FRIENDS OF
MIDWAY ATOLL

Subject: Friends of Midway Atoll National Wildlife Refuge and Battle of Midway National Memorial response to Federal Register Notice No: 16377 dated August 27, 2025, requesting public recommendations to NOAA for restoring American seafood competitiveness.

Date: October 1, 2025

The following comments are submitted in response to the August 27, 2025, Federal Register Notice (No: 16377) in which NOAA is requesting public input on implementation of Executive Order 14276, Restoring America's Seafood Competitiveness.

Friends of Midway Atoll National Wildlife Refuge and Battle of Midway National Memorial (FOMA) appreciate the opportunity to comment on the August 27, 2025, request from NOAA Fisheries, through the Federal Register, seeking public recommendations for "restoring American seafood competitiveness" that is in response to Executive Order 14276 dated April 17, 2025.

Background:
Founded in 1999, FOMA is a 501(c)(3) nonprofit organization whose mission is to help conserve, protect, and restore the biological diversity, historical legacy, and cultural heritage of Kuaihelani (Midway Atoll). FOMA consists of scientists, families of veterans of the Battle of Midway, Native Hawaiians and thousands of people dedicated to the protection of the unique biological, cultural and historic riches of Midway Atoll and surrounding ecosystems that make up the Papahānaumokuākea Marine National Monument (Monument). FOMA has a regular following of 17,000 people.

Midway Atoll National Wildlife Refuge

Kuaihelani (Midway Atoll) and its surrounding waters make up the Midway Atoll National Wildlife Refuge. Kuaihelani is sacred to Native Hawaiians. Midway Atoll and the surrounding Pacific Ocean was the site of the Battle of Midway which was considered a turning point in World War II for the allies in the Pacific and many historical relics remain at sea and on land. Kuaihelani is the breeding grounds for several million nesting seabirds which feed in the surrounding waters and is home to the largest breeding populations of Laysan and black-footed albatrosses in the world and provides for the only nesting pair of endangered short-tailed albatross in the U.S. Kuaihelani also supports a large number of endangered Hawaiian monk seals many of which reproduce on Kuihelani. Hawaiian monk seals are susceptible to being trapped in derelict fishing nets and other marine debris and are protected by the Marine Mammal Protection Act (MMPA). Between 2006 and 2014, 87 Hawaiian monk seals (approximately 32% of the population) were entangled in fishing nets (pmdphawaii.org). Green sea turtles occur in large numbers on Kuaihelani where female and male turtles come to bask on the undisturbed beaches. Sea turtles are susceptible to being caught directly or indirectly in fishing nets and other marine debris associated with commercial fishing. The lagoon of Midway Atoll provides resting habitat for a school of spinner dolphins that feed outside the atoll and has a healthy apex predator population including an influx of Tiger sharks especially during the albatross fledging season. Kuaihelani is also an important location for corals that occur at the farthest northern limits for corals as a result of the cooler water surrounding Kuaihelani. These corals may be critically important as ocean warming continues and corals "migrate" north in the archipelago to search out cooler temperatures. Derelict fishing gear, especially commercial fishing nets, are known to impact corals throughout the Northwestern Hawaiian Islands. At least 20 species of whales and dolphins, protected by the Marine Mammal Protection Act, are known to use the Monument and are likely to use the waters of Midway Atoll National Wildlife Refuge. Because of the well-documented and readily observed impacts of marine debris to the marine ecosystem and its inhabitants, FOMA has supported the Papahānaumokuākea Marine Debris Program (PMDP). By October 2024, PMDP had removed over 1 million pounds of marine debris since 2020, particularly derelict fishing nets, thus protecting the important resources of Midway Atoll and the Monument. **In 2025, PMDP removed over 50,000 pounds of marine debris from Kuaihelani alone.** PMDP estimates approximately 1 million pounds of ghost nets remain on Monument reefs and an estimated 115,000 pounds of derelict fishing gear wash into the Monument every year (pmdp.org).

Papahānaumokuākea Marine National Monument

The Northwestern Hawaiian Islands Marine National Monument was established by Presidential Proclamation 8031 in 2006. A year later, by Presidential Proclamation 8112, it was renamed the Papahānaumokuākea Marine National Monument (Monument) to reflect and honor its cultural significance to Native Hawaiians. The Monument was expanded through Presidential Proclamation 9478 in 2016, which established waters from 50 nm to 200 nm beyond the original boundary as the Monument Expansion Area. In 2010, the Papahānaumokuākea Marine National Monument was designated as the first mixed World Heritage site in the United States for its universal natural and cultural resources.

