1 Affected Environment

1.1 Pacific Islands Region

The EEZ of the Western Pacific Region spans from Hawaii in the east, to the Marianas archipelago in the west and south to America Samoa. The combined EEZ has a surface area of nearly 1.5 million mi^2 (3.9 km^2), constituting about half of the entire US EEZ.

The physical and biological environment covered in this PEIS includes those waters and fisheries found in the PIR EEZ. The resources in this region are governed by one of five FEPs developed by the WPFMC and NMFS. The FEPs include the American Samoa Archipelago FEP, the Hawaiian Archipelago FEP, the Mariana Archipelago FEP (which covers EEZ waters around Guam and Commonwealth of Northern Marianas Islands (CNMI)), and the PRIA FEP. Lastly, the Pacific Pelagic FEP covers management of highly migratory pelagic fishery resources such as tunas and billfish, which play an important role in the biological and socioeconomic environment of the western Pacific region

Because the action area is federal waters seaward of the 3 nm state/territorial boundary, most of the natural resources and human activities align with pelagic habitat. As such, a full description of the pelagic resources common to all areas will be presented first. Only characteristics unique to the specific archipelagic areas of the other FEPs will be described in their respective sections that follow.

1.1.1 Physical Environment

The physical environment of the greater Western Pacific Ocean is described in detail in the *Fishery Ecosystem Plan for Pacific Pelagic Fisheries of the Western Pacific Region* (WPFMC 2009a). In addition to the pelagic habitat, this document includes descriptions of deep reef slopes, banks and seamounts, and the deep ocean floor. Additional archipelagic-specific information is found in each of the corresponding FEPs.

1.1.1.1 Temperature

In the Western Pacific, the thermocline is generally from 1,312 to 2,624 ft deep (400 to 800 m) and forms a temperature gradient that inhibits mixing with the surface layer. Surface temperatures range from 72°F to 77°F (22°C to 25°C) throughout the year (Hawaii Ocean Time-Series 2015). Below the thermocline, water temperature is constant, between 32°F and 39°F (0 and 4°C).

1.1.1.2 Light Penetration and Turbidity

Light penetration decreases with depth. The epipelagic zone extends from the surface to nearly 656 ft (200 m). This is where virtually all primary productivity occurs. Below 656 ft, sunlight is too faint to drive photosynthesis. When waters become turbid, signaling excessive undissolved organic material, light penetration is reduced substantially. This is rare in open-ocean, oligotrophic waters and is generally a coastal phenomenon in the PIR.

1.1.1.3 Salinity, Dissolved Oxygen, Chlorophyll a, pH, Nitrogen

Over the last twenty years, salinity in the north Pacific has ranged from 34.8 to 35.3 parts per thousand (ppt). In general, variation in salinity is inversely related to rainfall, with lower salinity near the equator where rainfall is more prevalent, and higher salinity in northern latitudes where rainfall is lower. In any

Commented [KT1]: From Ariel - Are there issues/ components of the affected environment that were identified and eliminated from further study during scoping? If so, discuss here.

Commented [MF2]: Suggest inserting one solid map at the end of this section 1.1 and before 1.1.1 identifying the areas (HI, AS, GU, CNMI) covered by this PEIS. Get that reference established right up front and can refer back to that map in later sections. Such a map could also or instead be at the action area section at the very beginning of the PEIS.

given area, there are fluctuations throughout the year, caused by different weather patterns, however, the salinity remains relatively constant in wider Pacific Ocean (Hawaii Ocean Time-Series 2015).

DO at the surface is at a constant around 200 μmol kg^{-1}. DO remains steady to 2 mi (3.2 km) deep, decreasing to 50 μmol kg^{-1} at 4 mi (6.4 km). As cages will not be sited at pressures that great, the working range for aquaculture will be 200 μmol kg^{-1}(Hawaii Ocean Time-Series, 2015).

Chlorophyll a concentration is useful proxy for primary production. Average chlorophyll a at Station ALOHA is 27 mg/m^2, with large seasonal fluctuations (Hawaii Ocean Time-Series, 2015). Over the last 20 years, pH has been steadily declining from 8.12 to 8.04 (Hawaii Ocean Time-Series, 2015).

Commented [TS3]: From Colby: A stronger summary of the connection between ph and ocean acidification needs to be made here, and should include foreseeable estimates of ph reduction (thereby increasing ocean acidification) projections over the next 40 years (given that permits could be issued for 20 years or more)

Nitrogen over the last twenty years has averaged 4.5 mg $m^{-2}d^{-1}$. Large seasonal fluctuations range from a high of 9 $m^{-2}d^{-1}$ to a low of 1.25 $m^{-2}d^{-1}$ (Hawaii Ocean Time-Series, 2015).

1.1.1.4 Hypoxic waters

Hypoxic waters, where the concentration of DO in the water column decreases to a level that can no longer support living aquatic organisms, occur when DO levels drop below 2 mg/L. These areas are commonly called “dead zones,” and generally occur near inhabited coastlines with significant run-off. There are no known hypoxic waters in the PIR EEZ, and only a few in very isolated marine waters adjacent to land (e.g., some harbors).

1.1.1.5 Geological Features

Commented [TS4]: From Colby: Include a map of sea area around each different PIR area? I.e., Hawaiian islands, AS, Guam, CNMI, etc. This could apply for each of the sections below through 3.4.1.

The majority of the benthic environment within the project area is deep ocean floor, with an average depth of 16,400 ft (5,000 m). The seafloor can either be categorized as hardbottom (consolidated rock) or sediment. The type of sediment varies with depth and region and is categorized as either carbonates or terrigenous.

Banks and seamounts are common topographical features around active seafloor areas. Banks are generally volcanic structures of various sizes and occur both on the continental shelf and in oceanic waters. Coralline structures tend to be associated with shallower parts of the banks as reef-building corals are generally restricted to a maximum depth of 100 ft (30 m). Deeper parts of banks may be composed of rock, coral rubble, sand, or shell deposits. Banks thus support a variety of habitats that in turn support a variety of fish species (Levington 1995).

Seamounts are undersea mountains, mostly of volcanic origin, which rise steeply from the sea bottom and do not rise above sea level (Rogers 1994). Hawaii has 219 seamounts within its EEZ, American Samoa 34, Guam 45, and CNMI 147 (Allain et al. 2008). Seamounts have complex effects on ocean circulation including the Taylor column, when eddies trapped over seamounts form quasi-closed circulations. This likely helps retain pelagic larvae around seamounts and maintain the local fish population, thus contributing to the role of seamounts as stepping stones for transoceanic dispersal (Wilson and Kaufman 1987).

On banks and seamounts, species composition is closely related to depth, with a rapid decrease in species richness typically occurring between 650 and 1300ft (200 and 400 m) (Chave and Mundy 1994).

1.1.1.6 Oceanographic Features

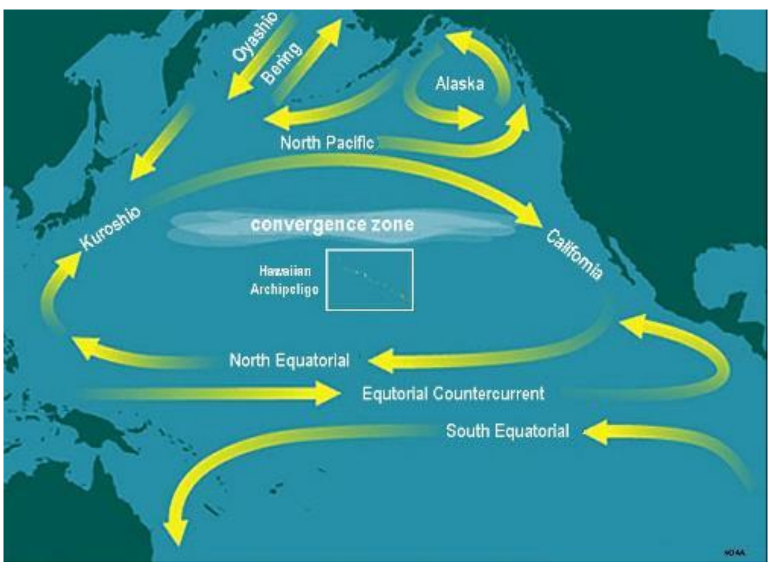
While the pelagic environment is thought to be devoid of physical features, surface and deep-water currents, convergence zones and fronts (upwelling and downwelling of water), thermoclines and haloclines (where temperature and salinity change quickly with depth), do create structure in the open-ocean that influences biological production. In addition, the impact of the atmosphere, which creates wind waves and facilitates the mixing of the surface waters, penetrates to approximately 1300 ft (400 m).

The Hawaii Ocean Time-Series (HOT) program has been conducting monthly cruises to the deep water, (> 13,000 ft [4000 m]) station ALOHA (A Long-term Oligotrophic Habitat Assessment; 22° 45'N, 158° 00'W), located approximately 62 mi (100 km) north of Oahu, Hawaii since 1988. Scientists have been collecting data on the hydrography, chemistry, and biology of the water column to develop the most comprehensive representation of the North Pacific subtropical gyre, and subsequently the best proxy for ocean water quality in the action area.

Surface Currents and Eddies

Surface currents are predominantly driven by wind, but are predictable enough to be mapped and named. These currents transport plankton, fish, heat, momentum, salts, oxygen, and carbon dioxide.

Eddies are short- to medium-lived circular currents that spin off of surface currents. They play important roles in regional climate (e.g., heat exchange) as well as the distribution of marine organisms. Persistent eddies generated by the interaction of the North Equatorial Current with the Big Island of Hawaii have been an area of interest for open-ocean aquaculture research (i.e., the Vellela project). These eddies propel deep, nutrient-rich cold water to the surface which can create localized increases in primary production (Bigg 2003). The edges of eddies, where the mixing is greatest, are often targeted by fishermen as these are areas of high biological productivity.



Commented [TS5]: From Colby: This too needs to be specifically mapped for each PIR island action area under consideration. We could be just at or above 2kts current speeds in many channel areas, particularly during major storm events, which should also be characterized in here. See http://www.pacioos.hawaii.edu/currents/model-hawaii/

Commented [MF6R5]: Couldn't they be summarized rather than specifically mapped for each PIR area? Could more detailed mapping be saved for individual project or area EISs?

Commented [TS7R5]: Yeah, I think I'd lean more that direction myself.

Commented [TS8]: From Colby: Then it should be included on more of a micro-scale for each PIR island action area under consideration

Commented [MF9R8]: Same question as above?

Figure 3-2. Surface Currents and Eddies in the Pacific Ocean Error! Reference source not found.

Transition Zones

Transition zones are areas of ocean water bounded to the north and south by large-scale surface currents originating from subarctic and subtropical locations (Polovina et al. 2001). The North Pacific Transition Zone (NPTZ), which migrates 1,000 mi (1,609 m) between summer and winter, supports a marine food chain that experiences variation in productivity in localized areas due to changes in nutrient levels brought on, for example, by storms or eddies. Some of the most abundant animals found in the Transition Zone such as flying squid, blue sharks, Pacific pomfret, and Pacific saury undergo seasonal migrations from summer feeding grounds in subarctic waters to winter spawning grounds in the subtropical waters. Other animals found in the NPTZ include swordfish, tuna, albatross, whales, and sea turtles (Polovina et al. 2001). In the winter months, the NPTZ may occur within the northernmost portion of the Hawaiian EEZ, although it predominantly occurs in international waters.

1.1.1.7 Extreme Weather

On average, four to five tropical cyclones occur in the central Pacific Ocean basin (between 140-180° W) each year. The Northeast Pacific activity generally begins in late May/early June and goes until late October/early November with a peak in late August/early September (Neumann et al. 1993).

1.1.1.8 Designated Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC)

The geographic extent of essential fish habitat for pelagic management unit species is from the shoreline to the edge of the exclusive economic zone (EEZ). Egg/larval pelagic MUS Essential Fish Habitat (EFH) is the water column to a depth of 656 ft (200 m) while juvenile/adult pelagic MUS EFH is designated to 1000 m. HAPC is designated to a depth of 3,280 ft (1,000 m) above seamounts and banks with summits shallower than 6,562 ft (2000 m) (WPFMC 2009a). Figures 4-2 through 4-5 in Chapter 4 depict several of these designated areas which may be found throughout the PIR.

1.1.2 Biological Environment

The biological environment of the Pelagic realm of the PIR, including the species addressed in this PEIS, is described in detail in the Final EIS for the Pacific Pelagic FEP and is incorporated here by reference (WPFMC 2009).

1.1.2.1 Benthic and Sessile Organisms

Commented [TS10]: From Colby: I can't imagine an aquaculture EIS in any action ocean action area that wouldn't have some sort of table and map of known coral and sponge abundance estimates and maps, wherever such data might be available

Commented [MF11R10]: Okay, maybe a table of the common species of corals and maps in the PIR and a notation of which areas (HI, GU, CNMI, AS) they occur in – assuming not all occur in each area? Like the table for marine mammals below?

Commented [TS12R10]: Maybe, or we can leave this sort of table for the sub-region sections

Marine invertebrates are a diverse group that includes corals, jellyfish, sponges, gastropods, cephalopods, bivalves, sea cucumbers, sea urchins and crustaceans. Most invertebrates are mobile, and can move freely in the environment, however, corals and sponges remain in one location upon settling out of the water column as larvae. In shallower nearshore areas corals, sponges and invertebrates occur in much higher densities than those in deeper offshore habitats. This section focuses on corals and sponges, which provide foundational habitat both in shallow and deep waters.

Deep Ocean Floor

The deep ocean floor is composed of mostly mud and sand, supporting very low densities of deposit feeders and suspension feeders. Primary productivity is near zero and these organisms rely on food from the surface waters that sinks to the bottom. Some areas of the deep ocean contain an accumulation of the shells of marine microbes composed of silicates and calcium carbonates, termed biogenic ooze (Chester 2003). The prevalence of carnivorous species is extremely low due to the lack of available prey (Levington 1995).

Nearshore Reefs

Commented [TS13]: From Colby: I've seen "nearshore" be defined differently depending on context, from intertidal zone, to 3 miles, and up to 9 miles. It may be helpful to define what each PIR island action area's definition of "nearshore" is.

Commented [MF14R13]: Can nearshore be defined more generally for the purposes of this PEIS intertidal to 3 miles and more detailed descriptions/definitions be saved for later individual project or areas EISs?

