	4.39
Exports from Hawai‘i	Fresh	142,330	867,698	6.10
	Frozen	177,122	225,960	1.28
Imports to Hawai‘i	Fresh	759,813	975,577	1.28
Continental U.S. Landings	Fresh	1,568,636	6,580,114	4.19
Exports from the Continental U.S.	Fresh	99,670	381,655	3.83
	Frozen	131,384	194,049	1.48
Imports to the Continental U.S.	Fresh	8,685,245	38,588,153	4.44
	Frozen	1,785,661	1,620,713	0.91

Domestic Consumption Trends

In 2019, the total domestic consumption of bigeye tuna in the U.S. was approximately 31 million lb. From 2008 to 2019, consumption of bigeye tuna in Hawai‘i generally increased. From approximately 11 million lb in 2009, consumption peaked at nearly 20 million lb in 2015 and then slightly decreased to approximately 17 million lb in 2019 (Figure 8).

Hawai‘i and continental U.S. consumption decreased from approximately 34 million lb in 2008 to about 22 million lb in 2011 before increasing to about 31 million lb in 2019. The sharp consumption declines from 2008 to 2011 may be partly due to the introduction of bigeye tuna quotas (Table 10), while the subsequent rebound may have been primarily driven by an increase in Hawai‘i landings (Table 1). Domestic consumption of bigeye tuna in the continental U.S. sharply decreased from nearly 20 million lb in 2008 to a low of 9.2 million lb in 2011 before increasing to approximately 13 million lb in 2015 (Figure 8).

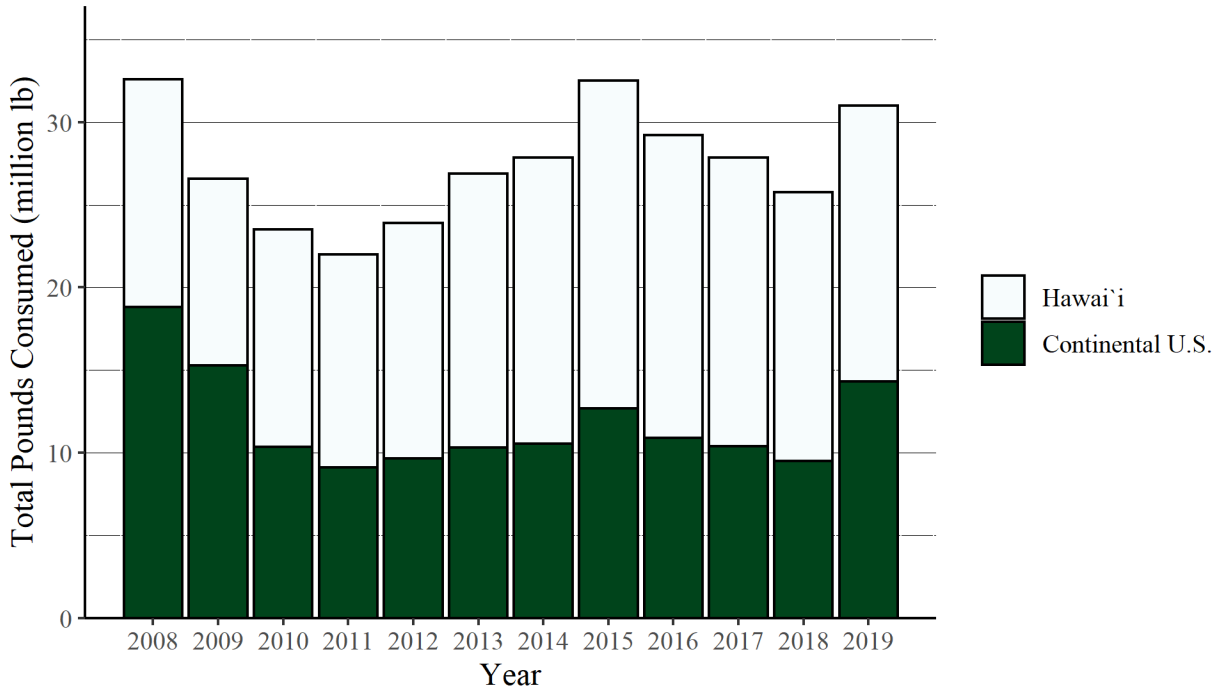

Figure 8. Total domestic consumption of bigeye tuna in Hawai‘i and the continental U.S.

Based on available data, an annual average of 4.8% of the bigeye tuna consumed in Hawai‘i was imported from 2008 to 2019 (Figure 9), though this calculation does not consider potential domestic shipments from the continental U.S. By contrast, between 78% and 96% of bigeye tuna consumed in the continental U.S. was imported during our study period (Figure 10). However, continental U.S. bigeye landings consumption increased from 3.8% in 2009 to 22% in 2018 before slightly decreasing to 18% in 2019. Although domestic shipment data were unavailable for this study, Loke et al. (2012) estimate that up to 30% of Hawai‘i bigeye tuna landings may be shipped to the continental U.S. for domestic consumption.

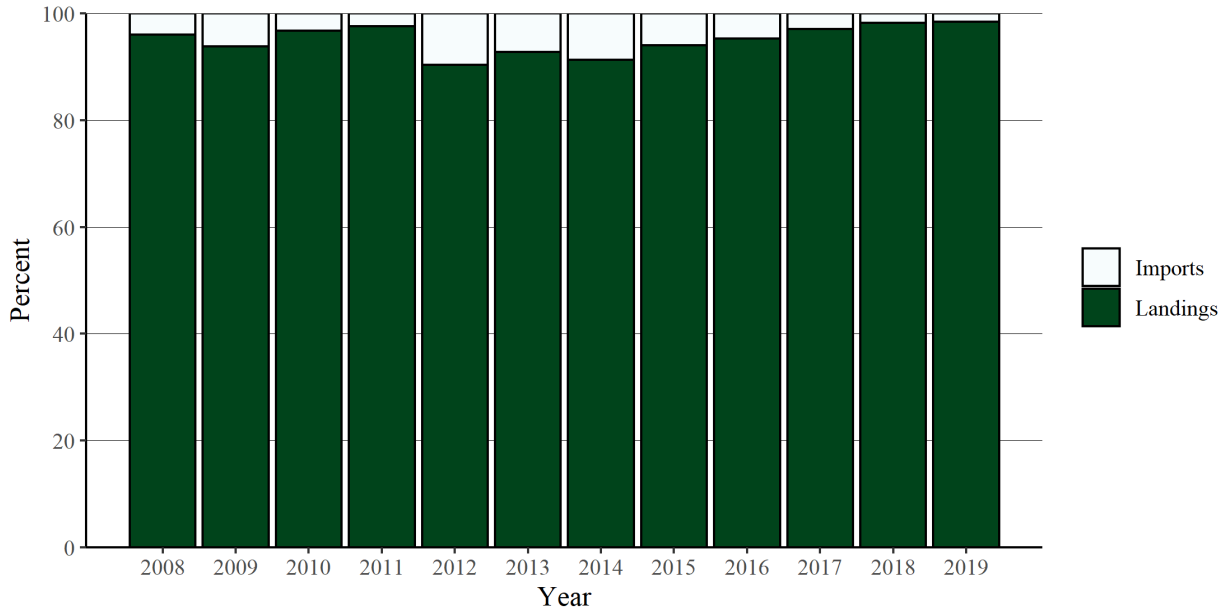

Figure 9. Annual share of local bigeye tuna consumption in Hawai‘i.

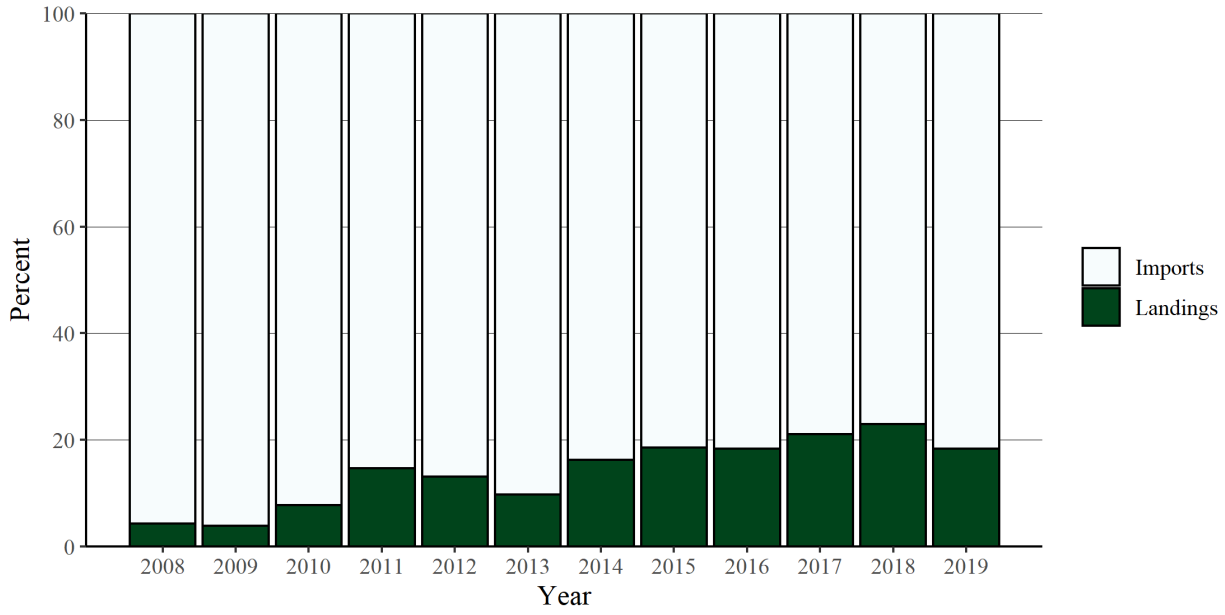

Figure 10. Annual share of domestic bigeye tuna consumption in the continental U.S.

Beginning around 2012, Hawaiian style restaurants serving raw ‘ahi poke started to gain popularity in the continental U.S. (Kandil 2016, Mishan 2016, Mishan 2018). This restaurant trend may help to explain the increase in tuna consumption in the continental U.S. from 2012 to 2015 (Figure 8), though the majority of the resulting supply was from frozen import product. High demand in the continental U.S. may also impact consumption in Hawai‘i through tourism. As tourists become aware of ‘ahi poke and associate it with Hawaiian culture, they may be more likely consume it while visiting Hawai‘i.

This consumption peak is also reflected in Hawai‘i pelagic landings and imports data. While Hawai‘i bigeye landings remained consistent from 2013 to 2019 (Table 1), bigeye imports to Hawai‘i increased from 2012 to 2015 to meet the increase in demand (Table 8). If domestic shipment data become available, future research could further analyze U.S. and Hawai‘i consumption trends for bigeye tuna in this study period.

Landings Summary and Ex-Vessel Prices

Landings of bigeye tuna in Hawai‘i increased by 23% with a 3.9% increase in revenue from 2008 to 2019 (Figure 11). Landings briefly increased from nearly 11 million lb in 2009 to approximately 19 million lb in 2015. Landings began to decrease in 2016—down to 16 million lb in 2018. Total bigeye tuna revenue increased by 59% from 2009 to 2016, with a high unit price of $5.23/lb in 2012. The unit price of bigeye tuna decreased to a low of $3.86/lb in 2019.

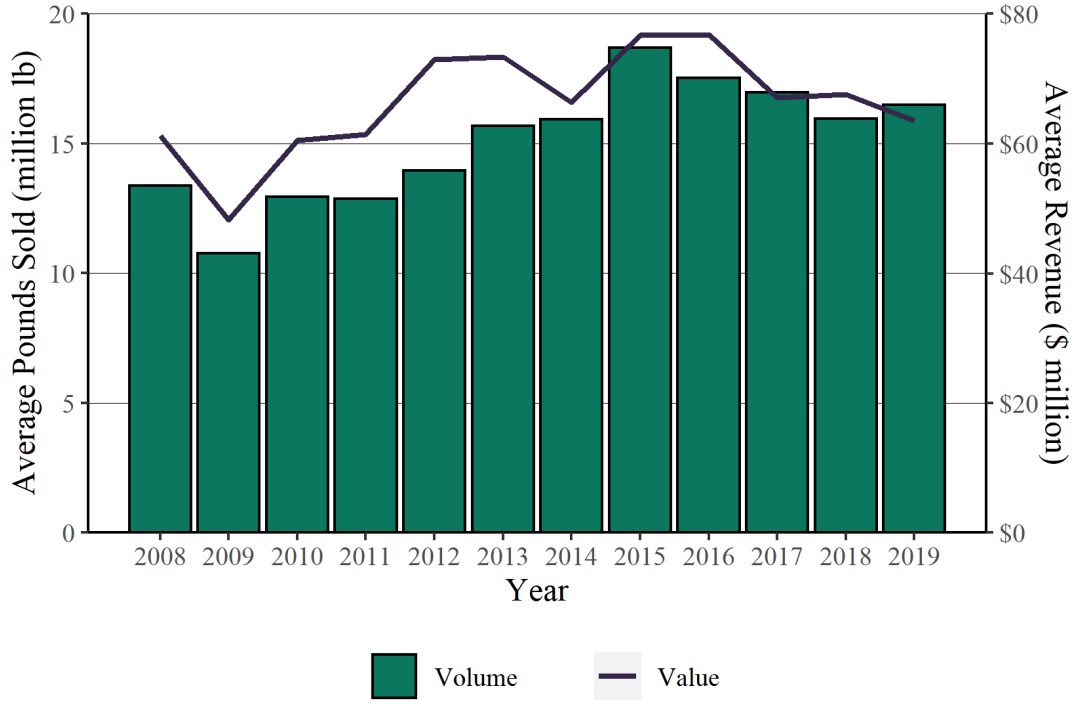

Figure 11. Average volume and value of bigeye tuna landed in Hawai‘i.

Several factors influence bigeye tuna ex-vessel prices, which can fluctuate by month or by day. Supply shortages due to inclement weather, fishery closures, or challenging fishing conditions can lead to ex-vessel price increases. Alternatively, given the perishable nature of fish, when high volumes enter the market, the supply influx can lower ex-vessel prices. For our analysis, we display the average annual and monthly ex-vessel prices for bigeye tuna (Figure 12).

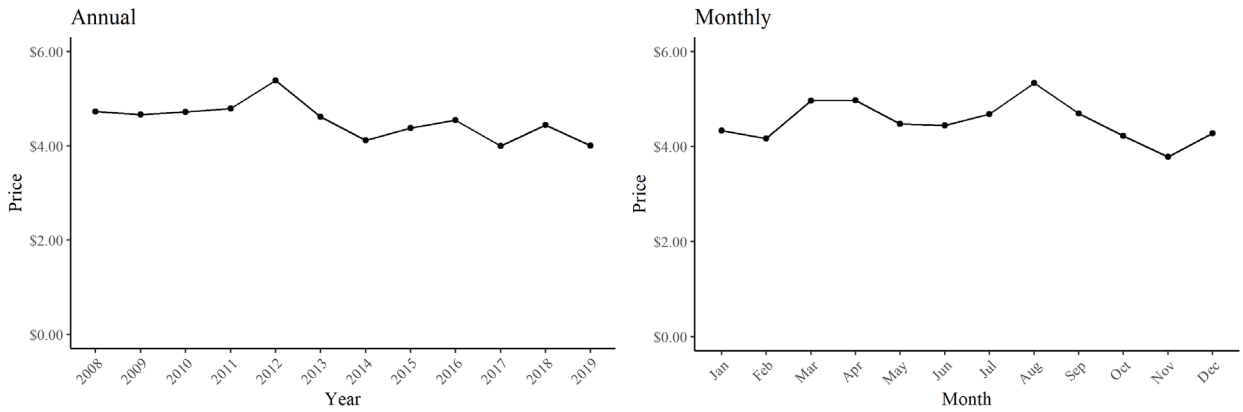

Figure 12. Annual and monthly average ex-vessel prices (per pound) for Hawai‘i bigeye tuna landings, 2008–2019.

Over the study period, average annual (inflation-adjusted) ex-vessel prices for bigeye tuna ranged from a low of $4.00/lb in 2017 and 2019 to a high of $5.83/lb in 2012 (Figure 12). The monthly averages show some trends in seasonality, with ex-vessel prices generally peaking to $5.33/lb in August and dropping to $3.79/lb in November across the study period. Based on this data from 2008 to 2019, our analyses show that higher bigeye tuna prices coincide both with summer months when supply is low and local holiday seasons when demand is high.