Papahānaumokuākea Marine National Monument is comprised of interconnected ecosystems such as coral islands surrounded by shallow reef, deeper reef habitat featuring seamounts, banks, and shoals mesophotic reefs with extensive algal beds, pelagic waters connected to the greater North Pacific Ocean, and deep-sea habitats reaching 5,000 meters in depth. These connected ecosystems provide essential habitats for rare species such as the threatened green sea turtle and the endangered Hawaiian monk seal, as well as habitat for more than 14 million seabirds that forage in the pelagic waters to nourish their chicks. The Monument is also home to 20 cetacean species, protected by the Marine Mammal Protection Act, with some listed as endangered under the Endangered Species Act. Many of these species are found nowhere else in the world. The monument is also a place of great historical significance. Research indicates that 60–80 sunken military vessels and hundreds of sunken aircraft are scattered across the seafloor. In addition to Navy steamers and aircraft, there are whaling ships, ancient Japanese sailing ships known as junks, motorized East Asian style fishing vessels known as Hawaiian fishing sampans, Pacific colliers, and other vessels from the 19th and 20th centuries.

Papahānaumokuākea is also sacred to Native Hawaiians or Kānaka ʻŌiwi, who regard the islands and wildlife as kūpuna, or ancestors. The Monument contains numerous well-preserved archaeological sites found on the islands of Nihoa and Mokumanamana, both of which are on the National Register of Historic Places and Hawaiʻi Register of Historic Places.

Deepwater banks and seamounts provide prime habitats for bottomfish-associated fish species that are important food sources for the critically endangered Hawaiian monk seals. Such banks also support populations of spiny and slipper lobsters, and colonies of precious gold, pink, and black corals that have been heavily disturbed in much of the remainder of the Pacific by the use of physically damaging harvest methods, such as trawling.

FOMA's public input on implementation of Executive Order 14276, Restoring America's Seafood Competitiveness and recommendations for "restoring American seafood competitiveness":

Overall Comment: An important action NMFS/NOAA could take to advance fisheries management and science in Hawaiʻi is to maintain the commercial fishing ban in Papahānaumokuākea Marine National Monument. It is well-documented that all of the above species are susceptible to commercial fishing impacts either directly through bycatch or indirectly from derelict fishing gear, discarded plastics as well as habitat destruction and these impacts are already occurring within the Monument from existing commercial fishing outside of the Monument. Therefore, FOMA is opposed to the expansion of commercial fishing in the Monument that would further threaten these sensitive resources. NOAA additionally should enhance MMPA protections to reduce interactions between protected species and commercial fisheries outside the Monument, as many of these species migrate through Papahānaumokuākea.

In addition, the protection of fisheries in marine protected areas such as the Monument have been shown to provide support to depleted fisheries outside the protected area through "spillover" effect (the reseeding of fishes outside the protected area). This was shown to be especially true in the Monument for ahi (bigeye tuna) and yellowfin tuna (Medoff et al. 2022, Lynham et al. 2020). Therefore, when assessing whether to open a marine protected area to commercial fishing, NOAA must consider the beneficial biological impacts those protected areas have on the larger ecosystem and on commercial fisheries sustainability outside of the protected areas.

Additionally, not allowing commercial fishing in the Monument will likely protect essential habitats and corals from the impacts of vessel groundings. Prior to Monument designation, from 1970-2006, there were 14 reported vessel groundings in the Northwestern Hawaiian Islands with the majority attributed to fishing vessels. The impacts from these vessel groundings ranged from oil or diesel fuel spills, permanent loss of essential fish habitat, and loss of miles of fishing lines, to temporary adverse impacts to marine life including corals. Since the designation of the Monument and exclusion of fishing, there have been no reported vessel groundings in the Monument.

Lastly, NOAA has not established a justifiable need to open currently closed areas to commercial fishing (see comments below).

Value of Marine Protected Areas (MPA):

NOAA should consider the values Marine Protected Areas (MPAs), such as the Monument, provide to healthy and sustainable fisheries and ecosystems. MPAs are known to enhance adaptive capacity at organismal, population, community, and ecosystem levels (Kroeker et al., 2019; Hofmann et al., 2021). Essentially, MPAs can provide a portfolio effect against climate-induced stressors and disturbances. Increased organism body sizes can confer greater individual tolerance to thermal and other climate stressors (Micheli et al., 2012; Barneche et al., 2018). Larger population sizes with a broader age distribution, as commonly found in fully and highly protected MPAs (Lester et al., 2009; Baskett and Barnett, 2015), may speed up recovery following disturbance including *via* maintenance of greater demographic and genetic diversity (Blasiak et al., 2020) and of reproductive output and juvenile recruitment (Micheli et al., 2012; De Leo and Micheli, 2015). Community and ecosystem resilience can be provided by maintenance of taxonomic and functional diversity as well as trophic and other species interaction linkages.