Commented [TS15R13]: Yeah I'm cool with that. Could put that definition at the beginning of the doc

Corals in nearshore habitats are primarily the well-known reef-building types in the class Anthozoa. These corals extract calcium from seawater to construct limestone skeletons that form reefs. Reef-building corals have a symbiotic relationship with photosynthetic algae, called zooxanthellae. Zooxanthellae provide corals with food and nutrients generated by photosynthesis, and in return the corals provide the algae a protected living environment. This relationship requires clear, low productive waters to allow for photosynthesis (Sumich 1996). It also limits the depth at which reef-building corals can live. Maximum growth occurs at depths of 16 to 50 ft (5 to 15 m), with maximum species diversity occurs at 33 to 100 ft (10-30 m) (WPFMC 2009c). Thirty meters is the depth at which growth rates slow, and may inhibit corals from adapting to changing sea level. Reef-building corals generally do not occur at depth greater than 330 ft (100 m) (WPFMC 2009c). Corals can supplement their nutrition by actively feeding on zooplankton and absorbing dissolved organic nitrogen in the water column (WPFMC 2009c).

Sponges are also reef-building organisms. Their bodies have pores and channels to allow water flow, allowing them to filter feed on bacteria and food particles in the water. A few species host photosynthesizing endosymbionts. Sponges are found in clear calm waters, as a large amount of turbidity would clog pores and inhibit feedings. Reef-building sponges are found in water less than 100 meters (NOAA 2010).

A coral reef ecosystem is one of the most productive systems in the world, despite being located in nutrient poor waters. The numbers of organisms associated with a coral reef is estimated to range from one to ten million (WPFMC 2009c). Coral reefs around the world are in decline for a wide range of reasons: disease; impacts from human activity such as over-fishing, coastal construction, runoff, sedimentation and other pollutants; the effects of climate change including ocean warming, acidification, sea level rise, altered circulation, and changing storm tracks and intensities; and aquatic invasive species (Brainard et al. 2011). As immobile organisms, corals cannot move away from these threats and are generally adversely impacted. Likewise, mobile organisms that need the coral reef habitat to survive are equally affected by these threats.

Offshore Reefs

Offshore reefs are comprised of different classes of corals and sponges, although these organisms often constitute much of the habitat complexity on the deep ocean floor. Deep sea coral and sponges occur at depths to 10,000 ft (3050 m). These are complex and fragile organisms typically growing on continental shelves and slopes, in offshore canyons, and oceanic slopes and seamounts (NOAA 2010). Deep sea corals and sponges lack the symbiotic algae of shallow water corals, and do not rely on sunlight to grow (Lumsden 2007). They are typically found in areas swept by strong bottom currents greater than 0.5 kt (>25 cm/sec), which prevent the accumulation of sediments that could smother them (WPFMC 2009c).

Deep sea corals are slow growing and long lived (WPFMC 2009c). A species of gold coral (*Gerardia* sp.) was estimated to be 2,742 years old, while a species of black coral (*Leiopathes* sp.) was estimated at 4,265 years old, both observed in Hawaii waters. These corals can form colonies over 300 ft (91 m) tall, creating important deep-sea habitats utilized by many different organisms (Lumsden 2007). Deep sea corals include over 3,000 species (Lumsden 2007). Black corals are most frequently found in vertical drop offs, which typically occur in depths of 98 to 328 ft (30-100 m). Pink, bamboo, and gold corals are typically found in deeper water ranging from 1,312 to 5,000 ft (400-1500 m) (Grigg 1993). While less is known about deep sea sponges, they also create complex deep-sea habitats. In the northeast Pacific, a glass sponge (Hexactinellida) was observed to grow 19 m high and many kilometers long (NOAA 2010).

Deep sea sponges and corals are also valuable resources. Red and pink corals (Family Coralliidae), black corals (Order Antipatharia) and gold corals (Family Gerardiidae) are prized in jewelry production. Bamboo coral (Family Isididae) is currently being investigated as a potential aid for bone grafts and other medical uses thanks to their collagen-like skeleton. The medical field may also benefit from the bio-active compounds contained in several species of deep sea corals (Lumsden 2007).

1.1.3 Present fish species and fisheries

The latest status information of the target, non-target, bycatch, biodiversity, and protected species that may be affected by fisheries can be found in the annual Stock Assessment and Fishery Evaluation (SAFE) reports (WPFMC 2019a, WPFMC 2019b, WPFMC 2019c, WPFMC 2019d, WPFMC 2019e). The remainder of this section is a discussion of some of those fishes that are currently cultured or may commercially important if cultured in the region.

1.1.3.1 Current wild and cultured finfish species in the PIR

Almaco Jack (Kahala) (*Seriola rivoliana*)[1]

Almaco jack (amberjack) has been commercially cultured by Kona Blue Water Farms/Blue Ocean Mariculture since 2005. To distinguish the fish from the wild caught species, Kona Blue Water Farms renamed the cultured species "kampachi." The facility is located 5.5 nm (10 km) west of Keauhou Bay on the island of Hawaii. The current permit authorizes the culture and harvest of 120,000 lbs. (54,400 kg) of kampachi over 2 years (Special Coral Reef Ecosystem Fishing Permit Application Form 2015).

Almaco jacks are found throughout the Pacific, occurring in deep seaward reefs (16 to 525 ft (5 - 160 m) deep), while occasionally entering shallower waters (WPFMC 2019c). Due to its prey preference, this species is susceptible to carrying ciguatera fish poisoning (CFP), which is a human foodborne illness that causes gastrointestinal and neurological symptoms (Tamaru et al. 2016). The risk of carrying this disease is greatly reduced for cultured almaco jack, since their controlled diet reduces exposure to ciguatoxin, the causative agent (Friedman et al. 2017).

Almaco jack are managed as part of the jack family in the region..

[1] S. rivoliana is not listed as a MUS in any FEP, while S. dumerili is listed. These species are very similar and are co-located in the Pacific.

Commented [TS16]: I took this heading from an FEP, but I don't think it's really great for what we're covering here. Really, I want this section to be coverage of
1. Which native species are currently cultured
2. Which specie would be commercially important, if they were cultured. I'm open to suggestions on a better name for this header

Commented [MF17R16]: How about something like "Present fish species and fisheries" or "Current wild and cultured fish species"?
Because they are an important part of the affected environment, we need to somewhere include those dominant wild fishes that aren't likely to be cultured in the foreseeable future but are an important part of the area, e.g., billfishes, tunas, bottomfishes, right?

Commented [TS19R18]: Yep, those are listed in the 'species with aquaculture potential' below. Do you think we need to do life characteristics for them like these? I also reference some of them in the offshore state of aquaculture, so in the next round we'll want to make sure the list here aligns with what's listed there.

Commented [MF18]: Change citations to reflect reference to the 2018 SAFE reports. http://www.wpcouncil.org/annual-reports/. A lot of the data and figures/tables throughout this affected environment section are taken from older SAFE reports and can be updated/replaced with info and tables from the 2018 SAFE Reports.

Table 1-1. Annual Catch Limits for the Jack Family by Region

Area	Annual Catch Limit (lbs.)
American Samoa	106,000
CMNI	228,000
Guam	66,000
Hawaii	127,205

Source: NMFS-Annual Catch Limits (2018)

Commented [TS20]: AS, CNMI and Guam are the bottomfish multispecies complex numbers from 2018 SAFE. Hawaii is the non-deep7 number

Commented [TS21]: Soooo the numbers here are taken from 2019 SAFE reports. The website, however, has TBD for most of these….WHAT DOES IT MEAN? https://www.fisheries.noaa.gov/pacific-islands/commercial-fishing/pacific-islands-annual-catch-limits

Forktail Rabbitfish (*Siganus argenteus)*

Forktail rabbitfish can be found through the Marianas Archipelago and American Samoa (WPFMC 2009b,c), inhabiting coastal seagrass beds, shallow reefs, and lagoons (WPFMC 2009d). This is an herbivorous species, feeding on red and green algae in shallow water up to 131 ft (40 m) in depth.

Currently this species is being cultured in CNMI at the Northern Marianas College. The study is focusing on improvements to larval culture, with the goal of providing fingerlings to local grow-out facilities. Rabbitfish are an important foodfish and successful aquaculture would provide an additional food supply to the islands (Ogo 2015).

Within the Marianas, rabbitish are one of the most harvested coral reef species groups. They are most common in Guam, decreasing in abundance moving northward along the Marianas Archipelago. There are six species of rabbitfish within the Marianas and the ACL is for the whole group. The 2016 ACL in CNMI was 10,200 lbs (4,600 kg) and in Guam was 18,600 lbs. (8,437kg).

Forktail rabbitfish are also in lower abundance around American Samoa (Carpenter et al. 2016). The American Samoa ACL was 200 pounds. No stock assessment has been conducted on this species or species group.

Commented [TS22]: I'm not finding ACLs for this species or species group in the 2018 SAFE reports. But maybe I'm overlooking something….

Pacific Threadfin (Moi) (*Polydactylus sexfilis*)

Pacific threadfin, known as moi in Hawaii, is a coastal species that occupies mangrove, lagoon, estuarine, soft substrate, and surf zone areas and occur throughout the PIR. Filaments under their jaws are designed to help them search for prey, crustaceans or small fish, in soft sediments (WPFMC 2009d).

A pilot open-ocean aquaculture operation was conducted in 2000, which cultured moi in an OceanSpar SeaStation 3000 cage in 100 ft (30 m) deep water off the coast of Honolulu, Hawaii. Roughly 70,000 moi were grown out from fingerlings to harvest over the course of a year. This study demonstrated that shallow water species could survive culture in deeper water (Helsley 2000). Moi are not currently commercially cultured in the PIR, although the species is included on the experimental permit for Kona Blue Water Farms.

ACL have not been established for this species, and no stock assessment has been completed. However, in Hawaii state waters, size and bag limits, as well as a closed season are part of the state management of moi (DNLR n.d.).

Commented [TS23]: From Colby: Are there at least any anecdotal signals of whether the stock might be depleted or healthy? I thought there were some data-poor estimates around HI

Commented [TS24R23]: At a cursory glance I'm not finding a bunch to that effect; doesn't mean it isn't out there.

1.1.3.2 Species with aquaculture potential in the PIR

Stocks of pelagic and bottom fishes, seamount groundfish, coral reef species, precious corals, and crustaceans are managed under a range of measures described in the FEPs for the PIR. The following species are not currently cultured in the PIR, however, there is likely to be regional interest in developing aquaculture programs due to their commercial importance:. ~~With the exception of yellowfin tuna and dolphinfish, the current state of science regarding these species viability as aquaculture species (from egg to harvest) is either minimal or non-existent. More information on this can be found in Ssection 3.1.5 State of Industry and Science in Offshore Auqculture:~~

Bigeye tuna (*Thunnus obesus*)
Yellowfin tuna (*Thunnus albacares*)
Albacore tuna (*Thunnus alalunga*)
Skipjack tuna (*Katsuwonus pelamis*)
Pacific striped marlin (*Tetrapturus auda*)
Blue marlin (*Makaira mazara*)
Swordfish (*Xiphias gladius*)
Dolphinfish (*Coryphaena hippurus, Coryphaena equiselas*)
Giant trevally (*Caranx ignobilis*)
Bluefin trevally (*Caranx melampygus*)
Wahoo (*Acanthocybium solandri*)
Ruby snapper (*Etelis coruscans*)
Red snapper (*E. carbunculus*)
Oblique banded snapper (*Pristipomoides zonatus*)
Lavender snapper (*P. sieboldii*)
Hawaiian pink snapper (*P. filamentosus*)
Long tailed pink snapper (*Aphareus rutilans*)
Hawaiian sea bass (*Hyporthodus quernus*)
Deepwater shrimp (*Heterocarpus* spp.)
Spiny lobster (*Panulirus* spp.)
Slipper lobster
Kona crab (*Ranina ranina*)

Commented [MF25]: I thought putting these in a list would be easier to read.

Commented [TS26R25]: I dig it!

Commented [MF27]: Should we be consistent using common English names of these fishes rather than Hawaiian names?

Commented [TS28R27]: Fair! I've updated those below to reflect this.

Commented [TS29]: Latin name could be any of these:
Scyllarides squammosus,
Scyllarides haani,
Parribacus antarcticus,
Arctides regalis,
Arctides timidus

With the exception of yellowfin tuna and dolphinfish, the current state of science regarding these species viability as aquaculture species (from egg to harvest) is either minimal or non-existent. More information on this can be found in Section 3.1.5 State of Industry and Science in Offshore Aquaculture.

1.1.4 Protected Species

1.1.4.1 Marine Mammals

This section provides a description of marine mammals that are found within the PIR. Marine mammals are protected under the MMPA, and some species receive additional protection under the Endangered Species Act ESA. There are twenty-five marine mammals present within the study area of the PIR (Table 3-1). Of those, seven are listed as endangered under the ESA (see Table 3-2): the blue whale (*Balaenoptera musculus*), false killer whale (*Pseudorca crassidens*), fin whale (*Balaenoptera* physalus), Hawaiian monk seal (*Neomonachus schauinslandi*), humpback whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*) and sperm whale (*Physeter macrocephalus*).

Commented [TS30]: From Colby: I would think that a more in-depth analysis, including maps, or known humpback breeding areas, and satellite/photo-ID of insular FKW known location sightings, and a map of monk seal range (with hotspots) would be included here, if not to inform potential siting or marine spatial planning, to at least disclose of the potential impacts if overlapping.