Lower monthly average ex-vessel prices could also suggest changes in the overall quality of the fish landings, as there is a price premium associated with high quality ‘ahi. Average ex-vessel prices for bigeye tuna ranged from $2.75/lb in November 2013 to a high of $6.54/lb in March and August 2012. Reflected in the annual average ex-vessel prices (Figure 12), the period of 2013 to 2017 also coincided with a higher volume of fresh bigeye tuna imports. The presence of an increased quantity of relatively cheaper imports could have lowered the ex-vessel value of local landings, and the role of imports is an important area for future research. The unit price of bigeye tuna fluctuated from 2015 to 2019, suggesting that the market sometimes saw increased shares of bigeye tuna during the fishery closures. Similar trends are also reflected in the volume and value of bigeye imports and exports.

Exports from Hawai‘i

Bigeye tuna from Hawai‘i consistently sold at high unit values from 2008 to 2019 (Table 12) and is exported fresh (Figure 14). In 2012, bigeye tuna exports peaked at almost $3 million in revenue (Figure 13). Since 2012, bigeye tuna export volume and revenue declined rapidly, reaching low values of approximately $65,000 and 11,000 lb in 2018. These figures correlate with the bigeye fishery closures of 2015, 2016, and 2017 (Table 10). In 2016, the closure lasted 113 days, which likely impacted a range of market channels for bigeye tuna. Declining exports may also be related to the global strengthening of the U.S. dollar during this time period, making U.S. products more expensive for foreign markets.

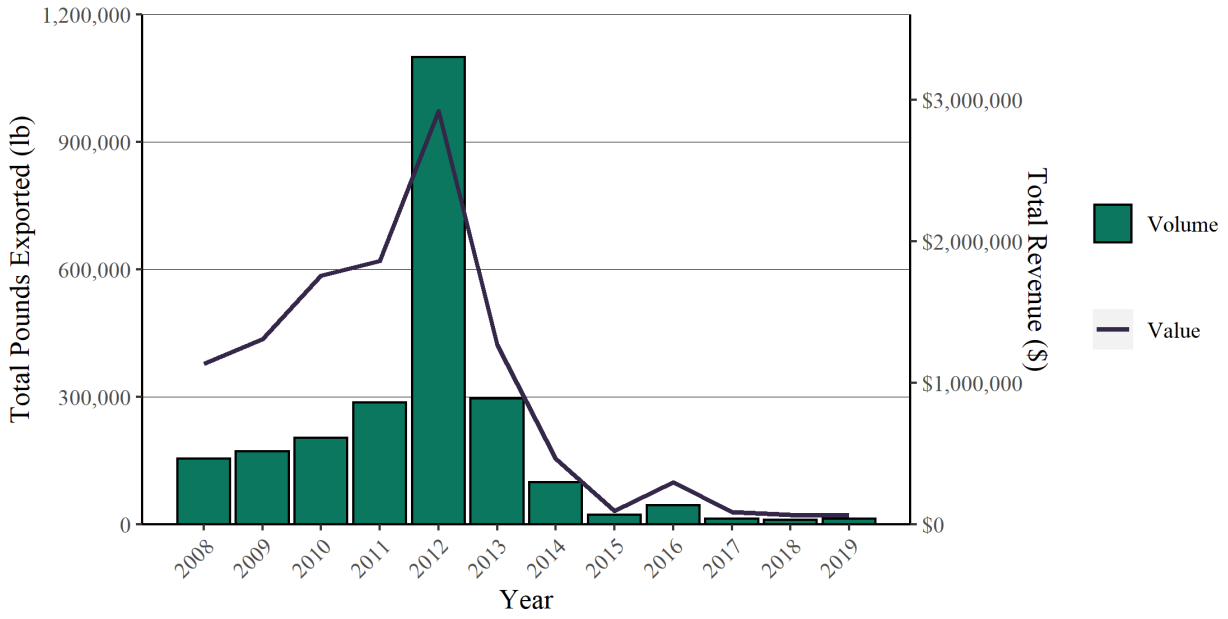

Figure 13. Total volume and value of bigeye tuna exports from Hawai‘i.

Figure 14 displays the total fresh and frozen bigeye tuna exports from Hawai‘i by export destination from 2008 to 2019. Japan is the largest export destination for fresh bigeye tuna from Hawai‘i, followed by Canada, Hong Kong, and South Korea. Over the study period, Hawai‘i exported an average of 70.6% of its fresh bigeye exports to Japan, 27.7% to Canada, 1.3% to Hong Kong, and 0.3% to South Korea. Fresh bigeye exports decreased below 21,000 lb in 2015, following the declining trend that started in 2012 (Figure 14). Minimal quantities of frozen bigeye tuna have been exported from Hawai‘i, with the exception of 2012 when frozen exports exceeded 670,000 lb and accounted for 29% of Hawai‘i bigeye export revenue that year. According to available data, Canada has been the largest export destination for frozen bigeye tuna, followed by South Korea. From 2008 to 2019, Hawai‘i exported an average of 97.3% of its frozen bigeye exports to Canada and 2.7% to South Korea.

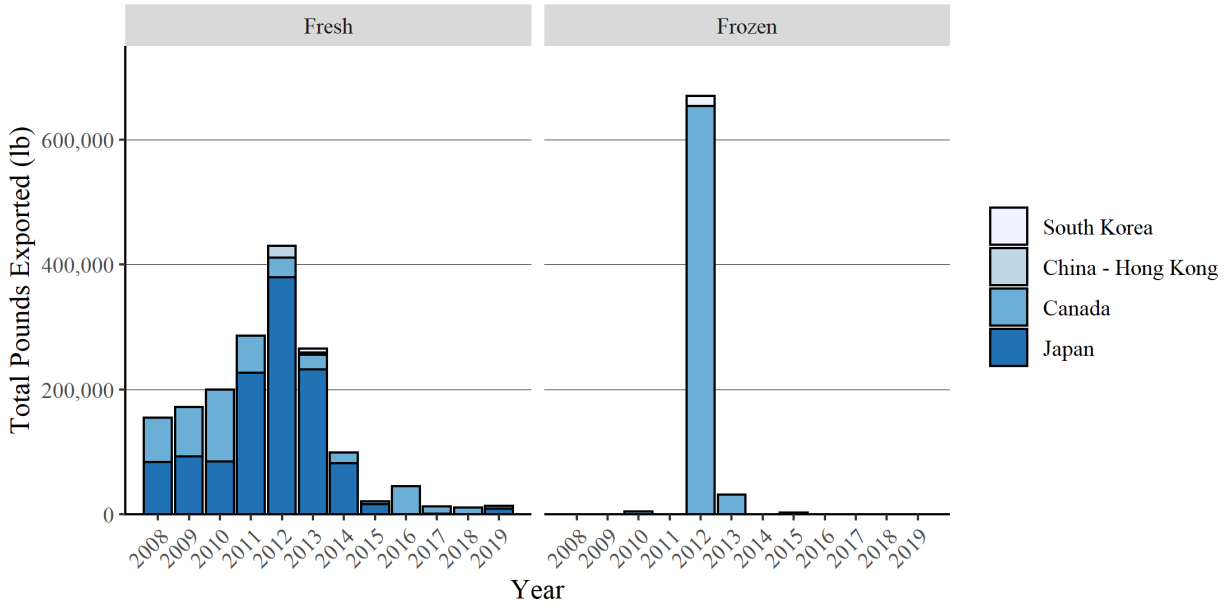

Figure 14. Total bigeye tuna export volume from Hawai‘i.

Table 12 shows the total annual fresh bigeye exports from Hawai‘i by country from 2008 to 2019. Across most years, the unit value of fresh bigeye tuna exports was highest for exports to Canada. However, this unit value temporarily decreased from 2012 to 2015 before increasing again.

Table 12. Total fresh bigeye tuna exports from Hawai‘i.

Export Destination	Volume (lb)	Value ($)	Unit Value ($/lb)
2008	**154,769**	**1,133,688**	**7.33**
Canada	71,366	810,546	11.36
Japan	83,403	323,142	3.87
2009	**171,701**	**1,309,119**	**7.62**
Canada	79,274	847,187	10.69
Japan	92,428	461,932	5.00
2010	**199,401**	**1,752,419**	**8.79**
Canada	115,138	1,224,814	10.64
Japan	84,263	527,605	6.26
2011	**286,271**	**1,861,682**	**6.50**
Canada	59,489	683,099	11.48
Japan	226,782	1,178,583	5.20
2012	**429,876**	**2,069,248**	**4.81**
Canada	31,274	298,792	9.55
China - Hong Kong	18,870	55,724	2.95
Japan	379,732	1,714,732	4.52
2013	**264,810**	**1,227,320**	**4.63**
Canada	23,423	176,118	7.52
China - Hong Kong	3,526	10,232	2.90
Japan	232,344	1,024,966	4.41
South Korea	5,516	16,004	2.90
2014	**98,515**	**462,974**	**4.70**
Canada	16,584	97,736	5.89

Export Destination	Volume (lb)	Value ($)	Unit Value ($/lb)
Japan	81,931	365,238	4.46
2015	**20,374**	**82,792**	**4.06**
Canada	4,498	17,074	3.80
Japan	15,875	65,718	4.14
2016	**44,983**	**295,938**	**6.58**
Canada	44,983	295,938	6.58
2017	**12,588**	**88,922**	**7.06**
Canada	12,099	84,261	6.96
Japan	488	4,661	9.54
2018	**10,937**	**65,447**	**5.98**
Canada	10,937	65,447	5.98
2019	**13,739**	**62,826**	**4.57**
Canada	4,372	37,426	8.56
Japan	9,366	25,400	2.71
Grand Total	**1,707,964**	**10,412,374**	**6.10**

In Table 13, we illustrate frozen bigeye exports from Hawai‘i from 2008 to 2019. Canada experienced a sharp increase in demand for frozen bigeye tuna in 2012, as well as a decrease in demand for fresh bigeye from 2012 to 2015. This decrease could be the result of currency-related substitution effects. The average unit value for frozen bigeye exports remained below $1.50/lb with the exception of 2015, when frozen bigeye exports to South Korea were valued at $4.81/lb.

Table 13. Total frozen bigeye tuna exports from Hawai‘i.

Export Destination	Volume (lb)	Value ($)	Unit Price ($/lb)
2008	**0**	**0**	**0.00**
2009	**0**	**0**	**0.00**
2010	**4,051**	**5,700**	**1.41**
Canada	4,051	5,700	1.41
2011	**0**	**0**	**0.00**
2012	**670,051**	**849,781**	**1.27**
Canada	653,253	822,150	1.26
South Korea	16,797	27,631	1.64
2013	**31,850**	**36,149**	**1.13**
Canada	31,850	36,149	1.13
2014	**0**	**0**	**0.00**
2015	**2,537**	**12,209**	**4.81**
South Korea	2,537	12,209	4.81
2016	**0**	**0**	**0.00**
2017	**0**	**0**	**0.00**
2018	**0**	**0**	**0.00**
2019	**0**	**0**	**0.00**
Grand Total	**708,489**	**903,839**	**1.28**

Imports to Hawai‘i

Figure 15 displays the total bigeye tuna import volume and value to Hawai‘i over the twelve-year study period. Import data are likely to be representative of the fresh bigeye market since the product is perishable. Given the longer shelf life of frozen product, some undetermined quantity

may reach Hawai‘i by domestic shipment from the continental U.S., making it challenging to ascertain the true size of the Hawai‘i seafood market using existing data sources. Fresh bigeye tuna accounted for all bigeye imports to Hawai‘i from 2008 to 2019. Hawai‘i bigeye tuna export revenue (Figure 13) was higher than bigeye tuna import value (Figure 15) from 2008 to 2019. Bigeye import volume sharply increased between 2012 and 2015, from about 309,000 lb in 2011 to approximately 1.4 million lb in 2012. It then gradually decreased from nearly 1.5 million lb in 2014 to around 253,000 lb in 2019. The value of bigeye imports to Hawai‘i decreased from approximately $1.6 million in 2014 to about $512,000 in 2019.

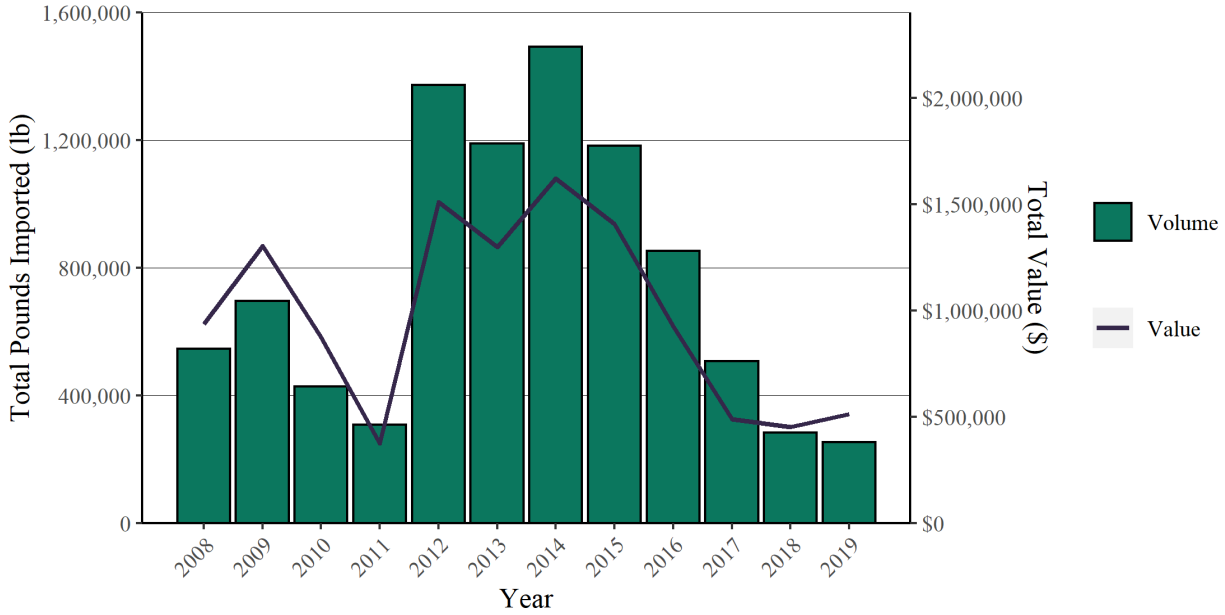

Figure 15. Total volume and value of bigeye tuna imports to Hawai‘i.

Figure 16 details the bigeye tuna market substitutes over the study period. For each year, we labelled imports totaling to less than 10% of annual bigeye tuna imports as “Other.” The countries included in this category are detailed in Table 14. Hawai‘i imported approximately 9 million lb of fresh bigeye tuna from 2008 to 2019, valued at over $11.7 million.

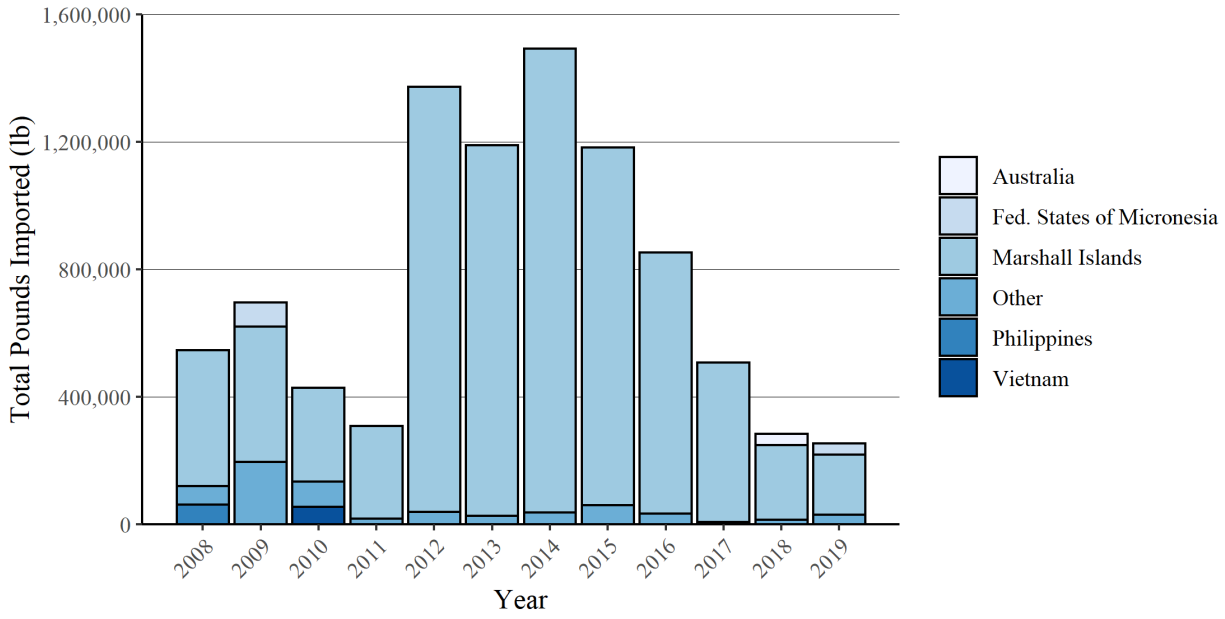

Figure 16. Total bigeye tuna import volume to Hawai‘i.