MPA networks can provide additional resilience through the protection of replicate and connected habitats or those that are essential to different life stages, promoting adaptive capacity and providing insurance against catastrophic disturbance, the risks of which rise with climate change (Allison et al., 2003; Sheehan et al., 2021). Across a network, many independently fluctuating populations can provide stability to the metapopulation (Anderson et al., 2015; Hammond et al., 2020). Well-designed networks of fully and highly protected MPAs along with effective management outside their borders are crucial to ensure MPAs effectiveness. MPA networks can provide additional resilience to species undergoing climate-induced range shifts, but the statistical effect size for species targeted by fisheries will depend on the extent to which MPAs reduce total fishing pressure (Fuller et al., 2015). Furthermore, recent models show how MPA network designs that take environmental conditions into account can improve outcomes. Modeling in coral reef systems revealed that MPA network designs that included warm, cool, and intermediate reefs (relative to only single or paired warm and cool environmental exposures) worked best to preserve coral cover (Walsworth et al., 2019). The authors credit active dispersal among reefs in the model, and the importance of warm reefs to provide adaptive power, moderate reefs to provide stepping stones, and cool reefs to provide better habitats after the ocean has warmed. Understanding how climate is likely to affect an area (e.g., considering climate velocity; Brito-Morales et al., 2018) will allow MPA design characteristics and adaptive management at the individual and network scale to address specific climate stressors and their outcomes, including shifts in species distributions, community composition, or connectivity (Rassweiler et al., 2020).

As Alan Friedlander, retired chief scientist for National Geographic's Pristine Seas Project and affiliate researcher at the Hawaii Institute of Marine Biology at the University of Hawaii at Manoa, stated in the Star Advertiser on September 22, 2025:

Industrial longlining, whose vessels set lines stretching more than 50 miles with 2,000 hooks, and purse seines, which surround over 100 metric tons of tuna in a single set, kill and injure animals that get in the way of their targeted catch, including sharks and sea turtles. Many of these species are at critically low levels globally and are unable to sustain even modest losses to their populations. The removal of species can have significant ecosystem effects. NOAA estimated that between 2019 and 2023, the Hawai'i-based longline fisheries caught more than 600,000 blue sharks, which are listed as near threatened. Endangered and critically endangered species — like the oceanic whitetip shark, once described as one of the most common large animals in pelagic waters but whose numbers have collapsed by 70%–95% — are also caught and often killed.

The ocean and land are interconnected. Seabirds, which poop in nearshore waters, provide critical nutrients to coral reef ecosystems that boost their growth. Longlines and purse seine nets entangle and kill these birds while they search for food, affecting their populations and the corals that rely on their delivery of nutrients. The evidence is clear: industrial fishing in a highly productive, rich marine ecosystem has damaging effects on the species that call the area home.

It's worth noting that Hawai'i longliners don't need these areas; they have consistently reached their annual bigeye catch quota, which is imposed under international agreement. Even after their bigeye quota was nearly doubled last year, the fleet still reaches its annual quotas without fishing in the monuments.

General Comments:

1. On April 17, 2025, the President signed an Executive Order on Restoring American Seafood Competitiveness. In response, the Department of Commerce, through NOAA Fisheries, launched a "bold, coordinated effort to revitalize the U.S. seafood sector" and called for public comments as a critical step to fulfill the President's vision of making the United States the "world's dominant seafood leader."

Comment: Figure 1 shows that China produces approximately three times the volume of seafood that America does. That is, China produces approximately 13 million metric tons of seafood while the U.S. produces approximately 4 million metric tons of seafood annually (Figure 1). According to the NOAA FOSS database going back to 1950, the highest U.S. catch ever was in 1994 with 4.575 million metric tons (10,086,000 pounds). Therefore, it is probably not reasonable or sustainable for the U.S. to be the "world's leader in seafood harvest." However, America should be the world leader in sustainable fisheries by focusing on the sustainability of our fisheries stocks, minimizing bycatch and habitat destruction, ensuring no stock is overharvested, investing more in environmentally sustainable aquaculture, and addressing the threats fisheries stocks face including habitat destruction, climate change, invasive species, diseases, etc.