Commented [TS31R30]: Not sure if these sorts of suggestions are more appropriate for a more specific type of document or if we need to be this detailed in a PEIS

Table 1-2. Marine Mammals in the PIR

Order	Common Name	Scientific Name	Range	Resident	Visitor	Rare
Baleen Whales (suborder Mysticeti)	Blue Whale	*Balaenoptera musculus*	American Samoa, CNMI, Guam, Hawaii, PRIA	N	N	Y
	Bryde's Whale	*Balaenoptera brydei*	American Samoa, CNMI, Guam, Hawaii, PRIA	N	Y	Y
	Fin Whale	*Balaenoptera physalus*	American Samoa, CNMI, Guam, Hawaii, PRIA	N	Y	Y
	Humpback Whale	*Megaptera novaeangliae*	American Samoa, CNMI, Guam, Hawaii, PRIA	Y	N	N
	Minke Whale	*Balaenoptera acutorostrata*	American Samoa, CNMI, Guam, Hawaii, PRIA	N	Y	Y
	Sei Whale	*Balaenoptera borealis*	American Samoa, CNMI, Guam, Hawaii, PRIA	N	N	Y
Toothed Whales (suborder Odontoceti)	Blainville's Beaked Whale	*Mesoplodon densirostris*	American Samoa, CNMI, Guam, Hawaii, PRIA	Y	Y	N
	Cuvier's Beaked Whale	*Ziphius cavirostris*	American Samoa, CNMI, Guam, Hawaii, PRIA	Y	Y	N
	Dwarf Sperm Whale	*Kogia sima*	American Samoa, CNMI, Guam, Hawaii, PRIA	Y	Y	N
	False Killer Whale	*Pseudorca crassidens*	American Samoa, CNMI, Guam, Hawaii, PRIA	Y	N	N
	Ginkgo-Toothed Whale	*Mesoplodon ginkgodens*	American Samoa, CNMI, Guam, Hawaii, PRIA	N	N	Y
	Killer Whale (Orca)	*Orcinus orca*	American Samoa, CNMI, Guam, Hawaii, PRIA	N	N	Y
	Longman's Beaked Whale	*Indopacetus pacificus*	American Samoa, CNMI, Guam, Hawaii, PRIA	N	N	Y
	Melon Headed Whale	*Peponocephala electra*	American Samoa, CNMI, Guam, Hawaii, PRIA	Y	N	N
	Pygmy Killer Whale	*Feresa attenuata*	American Samoa, CNMI, Guam, Hawaii, PRIA	Y	Y	N
	Pygmy Sperm Whale	*Kogia breviceps*	American Samoa, CNMI, Guam, Hawaii, PRIA	N	N	Y

Order	Common Name	Scientific Name	Range	Resident	Visitor	Rare
Toothed Whales (con't)	Short Finned Pilot Whale	*Globicephala macrorhynchus*	American Samoa, CNMI, Guam, Hawaii, PRIA	Y	N	N
	Sperm Whale	*Physeter macrocephalus*	American Samoa, CNMI, Guam, Hawaii, PRIA	N	N	Y
	Bottlenose Dolphin	*Tursiops truncatus*	American Samoa, CNMI, Guam, Hawaii, PRIA	Y	N	N
	Fraser's Dolphin	*Lagenodelphis hosei*	American Samoa, CNMI, Guam, Hawaii, PRIA	Y	N	N
	Pantropical Spotted Dolphin	*Stenella attenuata*	American Samoa, CNMI, Guam, Hawaii, PRIA	Y	N	N
	Risso's Dolphin	*Grampus griseus*	American Samoa, CNMI, Guam, Hawaii, PRIA	Y	Y	N
	Rough Toothed Dolphin	*Steno bredanensis*	American Samoa, CNMI, Guam, Hawaii, PRIA	Y	Y	N
	Spinner Dolphin	*Stenella longirostris*	American Samoa, CNMI, Guam, Hawaii, PRIA	Y	N	N
	Spotted dolphin	*Stenella attenuata*	American Samoa, CNMI, Guam, Hawaii, PRIA	N	N	N
	Striped Dolphin	*Stenella coeruleoalba*	American Samoa, CNMI, Guam, Hawaii, PRIA	Y	N	N
	Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	American Samoa, CNMI, Guam, Hawaii, PRIA	Y	N	N
Phocidae	Hawaiian Monk Seal	*Neomonachus schauinslandi*	Hawaii	Y	N	N

Table 1-3. Endangered Marine Mammals within the PIR

Common Name	Scientific Name	Range	Status	Residen		
Blue Whale	*Balaenoptera musculus*	American Samoa, CNMI, Guam, Hawaii, PRIA	Endangered	N	[illegible]	[illegible]
False Killer Whale (Hawaii Insular Distinct Population Segment)	*Pseudorca crassidens*	Hawaii	Endangered	Y	N	N
Fin Whale	*Balaenoptera physalus*	American Samoa, CNMI, Guam, Hawaii, PRIA	Endangered	N	Y	Y
Hawaiian Monk Seal	*Neomonachus schauinslandi*	Hawaii	Endangered	Y	N	N
Humpback Whale (Western North Pacific Distinct Population Segment)	*Megaptera novaeangliae*	CNMI, Guam	Endangered	N	Y	N
Sei Whale	*Balaenoptera borealis*	American Samoa, CNMI, Guam, Hawaii, PRIA	Endangered	Y	Y	Y
Sperm Whale	*Physeter macrocephalus*	American Samoa, CNMI, Guam, Hawaii, PRIA	Endangered	Y	Y	N

Commented [MF32]: Should this table have Resident and Visitor columns like the one above?

Commented [TS33R32]: I'd think so; will be updated with the SAFE reports

Commented [TS34R32]: Added this in to match above

The following are endangered marine mammals that occur within the PIR. Each species description includes 1) distribution, population and ESA status, 2) predation habits.

Blue Whale (*Balaenoptera musculus*)

The blue whale is a baleen whale in the suborder *Mysticeti*. It is the largest mammal on the planet, growing up to 109 ft (33 m) in length. It is listened as endangered under the ESA and is considered depleted under the MMPA (NMFS 2016b). Blue whales are found in all oceans except the Arctic, and some regional seas such as the Mediterranean, Okhotsk, and Bering Seas (Figure 3-2) (Reilly et al. 2008a). These animals were once abundant throughout the ocean; however, due to whaling pressure, populations have seen a massive decline. From 1868-1976 an estimated 365,870 blue whales were killed world-wide, with a majority taken near Baja California, Mexico and the South Aleutians (Stafford et al. 2001). The current global population for the species is uncertain, but is estimated to be 10,000-25,000, which is about 3-11% of the population in 1911, but is considered to be increasing (Reilly et al. 2008a). Blue whales found within the PIR are considered to be part of the Central Pacific stock (NMFS 2016b). This stock is believed to spend summers south of the Aleutians and the Gulf of Alaska, and migrate to lower latitudes in the Western Pacific, and less frequently the central Pacific, in the winter (Stafford et al. 2001). Overall, the migration patterns of the blue whale are not well understood, with some remaining in the same area for years, while others travel from higher latitudes to lower latitudes. The occurrence of a blue whale within the PIR is small, as waters that surround the islands are oligotrophic and would lack the zooplankton the blue whale eats. However, data collected during a 2010 systematic survey off Hawaii resulted in an abundance estimate of 81 blue whales within the Hawaiian Islands EEZ during summer and fall (Bradford et al. 2013). Although the majority of blue whales are expected to be at higher latitude feeding grounds during summer/fall, this is currently considered the best abundance estimate for the Central North Pacific stock (Carretta et al. 2013). There are no recent sighting records for the blue whale in the Marianas Island Study Area, although this area is in the distribution range for this species (WPFMC 2009d).

Source: Reilly et al., 2008a

Figure 1-1. Range of the Blue Whale

Blue whales feed almost exclusively on different types of zooplankton. Several stocks of blue whales are known to lunge feed and consume approximately 6 tons of zooplankton per day (Reilly et al. 2008a). These animals feed at the surface and at depths of up to 1,090 ft (330 m), following their prey’s diurnal vertical migrations (Reilly et al. 2008a).

Fin Whale (*Balaenoptera physalus*)

Commented [TS35]: •From Colby: I believe there is one observed interaction in HI LL fisheries in the last decade. I’d recommend citing that interaction, albeit still rare.

The fin whale is a baleen whale found throughout the world’s oceans, typically between 20° - 75°N and south latitudes (Figure 3-3). They are listed as endangered under the ESA and as depleted under the MMPA (Reilly et al. 2013). Pacific fin whale population structure is not well known, and NMFS has designated three stocks of fin whale in the North Pacific: the Hawaii stock; the California/Oregon/Washington stock; and the Alaska stock (Carretta 2013).

Source: Reilly et al., 2013

Figure 1-2. Range of the Fin Whale

Data suggests that there is year-round movement, with marked seasonal distribution for the Pacific, but no specific migration patterns (Watkins et al. 2000). These whales are considered rare in Hawaiian waters, with no sightings in CNMI, Guam or American Samoa (Hamilton 2009, Oleson 2013, WPFMC 2009c,d). Though, acoustic testing within the Mariana Islands confirmed that fin whales have been acoustically detected within the region (Oleson 2013). The North Pacific fin whale population has not been assessed since 1973. The population was estimated to have declined from 44,000 individuals to 17,000 in 1975 (Reilly et al. 2013). Campbell et al. (2015) reported no significant changes to the fin whale population off the coast of Southern California, which indicates the population is potentially stable.

Fin whales are opportunistic feeders, preying heavily on fish and crustaceans, but have been reported to feed on krill when available (NMFS 2015a). These whales most likely feed on the source that is available at the time, and will shift should another prey source become more available (Reilly et al. 2013).

Humpback Whale (*Megaptera novaenagliae*)

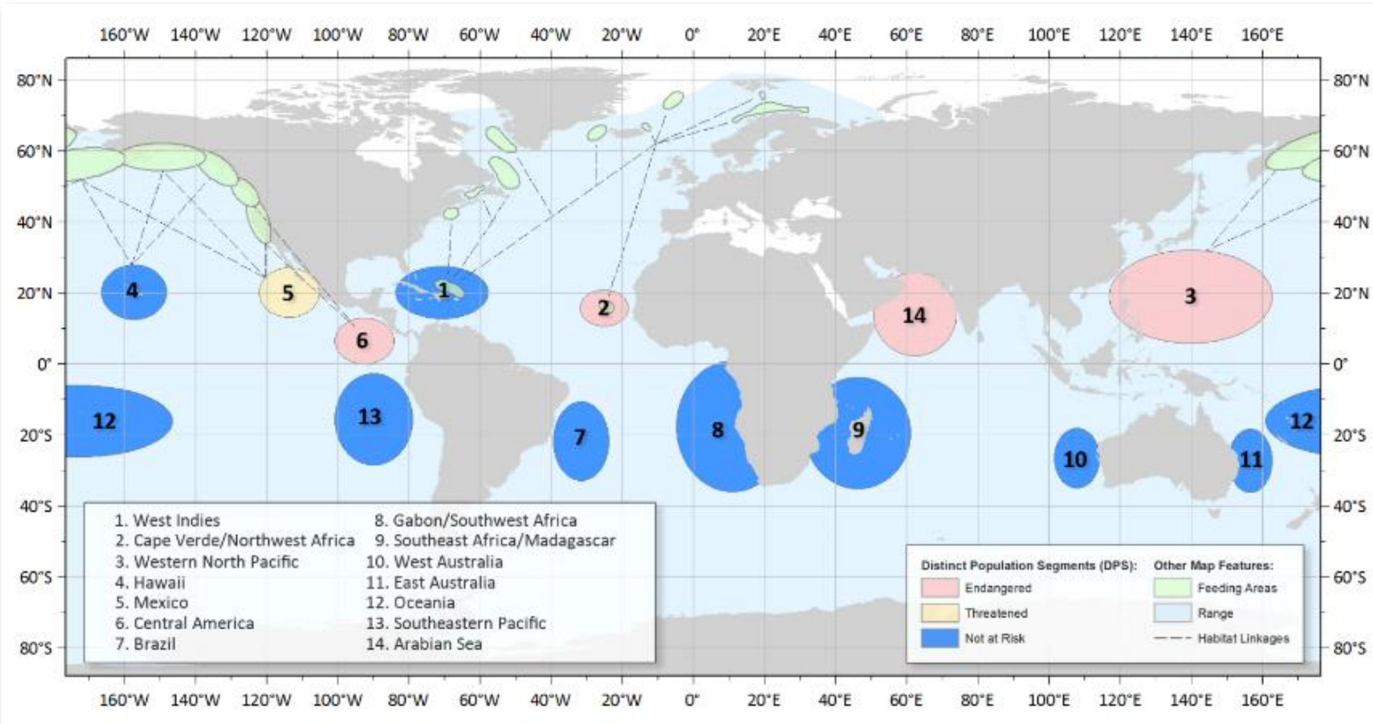
The humpback whale is a baleen whale found throughout the world's oceans (Figure 3-4). The global population is currently split up into fourteen different stocks, with the Hawaii, Western North Pacific, and

Oceania stocks occurring in the PIR (NMFS 2016c). Of these stocks, only the Western North Pacific is listed as endangered and depleted under the MMPA (Figure 3-5). The Hawaiian stock was recently delisted, and this stock and the Oceania stock are considered no longer depleted under the MMPA (NMFS 2016c). The Oceania Distinct Population Segment (DPS) consists of whales that breed/winter in the South Pacific Islands, including American Samoa (NMFS 2016c). Individuals in this population are believed to migrate to a largely undescribed Antarctic feeding area. A recent survey in 2008 estimated the Western North Pacific population at 1,100 individuals. This population, as all other stocks, was severely depleted due to whaling before global protection measures were adopted in 1966. Evidence suggests that the population of the Western North Pacific stock is increasing, but a comprehensive assessment has not been completed (Reilly et al. 2008b). Humpback whales undertake a long annual migration from spring/summer feeding grounds in higher latitudes, to warm tropical and subtropical waters to calf and mate in the fall/winter. The Western North Pacific stock spends October – July in the warm waters with individuals sighted in the Mariana Archipelago (Reilly et al. 2008b). Humpback whales have excellent low frequency hearing, producing frequencies between 25 Hz to 10 kHz, but may have sensitivity to frequencies between 40 Hz to 16 kHz (NMFS 2016g).

Humpback whales are filter feeders, consuming up to 3,000 lbs. (1360 kg) of krill and small fish each day (Reilly et al. 2008b).

Source: Reilly et al., 2008b

Figure 1-3. Global Range of the Humpback Whale



Source: NMFS 2016c
Note: Areas in red (2, 3, 6, 14) are endangered.