"Other" includes China - Taipei, Ecuador, Fiji, French Polynesia, Indonesia, New Zealand, Thailand, Maldives, Palau, Singapore, Sri Lanka, Tonga, and Western Samoa.

The volume of bigeye tuna imports increased from about 309,000 lb in 2011 to approximately 1.4 million lb in 2012 and remained high through 2015. Over the study period, Hawai‘i imported nearly 91% of its bigeye tuna volume from the Marshall Islands, which also supplied the lowest unit value of product (Table 14). The remaining countries listed in Table 14 each supplied less than 2% of Hawai‘i bigeye tuna imports from 2008 to 2019.

Table 14. Total bigeye tuna imports to Hawai‘i.

Import Origin	Volume (lb)	Value ($)	Unit Price ($/lb)
2008	**546,532**	**937,080**	**1.71**
Australia	11,570	86,825	7.50
China - Taipei	1,740	3,674	2.11
Ecuador	358	2,878	8.05
Fiji	11,088	21,156	1.91
French Polynesia	1,550	5,502	3.55
Indonesia	4,042	21,395	5.29
Marshall Islands	427,356	444,356	1.04
New Zealand	2,346	6,938	2.96
Philippines	61,741	196,610	3.18
Thailand	6,890	35,431	5.14
Vietnam	17,852	112,314	6.29
2009	**696,672**	**1,303,728**	**1.87**
China - Taipei	11,418	25,981	2.28
Ecuador	13,039	82,856	6.35
Fed. States of Micronesia	75,559	80,922	1.07
Fiji	9,866	20,376	2.07
French Polynesia	27,816	155,203	5.58

Import Origin	Volume (lb)	Value ($)	Unit Price ($/lb)
Indonesia	61,720	197,879	3.21
Marshall Islands	424,805	444,674	1.05
New Zealand	919	2,705	2.94
Philippines	4,090	14,969	3.66
Singapore	4,900	19,539	3.99
Vietnam	62,539	258,625	4.14
2010	**428,147**	**875,319**	**2.04**
Australia	4,753	22,308	4.69
Ecuador	408	3,440	8.43
Fed. States of Micronesia	3,403	3,570	1.05
Fiji	2,208	3,367	1.52
French Polynesia	36,816	174,534	4.74
Indonesia	26,049	79,327	3.05
Marshall Islands	294,653	300,108	1.02
Philippines	1,662	6,408	3.86
Sri Lanka	910	5,113	5.62
Tonga	1,135	6,335	5.58
Vietnam	54,466	268,006	4.92
Western Samoa	1,685	2,803	1.66
2011	**309,307**	**375,347**	**1.21**
Fiji	711	2,326	3.27
French Polynesia	10,629	51,823	4.88
Indonesia	1,616	4,560	2.82
Marshall Islands	292,317	296,540	1.01
Tonga	1,594	9,892	6.21
Vietnam	2,440	10,207	4.18
2012	**1,373,497**	**1,510,941**	**1.10**
Australia	3,453	15,611	4.52
Fiji	1,289	4,122	3.20
French Polynesia	14,406	84,818	5.89
Indonesia	624	2,459	3.94
Marshall Islands	1,335,166	1,325,553	0.99
Sri Lanka	2,520	7,627	3.03
Vietnam	16,040	70,750	4.41
2013	**1,189,252**	**1,298,397**	**1.09**
Australia	3,171	14,414	4.55
Fiji	1,467	7,235	4.93
French Polynesia	1,447	4,063	2.81
Indonesia	1,380	4,005	2.90
Marshall Islands	1,162,671	1,147,910	0.99
Philippines	9,568	72,935	7.62
Sri Lanka	5,241	16,474	3.14
Thailand	1,770	14,122	7.98
Vietnam	2,536	17,238	6.80
2014	**1,493,533**	**1,621,918**	**1.09**
Australia	9,774	75,118	7.69
French Polynesia	8,713	37,732	4.33
Indonesia	1,738	6,629	3.81
Marshall Islands	1,456,187	1,408,037	0.97
Philippines	5,684	27,585	4.85

Import Origin	Volume (lb)	Value ($)	Unit Price ($/lb)
Sri Lanka	2,566	16,425	6.40
Thailand	8,871	50,392	5.68
2015	**1,183,653**	**1,407,557**	**1.19**
Australia	18,446	111,328	6.04
Fiji	1,612	5,986	3.71
French Polynesia	22,387	104,478	4.67
Indonesia	13,119	83,014	6.33
Marshall Islands	1,124,326	1,077,647	0.96
Thailand	3,762	25,105	6.67
2016	**852,661**	**924,956**	**1.08**
Australia	29,307	136,039	4.64
Fiji	649	2,664	4.11
French Polynesia	3,391	17,159	5.06
Marshall Islands	818,356	765,073	0.93
Tonga	958	4,021	4.20
2017	**508,107**	**488,912**	**0.96**
Australia	2,965	16,234	5.48
French Polynesia	371	2,159	5.81
Indonesia	605	4,083	6.75
Maldives	2,446	15,371	6.28
Marshall Islands	501,719	451,065	0.90
2018	**283,350**	**451,143**	**1.59**
Australia	34,328	174,159	5.07
Ecuador	1,183	9,507	8.04
French Polynesia	1,240	7,236	5.83
Marshall Islands	235,416	212,334	0.90
Palau	11,182	47,908	4.28
2019	**253,046**	**511,623**	**2.02**
Australia	15,100	76,336	5.06
Ecuador	1,229	4,720	3.84
Fed. States of Micronesia	35,062	40,694	1.16
Fiji	789	2,752	3.49
Indonesia	6,734	28,572	4.24
Marshall Islands	188,861	349,697	1.85
Palau	3,646	2,981	0.82
Tonga	1,626	5,871	3.61
Grand Total	**9,117,755**	**11,706,920**	**1.28**

Yellowfin Tuna

Over our study period, Hawai‘i contributed 38% to 67% of the total landings and 38% to 76% of the total revenue for yellowfin tuna in the U.S. In 2019, Hawai‘i provided 67% of the total yellowfin tuna landings and 74% of the total yellowfin tuna revenue in the U.S. Similar in color, taste, and texture, yellowfin tuna is a valuable market substitute for bigeye tuna. It is predominately consumed raw as ‘ahi poke or sashimi in Hawai‘i. Frozen imported yellowfin also supports Hawai‘i demand for ‘ahi poke.

Yellowfin tuna is predominantly caught in the Hawai‘i deep-set longline fishery. Though it is secondary catch for vessels targeting bigeye tuna in waters near Honolulu, a portion of the Hawai‘i longline fleet travels to the Exclusive Economic Zone around the Palmyra Atoll to target yellowfin (Remington et al. 2020). The main Hawaiian Islands handline fleet also targets yellowfin tuna, though it contributes less than 2% of Hawai‘i tuna landings (WCPFC 2020). Yellowfin is landed year-round in Hawai‘i.

Hawai‘i landed an annual average of over 4.2 million lb of yellowfin tuna from 2008 to 2019 (Table 15), with a value of over $14 million at $3.50/lb. During this period, Hawai‘i exported an average of 73,000 lb of yellowfin tuna annually and imported an average of 477,000 lb annually. Frozen[10] yellowfin tuna exports from Hawai‘i were valued at only $1.43/lb, while fresh exports were valued at $8.86/lb. Hawai‘i imported an annual average of nearly 300,000 lb of frozen, gutted, and de-headed yellowfin tuna from 2008 to 2019, valued at $4.68/lb, priced nearly 42% higher than fresh imports.

Table 15. Average annual supply and value of yellowfin tuna, 2008–2019.

	Form	Volume (lb)	Value ($)	Unit Price ($/lb)
Hawai‘i Landings	Fresh	4,202,348	14,691,111	3.50
Exports from Hawai‘i	Fresh	51,993	460,520	8.86
	Frozen	21,236	30,409	1.43
Imports to Hawai‘i	Fresh	177,447	585,100	3.30
	Frozen, gutted head off	299,495	1,400,859	4.68
Continental U.S. Landings	Fresh	3,888,173	11,005,371	2.83
Exports from the Continental U.S.	Fresh	259,705	942,768	3.63
	Frozen	2,233,426	2,616,846	1.17
Imports to the Continental U.S.	Fresh	34,896,814	160,996,105	4.61
	Frozen, gutted head off	6,327,561	24,892,679	3.93
	Frozen, gutted head on	43,458	123,532	2.84
	Frozen, whole	1,000,984	1,138,556	1.14

The continental U.S. landed an annual average of about 3.9 million lb of yellowfin tuna from 2008 to 2019, valued at over $11 million at $2.83/lb (Table 15). On average, the continental U.S. exported nearly 2.5 million lb of yellowfin tuna annually from 2008 to 2019 and imported over 42 million lb annually. Imports of fresh and processed frozen yellowfin tuna to the continental U.S. were valued higher than frozen, whole imports (Table 15).

[10] The 10-digit Harmonized Tariff Schedule level describes the form of the product. Many of the frozen exports data of yellowfin tuna were not specified beyond the 8-digit HTS level, so we were unable to determine the form beyond “frozen.” However, the unit price closely resembles that of whole frozen imports of yellowfin tuna to the continental U.S., so it is reasonable to assume that at least some are in whole form. For consistency and unless otherwise specified, we use the conversion factors that assume the products classified as “frozen” are gutted.

Domestic Consumption Trends

The total domestic consumption of yellowfin tuna in 2019 was approximately 51 million lb, down from about 55 million lb in 2017. Yellowfin tuna consumption in Hawai‘i decreased from about 3.4 million lb in 2008 to around 2.5 million lb in 2010 (Figure 17). From 2011 to 2017, local consumption of yellowfin tuna sharply increased, peaking at 7.7 million lb in 2017 before decreasing to 6.1 million lb in 2019. This increase may have been driven by a period of strong recruitment and a subsequent increased catch per unit effort (WCPFC 2021).

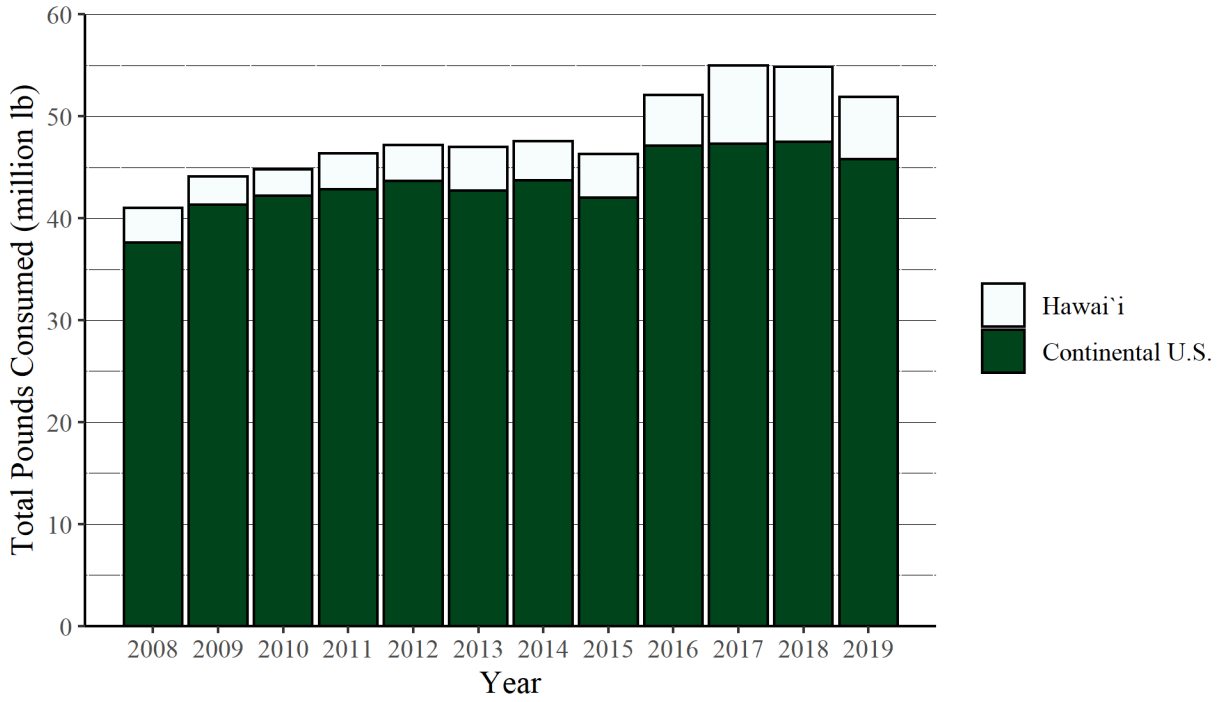

Figure 17. Total domestic consumption of yellowfin tuna in Hawai‘i and the continental U.S.

From 2009 to 2015, domestic consumption of yellowfin tuna in the continental U.S. slowly increased, then sharply increased from approximately 46 million lb in 2015 to about 55 million lb in 2017 (Figure 17). Domestic consumption then decreased slightly from 2018 to 2019. Although domestic shipment data were unavailable for this study, Loke et al. (2012) estimate that up to 30% of yellowfin tuna landings may be shipped to the continental U.S. for domestic consumption. Additionally, yellowfin tuna is common non-commercial catch in Hawai‘i (Hospital et al. 2011), which may add up to 22% in landings to local seafood supply (Loke et al. 2012). Future research could benefit from investigating these contributions to local and domestic consumption.

Most yellowfin tuna consumed in Hawai‘i is believed to be from local landings (Figure 18). From 2008 to 2019, the share of yellowfin tuna imports consumed in Hawai‘i remained below 23% (Figure 18). Conversely, the annual share of yellowfin tuna imports to the continental U.S. ranged from approximately 87% to 95% of its yellowfin consumption from 2008 to 2019 (Figure 19).

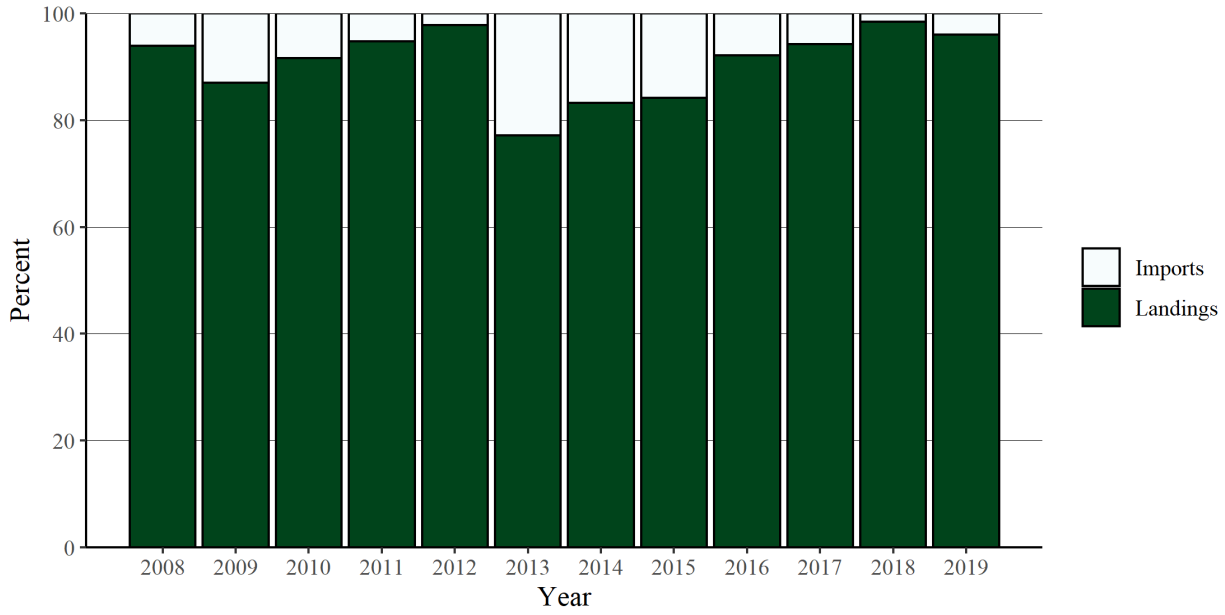

Figure 18. Annual share of local yellowfin tuna consumption in Hawai‘i.