2. NOAA states that in recent years, the seafood industry has faced increasing pressures from global competition, evolving market demands, and impacts from changing ocean conditions.

Comment: Although NOAA did not provide any specific examples of these concerns, Table 1 may depict some of these issues. Table 1 shows that 2/3rds of the U.S. catch of edible species is exported, and the U.S. imports twice as much edible fish than we harvest. In addition, it is well documented that a large portion of the edible fish exported to foreign countries is then processed by that country and resold back to U.S. consumers. Dramatically increasing the U.S. harvest would likely have little impact on the issues NOAA describes. Regulations that focus on imports and exports, as well as those requiring the sustainability of all fisheries (foreign and domestic) and the ethical treatment of all fishers is what is required.

3. NOAA states that between 2019 and 2023, domestic landings decreased by approximately 1 billion pounds (Figure 2).

Comment: Although this may be true, NOAA acknowledged that this decline may be the result of the impacts on the workforce from COVID-19 (NOAA 2023 – 2027 National Seafood Strategy). Since 1990, there have been rises and declines in commercially caught fish in the U.S. between approximately 8 and 10 billion pounds per year (Figure 3). Therefore, before NOAA assumes that the last 3 years are an anomaly and dramatic changes in regulations such as the opening of new areas to fishing is an imperative, NOAA must first analyze why the harvest was lower in recent years and whether this is outside the "normal fluctuation" in harvest rates to determine the root cause(s) of the decline. Any changes in regulations, including opening closed areas to commercial fishing, must be based on this analysis to ensure that such changes are necessary, and consistent with the regulations and policies of the Magnuson-Stevens Act, especially the protection of habitats and sustainability of all fish stocks. Until this evaluation is conducted there should be **no change** in existing commercial fishing regulations. The goal should not be to simply "increase the harvest rate," but to ensure sustainability of fish stocks over time for the American public and the benefit of ecosystem processes.

Potential factors driving changes to fisheries are well known, but may include the following:

- Fisheries responses to El Nino and La Nina effects
- Increasing ocean temperatures
- Habitat impacts
- Invasive species and diseases
- Overharvesting or unregulated harvesting by multiple countries, that may affect future recruitment
- Availability of fishers and processing facilities in the U.S.
- Life cycle strategies of certain species such as salmon who may not return to their natal streams for several years to spawn

4. NOAA Fisheries, in coordination with other federal agencies and partners, has identified a number of actions to meet the directives laid out in Executive Order 14276. Ongoing and future actions include:

a. Considering appropriate regulatory changes, especially for those fisheries with significant recent declines in landings and/or revenue.

Comment: NOAA should define "significant," and specify which fisheries or stocks meet this criterion when requesting public comment on "appropriate regulatory changes." NOAA should also state why these declines have occurred to justify any proposed changes in regulations and to illustrate how any changes in regulations would still meet the requirements of the Magnuson-Stevens Act.

If the Papahānaumokuākea Monument were opened to commercial fishing, the American public would lose the invaluable scientific, historic and cultural representation of this intact ecosystem. This could include using the Monument for baseline assessments as to what a healthy ecosystem and population structure for fishes and other organisms should look like and as a potential measure to establish what is a sustainable fishery outside the Monument. The Monument was established to recognize and protect these valuable American assets that are not represented anywhere else in America. The Monument and its protected fish populations and habitats are the basis for the repopulation of depleted stocks elsewhere. Commercial fishing in the Monument would exacerbate existing commercial fishing threats that originate outside the Monument such as derelict fishing gear (nets, especially), other debris such as plastics, and bycatch which can impact sensitive species such as Hawaiian monk seals, albatrosses and other seabirds, sea turtles, corals and sharks. An increase in unregulated vessel traffic resulting from opening the Monument to commercial fishing also poses a risk of invasive species introductions.

b. Assessing and potentially modifying advanced technology strategies to improve data collection

Comment: If not already collected, data should be collected on bycatch by species, loss and tracking of fishing gear including nets, and location of catch. NOAA should evaluate what data are necessary to evaluate and model oceanic conditions that may affect fisheries. Fisheries and stock data are necessary to evaluate, document and amend, as necessary, fishing regulations to ensure compliance with the Magnuson-Stevens Act. Data should be collected on imported seafood to ensure it complies with health standards and ethical fishing practices.

c. Updating the Seafood Trade Strategy to reflect new global trade dynamics

Comment: "New global trade dynamics" should be clearly defined so that the American public can comment on what appropriate updates should be included in the Seafood Trade Strategy.

d. Developing a collaborative, interagency America First Seafood Strategy.