Figure 1-4. The Fourteen Different Stocks of Humpback Whales

Sei Whale (*Balaenoptera borealis*)

The sei whale is a baleen whale found throughout the world's oceans (**Error! Reference source not found.**), separated into a Northern Hemisphere subspecies, *B. b. borealis,* and a Southern Hemisphere subspecies, *B. b. schlegellii* (NMFS 2014a). The sei whale is listed as endangered under the ESA and depleted under the MMPA. Sei whales migrate between tropical and subtropical latitude during winter, and temperate and sub polar latitudes in the summers (NMFS 2014a). Population abundance in the in the North Pacific was estimated to be 58,000-62,000 in 1974, but whaling decreased the population to an estimated 9,110 individuals in the North Pacific as of 2004 (Reilly at al. 2008c; DOD 2015). In 2010 the abundance of sei whales within the Hawaiian EEZ was estimated at 93 individuals (NMFS 2014a). In 2007 there were sixteen sei whales sighted within the waters of the Mariana Archipelago, resulting in an abundance estimate of 166 individuals (DOD 2015). The global population and population trend is unknown, but a decrease in sightings indicates that these whales are rare and in low abundance (Reilly et al. 2008c).

Figure 1-5. Global Range of the Sei Whale

Source: Reilly et al., 2008c

In the north Pacific, sei whales feed on a diversity of prey, including copepods, krill, fish and cephalopods (Reilly et al., 2008c). Sei whales, like other large baleen whales, are susceptible to ship strikes and entanglement in fishing gear (Carretta et al. 2011). Reports of human-caused deaths in the study area are rare, likely due to their largely offshore distribution. However, in March 2011, a subadult sei whale was found near Lahaina, Maui with its tail entangled in 30ft of heavy-gauge polypropylene line (Bradford and Lyman, 2013).

Commented [TS36]: From Colby: It seems relevant to mention the outcome of that event, and whether marine mammal response crews were able to remove the gear, and whether it was estimated to be a serious determination or not. If so, could help justify reduced significance as response networks are in place within some of the action areas. Furthermore, it would be good to include a table at the front of 3.4.1.2 outlining the marine mammal, and sea turtle response team infrastructure in each PIR action area in a table (e.g., HI will be more advanced than other areas, but other areas may have some infrastructure worth mentioning as well).

Commented [TS37R36]: Can't decide if this level of detail is necessary. I think not, but if we decide otherwise it can be incorporated into each region.

Commented [MF38R36]: Yeah, that has been my question about most of Colby's comments, i.e., is that level of detail necessary for a PEIS for the entire PIR or more appropriate for later individual aquaculture projects or subregions?

Sperm Whale (*Physeter macrocephalus*)

The sperm whale is the largest toothed whale, and is distributed globally, typically in waters deeper than 3,280 ft (1,000 m) (Figure 3-7). Females and young usually remain in latitudes lower than 40-50° where temperatures are warmer, while sexually immature males occur in colder waters, migrating to mate in warmer waters (Taylor et al. 2008). The sperm whale is listed as endangered under the ESA and depleted under the MMPA. The IWC divided the north Pacific into two management regions, western and eastern stocks[2] (Donovan 1991). NMFS designated three stocks in the north Pacific: (1) the Hawaii stock, (2) the California/Oregon/Washington stock, and (3) the Alaska stock (Carretta 2013). There is minimal information on sperm whales in American Samoa and the Mariana Archipelago. The global population is between 200,000 and 1,500,000 animals (NMFS 2014b). A 2010 population assessment estimated 3,354 whales in the Hawaiian EEZ (Bradford et al. 2013). Sperm whales have been sighted in American Samoa year-round, except February and March (WPFMC 2009c). A 2011 population assessment estimated 705 whales in the Mariana Islands (Fulling et al. 2011).

Sperm whales forage during deep dives that routinely exceed a depth of 1,314 ft. (400 m) and 30-minute duration, feeding on squid, other cephalopods, sharks and bottom-dwelling fish and invertebrates (NMFS 2014b). Whaling between 1800 and 1987 harvested between 436,000 and 1,000,000 individuals (NMFS 2014b).

[2] The management regime boundary consists of a zigzag pattern: 150°W at the equator, 160°W between 40 and 50°N, 180°W north of 50°N.

Figure 1-6. Global Range of the Sperm Whale. Source: Taylor et al., 2008

False Killer Whale (*Pseudorca crassidens*)

The false killer whale is a toothed whale found in tropical to warm temperate waters worldwide, generally in deep offshore waters (Figure 3-21) (Taylor et al. 2008). Data are lacking for most populations. While the species is not considered rare, there are few identified areas of high density. NMFS currently recognizes five stocks of false killer whale in the Pacific: (1) the main Hawaiian Islands insular stock includes animals that occur in waters within 100 mi (140 km) of the main Hawaiian Islands; (2) the Northwestern Hawaiian Islands stock, which includes animals inhabiting waters within 58 mi (93 km) of the Northwestern Hawaiian Islands and Kauai; (3) the Hawaii pelagic stock includes animals that inhabit waters greater than 25 mi (40 km) from the main Hawaiian Islands; (4) the Palmyra Atoll stock; and (5) the American Samoa stock (Carretta 2013).

The false killer whale's diet is mainly comprised of large game fish like dolphinfish, tuna, and billfishes. They have also been known to attack small cetaceans, humpback whales, and sperm whales (Taylor et al. 2008). False killer whale populations are susceptible to fishery entanglements due to overlap between fisheries and their preferred food (Carretta et al. 2011). Populations are believed to be in decline due to reduction in prey biomass by commercial fisheries, accumulation of anthropogenic contaminants, and interactions with near-shore and offshore longline fisheries (Oleson et al. 2010).

Source: Taylor et al., 2008

Figure 1-7. Global Range of the False Killer Whale

1.1.4.2 Sea Turtles

Five species of sea turtle occur in the action area (Table 3-3). All five species spend their early development in the pelagic (open ocean) environment, which lasts between 5 and 10 years (Carr 1987). Two species (green and hawksbill turtles) then migrate to nearshore habitats where they remain for the majority of their lives. Three sea turtle species (leatherback, loggerhead, and olive ridley sea turtles) are primarily pelagic throughout their lives, making trans-Pacific migrations between nesting and feeding habitats.

Commented [TS39]: From Colby: Perhaps include a map of satellite movements between and around the Hawaiian Islands (and any other similarly available data in other PIR island regions), and known nesting locations around all PIR islands. For example, would we want to site a facility directly offshore of a hawksbill nesting beach of Molokai?

Commented [MF40R39]: Again, is this level of detail necessary in a PIR-wide PEIS or more appropriate in subsequent EISs for individual projects or subareas?

Table 1-4. Sea Turtle Status and Distribution

Species Name and Regulatory Status			Presence in the Action Area	
Common Name	**Scientific Name**	**ESA Status**	**Open Ocean**	**Coastal**
Green	*Chelonia mydas*	Endangered/ Threatened	Yes	Primary
Hawksbill	*Eretmochelys imbricata*	Endangered	Yes	Primary
Loggerhead	*Caretta caretta*	Endangered	Primary	Rarely
Olive Ridley	*Lepidochelys olivacea*	Endangered/ Threatened	Primary	Rarely
Leatherback	*Dermochelys coriacea*	Endangered	Primary	Rarely

Each species description includes 1) distribution, population and ESA status, 2) foraging habits, 3) pelagic habitat use, including post-hatchling and migrations.

Green Sea Turtle (*Chelonia mydas*)

The green turtle is distributed worldwide across tropical and subtropical coastal waters between 45° North (N) and 40° South (S) (SWOT 2011). Major nesting beaches are found throughout the western and eastern Atlantic, Indian, and western Pacific Oceans, and are found in more than 80 countries (Hirth 1997). The breeding populations of the green sea turtle on the Pacific coast of Mexico is listed as endangered, and all other populations are listed as threatened. Both threatened and endangered populations could occur in the Study Area.

On April 6, 2016, the Green turtle was divided into 11 DPSs, three of which occur in the action area (81FR20058). The Central West Pacific DPS includes green turtles found in Guam and the Commonwealth of the Northern Mariana Islands. The Central South Pacific DPS includes turtles found in American Samoa and the Pacific Remote Island Areas (except Johnston Atoll). The Central North Pacific DPS includes turtles found in Hawaii and Johnston Atoll. The Central West Pacific and Central South Pacific DPSs are listed as endangered and the Central North Pacific DPS is listed as threatened (NMFS 2016d).

Commented [TS41]: From Colby: I think American Samoa Green sea turtles go farther offshore than HI Green sea turtles, so you might want to look into that and include that comparison between DPS populations, and include here. We have good satellite tagging maps on American Samoa Green sea turtle migration patterns that you might want to fold in here. Talk to Irene Kelly for the source on that.

Commented [MF42R41]: Same question as above.

Based on population assessments that are skewed towards nesting beach and nearshore data, the green turtle is the most abundant sea turtle species in the PIR. Based on habitat preference, the green sea turtle is likely to occur in the nearshore waters around the islands, outside of the action area. The species is less likely to occur in the deeper offshore waters that constitute the action area.

The green sea turtle seems to prefer shallow waters, usually less than 600 ft deep (186 m); it hauls out to bask on sandy beaches throughout the main Hawaiian Islands (Parker and Balazs 2011). The green turtle is herbivorous, foraging on a variety of macroalgae and seagrass. Red algae is a dietary staple, with the introduced algae *Acanthophora spicifera*, *Hypnea musciformis*, and *Gracilaria salicornia* making up 44 percent of all stomach contents (Arthur and Balazs 2008). Seagrasses, sponges, crustaceans, and other invertebrates are also occasionally eaten (Russell et al. 2011).

Post-hatchlings live at the surface in the open ocean for approximately 3 years (Hirth 1997; Reich et al. 2007), after which they move to neritic habitats. Green turtles are believed to become true coastal species, settling into areas rich in seagrass and algae after approximately 5 to 6 years (Bresette et al. 2006; Musick and Limpus 1997). A small number of green turtles appear to remain in the open ocean for extended periods, perhaps never moving to coastal feeding sites, though the reasons for this behavior is not yet understood (NMFS and USFWS 2007; Pelletier et al. 2003).

Green turtles are highly migratory throughout their lives. They may travel thousands of kilometers between their juvenile developmental grounds and adult breeding and nesting grounds (Mortimer and Portier 1989). When they reach sexual maturity, green turtles begin migrating regularly between feeding grounds and nesting areas every few years (Hirth 1997).

Hawksbill Sea Turtle (*Eretmochelys imbricate*)

Commented [TS43]: From Colby Different turtle DPS populations are known to have wildly different natural history and migration patterns, even within the same body of ocean, so it is probably out of context to compare something like migratory patterns between different DPS populations between different oceans (Pacific and Atlantic).

Hawksbill sea turtles are distributed throughout the tropics, ranging from 30° N to 30° S latitude in the Pacific. The hawksbill is the most coastal of the marine turtles, with juveniles and adults preferring coral reef habitats (NMFS 2010). In the Pacific, the pelagic habitat of hawksbill juveniles is unknown. The hawksbill is federally listed as endangered throughout its range; no critical habitat has been designated in the PIR. The hawksbill is considered a single global population and at this time is not undergoing a DPS review (NMFS and USFWS 2013a)

The hawksbill remains in the oceanic environment until reaching a carapace length of approximately 15 inches (38 cm), interpreted as 7 to 10 years, and then recruits into coastal habitats and transition from a pelagic to a benthic diet (NMFS and USFWS 2013a). Reefs provide shelter and food for resting and foraging hawksbills, and individuals are known to visit the same resting spot repeatedly. The hawksbill is found around rocky outcrops and high-energy shoals—optimum sites for sponge growth—and mangrove-lined bays and estuaries (NMFS 2010). Adult hawksbill turtles can migrate long distances between nesting beaches and foraging areas, including a documented 1,160 mi (1,866 km) traverse in the Atlantic (Spotila 2004). While home range appears to be less than 0.8 mi^2 (2 km^2) in Hawaii (Parker et al. 2009), they are known to traverse between the main Hawaiian islands (Seitz et al. 2012; Ligon and Bernard 2000; Parker et al. 2009).

Unlike other marine turtles, hawksbills are not generally deep divers, which may be a reflection of the shallow depths of their primary food, sponges and macroalgae (NMFS and USFWS 2013a). Coral reefs and hardbottom areas are their preferred habitats, which are seldom found in waters deeper than the shelf break. Little auditory research has been done on the hawksbill turtle.

Loggerhead Sea Turtle (*Caretta caretta*)

Commented [MF44]: Just moved this here so paragraphs on these turtles would follow the same order as in Table 3-3.

Commented [TS45R44]: Great! Weird, I just realized there doesn't seem to be a 'resolve' option on here as there is in most versions of word…

Loggerhead sea turtles occur throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. Two of the nine DPS occur in the Pacific, the endangered North Pacific and South Pacific DPS, and could occur in the area, but would be uncommon transient visitors. Within the Action Area, the species is pelagic, transiting between breeding and feeding areas. Juvenile loggerheads feed on pelagic crabs and adults feed on _____. The most understood feeding grounds are off the coast of Baja Mexico. Some DPS outside the action area are listed as threatened.

Olive Ridley Sea Turtle (*Lepidochelys olivacea*)

The olive ridley sea turtle is considered the most abundant sea turtle in the world, with an estimated 800,000 nesting females annually. Olive ridleys are globally distributed in the tropical regions of the South Atlantic, Pacific, and Indian Oceans. Breeding populations of olive ridley turtles on the Pacific coast of Mexico are listed as endangered and all other populations are listed as threatened, though data appear to indicate a possible separation of populations by ocean basins. At this time there is no DPS review (NMFS and USFWS 2014). Both threatened and endangered populations could occur in the study area.

The olive ridley feeds on a wide variety of food items, including algae, lobster, crabs, tunicates, mollusks, shrimp, and fish.

Leatherback Sea Turtle (*Dermochelys coriacea*)

The leatherback is classified as endangered throughout its range. The Western Pacific leatherback, which is the sub-population that occurs in the action area, has declined more than 80% over the last three generations. While the leatherback is considered a global population, data appear to indicate a possible separation of populations by ocean basins. At this time there is no DPS review (NMFS and USFWS 2013b).

Leatherback turtles almost exclusively forage on sea jellies and other soft-bodied animals. Leatherbacks can dive to depths of 4,200 ft (1,280 m)—deeper than any other turtle—and can stay down for up to 85 minutes. In the Pacific, leatherbacks migrate between nesting habitats in Indonesia and Papua New Guinea to feeding grounds in the neritic eastern North Pacific, including habitat off Washington/Oregon and Northern California that have been designated critical habitat (77 FR 4170). There is no designated critical habitat within the PIR.