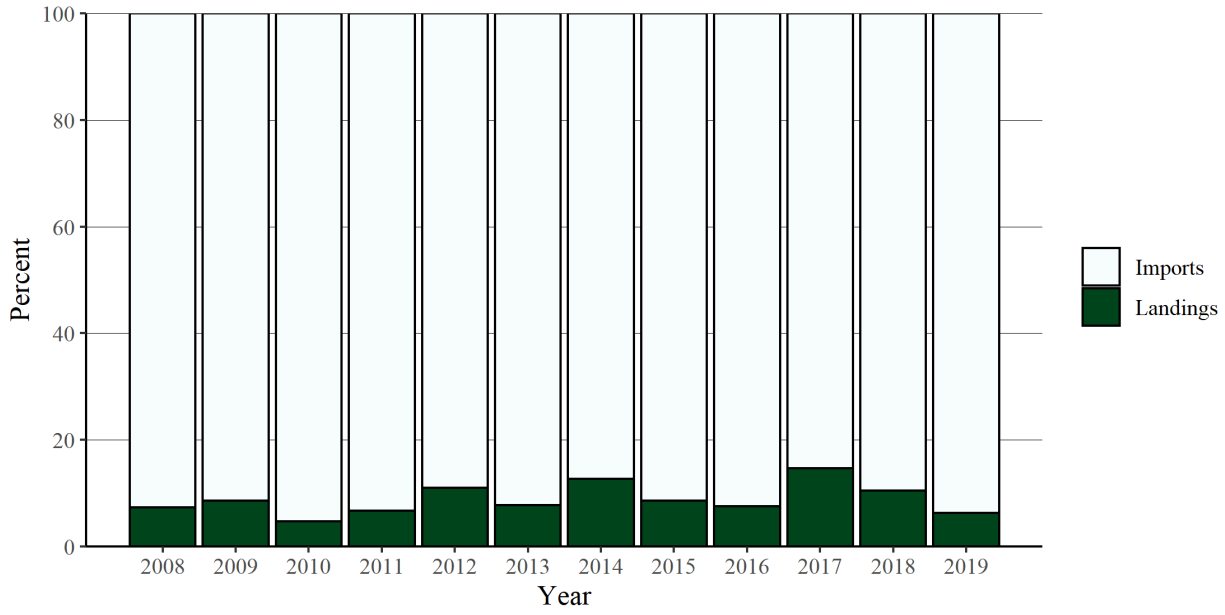

Figure 19. Annual share of domestic yellowfin tuna consumption in the continental U.S.

Landings Summary and Ex-Vessel Prices

Landings of yellowfin tuna in Hawai‘i increased by 65% from 2009 to 2017 (Figure 20). Yellowfin tuna landings sharply increased from approximately 4.6 million lb in 2016 to nearly 7.3 million lb in 2017. Yellowfin tuna landings decreased from around 3.2 million lb in 2008 to nearly 2.4 million lb in 2010. From 2011 to 2015, local landings of yellowfin tuna remained relatively stable in terms of volume and value.

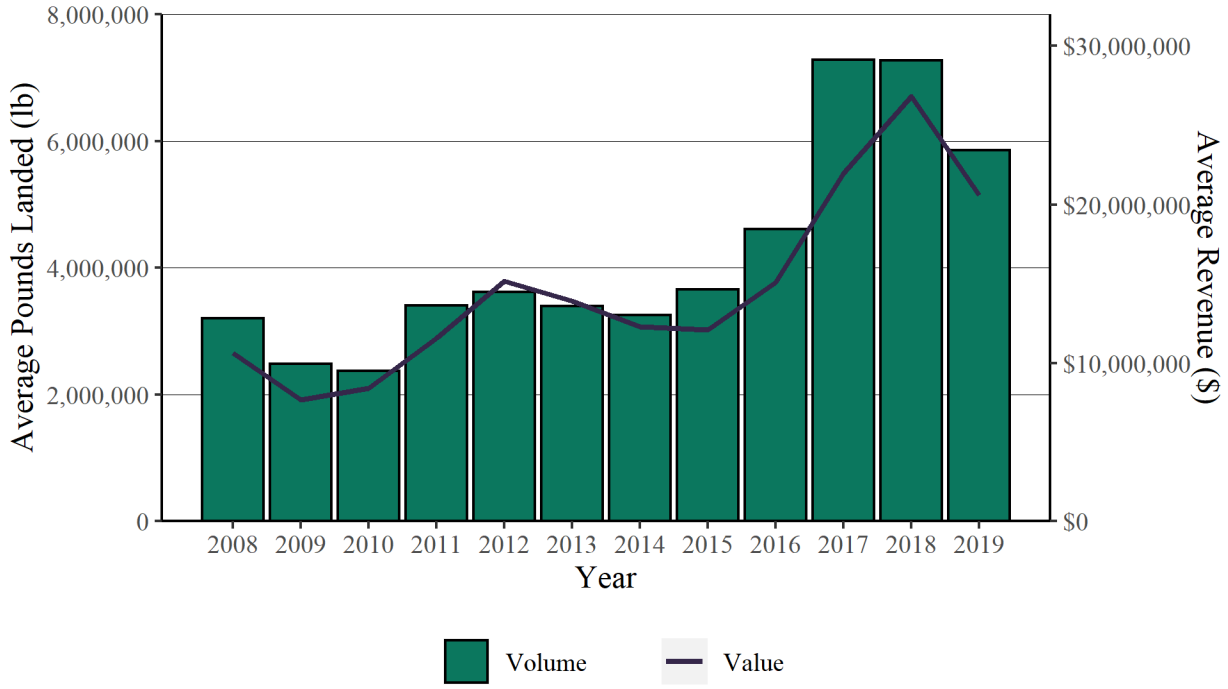

Figure 20. Average volume and value of yellowfin tuna landed in Hawai‘i.

Average annual and monthly ex-vessel prices (inflation-adjusted) for yellowfin tuna from 2008 to 2019 are shown in Figure 21. Across the study period, average annual ex-vessel prices ranged from a low of $3.01/lb in 2017 to a high of $4.11/lb in 2012. A higher volume of domestic landings (Figure 20), coupled with increased frozen imports (Figure 25) could have contributed to average ex-vessel price declines from 2013 to 2017. Yellowfin prices rose in 2018 and stabilized in 2019 as imports were reduced. By month, ex-vessel prices ranged from a low of $1.91/lb in March 2011 to a high of $5.36/lb in October 2011. Average monthly ex-vessel prices can demonstrate seasonal fluctuations in response to supply, and during the study period prices peaked at $3.88/lb in March and $3.82/lb in August. Similar to bigeye tuna, yellowfin prices dropped to a low monthly average of $3.07/lb in November.

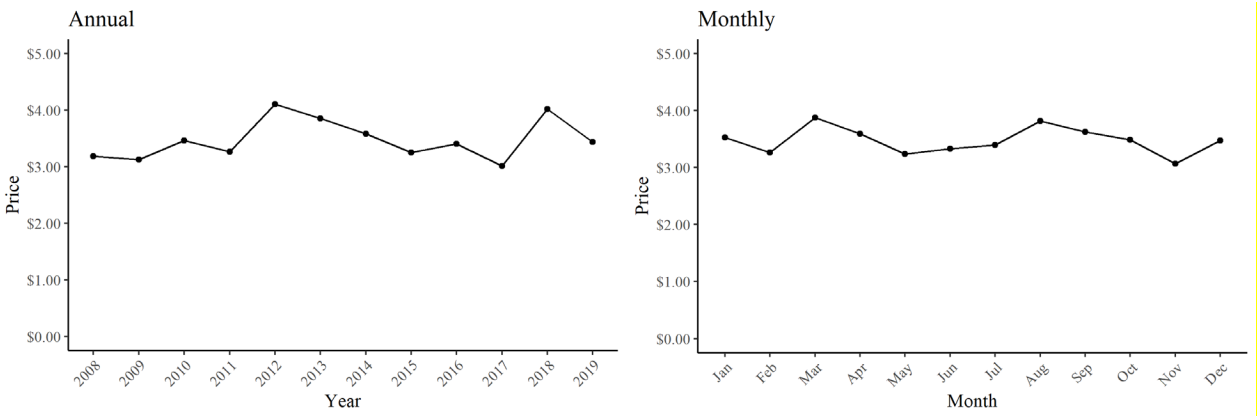

Figure 21. Annual and monthly average ex-vessel prices (per pound) for Hawai‘i yellowfin tuna landings, 2008–2019.

Exports from Hawai‘i

On average, Hawai‘i exports only 1.3% of its yellowfin tuna landings annually (Table 3). In 2019, Hawai‘i exported 0.1% of its yellowfin landings. Yellowfin tuna exports from Hawai‘i increased from about 39,000 lb in 2010 to approximately 179,000 lb in 2012 (Figure 22). From 2012 to 2013, export volume decreased by about 46%. Export volume and revenue continued to follow a decreasing trend, reaching approximately 6,000 lb in 2019.

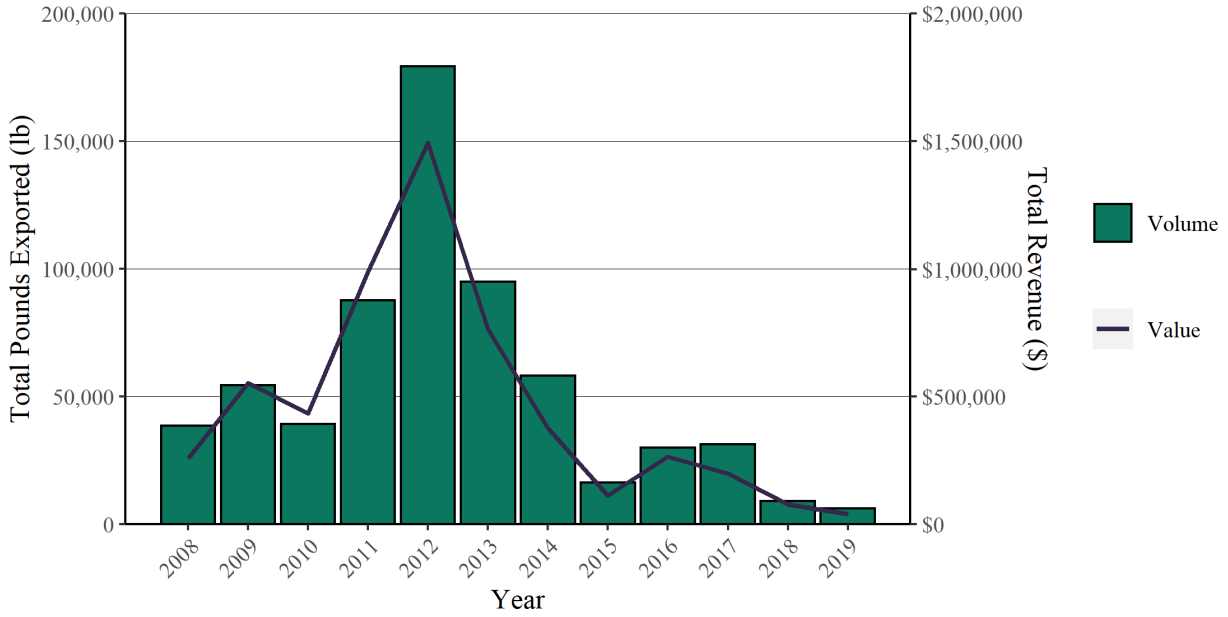

Figure 22. Total volume and value of yellowfin tuna exports from Hawai‘i.

Figure 23 illustrates fresh yellowfin exports from Hawai‘i by form and export destination. Japan is the main export destination for fresh yellowfin tuna from Hawai‘i, followed by Canada (Figure 23). From 2008 to 2019, Hawai‘i exported an average of 85% of fresh yellowfin to Japan and about 15% to Canada. In 2008, all fresh yellowfin tuna exports were shipped to Canada, and from 2009 to 2015, between 94% and 98% of yellowfin tuna exports from Hawai‘i went to Japan. Figure 23 reveals a fluctuating trend in fresh yellowfin exports over the study period, ending with a sharp decrease in recent years. The only frozen yellowfin tuna exports from

Hawai‘i in 2012 went to South Korea and Canada, 92% went to South Korea. It is possible that during years of low exports from Hawai‘i, demand for fresh yellowfin had increased in the continental U.S., decreasing the amount of yellowfin exports to Japan. This decline in exports may also be related to the global strengthening of the U.S. dollar, making U.S. products more expensive for foreign markets. However, our data omit domestic shipments to the continental U.S.; future research incorporating these data could better reveal the source of these trends.

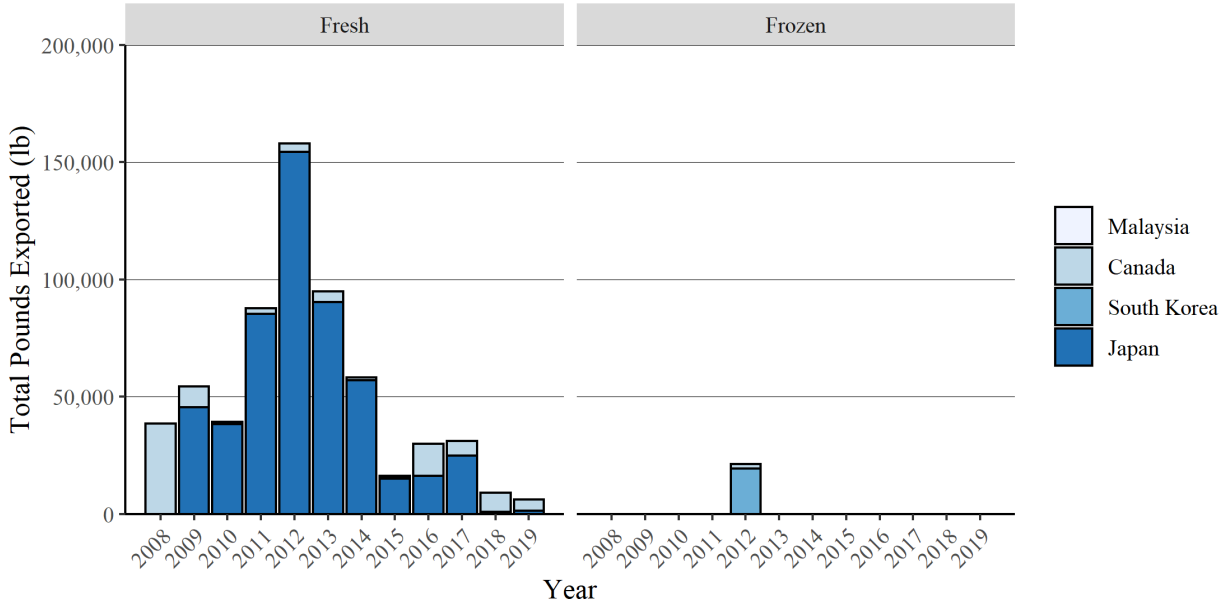

Figure 23. Total yellowfin tuna export volume from Hawai‘i.

Expanding on the above figures, Table 16 and Table 17 summarize fresh and frozen yellowfin tuna exports from Hawai‘i from 2008 to 2019, by destination. The unit price of fresh yellowfin tuna exports to Japan decreased from a high of $11.39/lb in 2011 to $1.83/lb in 2019. Unit prices for fresh yellowfin exports to Canada ranged from $6.68/lb to $10.76/lb. Although Hawai‘i only exported frozen yellowfin tuna in 2012, the unit price was at $7.42/lb.