Comment: NOAA should clearly describe the goals of an America First Seafood Strategy so that the public may provide responsive comments.

5. "We are asking for your input on how to improve fisheries management and science, specifically on the following issues:"

a) Regulations that govern fishing activities that may be suspended, revised, or rescinded

Comment: Without clearly articulating the need, how can the American public comment on which regulations should be suspended, revised or rescinded? It is premature to be requesting this information from the American public. It is the role of NOAA to articulate need, and its justification, which in turn should be based on scientific evidence and analysis. Such analysis involves many complicated factors that the general public may not understand, or it may entail foundational data inaccessible to the public.

b) Challenges specific fisheries are facing, suggestions for innovative improvements, and examples of existing federal fishery regulations that could be modified to enhance U.S. fishing businesses

Comment: Although commercial fishers are very knowledgeable about the species they harvest and the associated regulations, and would likely be able to provide critical insight into the challenges they face and ideas for improvements to address those challenges, it is NOAA that should consider that input in the evaluation of regulatory processes to avoid the regulated regulating themselves to "enhance their fishing businesses."

c) Ways to improve fisheries management and science, including:
How can less expensive and more reliable technologies and cooperative research be used to support fisheries assessments?

How can NOAA Fisheries modernize data collection and analytical practices to improve the responsiveness of fisheries management to real-time ocean conditions?

What types of data, forecasting tools, or information products are most needed by U.S. fishing businesses to adapt their operations effectively to changing economic and/or environmental conditions and maintain access to fishery resources, and how can NOAA Fisheries best support the development and dissemination of such resources?

Comment: In addition, NOAA should be requesting ideas (technology, data collection, fishing gear, etc.) to reduce the **impacts** of commercial fishing on resources such as coral reefs, sea turtles and Hawaiian monk seals from fishing nets, to reduce impacts on seabirds from long-line fishing, and improved mechanisms to reduce overall bycatch which is a waste of biological resources.

c) How to expand exempted fishing permit programs to promote fishing opportunities nationwide

Comment: As stated above, unless there is a rigorous assessment and justifiable need to expand "exempted fishing permit programs" that is vetted by the American public, no action should be taken. Information provided in this request for public comment does not meet this standard for all of the reasons listed above. Specifically, in Hawai'i (Figure 4), the trends in commercial landings seem to mirror those nation-wide (Figure 3) with the highest level of landings being in 2016 to 2019, **after** the expansion of the Monument, when landings exceeded 35 million pounds. Like the rest of the U.S., landings declined in 2020 to approximately 28 million pounds and is slowly climbing back up to over 32 million pounds in 2024 (source NOAA FOSS data). These trends do not seem to warrant a need to allow commercial harvesting in the Monument as the highest landing rates occurred prior to COVID-19, and these data may reflect simply a response to the Pandemic.

Summary

NOAA has not justified the need to open the Monument and other protected areas to commercial fishing, and resuming commercial fishing in the Monument could significantly impact the integrity of the biological ecosystem including depleting fish stocks that serve a biological function of repopulating depleted areas outside the Monument; changing the population structure of fishes that serve to highlight our understanding of what these structures should look like elsewhere; directly injuring and killing such sensitive species as Hawaiian monk seals, sea turtles, albatross and other sea birds, whales, sharks, corals, etc.; and, impacting fragile and vital habitats such as seamounts and reefs. Seamounts are particularly important as commercial tuna fishing can significantly impact the ecological resources by depleting tuna populations and, through bycatch, harm other marine life such as sharks, seabirds, and marine mammals that are attracted to seamounts as feeding grounds. In addition, bottom trawling can physically damage the delicate and often slow-growing benthic habitats on seamounts, such as corals and sponges, altering the physical structure of these unique ecosystems. This habitat destruction can have long-lasting effects on the biodiversity and health of the seamount environment.

Friends of Midway Atoll National Wildlife Refuge and Battle of Midway National Memorial oppose the opening of the Monument to commercial fishing.

Request for transparency in NOAA's process

We urge NOAA Fisheries, in responding to input received through its Federal Register Notice, to uphold its legacy of transparent regulatory processes and its commitment to public engagement while supporting sound fisheries management. To maintain effective fisheries management, we recommend continuing and enhancing engagement with local communities, and increased investment in cooperative research for Papahānaumokuākea Marine National Monument.

Figure 1. Top 10 fishing nations worldwide in 2021 in metric tons. Source Statista 2025.