Commented [TS46]: •. From Colby We have excellent DNA profile maps of migration patterns between the two populations of Pacific leatherback. Also, there is some more recent population dynamics and life history information in our last few longline biops that you should probably include. I can provide these information bullets that I got from our biops, and the maps that I got from Irene Kelly, if interested.

Commented [MF47R46]: Bullets or a very brief summary of that info sounds okay. No more than a short (3-sentence) paragraph, I think.

1.1.4.3 Seabirds

The four ESA-listed seabird species known to occur within the PIR are in Table 3-4. Others known to occur within the area are shown in Table 3-5.

In this assessment, migrating and permanent shore birds and terrestrial birds are not considered due to the low likelihood of these species occurring 3 nm (5.6 km) offshore.

Table 1-5. ESA Listed Seabirds in the PIR

Common Name	Scientific Name	Conservation Status	Range	Open Ocean?
Band-rumped Storm Petrel	*Hydrobates castro*	Endangered	Hawaii, CNMI, Guam	Yes

Common Name	Scientific Name	Conservation Status	Range	Open Ocean?
Hawaiian Petrel	*Pterodroma sandwichensis*	Endangered	Hawaii	Yes
Newell's Shearwater	*Puffinus newelli*	Threatened	Hawaii	Yes
Short-tailed Albatross	*Phoebastria albatrus*	Endangered	Hawaii, CNMI, Guam	Yes

Table 1-6. Non-ESA MBTA Seabirds Occurring in the PIR

Family	Common Name	Scientific Name
Diomedeidae	Blackfooted Albatross	*Phoebastria nigripes*
	Laysan Albatross	*Phoebastria immutabilis*
	Short-tailed Albatross	*Phoebastria albatrus*
Procellariidae	Audubon's Shearwater	*Puffinus lherminieri*
	Bonin Petrel	*Pterodroma hypoleuca*
	Black-winged Petrel	*Pterodroma nigripennis*
	Bulwer's Petrel	*Bulweria bulwerii*
	Christmas Shearwater	*Puffinus nativitatis*
	Collared Petrel	*Pterodroma brevipes*
	Cook's Petrel	*Pterodroma cookii*
	Hawaiian Petrel	*Pterodroma sandwichensis*
	Herald Petrel	*Pterodroma heraldica*
	Mottled Petrel	*Pterodroma inexpectata*
	Newell's Shearwater	*Puffinus newelli*
	Short-tailed Shearwater	*Puffinus tenuirostris*
	Sooty Shearwater	*Ardenna grisea*
	Tahiti Petrel	*Pseudobulweria rostrata*
	Wedge-tailed Shearwater	*Puffinus pacificus*
Hydrobatidea	Band Rumped Storm Petrel	*Hydrobates castro*
	Leach's Storm Petrel	*Oceanodroma leucorhoa*
	Matsudaira's Storm Petrel	*Oceanodroma matsudairae*
Laridae	Black-naped Tern	*Sterna sumatrana*
	Black Noddy	*Anous minutus*
	Blue-Grey Noddy	*Procelsterna cerulea*
	Brown Noddy	*Anous stolidus*
	Grey-backed Tern	*Onychoprion lunatus*
	Grey-blue Noddy	*Procelsterna cerulea*
	Sooty Tern	*Onychoprion fuscatus*
	White Tern	*Gygis alba*
Fregatidae	Lesser Frigatebird	*Fregata ariel*
	Great Frigatebird	*Fregata minor*
Sulidae	Masked Booby	*Sula dactylatra*
	Red-footed Booby	*Sula sula*
	Brown Booby	*Sula leucogaster*
Phaethontidae	Red-Tailed Tropicbird	*Phaethon rubricauda*
	White-tailed Tropicbird	*Phaethon lepturus*

Commented [TS48]: None of the other protected species have tables of non-listed species. Either we should add in a table like this for Marine Mammals, Sea Turtles, Sharks and Rays or we should remove this one.

Also, the ESA listed ones in the previous table are also included in this one. So we got some ‘splaining to do.

The following sea bird species are endangered within the PIR and occur in more than one region. Each species description includes 1) distribution, population and ESA status, and 2) reproduction and predation habits.

Commented [MF49]: Move this sentence below Table 3-5.

Short Tailed Albatross (*Phoebastria albatrus*)

The endangered short-tailed albatross is a large pelagic seabird ranging across the North Pacific, including Hawaii and the Marianas (Figure 3-8). Adults are distinguishable by their white heads and body, a golden color around their heads and neck, and large pink bill. Bodies are 33 to 36 inches (84-91 cm) long with a wingspan of 84 to 90 inches (213-229 cm), and an average life span of 12-45 years. The highest densities are in Japan, the location of the primary nesting colony. The current population is estimated at 3,000 individuals (USFWS 2011a), less than 1% of the estimated historical population (USFWS 2011a). These birds only breed on the Japanese islands of Torishima Island and Minami-kojima. Single nests occasionally occur on Midway Island, Hawaii (BirdLife International 2016a).

Commented [TS50]: •From Colby While this population estimate is derived from the 2012 USFWS BIOP, and you may want to continue citing that as it is the last signed BIOP, all indications are that the population is substantially higher than that. The USFWS fiver year review of Short-tailed albatross (Federal Register 79:86 (May 5, 2014) p 25613, https://www.st.nmfs.noaa.gov/Assets/nationalseabirdprogram/doc4445.pdf) suggested a total population estimate of 4,354 individuals. Furthermore, Deguchi et al. (2017) (https://zslpublications.onlinelibrary.wiley.com/doi/pdf/10.1111/acv.12322) suggested an annual population growth of 7% per year, which would give us a current estimate of around 6,106 individuals.

Source: BirdLife International 2016a

Figure 1-8. Short-tailed Albatross Range in the Northern Pacific

Pairs lay a single egg in late October or November and hatch in late December or January. Chicks remain at the nest for about five months before moving to the feeding areas in the Northern Pacific (USFWS, 2008). The population is increasing, with pairs recently nesting on other islands in Japan, in addition to a steady increase of birds returning to the two main colonies (USFWS 2011a). Short-tailed albatross spend a majority of their life in the open ocean, foraging for prey on the surface, typically squid, fish, flying fish eggs and shrimp (BirdLife International 2016a).

Newell's Shearwater (*Puffinus newelli*)

Newell's shearwater, listed as threatened under the ESA, is primarily found in Hawaii, with rare sightings in CNMI (Figure 3-25) (USFWS, 201c). Adults are black with a white underparts and short sharply hooked beaks. Birds are medium sized, 13-in. 33-cm long; with a wingspan of 12-14 in. (30-35cm) in length. The population is estimated at 84,000 individuals, with 16,700-19,300 breeding pairs (BirdLife International 2016d). Populations are declining at an estimated 3.2% per year since 2005.

Source: BirdLife International, 2016d

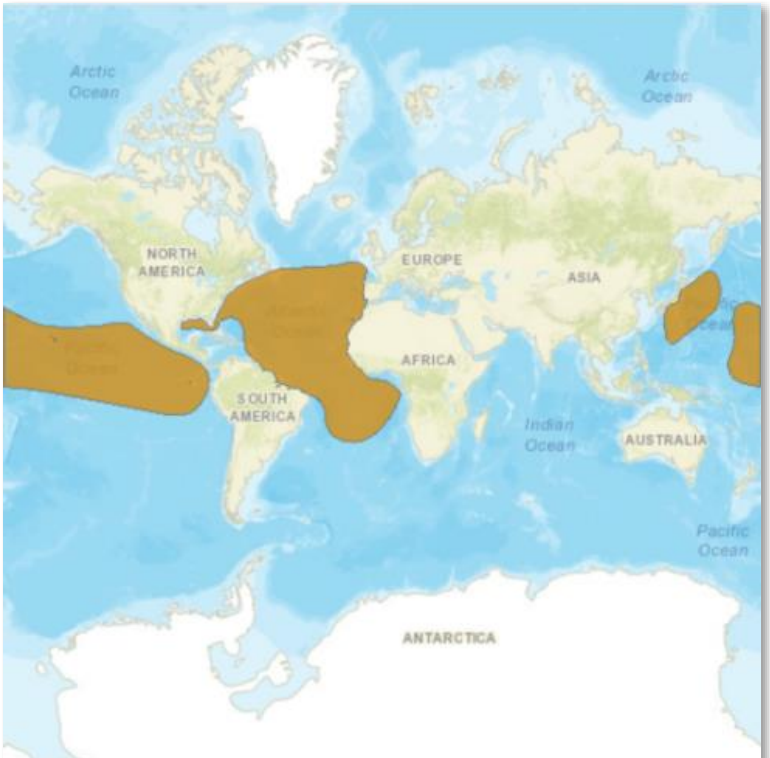
Figure 1-9. Range of the Newell's Shearwater

Newell's shearwater typically nest in burrows associated with root structure of trees on Kauai, but smaller colonies exist on Maui, Molokai, Lehua Islet, and possibly on Oahu. Birds reach maturity at six to seven years and breeding pairs only produce one egg in early June, with the chicks leaving the nest by November (BirdLife International 2016d). The birds' diet is not well known however it is presumably comprised of fish and squid, with birds foraging hundreds of kilometers offshore in large mixed species flocks. Newell's shearwaters typically follow large predatory fish, which will drive the small prey fish to the surface. To catch prey the bird dives into the water using its wings to swim down to 32 ft (10 m) (Mitchell et al. 2005).

Band-rumped Storm Petrel (*Hydrobates castro*)

The endangered band-rumped storm petrel (*Hydrobates castro*, previously known as *Oceanodroma castro*), is found in Hawaii, Guam and CNMI (Figure 3-9) (USFWS 2011b). Adults are blackish-brown with pale in bars and a clear curved white band across the rump. Birds are 7.5 to 9 inches (19-23 cm) in length with a wingspan of about 16.5 to 18 inches (42-45 cm) (BirdLife International 2016b). The species as a whole has localized populations spread throughout the world's tropical and subtropical oceans. In 2002, the population was estimated to be around 171-221 pairs. These birds prefer to nest on rugged cliffs and slopes, where correctly assessing the population size if difficult (Pyle and Pyle, 2009). The population is suspected to be in decline due to predation by invasive species, habitat degradation, and unsustainable levels of exploitation (BirdLife International 2016b). Breeding occurs in the spring and summer, however, there is limited knowledge of this species' life history as the population is small and lives in remote areas of the islands.

This bird is highly pelagic, approaching land to breed, or a rare rest. It feeds mainly on planktonic crustaceans, fish and squids. Feeding mainly occurs during the day via seizing prey from the surface or dipping (BirdLife International 2016b).



Source: BirdLife International 2016b

Figure 1-10. Global Range of the Band-rumped Storm Petrel

Note

1.1.4.4 Sharks and Rays

This section provides information on sharks and rays that are found throughout the PIR, focusing particularly on the three species that are protected under the Endangered Species Act (ESA). The scalloped hammerhead shark (*Sphyrna lewini*) is listed as endangered, while two species are listed as threatened: giant manta ray (*Manta birostris*) and the oceanic whitetip shark (*Carcharhinus longimanus*).

Scalloped Hammerhead Shark (*Sphyna lewini*) – Indo West Pacific DPS

The scalloped hammerhead shark lives in coastal warm temperate and tropical seas throughout the world. Its range includes continental and insular shelves, as well as adjacent deep waters, but is seldom found in waters cooler than 22° C (Compagno 1984, Schulze-Haugen and Kohler 2003). It ranges from the intertidal and surface to depths of up to 450-512 m (Sanches 1991,

Commented [MF51]: Are there paragraphs for Hawaiian petrel and Newell's shearwater? Also, put the paragraphs on the four endangered seabirds in the same order as the appear in table 3-4.

Commented [TS52R51]: added Newell's shearwater; Hawaiian petrel will be only in the Hawaii section, I believe

Commented [TS53]: •From Colby: . I'd include maps of known abundance around PIR action areas for scalloped hammerhead, oceanic whitetip, and silky sharks. I would also add giant manta ray.

Commented [TS54R53]: Giant manta ray added' from what I can tell silky sharks aren't currently listed under ESA so I won't include them here.

Commented [TS55]: Should we do a table of all shark and ray species found in the region? Or just these listed ones? Trying to be consistent with other sections, but even looking at the FMPs sharks and rays are largely ignored under the 'protected species' sections.

Not currently finding a table to steal…but I feel like there must be one somewhere. Sharks and rays are included in SAFE reports but the tables include a whole host of other (mainly reef) species.

Klimley 1993), with occasional dives to even deeper waters (Jorgensen et al. 2009). It has also been documented entering enclosed bays and estuaries (Compagno 1984).

NMFS issued a final determination in July 2014 to list the Indo-West Pacific DPS of scalloped hammerhead shark as threatened species under the Endangered Species Act (ESA). This range of this DPS includes the U.S. Pacific territories and the Pacific Remote Island Areas [excluding Johnston Atoll]). On November 17, 2015, NOAA Fisheries published a notice (80 FR 71774) announcing that no areas meet the definition of critical habitat for the scalloped hammerhead shark.

Giant Manta Ray (*Manta birostris*)

Manta birostris, the giant manta ray, is found worldwide in tropical, subtropical, and temperate bodies of water. It is commonly found offshore, in oceanic waters, and near productive coastlines. This ray is considered to be a migratory species, with estimated distances travelled of up to 1,500 km. Yet, despite their large range, the species is infrequently encountered (with the exception of a few areas noted for manta ray aggregations). There are no current or historical estimates of the global abundance of *M. birostris*, with most estimates of subpopulations based on anecdotal diver or fisherman observations. These populations potentially range from around 100-1,500 individuals. On January 22, 2018 NMFS published a final rule to list the giant manta ray (Manta birostris) as a threatened species under the Endangered Species Act (ESA) (83 FR 2916). After completing a comprehensive status review, and after taking into account efforts being made to protect these species, NMFS determined that the giant manta ray is likely to become an endangered species within the foreseeable future throughout a significant portion of its range. NMFS also concluded that critical habitat is not determinable because data sufficient to perform the required analyses are lacking.