Table 16. Total fresh yellowfin tuna exports from Hawai‘i.

Export Destination	Volume (lb)	Revenue ($)	Unit Price ($/lb)
2008	**38,539**	**257,569**	**6.68**
Canada	38,539	257,569	6.68
2009	**54,485**	**552,979**	**10.15**
Japan	45,503	477,635	10.50
Canada	8,982	75,344	8.39
2010	**39,271**	**432,979**	**11.03**
Japan	38,429	423,929	11.03
Canada	842	9,049	10.75
2011	**87,795**	**988,427**	**11.26**
Japan	85,323	971,577	11.39
Canada	2,471	16,850	6.82
2012	**158,074**	**1,463,910**	**9.26**
Japan	154,403	1,433,741	9.29
Canada	3,671	30,169	8.22
2013	**94,938**	**764,047**	**8.05**

Export Destination	Volume (lb)	Revenue ($)	Unit Price ($/lb)
Japan	90,509	718,476	7.94
Canada	4,429	45,571	10.29
2014	**58,217**	**376,121**	**6.46**
Japan	57,003	364,969	6.40
Canada	1,215	11,152	9.18
2015	**16,233**	**112,473**	**6.93**
Japan	15,212	98,304	6.46
Canada	783	8,423	10.76
Malaysia	238	5,746	24.13
2016	**29,948**	**265,412**	**8.86**
Canada	13,605	110,805	8.14
Japan	16,343	154,607	9.46
2017	**31,187**	**197,312**	**6.33**
Canada	6,363	58,954	9.27
Japan	24,824	138,358	5.57
2018	**9,105**	**76,135**	**8.36**
Canada	8,080	67,332	8.33
Japan	1,025	8,803	8.59
2019	**6,122**	**38,881**	**6.35**
Canada	4,742	36,349	7.67
Japan	1,380	2,532	1.83
Grand Total	**623,913**	**5,526,243**	**8.86**

Table 17. Total frozen yellowfin tuna exports from Hawai‘i.

Export Destination	Volume (lb)	Revenue ($)	Unit Price ($/lb)
2008	**0**	**0**	**0.00**
2009	**0**	**0**	**0.00**
2010	**0**	**0**	**0.00**
2011	**0**	**0**	**0.00**
2012	**21,236**	**30,409**	**1.43**
Canada	1,785	13,236	7.42
South Korea	19,452	17,172	0.88
2013	**0**	**0**	**0.00**
2014	**0**	**0**	**0.00**
2015	**0**	**0**	**0.00**
2016	**0**	**0**	**0.00**
2017	**0**	**0**	**0.00**
2018	**0**	**0**	**0.00**
2019	**0**	**0**	**0.00**
Grand Total	**21,236**	**30,409**	**1.43**

Imports to Hawai‘i

Overall, imports of yellowfin tuna to Hawai‘i exceeded yellowfin exports from Hawai‘i over the twelve-year study period (Figure 24). Import data are likely to be representative of the fresh yellowfin market since the product is perishable and is less likely to be imported. Given the shelf life of frozen product, some undetermined amount may reach Hawai‘i by domestic shipment from the continental U.S., making it challenging to determine the true size of the Hawai‘i

seafood market using existing data sources. Yellowfin import volume increased from approximately 75,000 lb in 2012 to 974,000 lb in 2013. Imports then decreased to less than 645,000 lb in 2014. By 2018, exports of yellowfin tuna decreased to about 117,000 lb. Yellowfin imports increased to about 242,000 lb in 2019.

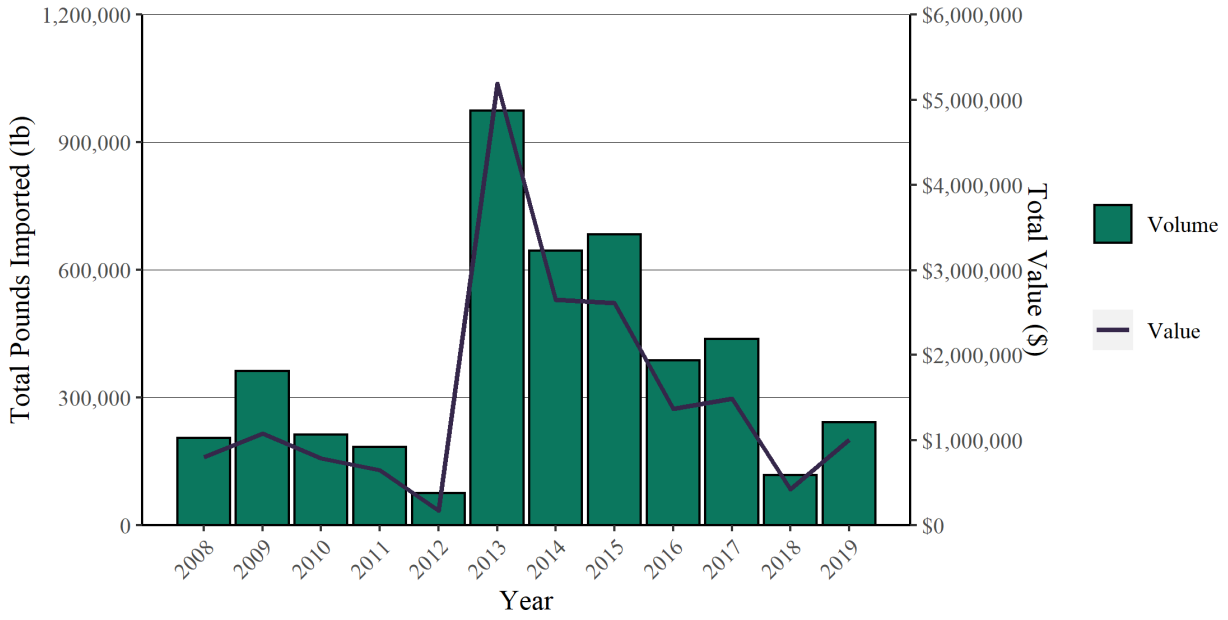

Figure 24. Total volume and value of yellowfin tuna imports to Hawai‘i.

Figure 25 displays yellowfin tuna imports to Hawai‘i by form and importing country from 2008 to 2019. The “Other” category includes all import origins that composed less than 20% of the total import volume each year. Until 2013, Hawai‘i imported predominately fresh yellowfin tuna, with up to 35% originating from the Marshall Islands, 14% from Fiji, and 13% from Australia. Frozen yellowfin tuna imports to Hawai‘i sharply increased from around 2,800 lb in 2012 to above 716,000 lb in 2013 and remained higher than fresh yellowfin imports through 2017. The Philippines and Thailand were the largest importers for frozen yellowfin from 2013 to 2017. Over the study period, Hawai‘i imported an average of 55% of its frozen yellowfin tuna from Thailand and 39% from the Philippines. According to our data sources, Hawai‘i did not import frozen yellowfin in 2019.

Frozen yellowfin tuna imports are the primary market substitute for those locally landed in Hawai‘i and are the primary source of poke in most Hawai‘i grocery retailers. As previously discussed, imported frozen yellowfin sells for $8–$11/lb less than fresh, local ‘ahi, and has a more stable price. Frozen ‘ahi is treated with carbon monoxide—known as tasteless smoke—to

retain its color.

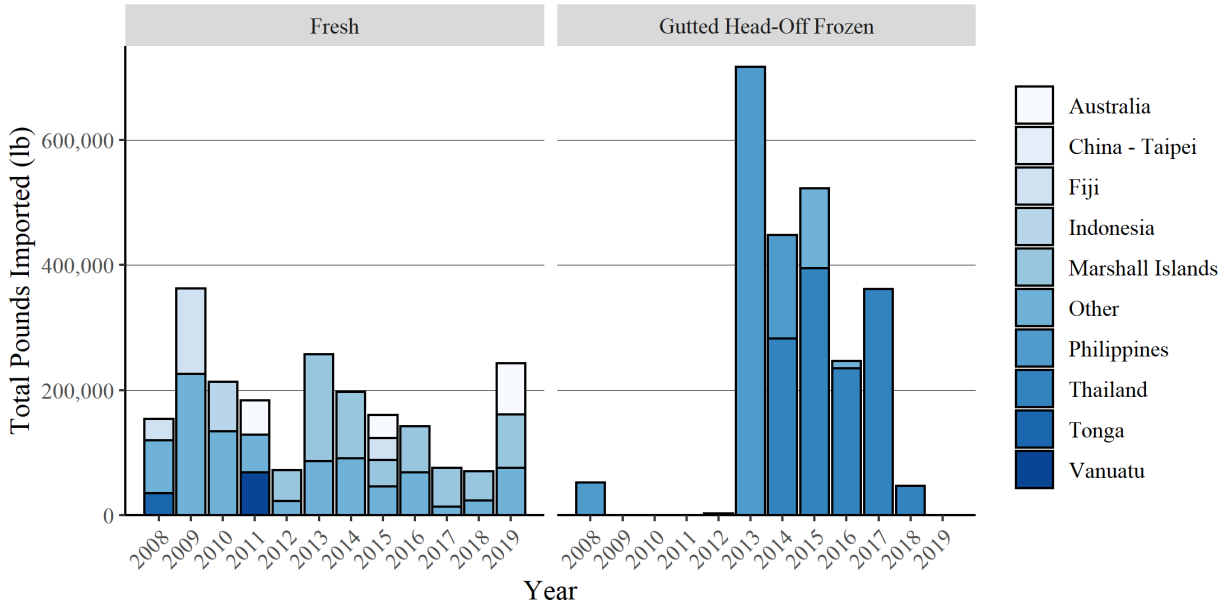

Figure 25. Total yellowfin tuna import volume to Hawai‘i.

"Other" fresh includes Costa Rica, Ecuador, French Polynesia, Japan, Kiribati, Maldives, New Zealand, Palau, Panama, Singapore, Sri Lanka, Vietnam, and Western Samoa. "Other" gutted head-off frozen includes China and Japan.

Table 18 and Table 19 detail the fresh and frozen imports of yellowfin tuna to Hawai‘i during the study period. The annual unit price for fresh yellowfin tuna imports averaged between $2.00/lb and $4.00/lb from 2008 to 2019 (Table 18). Unit prices were higher from importing origins individually comprising less than 20% of fresh yellowfin imports each year, as well as from Australia. Imports from the Marshall Islands—one of the larger import origins of fresh yellowfin to Hawai‘i—have had some of the lowest unit prices over the study period, at a mere $0.97/lb in 2016.

Table 18. Total fresh imports of yellowfin tuna to Hawai‘i.

Import Origin	Volume (lb)	Value ($)	Unit Price ($/lb)
2008	**153,404**	**624,955**	**4.07**
Australia	21,656	133,087	6.15
Costa Rica	3,428	18,917	5.52
Ecuador	448	3,245	7.25
Fiji	34,110	59,131	1.73
Marshall Islands	9,378	9,890	1.05
Philippines	12,313	89,301	7.25
Thailand	12,985	89,733	6.91
Tonga	35,318	47,839	1.35
Vietnam	23,768	173,813	7.31
2009	**362,568**	**1,074,775**	**2.96**
Australia	6,453	38,204	5.92
China - Taipei	1,956	4,384	2.24
Fiji	136,934	305,430	2.23
French Polynesia	5,465	32,268	5.90

Import Origin	Volume (lb)	Value ($)	Unit Price ($/lb)
Indonesia	38,396	111,986	2.92
Marshall Islands	66,079	72,103	1.09
Philippines	18,347	77,308	4.21
Singapore	1,662	7,600	4.57
Thailand	13,629	76,914	5.64
Tonga	9,680	18,324	1.89
Vietnam	63,967	330,254	5.16
2010	**212,914**	**788,109**	**3.70**
Australia	11,319	53,592	4.73
Fiji	13,126	24,585	1.87
French Polynesia	7,524	36,831	4.89
Indonesia	78,813	295,095	3.74
Marshall Islands	22,725	24,093	1.06
Philippines	16,535	93,083	5.63
Singapore	4,824	16,405	3.40
Sri Lanka	9,401	58,126	6.18
Thailand	19,370	58,581	3.02
Tonga	5,794	19,459	3.36
Vanuatu	754	4,065	5.39
Vietnam	21,319	101,753	4.77
Western Samoa	1,411	2,440	1.73
2011	**183,334**	**648,890**	**3.54**
Australia	54,990	239,153	4.35
Fiji	19,050	37,619	1.97
French Polynesia	1,188	4,281	3.60
Indonesia	1,795	6,925	3.86
Philippines	1,168	5,034	4.31
Sri Lanka	28,021	175,912	6.28
Thailand	1,056	3,090	2.93
Tonga	5,889	32,983	5.60
Vanuatu	68,520	140,975	2.06
Western Samoa	1,658	2,918	1.76
2012	**72,087**	**151,994**	**2.11**
Australia	2,094	10,731	5.12
Costa Rica	401	3,471	8.65
Fiji	6,960	13,985	2.01
French Polynesia	6,041	37,017	6.13
Marshall Islands	50,041	56,803	1.14
Sri Lanka	2,264	11,592	5.12
Tonga	1,537	8,759	5.70
Vietnam	2,749	9,637	3.51
2013	**257,394**	**781,120**	**3.03**
Australia	12,963	85,579	6.60
Costa Rica	2,562	20,093	7.84
Fiji	14,830	64,730	4.36
Kiribati	443	7,514	16.96
Marshall Islands	170,688	176,170	1.03
Philippines	44,368	356,898	8.04
Sri Lanka	2,707	6,809	2.52
Thailand	2,502	20,785	8.31

Import Origin	Volume (lb)	Value ($)	Unit Price ($/lb)
Tonga	1,243	5,236	4.21
Vietnam	5,086	37,307	7.34
2014	**197,120**	**601,742**	**3.05**
Australia	13,133	96,909	7.38
Fiji	28,704	129,489	4.51
French Polynesia	10,728	68,025	6.34
Japan	2,134	9,533	4.47
Maldives	4,815	16,457	3.42
Marshall Islands	105,899	108,553	1.03
Sri Lanka	10,348	75,732	7.32
Thailand	4,343	35,575	8.19
Tonga	11,861	41,738	3.52
Vietnam	5,154	19,731	3.83
2015	**160,221**	**607,090**	**3.79**
Australia	37,093	185,528	5.00
Fiji	35,124	142,735	4.06
French Polynesia	28,252	134,948	4.78
Indonesia	6,830	47,125	6.90
Japan	631	5,027	7.97
Marshall Islands	41,991	43,485	1.04
New Zealand	2,238	6,521	2.91
Panama	443	2,655	5.99
Sri Lanka	2,533	11,778	4.65
Thailand	1,111	5,455	4.91
Tonga	1,063	3,026	2.85
Vietnam	2,912	18,807	6.46
2016	**141,876**	**386,017**	**2.72**
Australia	27,123	118,905	4.38
Fiji	11,543	46,940	4.07
French Polynesia	18,113	92,130	5.09
Indonesia	606	4,057	6.69
Maldives	2,597	16,588	6.39
Marshall Islands	73,238	70,800	0.97
New Zealand	981	4,229	4.31
Panama	2,357	4,999	2.12
Philippines	1,653	9,214	5.57
Sri Lanka	1,678	10,153	6.05
Tonga	1,986	8,002	4.03
2017	**75,799**	**132,725**	**1.75**
Fiji	644	3,057	4.75
French Polynesia	7,399	33,240	4.49
Japan	525	3,395	6.47
Maldives	679	5,202	7.66
Marshall Islands	62,327	62,474	1.00
Sri Lanka	1,739	6,352	3.65
Thailand	2,487	19,005	7.64
2018	**70,319**	**219,105**	**3.12**
Australia	7,531	52,511	6.97
Marshall Islands	47,108	44,614	0.95
Panama	1,387	8,124	5.86

Import Origin	Volume (lb)	Value ($)	Unit Price ($/lb)
Philippines	12,868	102,886	8.00
Sri Lanka	1,424	10,970	7.70
2019	**242,326**	**1,004,684**	**4.15**
Australia	81,000	442,942	5.47
Costa Rica	8,918	26,340	2.95
French Polynesia	796	3,383	4.25
Indonesia	23,651	134,999	5.71
Maldives	8,960	43,984	4.91
Marshall Islands	85,493	199,195	2.33
Palau	6,499	5,510	0.85
Panama	12,200	62,923	5.16
Philippines	9,251	63,114	6.82
Tonga	5,558	22,294	4.01
Grand Total	**2,129,361**	**7,021,206**	**3.30**

From 2008 to 2019, the unit prices of frozen yellowfin tuna imports to Hawai‘i ranged from $3.40/lb to $7.23/lb (Table 19). The Philippines and China - Taipei supplied the highest valued frozen yellowfin, while the highest import volume originated from the Philippines and Thailand. As shown in Figure 25, frozen imports of yellowfin from 2008 to 2019 were inconsistent, with no imports from 2009 to 2011 and only small quantities in 2012.