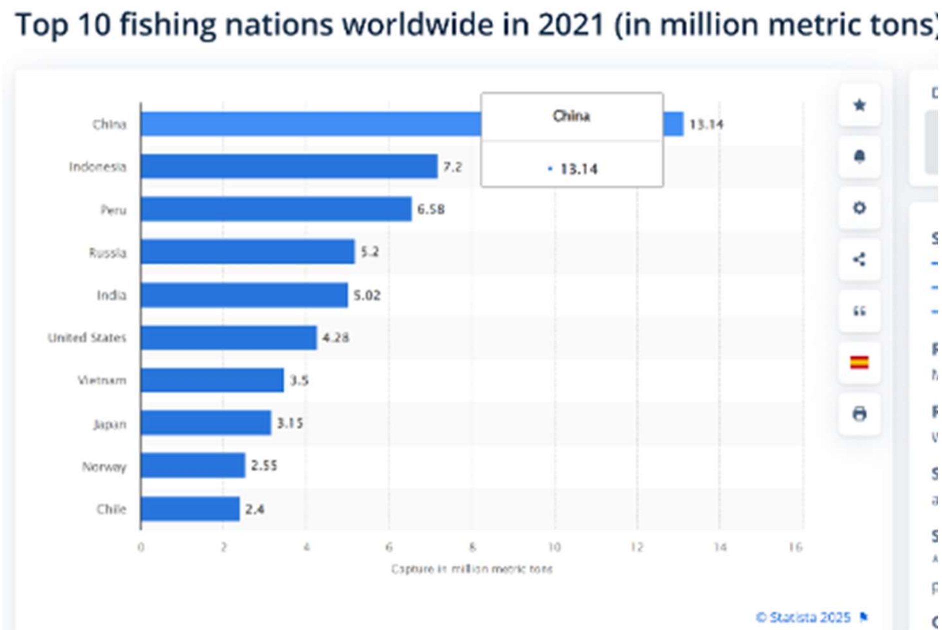


Table 1. U.S. commercial landings, imports and exports of all fish species in 2021 and 2022 (FOSS data portal).

Table 1. U.S. supply of commercial finfish and shellfish, 2021 to 2022 (thousands of pounds) (FOSS Data Portal).

Category	*Domestic Landings*		*Imports*		*Exports*	
	2021	2022	2021	2022	2021	2022
Grand Total	**8,574,142**	**8,350,171**	**14,383,371**	**14,863,282**	**7,243,723**	**6,561,979**
All finfish	7,210,854	6,955,692	8,599,803	9,460,602	6,754,222	6,072,928
All shellfish	1,363,288	1,394,478	5,783,568	5,402,680	489,501	489,051
All edible	**7,107,964**	**6,771,988**	**13,460,155**	**13,800,214**	**5,763,294**	**5,476,910**
Edible finfish	5,770,398	5,394,210	7,676,587	8,397,533	5,273,793	4,987,859
Edible shellfish	1,337,566	1,377,778	5,783,568	5,402,680	489,501	489,051
All non-edible (industrial)	**1,466,178**	**1,578,182**	**923,216**	**1,063,069**	**1,480,429**	**1,085,069**
Non-edible finfish	1,440,456	1,561,482	923,216	1,063,069	1,480,429	1,085,069
Non-edible shellfish	25,722	16,700	NA	NA	NA	NA

Figure 2. U.S. Commercial Landings and Revenue 2013 – 2022. Source NOAA 2024.