Oceanic Whitetip Shark (*Carcharhinus longimanus*)

Oceanic whitetip sharks are large sharks found in tropical and subtropical oceans throughout the world. They are long-lived, late maturing, and have low to moderate productivity. In January 2018, NMFS published a final rule to list the oceanic whitetip shark as a threatened species under the Endangered Species Act (ESA) (83 FR 4153). After completing a comprehensive status review, and after taking into account efforts being made to protect the species, NMFS concluded that this shark is likely to become endangered throughout all or a significant portion of its range within the foreseeable future. At that time, NMFS concluded that critical habitat was not determinable because data sufficient to perform the required analyses were lacking. In March 2020, NMFS determined that critical habitat designation for this species is not prudent, as there are no identifiable physical or biological features that are essential to the conservation of the oceanic whitetip shark within areas under U.S. jurisdiction.

Potential Aquaculture Species and the Status of those Stocks in Federal Waters

This section describes the life history characteristics of Pacific pelagic MUS that are most likely to be cultured under this action. Full descriptions of these species and all other Pelagic Management Unit Species are available in the Fishery Ecosystem Plan for Pelagic Fisheries of the Western Pacific Region (WPFMC 2009a). Also see Appendix C for a list of MUS species listed in the FEPs. In the near term, culture of oysters, algae, and aquarium fish in the western Pacific region is expected to occur nearshore or on land.

1.1.5 Economic and Social Environment

The description of economic and social environment is largely focused on island area (American Samoa, Hawaii, Marianas, and PRIA). Unless otherwise noted, the information provided in this section comes from the 2018 SAFE Reports for the Pelagics FEP, American Samoa FEP, Hawaii FEP, Marianas FEP, and Pacific Remote Island Area FEP. For information on aquaculture in Pacific Islands Region, refer to Section 3.1.1. This section includes relevant information on the past and present aquaculture business operations and some discussion with economic implications, specifically description of aquaculture activities in American Samoa, Hawaii, Marianas (CNMI and Guam), and PRIA, gear types and technology, and the aquaculture gear acting as FADs.

Section 3.1.2 describes various management concerns with regard to aquaculture operations, including those related to escapements, genetically engineered organisms, diseases, water quality, benthic effects, and the potential FAD effects resulting from aquaculture gear. As described in Section 3.1.1., while species conducive to commercial marine aquaculture are fast-growing and successfully reproduced in hatcheries, those commanding the highest value or fastest growth rate are those likely to be raised in an aquaculture setting.

As identified earlier in Section 3.1.1.1, yellowfin tuna, bigeye tuna, mahi mahi, almaco jack, giant trevally, bluefin trevally, and pacific threadfin are among those species with the highest potential for aquaculture cultivation in all areas under consideration. In addition, albacore has also been identified as a potential aquaculture product in American Samoa because of its higher relative value in local markets, and for the same reason, rabbitfish has been identified as a potential product in CNMI and Guam. There is some potential for certain mollusks, edible algae, and crustaceans to be cultured through aquaculture, although these are most likely to be cultured nearshore, rather than in federal waters.

One motivation for further U.S. aquaculture production is due to the import deficit required to meet U.S. demand for seafood products. U.S. per capita seafood consumption is comprised of a combination of domestic and imported products. From 2000 until 2016, consumption of seafood ranged from 14.4 lbs (6.5 kg) per capita (edible meat) in 2012 to 16.6 lbs (7.5 kg) (edible meat) per capita in 2004 (NMFS 2017a,b). With U.S. population increasing during the same period from 281 million to 322 million, domestic distributors increasingly turned to imported product to help satisfy domestic demand for seafood, often at a lower price. In 2016, the U.S. exported about 2.9 billion lb. (1.3 billion kg) of edible fishery products valued at $5.4 billion and imported approximately 5.8 billion lbs. (2.6 billion kg) valued at $19.5 billion, resulting in a seafood trade deficit of $14.1 billion. This represented a 1.6% increase in volume and 3.7% increase in value for imports and 6.8% decrease in volume and 3.3% decrease in value from exports relative to 2015. In 2015, U.S. aquaculture produced 313,683 tons (284,568 t) valued at $1.4 billion, a small fraction of the amount of fishery products imported.

Commented [MF56]: Update to 2018 SAFE Reports.

Commented [TS57]: This list occurs throughout; once we settle on the species in the 'species with aquaculture potential' section, I'll clean this throughout the doc

Commented [MF58R57]: Okay. At same time, can decide if use mahi mahi or dolphinfish.

State of Industry and Science in Offshore Aquaculture

The following sections describe past and ongoing offshore aquaculture research and commercial ventures (Section 3.1.1) globally. The discussion focuses on open ocean aquaculture, most relevant to the proposed action. Information regarding each sub region can be found in their respective sections later in this document.

State of the Global Industry

Offshore aquaculture is a growing field. While nearshore and land-based aquaculture have been practiced for centuries, commercial-scale cage culture became prevalent in the mid-20th century and offshore aquaculture only became active in the early 2010s. Commercial operations currently exist in at least seven countries, with research efforts in at least an additional five. Although many of these operations are still relatively small, the sector is expected to grow in the future.

As with near-shore and land-based aquaculture, ideal candidate species for commercial offshore aquaculture are fast growing and successfully reproduced in hatcheries (i.e., there is complete control over the entire life cycle). Commercial and pilot offshore facilities are currently raising a variety of high-value finfish, mollusks, and seaweeds. These species can be raised in monoculture, however, there is also potential for integrated multitrophic aquaculture (IMTA), which would involve raising finfish alongside mollusks and/or seaweeds, which extract nutrients from the environment, in an effort to increase efficiency, improve ecosystem functioning and provide alternate harvestable revenue streams. In the PIR, these species could include Pacific oysters (*Crassostrea gigas*), several species of edible algae and crustaceans.

While there is great potential for culturing extractive species in the offshore environment, there is limited information and experience for this in the PIR. In other regions, mussel culture, oyster culture, and kelp culture has developed in nearshore waters and could be promising for offshore culture. In California, specifically, mussels are being cultured in federal waters. ~~impacts~~.

Reef fish and coastal migratory pelagic species can also be raised in aquaculture systems, but are better-suited for near-shore operations. Additionally, only those commanding the highest value or exhibiting the highest growth rates would likely be cultured in an offshore system, given the expenses involved in operating in an offshore environment. Given this, it is likely that many species of interest for culture in the PIR would be high value species currently managed as wild fisheries, which could include albacore *(Thunnus alalunga*), yellowfin tuna (*Thunnus albacares)*, bigeye tuna (*Thunnus obesus*), dolphinfish (*Coryphaena hippurus)*, and Pacific Bluefin tuna (*Thunnus orientalis*).

Several tuna species and dolphinfish have previously been identified as potential candidates for aquaculture and are the subjects of ongoing research in the field. Many tunas are currently 'ranched', where wild juveniles are captured and held in a netpen until they reach a marketable size, primarily in Australia, Mexico, and the Mediterranean. However, this form of aquaculture is prohibited under the alternatives listed in this action due to its heavy reliance on wild broodstock, as well as fish taken from wild fisheries for feed. To successfully rear fish from hatchery to harvest, the life cycle of the fish must be fully under control of the producer. Currently, the

Commented [TS59]: I'll be updating this entire section next week. It's gonna need a bit of an overhaul, so I'm focusing on it on Monday.

Commented [TS60R59]: Still not *wonderful* but much more coherent and accurate than before.

Commented [TS61]: US, MX, Panama, Singapore, Brunei Turkey

These and the next are from https://www.packard.org/wp-content/uploads/2019/02/Offshore_Aquaculture_Report.pdf

Report is pretty recent, gives a good overview, but kinda questionable in its tone (uses the term 'skin in the game' a few times) and I really wonder why they chose a picture presumably from a salmon capture fishery as their representation of an offshore aquaculture facility. But I digress.

Commented [TS62]: Chile, Japan, Indo, China, Norway

Commented [TS63]: This lists more but it's out of date (table on page 29 in the doc/35 of the PDF): http://pdacrsp.oregonstate.edu/pubs/annual_reports/25thAnnualTechReportVol2.pdf

Commented [MF64]: I think the convention on using a comma after i.e. and e.g. may be changing but I saw a recent edit by Bob where he said to always use it. So, we shall. And, grammarly says to use the comma. ;-)

Commented [MF65]: I usually only put a comma like this in a list of four or more things, but I think I saw something from Bob that we put a comma here even in a list of three.

Commented [TS66R65]: Fair, seems like Oxford comma is getting more traction these days…

Commented [TS67]: I'm saying this now, knowing that the main impact concern for raising mussels and kelp is entanglements. GARFO is experiencing a tough time getting site licenses for any offshore due to risk of entanglement for right whales. This risk also exists for netpens, too. There's really no data on these actual ...

Commented [MF68R67]: How about two or three more sentences here with a little bit of info on mollusk and seaweed culture elsewhere?

Commented [TS69R67]: Moved this word ('impacts') over to preserve the comment

Commented [MF70]: I think current convention is one space after a period. I'm seeing sometimes one and sometimes two spaces in this document. Let's make it consistently one space.

Commented [MF71]: Let's double check if I'm right about our SFD convention of putting a comma in a list of three.

Pacific Bluefin is the only tuna species with a life cycle that can be consistently reproduced under hatchery conditions, though research is ongoing for other species.

Dolphinfish have been successfully reproduced under hatchery conditions and research into commercial rearing has been ongoing for more than 30 years. For dolphinfish and Bluefin tuna, challenges to commercial production beyond closing the life cycle include addressing technical and physical specifications (e.g., precise water quality for larval rearing, collisions with tank walls), and disease (e.g., the 'puffy snout' syndrome experienced by tunas held in captivity). These constraints have hampered commercial efforts for these species but research is continuing.

Although offshore aquaculture technologies may so far be limited for tunas and dolphinfish, commercial operations and research for other managed species are farther along in the PIR and elsewhere. The following eight managed finfish species have the most advanced scientific understanding to be pursued commercially: Pacific threadfin (*Polydactylus sexfilis*), amberjack (*Seriola rivoliana*), giant ulua (*Caranx ignobilis*), bluefin trevally (*Carynx melampygus*), mahi mahi (*Coryphaena hippurus*), red snapper (*Lutjanus campechanus*), Nenue (*Kyphosus spp.*), and Giant Grouper (*Epinephelus lanceolatus*). Details on these operations and research are further outlined in their respective sub-region sections below.

1.1.5.1 Aquaculture in the open ocean: gear types and technology

Siting aquaculture facilities in an offshore environment brings a unique set of challenges. In addition to the optimal siting characteristics related to water quality for most nearshore aquaculture (e.g., temperature, dissolved oxygen, salinity, current direction and speed), offshore facilities also have to contend with extreme weather conditions. Offshore facilities require access to land-based services, including vessels and harbors, hatchery facilities, and facilities for staff. These considerations are outlined in the respective section for each subregion of the PIR.

This action focuses primarily on cage and net pen culture, with general discussion of other gear types and technologies. There are a wide variety of nets and cages that can be used in open ocean aquaculture, some of which have been used for decades while others are fairly new to the industry. Appendix B has an outline of cages and net pens that are currently used within the industry, as well as several technological innovations that prevent vessel collisions, monitor and minimize animal entanglements, safely exclude predators, and reduce or eliminate risks personnel. .

Radar reflecting buoys

1.1.6 Federally managed sanctuaries, monuments and wildlife refuges

Federally managed sanctuaries, monuments and wildlife refuges are discussed in detail in their respective sub-regions, however, figure 3-10 gives a broad overview of these designated areas throughout the PIR:

Commented [TS72]: There are loads more species we could highlight worldwide, but focusing on what might be of interest to PIR.

Commented [TS73]: While these are a 'state of the science' of sorts, most of them are developed in response to, or in anticipation of, a problem/ impact. Wondering if the rest of this should just got in Chapter 4.

Commented [MF74]: How about moving all these items that are noted on the next page to Appendix B?

Commented [TS75R74]: Sure! I've moved them there for now; will look into updating that appendix at a later date. Could consider contacting James Morris and the NCCOS team about any lit reviews or 'state of science' docs they might already have that would be more up to date and accurate https://coastalscience.noaa.gov/research/marine-spatial-ecology/

Leaving this header in just so the comment isn't lost.

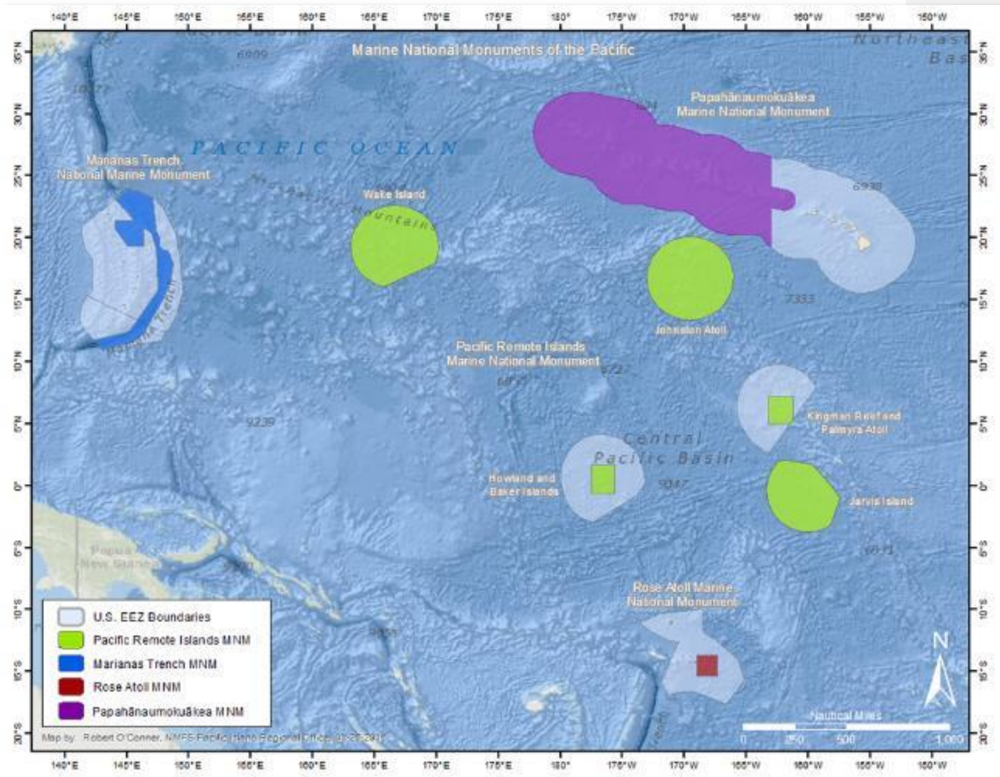


Figure 1-11. Marine National Monuments of the Pacific Island Region

1.2 Pacific Islands Sub-Regions

1.3 American Samoa

The Samoa archipelago consists of seven major volcanic islands distributed between the Independent State of Samoa and American Samoa. This document will describe the relevant environment only for American Samoa.