Table 19. Total frozen yellowfin tuna imports to Hawai‘i.

Import Origin	Volume (lb)	Value ($)	Unit Price ($/lb)
2008	**51,935**	**176,662**	**3.40**
Philippines	51,935	176,662	3.40
2009	**0**	**0**	**0.00**
2010	**0**	**0**	**0.00**
2011	**0**	**0**	**0.00**
2012	**2,756**	**18,398**	**6.68**
China - Taipei	2,756	18,398	6.68
2013	**716,502**	**4,410,897**	**6.16**
Philippines	716,502	4,410,897	6.16
2014	**447,503**	**2,049,327**	**4.58**
Philippines	165,347	1,010,076	6.11
Thailand	282,156	1,039,250	3.68
2015	**522,680**	**2,005,952**	**3.84**
China	22,300	106,198	4.76
Indonesia	80,001	389,640	4.87
Thailand	315,843	1,510,113	4.78
2016	**246,077**	**982,718**	**3.99**
Japan	11,164	80,766	7.23
Thailand	234,914	901,952	3.84
2017	**361,765**	**1,357,729**	**3.75**
Thailand	361,765	1,357,729	3.75
2018	**46,738**	**205,190**	**4.39**
Thailand	46,738	205,190	4.39
2019	**0**	**0**	**0.00**
Grand Total	**2,395,956**	**11,206,872**	**4.68**

Swordfish

Over the study period, Hawai‘i contributed 22% to 48% of the domestic landings and 20% to 41% of the total revenue for swordfish in the U.S. In 2019, Hawai‘i provided 28% of the total swordfish landings and 25% of the total swordfish revenue in the U.S. Swordfish is caught by the shallow-set longline fishery in Hawai‘i which fishes primarily in the first half of the year (Remington et al. 2020). The depth of set for longline gear can be adjusted for deep-sets to target tunas or for shallow-sets to target swordfish. Shallow-set longline effort for swordfish has been steadily declining since 2005. This is partially due to fishery closures associated with sea turtle interaction caps (Remington et al. 2020) and safety at sea considerations since the fishery is most active during the roughest fishing conditions of the year. The trip length for swordfish is typically longer, the distance to fishing grounds is farther, and bait is more expensive which all contribute to much higher trip costs compared to deep-set tuna trips. As a result of fluctuating revenue over the years, the swordfish fishery has experienced decreasing economic returns (Pan 2018).

On average, Hawai‘i landed approximately 2 million lb of swordfish annually from 2008 to 2019 (Table 20). Previous research has estimated that over 90% of Hawai‘i swordfish landings may be shipped to the continental U.S. (Loke et al. 2012), although domestic shipment data were not available for this study. From available landings and trade data, we calculate that Hawai‘i exported an annual average of around 22,000 lb over the study period, only 15% of which was fresh. Generally, swordfish exported from Hawai‘i and imported to Hawai‘i was either in fillet or meat[11] forms. Whole, fresh swordfish exports sold for an average of $7.20/lb, while the average unit value of Hawai‘i swordfish landings was only $2.59/lb. During the same time span, Hawai‘i imported an annual average of approximately 42,000 lb of swordfish, 56% of which was fresh fillets valued at $0.90/lb.

Table 20. Average annual supply and value of swordfish, 2008–2019.

	Form	Volume (lb)	Value ($)	Unit Price ($/lb)
Hawai‘i Landings	Fresh	1,965,150	5,095,225	2.59
Exports from Hawai‘i	Fresh	1,497	10,782	7.20
	Meat Fresh	1,971	3,667	1.86
	Meat Frozen	18,934	52,987	2.80
Imports to Hawai‘i	Fillet Fresh	23,410	21,105	0.90
	Fresh	8,647	38,615	4.47
	Frozen	10,109	28,841	2.85
Continental U.S. Landings	Fresh	4,646,473	15,470,582	3.33
Exports from the Continental U.S.	Fillet Fresh	108,611	178,076	1.64
	Fillet Frozen	93,247	162,062	1.74
	Fresh	35,913	187,273	5.21
	Frozen	55,929	130,715	2.34
	Meat Fresh	6,488	10,588	1.63

[11] The Harmonized Tariff Schedule code describes “meat” product forms as chunked or minced and excludes steaks and fillets.

	Form	Volume (lb)	Value ($)	Unit Price ($/lb)
	Meat Frozen	106,676	120,886	1.13
Imports to the Continental U.S.	Fillet Fresh	210,015	368,018	1.75
	Fillet Frozen	11,149,146	19,815,184	1.78
	Fresh	14,466,042	57,489,992	3.97
	Frozen	80,359	222,088	2.76
	Meat Fresh	117,232	150,699	1.29
	Meat Frozen	3,345,806	2,340,131	0.70
	Steaks Fresh	110,008	174,411	1.59
	Steaks Frozen	1,727,912	3,920,950	2.27

The continental U.S. landed an annual average of about 4.6 million lb of swordfish from 2008 to 2019, about 9% of which the continental U.S. exported (Table 20). Fresh swordfish fillets and frozen meat were the primary export forms. The continental U.S. imported over eighteen times more swordfish than it landed from 2008 to 2019. The most prominent import forms to the continental U.S. were fresh, whole swordfish at $3.97/lb and frozen swordfish fillets at $1.78/lb. Fresh swordfish was the highest valued import form to the continental U.S. from 2008 to 2019.

Domestic Consumption Trends

The majority of Hawai‘i swordfish landings are consumed domestically. Hawai‘i has a lower demand for swordfish than the continental U.S. Unlike bigeye and yellowfin tunas, there is not a strong local preference for fresh swordfish. Poke and sashimi are popular in Hawai‘i, and fresh swordfish is only available seasonally, so it may be difficult for locally caught swordfish to maintain a market presence.

In 2019, the total domestic consumption of swordfish in the U.S. was approximately 38 million lb. Domestic consumption of Hawai‘i swordfish landings sharply decreased from around 3.8 million lb in 2008 to 1.5 million lb in 2019 (Figure 26). The decrease in local consumption of swordfish was likely prompted by swordfish fishery closures due to sea turtle interaction caps and a decrease in shallow-set longline fishing effort. Though local consumption increased briefly in 2014 and 2017, it then resumed a decreasing trend. By contrast, swordfish consumption in the continental U.S. was much higher than in Hawai‘i.

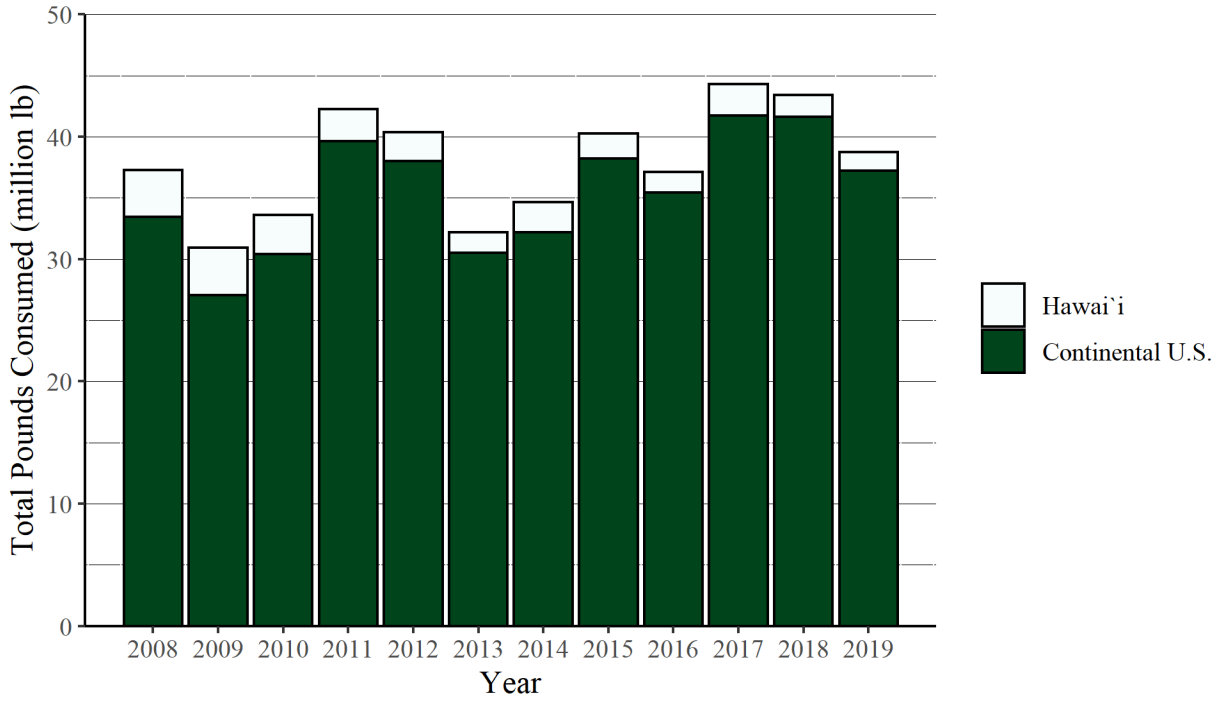

Figure 26. Total domestic consumption of swordfish in Hawai‘i and the continental U.S.

With the exception of two sharp declines in 2009 and 2013, domestic consumption of swordfish in the continental U.S. increased over the study period, from about 27 million lb in 2009 to nearly 42 million lb in 2018 (Figure 26). The trend of total domestic consumption of swordfish in the U.S. closely mirrored that of the continental U.S. consumption, albeit with a more pronounced decrease in 2013 (Figure 26).

Based on available data, our calculations show that between 97.9% and 99.9% of the swordfish consumed in Hawai‘i was from Hawai‘i landings from 2008 to 2019 (Figure 27). Conversely, the continental U.S. imported between 81.1% and 91.3% of its swordfish over the study period to satisfy consumption demand (Figure 28). While our results present an analysis of the available data, we acknowledge that incorporating domestic shipment data may provide a more nuanced illustration of domestic consumption trends. Loke et al. (2012) estimate that upwards of 90% of Hawai‘i swordfish landings may be shipped to the continental U.S., and thus we encourage future research to further explore these trends.

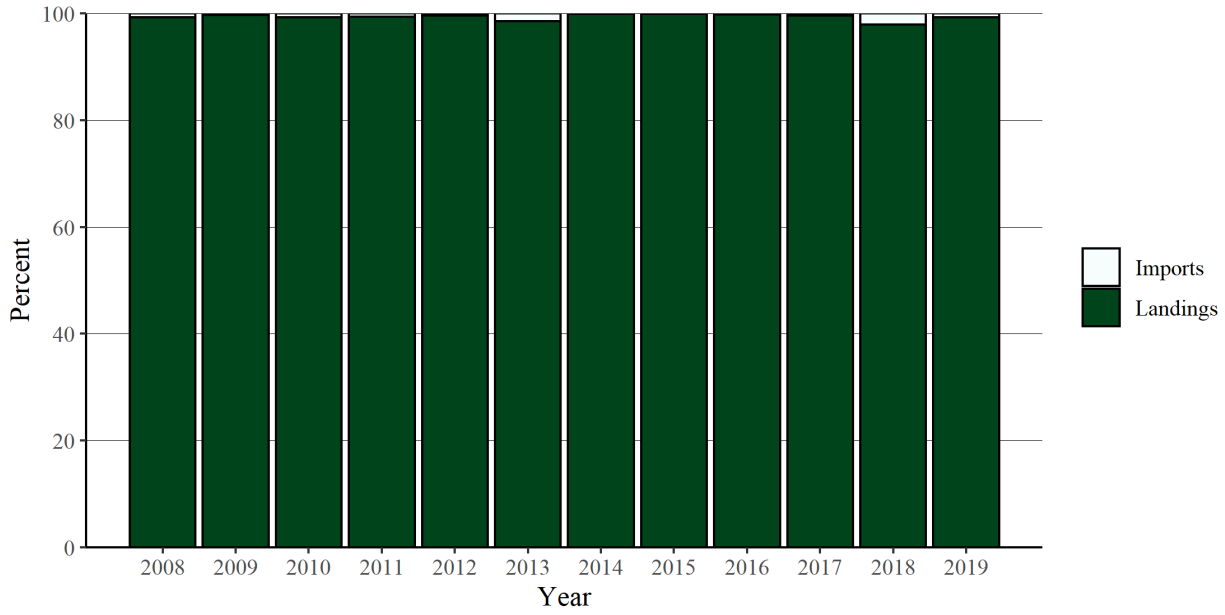

Figure 27. Annual share of local swordfish consumption in Hawai‘i.

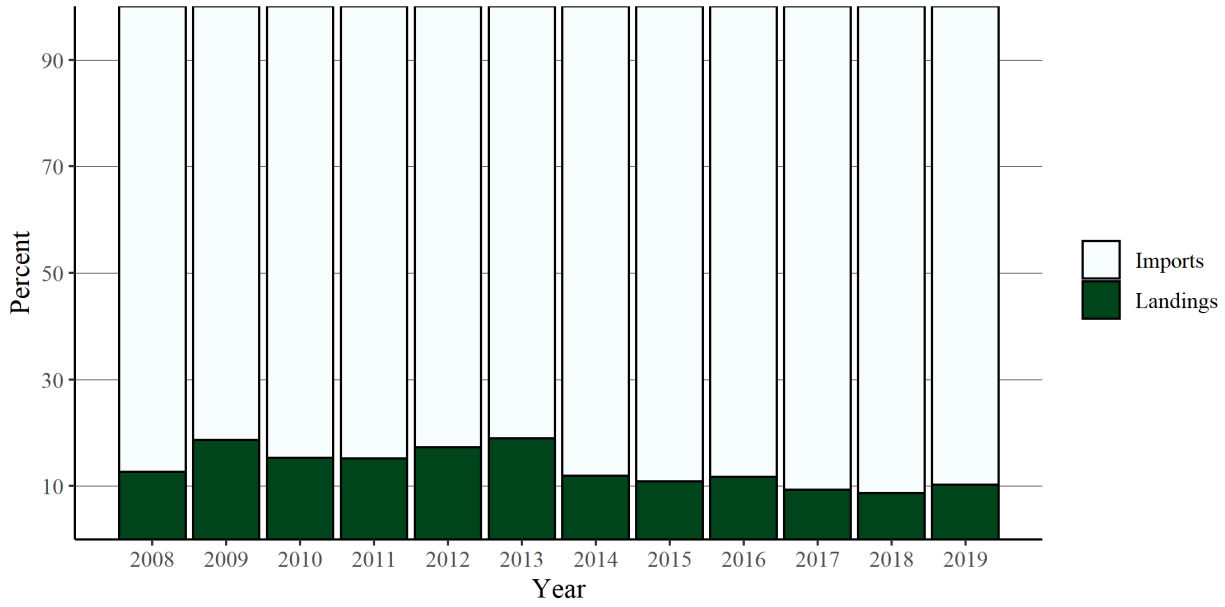

Figure 28. Annual share of domestic swordfish consumption in the continental U.S.

Landings Summary and Ex-Vessel Prices

Total Hawai‘i landings of swordfish decreased overall between 2008 and 2019, from approximately 3.8 million lb in 2008 to about 745,000 lb in 2019 (Figure 29). Landings briefly increased to around 2.5 million lb in 2014 and 1.6 million lb in 2016 before decreasing again.