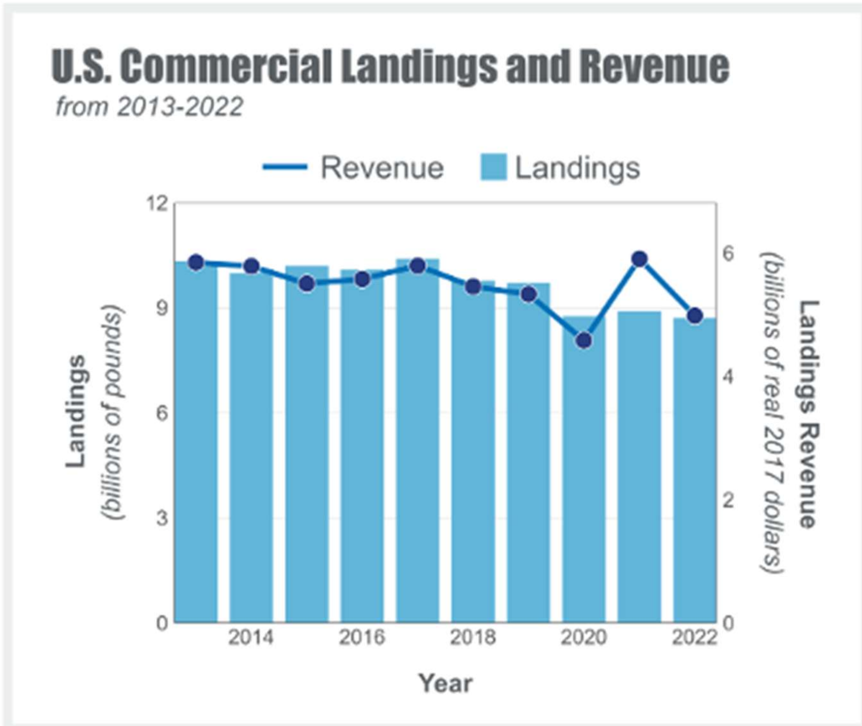


Figure 3. Pounds of Commercial Fisheries landed by year. NOAA FOSS database.

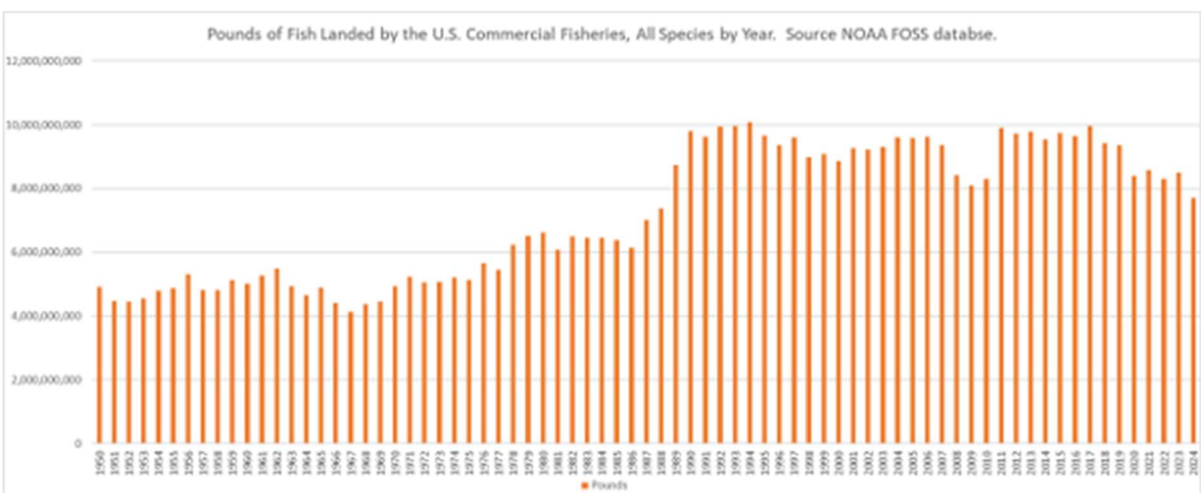
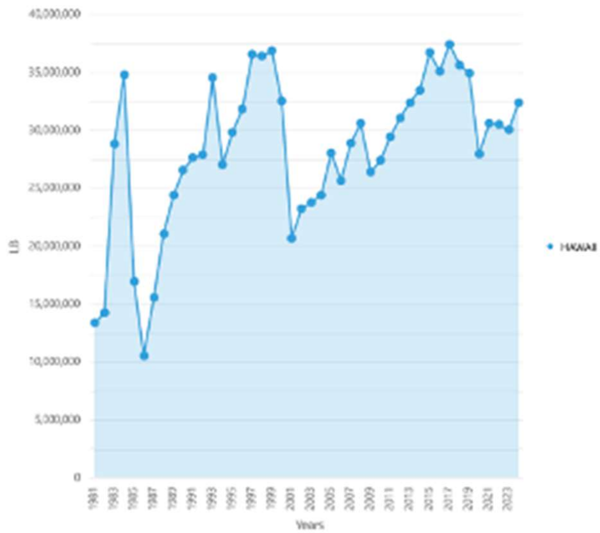


Figure 4. Total commercial landings of all species in Hawai'i since 1981. Source NOAA FOSS database.

Landings Chart



Selected Parameters

References

Allison G. W., Gaines S. D., Lubchenco J., Possingham P. (2003). Ensuring Persistence of Marine Reserves: Catastrophes Require Adopting an Insurance Factor. *Ecol. Appl.* 13, 8–24. doi: 10.1890/1051-0761(2003)013[0008:EPOMRC]2.0.CO;2

Anderson S. C., Moore J. W., McClure M. M., Dulvy N. K., Cooper A. B. (2015). Portfolio Conservation of Metapopulations Under Climate Change. *Ecol. Appl.* 25, 559–572. doi: 10.1890/14-0266.