American Samoa consists of five inhabited, volcanic islands - Tutuila, Aunuu, Ofu, Olosega, and Tau – and two uninhabited islands – Swains Island and Rose Atoll. Tutuila, the largest island (55 mi^2 [143 km^2]), is the center of government and business. Aunuu is a small island that lies one-quarter mile off the coast of Tutuila. The three islands of Ofu, Olosega, and Tau are collectively referred to as the Manua islands (with a total land area of less than 20 mi^2 [52 km^2]) and lie 70 mi (113 km) east of Tutuila. Swain's Island has a landmass of 0.6 mi^2 (1.5 km^2) and lies 225 mi (40 km) north of Tutuila. Rose Atoll is a small atoll centered in the 13,436 mi^2 (35,000 km^2) Rose Atoll MNM, which prohibits commercial fishing, including aquaculture. American Samoa's total land mass is about 77 mi^2 (200 km^2), and its EEZ is approximately 150,580 mi^2 (390,000 km^2).

The FEP for the American Samoa Archipelago (WPFMC 2009c) provides a complete description of the affected environment.

1.3.1 Physical Environment

The physical environment includes climate, air quality, visual plane (aesthetics), in addition to ocean currents and geological and oceanographic features. Relevant features include currents and eddies as they relate to dissipation of facility discharge, winds and sea surface conditions as they relate to access to the site, extreme weather events as they relate to safety at sea and potential loss of or damage to equipment, topography as it relates to distance to seafloor. Visual planes, a potential public aesthetic issue in nearshore waters, are not affected in waters beyond three miles from land.

1.3.1.1 Geological Features

Coastline

American Samoa is an oceanic archipelago without a continental shelf. Therefore, shallow water habitats generally only occur within 0.5 to 2 mi (0.8 to 3.2 km) from shore because of the steep slope of the seafloor (Craig 2009). American Samoa has one sheltered, deep-draft harbor, Pago Pago, on the island of Tutuila. Nearshore benthic (bottom) habitats include coral reefs and reef slopes, seagrass beds, mangrove forests, and sandy, hard, and rubble substrate in the subtidal and intertidal zones. Figure 3-10 shows shallow waters, 160 to 328 ft (50 to 100 m) deep, extending into the EEZ to the east and west of Tutuila (PIBHMC 2008). The figure shows an elevated ridge around the seaward rim of Tutuila's insular shelf, likely a drowned barrier reef complex where areas of high coral cover have been observed (PIFSC 2008). The seafloor drops off into deep waters within the 3 nm (5.6 m) territorial seas for the islands of the Manu‘a group.

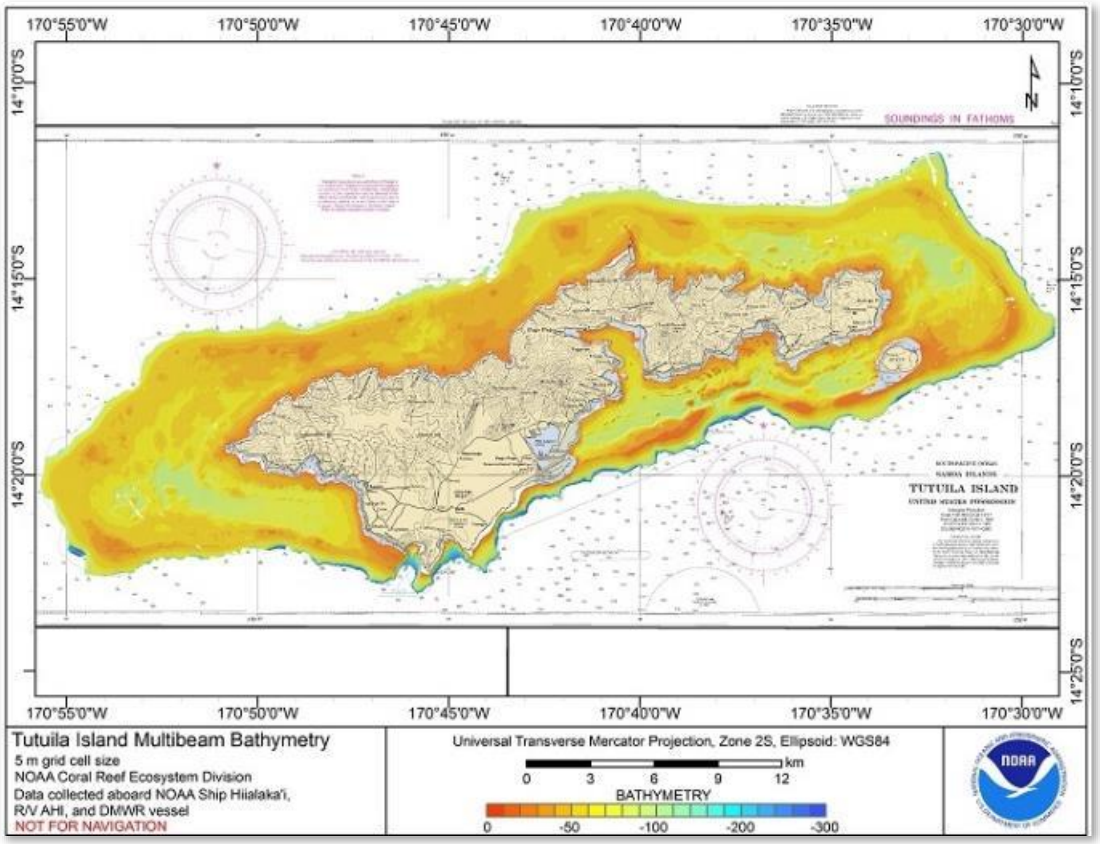
Commented [TS76]: Unsure what terminology to use here.

Commented [MF77]: We'll need to determine if these glottal stops (aka, ‘okina) and other diacritical marks are used in federal documents. If so, the ‘okina is correctly written as an upside down apostrophe

Commented [TS78]: Do we really need this paragraph if it's already stated in the 'PIR' level section prior? This question is relevant throughout

Commented [TS79]: From Colby All areas outside 3 miles should be mapped out and included in this PEIS in each PIR action area island region to the extent practicable, and available

Commented [TS80R79]: I agree! Leaving this in or later when we send it along the chain of review.



Source: PIBHMC-UH

Figure 1-12. Bathymetry of Nearshore Tutuila Island

Open Ocean

In general, the waters in the EEZ of American Samoa are oceanic, with average depth greater than 3300 ft (1000 meters). Deep ocean benthic habitat includes hard, soft, and biogenic habitats at water depths below 655 ft (200 m), and is by far the largest benthic habitats in the world (Neighbors and Wilson 2006). Soft sediments are made up mostly of mud and sand and are generally low in biological productivity.

There are 48 seamounts within the American Samoa EEZ (Kendall and Poti 2011), with the majority rising from depths around 13,123 feet (4,000 m) (WPFMC 2009c). Vailulu'u seamount is the only hydrothermally active seamount within the EEZ (Koppers et al. 2010).

Banktops (defined as all submerged marine habitats at depths between the shoreline and 328 ft [100 m]) are greatest around Tutuila and Aunuu, where the depth interval declines gradually from shoreline to about 328 ft (100 m). Tau, has significantly smaller surrounding banktop habitat, with depth intervals descending much more steeply from shoreline to about 328 feet. Rose Atoll and Swains Island have only limited shallow banktop, with depths that descend rapidly from 66 to 328 ft (20 to 100 m).

1.3.1.2 Oceanographic Features

At the broadest scale, the Samoan archipelago lies along the northern edge of the South Pacific Gyre, a series of connected ocean currents with a counter-clockwise flow that spans the Pacific basin (Alory and Delcroix 1999; Tomczak and Godfrey 2003; Craig 2009). At a regional scale centered on the Samoan Archipelago, the major surface currents and eddies that affect the archipelago are the westward flowing South Equatorial Current, which occurs all year between 5° and 15° S; the South Equatorial Counter Current, which interrupts the South Equatorial Current between 9° and 12° S by during the summer; and the Tonga Trench Eddy, an eddy that regularly occurs between September and December south of the archipelago (Kendall and Poti 2011). Of these, the South Equatorial Counter Current is the most prominent current feature in the region, occurring at approximately 656 ft (200 m) depth, and strongest in January and February (Kessler and Taft 1987; Chen and Qui 2004)

The entire Samoan Archipelago experiences relatively high and stable ocean temperatures throughout the year, with an average range from 81°F (27.2°C) in August to 85°F (29.5°C) in March.

Wave power exposures are typically highest on the eastern- and southern-facing coasts of Samoan islands but can vary seasonally and among years (Barstow and Haug 1994). Ocean swell from the south and wave power in general are highest during May to September (6.5 to 9.8 ft [2 to 3 m] wave height is common) with the increased intensity of the Trade Winds and frequency of swell producing storms at higher latitudes (Barstow and Haug 1994; PIFSC 2008).

1.3.1.3 Extreme Weather

American Samoa's tropical climate is characterized by year-round mild air temperatures, high humidity, persistent Trade Winds, and infrequent but severe cyclonic storms, and is influenced by global climate trends and inter-annual variability associated with shifts in ocean-atmospheric conditions. Mean daily air temperature varies between 72°F (22°C) and 86°F (30°C) (SPSLCMP 2007). Maximum rainfall occurs in the austral summer (December to February), where it can exceed 12 inches (300 millimeters [mm]) per month. In winter (June to August), rainfall is 30 percent lower, at approximately 8 inches (200 mm) per month (Craig 2009).

Commented [TS81]: From Colby: Map? Coordinates? Environmental sensitivity? Known hydrothermal values to ecosystems (locally and globally)? This is like pointing out that a leprechaun cabin with stockpiles of gold exists somewhere in a forest of which you are planning development, and leaving it at that.

Commented [MF82R81]: Same question or all of Colby's comments of this type above and below: Is that level of detail necessary in a PEIS, even in the sub-regional sections of the document? If so, this PEIS will end up being some hundreds of pages long.

Commented [TS83]: •From Colby: Map? Coordinates? Environmental sensitivity? Known banktop values to ecosystems?

Commented [TS84]: From Colby: I'd insert a current map, or potentially two current maps if there are different winter/summer deviations.

Commented [TS85]: From Colby: ; I'd insert an ocean temperature map, or potentially two ocean temperature maps if there are different winter/summer deviations

Commented [TS86]: From Colby: I'd insert wave power maps, or potentially two wave power maps assuming substantially different winter/summer deviations.

Tsunamis are rare events caused by earthquakes or underwater landslides. On September 29, 2009 a tsunami devastated American Samoa, Samoa and Tonga with run-ups (height above ambient sea level) as high as 40 ft (12 m) (USGS 2009).

Cyclonic storms (also called tropical storms, hurricanes or typhoons) are infrequent but severe weather conditions. The Samoan EEZ lies along the eastern edge of a region conducive to development of cyclonic storms in the south Pacific (Craig 2009). American Samoa experiences major cyclones, which can yield maximum winds of 150 miles per hour (mph) (241 km/hr), approximately once every 5 years. They normally approach from the north, but occasionally approach from the east, southeast, or west. Six cyclones have struck or passed near the Samoan Archipelago in the past 30 years, including two recent and very powerful Category 5 storms with sustained winds over 155 mph (250 km/hr). The most recent cyclones have occurred at intervals of 1 to 13 years and have had varying impacts across the islands (Craig 2009).

1.3.2 Biological Environment

The biological environment of American Samoa, including the species addressed in this PEIS, are described in detail in the *Fishery Ecosystem Plan for American Samoa Fisheries* which is incorporated here by reference (WPFMC 2009c). Specific resources of concern, identified during scoping and interagency informal consultations are described to the level necessary for appropriate analysis.

1.3.2.1 Benthic and Sessile Organisms

Commented [TS87]: From Colby: I can't imagine an aquaculture EIS in any action ocean action area that wouldn't have some sort of table and map of known coral and sponge abundance estimates and maps, wherever such data might be available

Nearshore Reefs

Coral reefs in American Samoa consist of fringing coral reef flats bordered by coral reef slope (or shelf). There are more than 250 species of corals in American Samoa in reef flats, reef crest, and reef slopes (NOAA 2012). Reef slope extending from depths of 164 to 328 feet (50 to 100 m) borders many coral reefs and consists primarily of carbonate rubble, algae, and microinvertebrate communities (WPFMC 2009a). Spur and groove reef formations (linear patterns of coral interspersed with sand channels) are common on slope habitats (Fenner et al. 2008b). Coral reefs at depths between 98 to 164 feet (30 and 50 m), or even deeper, have been found on several of the spurs extending seaward from corners of the Manu'a Islands (PIFSC 2008). Bare et al. (2010) report on mesophotic coral reefs (zooxanthellate, scleractinian coral reefs that generally occur at depths from 98 feet (30 m) to more than 492 feet (150 m) documented around Tutuila. Tutuila has approximately 17.2 square miles (44.5 square km) of coral reef habitat, which constitutes more than half of the total coral reef habitat in the archipelago. The Manua Islands, Rose Atoll, and Swains Island combined have approximately 12.3 square miles (31.9 square km) of coral reef habitat (NCCOS 2005).

There are approximately 2,700 known species associated with coral reef habitat in American Samoa. The benthic communities are dominated by crustose calcareous algae, followed by live hard corals, dead corals (less common and almost none recently dead), and brown macroalgae (very rare). Invertebrate filter feeders are rare, small, and physically similar in appearance, making total species counts problematic. Fish fauna is dominated by small to medium-sized herbivores, with some large reef fish species uncommon to rare (Fenner et al. 2008b).