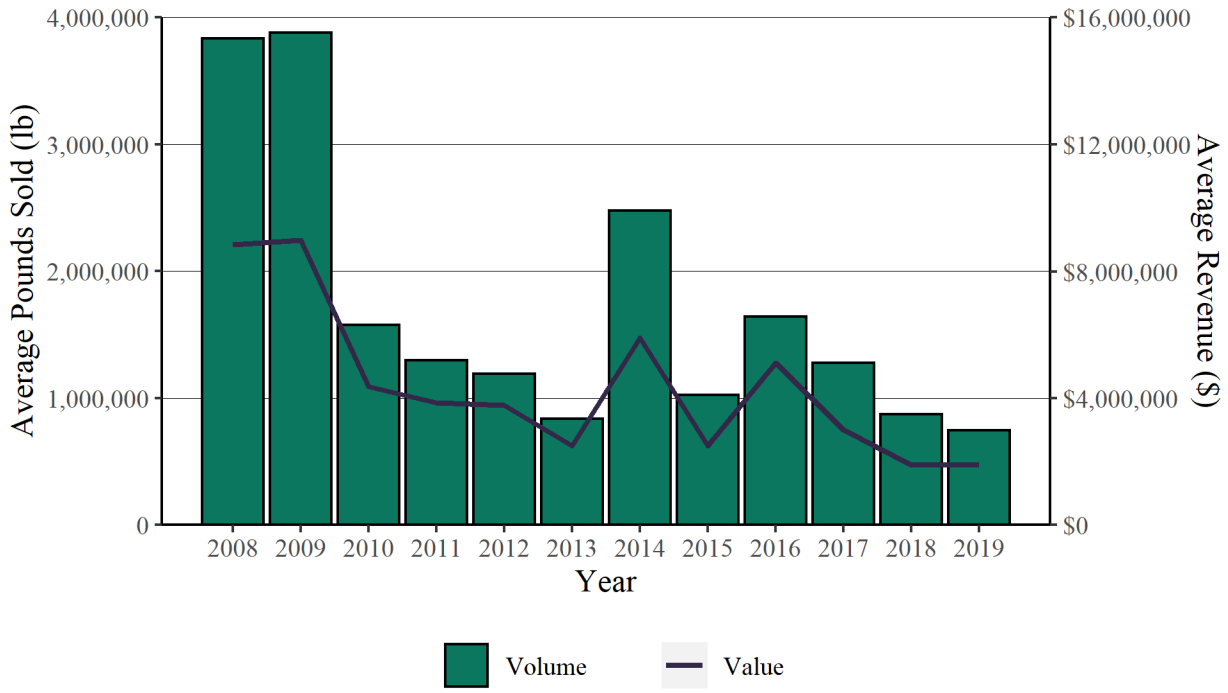

Figure 29. Average volume and value of swordfish landed in Hawai‘i.

Annual and monthly average ex-vessel prices for swordfish from 2008 to 2019 are shown in Figure 30. Average annual ex-vessel prices (inflation-adjusted) followed a general increasing trend from $3.51/lb in 2008 to a high of $4.50/lb in 2012, before decreasing to a low of $3.50/lb in 2014. Prices then increased from 2015 to 2017 before decreasing again through 2019. By month, ex-vessel prices ranged from a low of $1.66/lb in April 2018 to a high of $6.09/lb in January 2013. Monthly average ex-vessel prices can illustrate seasonal supply peaks of swordfish, as swordfish effort is typically highest in the first quarter of the year. After that, fishers often switch gear to target bigeye tuna, and swordfish fishing picks up again in the last quarter of the year. From 2008 to 2019, swordfish landings sold for an average of $4.52/lb in January, with the lowest prices in April at an average of $2.79/lb.

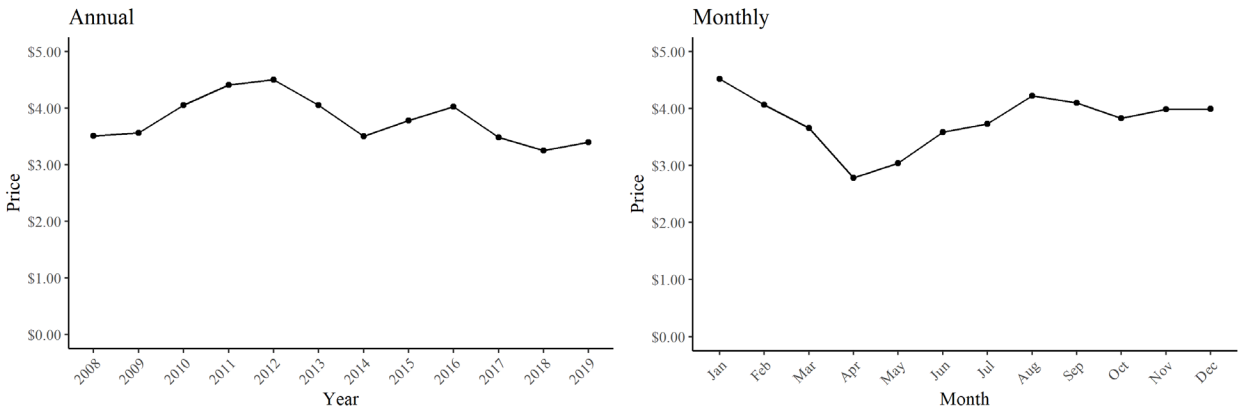

Figure 30. Annual and monthly average ex-vessel prices (per pound) for Hawai‘i swordfish landings, 2008–2019.

Exports from Hawai‘i

Based on available data, the majority of swordfish landed in Hawai‘i was consumed domestically, and about 1.1% of Hawai‘i swordfish landings were exported to foreign markets from 2008 to 2019. However, when domestic shipment data are considered, Hawai‘i may ship over 90% of its swordfish landings to the continental U.S. (Loke et al. 2012). Table 21 shows the total swordfish exports from Hawai‘i over the twelve-year study period. Swordfish exports reached a maximum of nearly 22,000 lb in 2008 before sharply decreasing to less than 400 lb in 2009. Hawai‘i only exported swordfish again in 2015. Canada was the only swordfish export destination from Hawai‘i from 2008 to 2019, with just three years of exports. Over the twelve-year study period, 90% of the volume exported was in 2008 and was valued at around $3.31/lb. Of the product forms, 79% of exports were frozen meat.

Table 21. Total swordfish exports from Hawai‘i.

Export Destination	Volume (lb)	Value ($)	Unit Price ($/lb)
2008	**21,552**	**71,235**	**3.31**
Fresh			
Canada	2,618	18,248	6.97
Meat Frozen			
Canada	18,934	52,987	2.80
2009	**376**	**3,316**	**8.81**
Fresh			
Canada	376	3,316	8.81
2010	**0**	**0**	**0.00**
2011	**0**	**0**	**0.00**
2012	**0**	**0**	**0.00**
2013	**0**	**0**	**0.00**
2014	**0**	**0**	**0.00**
2015	**1,971**	**3,667**	**1.86**
Meat Fresh			
Canada	1,971	3,667	1.86
2016	**0**	**0**	**0.00**
2017	**0**	**0**	**0.00**

Export Destination	Volume (lb)	Value ($)	Unit Price ($/lb)
2018	**0**	**0**	**0.00**
2019	**0**	**0**	**0.00**
Grand Total	**23,900**	**78,218**	**3.27**

Imports to Hawai‘i

Swordfish imports to Hawai‘i peaked in 2013 (Figure 31) corresponding with a decrease in landings that year (Figure 29). Swordfish imports to Hawai‘i decreased sharply from over 25,000 lb in 2013 to about 2,000 lb in 2014, increasing again to approximately 37,000 lb in 2018 (Figure 31). Similarly, swordfish landings slightly increased in 2014 and 2016 (Figure 29).

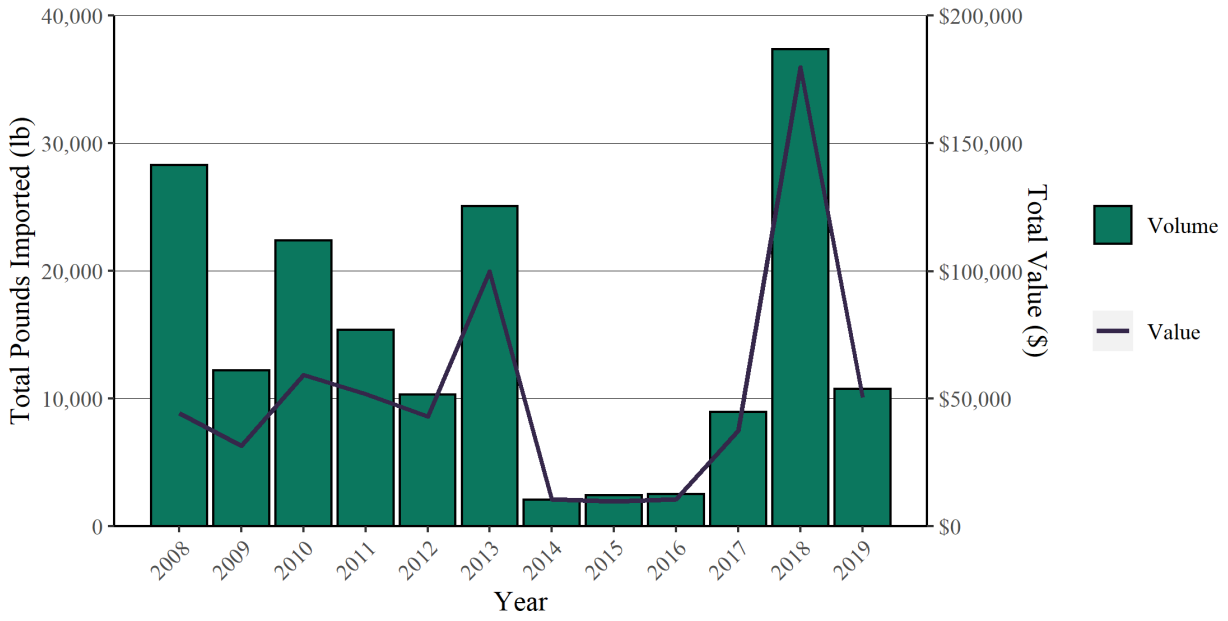

Figure 31. Total volume and value of swordfish imports to Hawai‘i.

Figure 32 shows swordfish imports to Hawai‘i by product form and country from 2008 to 2019. According to available data, Costa Rica and Australia were the most consistent import origins of fresh swordfish to Hawai‘i. Over the study period, Hawai‘i imported an average of 20% of its fresh swordfish from Costa Rica and 18% from Australia. Hawai‘i imported 25% of fresh swordfish from Ecuador in the last years of the study period, which totaled to the highest share of any import origin from 2008 to 2019. However, the Philippines supplied the highest volume of fresh swordfish imports to Hawai‘i in a single year, accounting for 92% of the product imports for 2008. Hawai‘i imported fresh swordfish fillet only once over the study period, originating from the Philippines in 2008 at around 23,000 lb. With the exception of 2009 through 2011 and 2013, a low volume of frozen swordfish is imported to Hawai‘i. Indonesia, Thailand, and New Zealand were the only import origins of frozen swordfish to Hawai‘i from 2008 to 2019; 75% was from Indonesia.

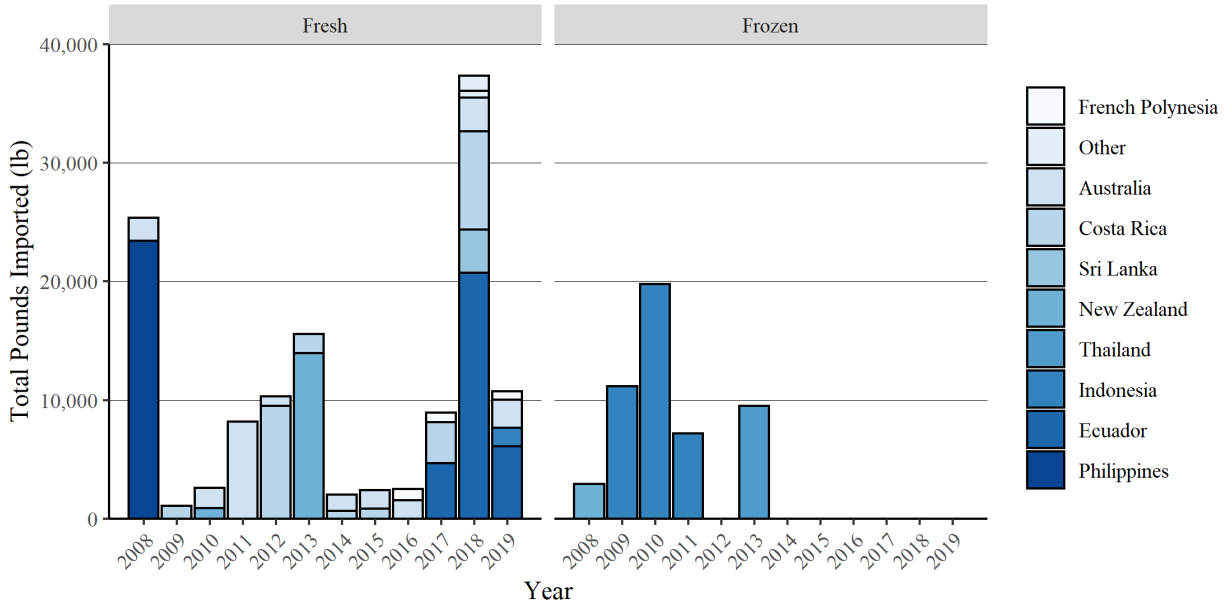

Figure 32. Total swordfish import volume to Hawai‘i.

Table 22 shows the fresh swordfish imports to Hawai‘i by import origin from 2008 to 2019. Fresh swordfish accounted for approximately 72% of all swordfish imports to Hawai‘i over the study period. Hawai‘i imported over 127,000 lb of fresh swordfish from 2008 to 2019, valued at over $484,000. Imports to Hawai‘i from Sri Lanka had the highest unit value, reaching $6.34 in 2018. The average unit value of fresh swordfish imports over the study period was $3.81.

Table 22. Total fresh swordfish imports to Hawai‘i.

Import Origin	Volume (lb)	Value ($)	Unit Price ($/lb)
2008	**25,381**	**32,792**	**1.29**
Philippines (Fresh fillet)	23,410	21,105	0.90
Australia	1,971	11,687	5.93
2009	**1,064**	**3,355**	**3.15**
Costa Rica	1,064	3,355	3.15
2010	**2,601**	**10,294**	**3.96**
Australia	1,698	7,631	4.49
New Zealand	903	2,663	2.95
2011	**8,176**	**34,535**	**4.22**
Australia	8,176	34,535	4.22
2012	**10,306**	**42,950**	**4.17**
Australia	797	3,206	4.02
Costa Rica	9,508	39,744	4.18
2013	**15,581**	**61,560**	**3.95**
Costa Rica	1,635	6,981	4.27
New Zealand	13,946	54,580	3.91
2014	**2,050**	**10,557**	**5.15**
Australia	1,378	7,923	5.75
Costa Rica	672	2,633	3.92
2015	**2,424**	**9,756**	**4.03**
Australia	1,590	7,409	4.66

Import Origin	Volume (lb)	Value ($)	Unit Price ($/lb)
Costa Rica	833	2,348	2.82
2016	**2,511**	**10,669**	**4.25**
Australia	1,541	6,645	4.31
French Polynesia	970	4,024	4.15
2017	**8,964**	**37,559**	**4.19**
Costa Rica	3,476	9,569	2.75
Ecuador	4,668	23,481	5.03
French Polynesia	820	4,508	5.50
2018	**37,355**	**179,911**	**4.82**
Australia	2,851	15,503	5.44
Costa Rica	8,261	28,363	3.43
Ecuador	20,712	103,401	4.99
French Polynesia	569	2,844	5.00
New Zealand	1,281	6,454	5.04
Sri Lanka	3,680	23,346	6.34
2019	**10,760**	**50,546**	**4.70**
Australia	2,392	12,619	5.28
Ecuador	6,117	29,050	4.75
French Polynesia	721	3,606	5.00
Indonesia	1,530	5,271	3.45
Grand Total	**127,171**	**484,483**	**3.81**

About 28% of swordfish imports to Hawai‘i were frozen, totaling to nearly 51,000 lb (Table 23). The average unit value for frozen swordfish imports was less than that of fresh imports. Frozen swordfish imports from Thailand had the highest value at $4.03/lb in 2013, followed by imports from New Zealand at $3.93/lb in 2008.

Table 23. Total frozen swordfish imports to Hawai‘i.