Barneche D. R., Robertson D. R., White C. R., Marshall D. J. (2018). Fish Reproductive-Energy Output Increases Disproportionately With Body Size. *Science* 360, 642–645. doi: 10.1126/science.aao6868

Baskett M. L., Barnett L. A. K. (2015). The Ecological and Evolutionary Consequences of Marine Reserves. *Annu. Rev. Ecol. Evol. Syst.* 46, 49–73. doi: 10.1146/annurev-ecolsys-112414-054424

Blasiak R., Wynberg R., Grorud-Colvert K., Thambisetty S., Bandarra N. M., Canário A. V. M., et al. (2020). The Ocean Genome and Future Prospects for Conservation and Equity. *Nat. Sustain.* 3, 588–596. doi: 10.1038/s41893-020-0522-9

Brito-Morales I., García Molinos J., Schoeman D. S., Burrows M. T., Poloczanska E. S., Brown C. J., et al. (2018). Climate Velocity can Inform Conservation in a Warming World. *Trends Ecol. Evol.* 33, 441–457. doi: 10.1016/j.tree.2018.03.009

De Leo G. A., Micheli F. (2015). The Good, the Bad and the Ugly of Marine Reserves for Fishery Yields. *Philos. Trans. R. Soc B Biol. Sci.* 370, 20140276. doi: 10.1098/rstb.2014.0276

Fuller E., Brush E., Pinsky M. L. (2015). The Persistence of Populations Facing Climate Shifts and Harvest. *Ecosphere* 6, art153. doi: 10.1890/ES14-00533.1

Hammond M., Loreau M., de Mazancourt C., Kolasa J. (2020). Disentangling Local, Metapopulation, and Cross-Community Sources of Stabilization and Asynchrony in Metacommunities. *Ecosphere* 11, e03078. doi: 10.1002/ecs2.3078

Hofmann G. E., Hazen E. L., Ambrose R. F., Aseltine-Neilson D., Carter H., Caselle J. E., et al. (2021). *Climate Resilience and California's Marine Protected Area Network: A Report by the Ocean Protection Council Science Advisory Team Working Group and California Ocean Science Trust*.

Kroeker K. J., Carr M. H., Raimondi P. T., Caselle J. E., Washburn L., Palumbi S. R., et al. (2019). Assessing the Potential Role of Marine Protected Areas and Fisheries Management Approaches for Resilience Management in a Changing Ocean. *Oceanography* 32, 10. doi: 10.5670/oceanog.2019.318

Lester S. E., Halpern B. S., Grorud-Colvert K., Lubchenco J., Ruttenberg B. I., Gaines S. D., et al. (2009). Biological Effects Within No-Take Marine Reserves: A Global Synthesis. *Mar. Ecol. Prog. Ser.* 384, 33–46. doi: 10.3354/meps08029

Lynham, John et al., *Impact of two of the world's largest protected areas on longline fishery catch rates,* 11 NATURE COMMUNICATIONS 979 (2020).

Medoff, Sarah et al., *Spillover benefits from the world's largest fully protected MPA*, 378 SCIENCE 313, (2022).

Micheli F., Saenz-Arroyo A., Greenley A., Vazquez L., Montes J. A. E., Rossetto M., et al. (2012). Evidence That Marine Reserves Enhance Resilience to Climatic Impacts. *PloS One* 7, e40832. doi: 10.1371/journal.pone.0040832

Rassweiler A., Ojea E., Costello C. (2020). Strategically Designed Marine Reserve Networks Are Robust to Climate Change Driven Shifts in Population Connectivity. *Environ. Res. Lett.* 15, 034030. doi: 10.1088/1748-9326/ab6a25

Sheehan E. V., Holmes L. A., Davies B. F. R., Cartwright A., Rees A., Attrill M. J. (2021). Rewilding of Protected Areas Enhances Resilience of Marine Ecosystems to Extreme Climatic Events. *Front. Mar. Sci.* 8, 1182. doi: 10.3389/fmars.2021.671427

Walsworth T. E., Schindler D. E., Colton M. A., Webster M. S., Palumbi S. R., Mumby P. J., et al. (2019). Management for Network Diversity Speeds Evolutionary Adaptation to Climate Change. *Nat. Clim. Change* 9, 632–636. doi: 10.1038/s41558-019-0518-5