Import Origin	Volume (lb)	Value ($)	Unit Price ($/lb)
2008	**2,926**	**11,488**	**3.93**
New Zealand	2,926	11,488	3.93
2009	**11,146**	**28,117**	**2.52**
Indonesia	11,146	28,117	2.52
2010	**19,774**	**49,078**	**2.48**
Indonesia	19,774	49,078	2.48
2011	**7,194**	**17,217**	**2.39**
Indonesia	7,194	17,217	2.39
2012	**0**	**0**	**0.00**
2013	**9,503**	**38,303**	**4.03**
Thailand	9,503	38,303	4.03
2014	**0**	**0**	**0.00**
2015	**0**	**0**	**0.00**
2016	**0**	**0**	**0.00**
2017	**0**	**0**	**0.00**
2018	**0**	**0**	**0.00**
2019	**0**	**0**	**0.00**
Grand Total	**50,543**	**144,203**	**2.85**

Discussion

Hawai‘i commercial fisheries provide high quality seafood for Hawai‘i residents and visitors, and contribute substantially to seafood supply and revenues in the U.S. as a whole. From available data, we estimate that Hawai‘i accounted for 47% of national tuna landings and 60% of the total U.S. tuna revenue in 2019. Hawai‘i also supplied 86% of both the national bigeye tuna landings and 86% of national bigeye revenue in 2019. Hawai‘i contributed 67% of yellowfin tuna landings and 74% of the national yellowfin revenue, along with 28% of swordfish landings and 25% of the national swordfish revenue in 2019.

Based on available data, we estimate that Hawai‘i landed an annual average of 15 million lb of bigeye tuna and consumed an average of about 15.7 million lb of bigeye each year. Hawai‘i exported an annual average of around 1.3% of its bigeye tuna landings and imported an annual average of around 4.8% of locally consumed bigeye. We also show that Hawai‘i landed an annual average of 4.2 million lb of yellowfin tuna and consumed an average of about 4.5 million lb annually. Hawai‘i exported an annual average of less than 1.3% of yellowfin tuna landings and imported an annual average of 8.2% of locally consumed yellowfin. However, our estimates do not consider potential domestic shipments from the continental U.S. The continental U.S. imports frozen tuna from foreign sources and then domestically ships an undetermined amount of those imports to Hawai‘i, where it is consumed. Similarly, up to 30% of Hawai‘i bigeye and yellowfin landings could be shipped to the continental U.S. for domestic consumption (Loke et al. 2012).

According to our calculations from available data, Hawai‘i landed an annual average of about 2 million lb of swordfish. Hawai‘i exported an annual average of 0.5% of its swordfish landings and imported an annual average of 0.6% of locally consumed swordfish. When domestic shipment data are considered, over 90% of local swordfish landings may be shipped to the continental U.S. (Loke et al. 2012). Similarly, industry estimates suggest approximately 18% of Hawai‘i longline landings are shipped domestically to the continental U.S. (Hawaii Longline Association 2020). Indeed, this robust local supply of pelagic species is important to meet the growing demand of tourists and residents, as well as national consumption of pelagic seafood.

Overall, our market analyses show that Hawai‘i may be able to maximize earnings from its landings while meeting consumption demand for pelagic species. For most product forms of each species, export revenues exceeded import values over our study period, while import unit values were generally lower than the prices of local landings. In comparison to local ex-vessel prices, high export unit values allow Hawai‘i to generate additional revenue from its commercial pelagic landings, while lower import values can fill consumption demand for pelagic species at a lower price than local landings. Future studies could incorporate the added costs of shipping, processing, and other associated expenses into these calculations to determine if the cost of trade at higher unit values does indeed yield additional economic benefit for Hawai‘i.

Although domestic shipment data were unavailable, Loke et al.'s 2012 estimations provide key insight to bolster our estimates of pelagic fisheries market trends. Further research could analyze updated domestic shipment data over the study period to articulate nuances in pelagic market supply and consumption trends between Hawai‘i and the continental U.S. We selected this study period in order to establish a baseline of market trends in recent years. Future studies could replicate these analyses and utilize this report as a model of comparison to measure the impacts of COVID-19 and the post-pandemic economic recovery.

Acknowledgments

A number of colleagues past and present were instrumental to the completion of this project. First and foremost, I would like to thank Emily Rollins for her work in conceptualizing this analysis, structuring its execution, writing the original code, and drafting the first version of this manuscript. Your foundational contributions were indispensable, and I hope I've carried your vision to a satisfactory conclusion. I also want to express my gratitude to Jonathan Sweeney for his frequent guidance on coding and Hawai‘i pelagic fisheries, which made the completion of this analysis possible. I wish to thank Justin Hospital for his revision support and comments to bring the final product to review. Similarly, I want to thank Russell Ito for sharing his expertise and his comments as a reviewer. I greatly appreciate the fresh perspective and industry knowledge that we could incorporate into this paper because of his contribution. Finally, I am grateful to Adam Ayers for his writing guidance.

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Appendix A Ancillary Data Sources

Table A 1. Price adjustment

YR	CPI	CPI-adjustment
2008	228.86	1.23
2009	230.05	1.22
2010	234.87	1.20
2011	243.62	1.16
2012	249.47	1.13
2013	253.92	1.11
2014	257.59	1.09
2015	260.17	1.08
2016	265.28	1.06
2017	272.01	1.04
2018	277.08	1.02
2019	281.59	1.00

Honolulu CPI, 1982-84=100

Table A 2. Conversion factors (CF) to live weight for traded species.

Species group	Form	CF	Source and explanation of conversion factors
Bigeye tuna	Fresh	1.04	Source:(1), for fresh/chilled
Bigeye tuna	Frozen[12]	1.20	Source:(1), based on average for all countries of fresh[13]/chilled, gutted
Yellowfin tuna	Fresh	1.00	Source:(1), for fresh/chilled
Yellowfin tuna	Frozen	1.10	Source:(1), for frozen, gutted.
Yellowfin tuna	Frozen (g/h)	1.25	Source:(1), for fresh/chilled, gutted, head off
Yellowfin tuna	Frozen (g/nh)	1.10	Source:(1), for frozen, gutted
Yellowfin tuna	Frozen (W)	1.00	Assume whole frozen yellowfin tuna is same weight as live
Albacore tuna	Fresh	1.00	Source:(1), for fresh/chilled
Albacore tuna	Frozen	1.10	Source:(1), for frozen, gutted
Albacore tuna	Preserved	1.92	Source:(2), basic conversion factor for prepared or preserved canned tuna
Skipjack tuna	Fresh	1.00	Source:(1), for fresh/chilled, gutted
Skipjack tuna	Frozen	1.10	Source:(1), for frozen, gutted (for Mexico)
Tuna (unspecified)	Fresh	1.00	Assume similar for all tunas
Tuna (unspecified)	Frozen	1.12	Source:(1), average of all frozen tuna conversions in table
Tuna (unspecified)	Fillets	1.92	Source:(2), skin off conversion factor for tuna fillet
Tuna (unspecified)	Preserved	1.92	Source:(2), basic conversion factor for prepared or preserved canned tuna
Swordfish	Fresh	1.02	Source:(1), based on average for all countries in fresh/chilled
Swordfish	Frozen	1.35	Source:(1), based on average of range for frozen, head off
Swordfish	Fillets	2.47	Source:(1), based on average for all countries in frozen fillets, boneless, skin off
Mahimahi	Fresh	1.00	Source:(3), for whole
Mahimahi	Frozen	1.20	Source:(3), for gutted
Mahimahi	Fillets	3.33	Source:(3), for raw fillets, fresh & frozen
Squid (unspecified)	Frozen, dried, salted, brine	1.55	Source:(2), for dried, whole
Squid (unspecified)	Prepared/ preserved	1.28	Source:(2), based on average for whole and dried, whole
Squid (unspecified)	Fillet frozen	1.45	Source:(2), for frozen, raw, gutted

[12] When frozen form is not further specified beyond 8-digit level, and with the exception of swordfish, assume gutted. For swordfish and sharks, assume head-off.

[13] Assuming all else equal, a frozen product is not significantly different than fresh.

Species group	Form	CF	Source and explanation of conversion factors
Squid (unspecified)	Frozen	1.00	Source:(2), for frozen, whole
Squid (unspecified)	Dried, salted, brine	1.55	Source:(2), for dried, whole
Squid (unspecified)	Live, fresh	1.00	Assume live, fresh squid is same weight as reported trade volume
Shark (unspecified)	Frozen	2.00	Source:(2), for gutted, head off
Shark (unspecified)	Fins dried	1.00	Source:(2), for fins dried
Shark (unspecified)	Fresh	1.24	Source:(3), based on average for fresh/chilled, gutted thresher sharks and shortfin mako shark, which were the only species-specific shark landings sold from 2008 to 2019
Bluefin tuna Pac.	Frozen	1.18	Source:(1), for frozen, gutted, tail off, gilled.
Bluefin tuna Pac.	Fresh	1.00	Assume fresh Pacific bluefin tuna is whole.
Bluefin tuna Atl.	Frozen	1.11	Source:(1), for frozen, gutted.
Bluefin tuna Atl.,Pac.	Fresh	1.00	Assume fresh Atlantic, Pacific bluefin tuna is whole.
Bluefin tuna	Fresh	1.00	Assume fresh bluefin tuna is whole.
Bluefin tuna	Frozen	1.17	Sources:(2, 3), based on average for gutted bluefin tuna, and frozen and gutted other tunas.
Bluefin tuna Southern	Fresh	1.00	Assume fresh Southern bluefin tuna is whole.
Bluefin tuna Southern	Frozen	1.18	Source:(1), for frozen, gutted, tail off, gilled.

Sources: 1. FAO 2000, 2. FAO n.d., 3. NMFS n.d.

Key: g/h = gutted, head-on, g/nh = gutted, head-off, W = whole

Includes product forms in data specified as “meat” and “steaks”, whether fresh or frozen.

Appendix B Data Queries

All data sets used in this report are publicly available, and project metadata can be found in the NMFS InPort at the following page: https://www.fisheries.noaa.gov/inport/item/65801. Details of the data sources and data query instructions are listed below. Code used to complete the data analyses were written and executed in R Studio using the R coding language. A copy can be found on the report's GitHub site: https://github.com/CrystalDombrow-NOAA/Hawaii-Pelagic-Fisheries-Market-Analysis

AllTrade 2008–2019.csv: Honolulu trade data by species, 2008–2019.

- https://www.fisheries.noaa.gov/foss/
- Queried on April 12, 2021
- Foreign Trade category
  Selected: Exports, Imports, and Re-Exports for "Trade Type", Monthly for "Time range", 2008–2019 for "Year", All Months for "Month", U.S. Customs District for "Geographic Scale", All Districts (including lines that start with " "), All Products for "Product"
- Clicked "Run Report" button
- Selected in dropdown menu: "2. Detailed Report"
- Select "Actions" then "Filter"
- Column: select U.S. Customs District, Operator: select =, Expression: write HONOLULU, HI
- Click "Apply" button
- Clicked "Format & Download" button, selected "Download", .csv format

HIContributiontoUSSwordfish.csv: Hawai‘i and U.S. swordfish landings, 2008–2019.

- https://www.fisheries.noaa.gov/foss/
- Queried on July 9, 2021
- Landings category
- Selected: Commercial for “Data Set”, 2008–2019 for “Year”, States for “Region Type”, All States except PROCESS AT SEA for “State Landed”, SWORDFISH for “Species”, Totals by Year/Species for “Report Format”
- Clicked "Run Report"

- https://www.fisheries.noaa.gov/foss/
- Queried on July 9, 2021
- Landings category
- Selected: Commercial for “Data Set”, 2008–2019 for “Year”, States for “Region Type”, HAWAII for “State Landed”, SWORDFISH for “Species”, Totals by Year/Species for “Report Format”
- Clicked "Run Report"

HIContributiontoUSTuna_bySpecies.csv: Hawai‘i and U.S. tuna landings by species, 2008–2019.

- https://www.fisheries.noaa.gov/foss/
- Queried on July 9, 2021
- Landings category
- Selected: Commercial for “Data Set”, 2008–2019 for “Year”, States for “Region Type”, All States except PROCESS AT SEA for “State Landed”, [Albacore, bigeye, black skipjack, blackfin, bluefin, bluefin pacific, kawakawa, little tunny, skipjack, yellowfin tunas] for “Species”, Totals by Year/Species for “Report Format”
- Clicked "Run Report"

- https://www.fisheries.noaa.gov/foss/
- Queried on July 9, 2021
- Landings category
- Selected: Commercial for “Data Set”, 2008-2019 for “Year”, States for “Region Type”, HAWAII for “State Landed”, [Albacore, bigeye, black skipjack, blackfin, bluefin, bluefin pacific, kawakawa, little tunny, skipjack, yellowfin tunas] for “Species”, Totals by Year/Species for “Report Format”
- Clicked "Run Report"

HIContributiontoUSTuna_Total.csv: Hawai‘i and U.S. tuna landings, all tuna species combined, 2008–2019.

- https://www.fisheries.noaa.gov/foss/
- Queried on July 9, 2021
- Landings category
- Selected: Commercial for “Data Set”, 2008-2019 for “Year”, States for “Region Type”, All States except PROCESS AT SEA for “State Landed”, [Albacore, bigeye, black skipjack, blackfin, bluefin, bluefin pacific, kawakawa, little tunny, skipjack, yellowfin tunas] for “Species”, Totals by Year for “Report Format”
- Clicked "Run Report"

- https://www.fisheries.noaa.gov/foss/
- Queried on July 9, 2021
- Landings category
- Selected: Commercial for “Data Set”, 2008–2019 for “Year”, States for “Region Type”, HAWAII for “State Landed”, [Albacore, bigeye, black skipjack, blackfin, bluefin, bluefin pacific, kawakawa, little tunny, skipjack, yellowfin tunas] for “Species”, Totals by Year for “Report Format”
- Clicked "Run Report"

Landings.csv: Hawai‘i landings data by species, 2008-2019.

- https://apps-pifsc.fisheries.noaa.gov/wpacfin/total-landings.php

- Queried on April 14, 2021
- Selected: Hawaii for "1. Island Area", WPacFIN's Best Estimated Total Commercial Landings for "2. Data Collections", 2008 "Start Year" and 2019 "End Year" for "3. Date Range", no selections for "4. Choose name Type", Individual for "5. How do you want to select species?", Select All Species for "6. Species", Order by Year then Species
- Clicked "Get Results"

MonthlyPrices.csv: Hawai‘i monthly average ex-vessel prices by species, 2008–2019.

- https://www.fisheries.noaa.gov/inport/item/5610
- Queried on April 14, 2021
- Downloaded DAR raw dealer data directly from website
- Dropped "unknown" species category

USLandings.csv: U.S. landings data by species, 2008–2019.

- https://www.fisheries.noaa.gov/foss/
- Queried on April 12, 2021
- Landings category
- Selected: "Commercial", 2008-2019 for "Year", States for "Region Type", All States except HAWAII and PROCESS AT SEA for "State Landed", ALL SPECIES for "Species"
- Clicked "Run Report" button
- Selected in dropdown menu: "9. Landings by Year, State, Species"
- Clicked "Format & Download" button, selected "Download", .csv format

- https://www.fisheries.noaa.gov/foss/
- Queried on April 12, 2021
- Landings category
- Selected: "Commercial", 2008–2019 for "Year", States for "Region Type", HAWAII for "State Landed", ALL SPECIES for "Species"
- Clicked "Run Report" button
- Selected in dropdown menu: "9. Landings by Year, State, Species"
- Clicked "Format & Download" button, selected "Download", .csv format

USTradeDat.csv: U.S. trade data by species, 2008–2019.

- https://www.fisheries.noaa.gov/foss/
- Queried on April 14, 2021
- Foreign Trade category
- Selected: Exports and Imports for "Trade Type", Monthly for "Time range", 2008–2019 for "Year", All Months for "Month", U.S. Customs District for "Geographic Scale", All Districts (including lines that start with " "), All Products for "Product"
    - Downloaded in 3 parts: years 2008-2012, 2013-2016, 2017–2019
    - "All" States = 49 states, not including Hawaii

    - "All" Species = All species in FOSS database, for Hawaii and 49 remaining states separately
    - "All" Species for "All" States = All species in FOSS database for 49 remaining states, not including Hawaii
- Clicked "Run Report" button
- Selected in dropdown menu: "2. Detailed Report"
- Clicked "Format & Download" button, selected "Download", .csv format