Offshore Reefs

Data on offshore reefs consisting of precious corals around American Samoa are lacking, though they likely occur in suitable habitats across the archipelago. These habitats are characterized by areas that are swept by strong currents at depths of 328 to 4,921 ft (100 to 1,500 m). Steep banks with high currents along Tau's southern shore are known areas of suitable habitat (NOAA 2012). The American Samoa FEP identifies eleven federally managed species: three pink coral, three gold coral, two bamboo coral, and three black coral species (WPFMC 2009c).

1.3.2.2 Significant Aquaculture Species and the Status of those Stocks in Federal Waters

Fin Fish

This section describes the life history characteristics of American Samoa MUS that are most likely to be cultured under the proposed action. Full descriptions of these species and all other American Samoa MUS are available in the Fishery Ecosystem Plan for the American Samoa Archipelago (WRPFMC 2009c). Refer to Section 3.3.2.2 for potentially cultured pelagic species. In the near term, culture of oysters, algae, and aquarium fish in the western Pacific region is expected to occur nearshore or on land.

1.3.2.3 Protected Species

Marine Mammals

Cetaceans listed as endangered under the ESA and that have been observed in the Western Pacific Region comprise the humpback whale (Megaptera novaeangliae), sperm whale (Physeter macrocephalus), blue whale (Balaenoptera musculus), fin whale (B. physalus), and sei whale (B. borealis). In addition, one endangered pinniped, the Hawaiian monk seal (Monachus schauinslandi), occurs in the region.

Sperm whales, endangered throughout their range, have historically been observed around Samoa throughout the year except February and March (Reeves et al. 1999). Sperm whales are occasionally seen in the Fagatele Bay Sanctuary as well. Population size in the area is unknown as no stock assessments have been conducted for sperm whales in American Samoa. There have been no documented sightings of the endangered blue whale, fin whale or sei whale in America Samoa, though their range overlaps with the area.

In 2016, NMFS designated 14 DPS for the humpback whale, with four maintaining an endangered status and one listed as threatened. The other nine DPS, including the Oceania DPS, are not listed under the ESA (81FR62260). Oceania humpbacks occasionally migrate into Samoan waters during their winter migration. A majority of these animals remain near Tonga, however some are seen around Samoa.

Other marine mammals that have been sighted in American Samoa are outlined in Table XX. For further information on marine mammals occurring in the action area please see the American Samoa FEP and Section 3.2 Pelagic Environment.

Table 1-7 Non-ESA listed marine mammals of the Western Pacific

Common Name	Scientific Name	Common Name	Scientific Name
Blainsville beaked whale	*Mesoplodon densirostris*	melon-headed whale	*Peponocephala electra*

bottlenose dolphin	*Tursiops truncatus*	minke whale	*Balaenoptera acutorostrata*
Bryde's whale	*Balaenoptera edeni*	Pacific white-sided dolphin	*Lagenorhynchus obliquidens*
common dolphin	*Delphinus delphis*	pygmy killer whale	*Feresa attenuata*
Cuvier's beaked whale	*Ziphius cavirostris*	pygmy sperm whale	*Kogia breviceps*
Dall's porpoise	*Phocoenoides dalli*	Risso's dolphin	*Grampus griseus*
dwarf sperm whale	*Kogia simus*	rough-toothed dolphin	*Steno bredanensis*
false killer whale	*Pseudorca crassidens*	short-finned pilot whale	*Globicephala macrorhynchus*
Fraser's dolphin	*Lagenodelphis hosei*	spinner dolphin	*Stenella longirostris*
killer whale	*Orcinus orca*	spotted dolphin	*Stenella attenuata*
Longman's beaked whale	*Indopacetus pacificus*	striped dolphin	*Stenella coeruleoalba*

Sea Turtles

All Pacific sea turtles are designated under the Endangered Species Act as threatened or endangered. Sea turtles observed in American Samoa are the leatherback sea turtle, green sea turtle, hawksbill sea turtle, and olive ridley sea turtle.

In 1993, the crew of an American Samoa government vessel engaged in experimental longline fishing, pulled up a small freshly dead leatherback sea turtle about 3.5 mi (5.6 km) south of Swains Island. This was the first leatherback sea turtle seen by the vessel's captain in 32 years of fishing in the waters of American Samoa. The nearest known leatherback nesting area to the Samoan archipelago is the Solomon Islands (Grant 1994).

Green sea turtles appear to be most abundant in the waters of Rose Atoll, the largest nesting site in the archipelago. After nesting, females migrate to feeding grounds in Fiji and other South Pacific islands. After several years, the turtles will return to Rose Atoll to nest again (Craig 2002). Subadult and adult green sea turtles also occur in low abundance in nearshore waters around Tutuila, Ofu, Olosega, Tau and Swains Island, with sporadic, low-level nesting on Tutuila and Swains Island (Maison et al. 2010).

Hawksbill sea turtles are most commonly found at Tutuila and the Manua Islands, with an estimated 50 females nesting annually on Tutuila and 30 on the Manua Group (WPFMC 2009c). They are also known to nest at Rose Atoll and Swains Island (Utzurrum 2002).

Commented [TS88]: From Colby: There should be more discussion of each turtle species in each PIR island action area specifically on best estimates of abundance, nesting females, and status.

Commented [TS89R88]: I think I'd vote to make a clear reference to the places where this information can be found, rather than include it here.

Commented [TS90]: •From Colby: , regarding leatherback interactions and ridiculous reference to only one interaction back in 1993 (which implies a very false narrative); My goodness, this is an irrelevant story. See our 2017-2018 PIRO A.S. observer program annual reports (https://www.fisheries.noaa.gov/pacific-islands/fisheries-observers/pacific-islands-longline-quarterly-and-annual-reports), and request the reports going back 1+ decade/s (but if including you'd want to correctly extrapolate for observer coverage rate, which was less some years back). Just since 2017 alone there has been 3 leatherback interactions.

Commented [TS91R90]: Yeah I agree; it's directly from the FMP. Proposed solution: we get some relevant stats from the observer reports so we can just say "roughly this many have been seen annually since 2016' or something of the like. I'd do this for each of the species outlined here. We could also further simplify and create a figure with historical interactions and have all species represented on the same graph.

Commented [TS92]: From Colby; 10 observed interactions of G.S.T.'s alone since 2017 in A.S. (https://www.fisheries.noaa.gov/pacific-islands/fisheries-observers/pacific-islands-longline-quarterly-and-annual-reports).

Commented [TS93]: From Colby: 2 interactions of Hawksbill S.T.'s since 2017 in A.S. (https://www.fisheries.noaa.gov/pacific-islands/fisheries-observers/pacific-islands-longline-quarterly-and-annual-reports).

Olive ridley sea turtles are uncommon in American Samoa, although there have been at least three sightings. A necropsy of one recovered dead olive ridley found that it was injured by a shark, and may have recently laid eggs, indicating that there may be a nesting beach in American Samoa (Utzurrum 2002).

Commented [TS94]: From Colby: 4 interactions of Olive ridley S.T.'s since 2017 in A.S. (https://www.fisheries.noaa.gov/pacific-islands/fisheries-observers/pacific-islands-longline-quarterly-and-annual-reports).

Seabirds

The only endangered seabird found in American Samoa is Newell's shearwater. The Newell's shearwater is known in Samoan as *ta`i`o* and has been identified as a 'visitor' to Tutuila by the National Park Service[14] , far from its common foraging grounds in the North Pacific to the north and west of the Hawaiian Islands.

Other seabirds that occur in American Samoa are outlined in Table XX. For further information on seabirds occurring in the action area please see the American Samoa FEP and Section 3.2 Pelagic Environment.

Commented [TS95]: Should we link to the SAFE report instead? It's got a good (giant) table with a list of species, resident/visitor status, ESA status, MMPA status.

Table 1-8 Non-ESA listed birds that occur in American Samoa

Residents (i.e., breeding)	
wedge-tailed shearwaters	*Puffinus pacificus*
Audubon's shearwater	*Puffinus lherminieri*
Christmas shearwater	*Puffinus nativitatis*
Tahiti petrel	*Pseudobulweria rostrata*
herald petrel	*Pterodroma heraldica*
collared petrel	*Pterodroma brevipes*
red-footed booby	*Sula sula*
brown booby	*Sula leucogaster*
masked booby	*Sula dactylatra*
white-tailed tropicbird	*Phaethon lepturus*
red-tailed tropicbird	*Phaethon rubricauda*
great frigatebird	*Fregata minor*
lesser frigatebird	*Fregata ariel*
sooty tern	*Sterna fuscata*
brown noddy	*Anous stolidus*
black noddy	*Anous minutus*
blue-gray noddy	*Procelsterna cerulea*
common fairy-tern (white tern)	*Gygis alba*
bristle-thighed curlew	*Numenius tahitiensis*
Visitors/vagrants:	
short-tailed shearwater	*Puffinus tenuirostris*
mottled petrel	*Pterodroma inexpectata*
Phoenix petrel	*Pterodroma alba*
white-bellied storm petrel	*Fregetta grallaria*
Polynesian storm petrel (pratt - resident)	*Nesofregetta fuliginosa*
laughing gull	*Larus atricilla*
black-naped tern	*Sterna sumatrana*

Sharks and Rays

All sharks and rays that occur in American Samoa occur elsewhere in the PIR. Thorough descriptions of each species are provided in Section 3.2 (Protected Species).

1.3.3 Social and Economic Environment

1.3.3.1 Past and Present Commercial Offshore Aquaculture Operations

State of aquaculture industry

There is currently no salt-water aquaculture conducted in American Samoa. Land-based freshwater aquaculture being conducted includes raising tilapia and freshwater prawns. An effort to raise mangrove crabs has met with some success, but is currently not in operation. A few backyard farmers are conducting aquaponics (Tagarino 2017).

Prior to 2010, aquaculture efforts were aided by the USDA Land Grant Program, NOAA Sea Grant Program, and the National Fish and Wildlife Foundation. Projects included the aquaculture research and demonstration facility *Center for Sustainable Integrated Agriculture and Aquaculture*, and the *Coral Farming for Village Industry and Coral Reef Rehabilitation Project*. The continuation of these projects has been impacted by the 2009 tsunami and loss of funding (M. King 2010).

1.3.3.2 Relevant Fisheries and Communities

Of the wild-caught species of finfish, yellowfin tuna, bigeye tuna, mahi mahi, albacore, almaco jack (amberjack) , giant trevally, bluefin trevally, and pacific threadfin are most likely to be cultured under this action. Section 3.2.2.2.1. describes the life history characteristics of Pacific pelagic MUS (yellowfin tuna, bigeye tuna, mahi mahi, and albacore) and Section 3.3.2.2.1. describes that of species managed under the American Samoa FEP. The potential for albacore is specific to American Samoa because of the large amount of albacore sold to American Samoa canneries. Fisheries that catch these species, supporting industries and surrounding fishing communities, will be the focus of the discussion with regard to the economic and social environment potentially affected by this action.

Commented [TS96]: •From Colby: An abbreviated analysis and discussion of failed efforts to develop a fresh fish export business for yellowfin and bigeye would be really useful in this EIS. When I was in A.S. last year I met a business man representing the yellowfin sea ranching operations in Mexico. He told me that they were going to invest a couple hundred thousand dollars investigating the potential for wild caught export of yellowfin to Japan.

Commented [TS97R96]:

1.3.3.3 Characteristics and Economic Feasibility of Aquaculture Operations that May Operate in Offshore-waters of American Samoa

Pago Pago harbor is a deep draft harbor important to the US Fishing Industry, specifically purse seine vessels. The StarKist cannery is the primary business sited along the harbor's wharf. The harbor is deep and wide enough to accommodate many of the largest class ships, including cruise ships and tankers, as well as personal yachts and sailboats (ASG Department of Port Administration 2017).

Given the presence of the cannery, a small longline fleet, and support for large distant-water fisheries, both local and export markets for aquaculture products would likely be simple to develop.

1.3.3.4 Scope of Fishing Industry - Wild Stocks

Description of Commercial Fisheries

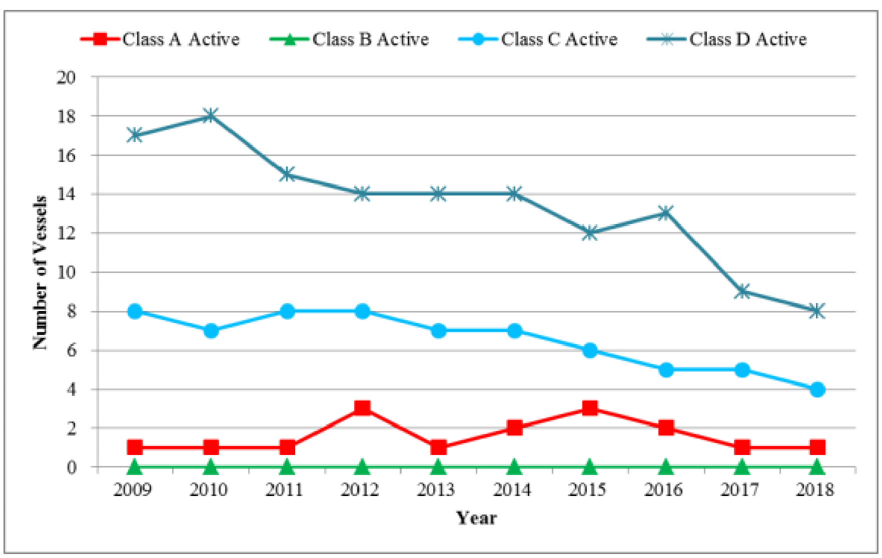
American Samoa pelagic fisheries

The pelagic fishery in American Samoa is and has been an important component of the American Samoan domestic economy. American Samoan dependence on fishing undoubtedly goes back as far as the peopled history of the islands of the Samoan archipelago, about 3,500 years ago. Many aspects of the culture have changed in contemporary times but American Samoans have retained a traditional social system that continues to strongly influence and depend upon the culture of fishing.

American Samoa is a landing and canning port for the U.S. Purse seine fishery for skipjack and yellowfin tuna, with the largest catch of all U.S. pelagic fisheries in the region. The U.S. longline fishery for South Pacific albacore conducted primarily in the American Samoa EEZ comprises the second-largest of the U.S. longline fisheries in the FEP (after Hawai`i). Prior to 1995, the pelagic fishery was largely a troll fishery. Horizontal longlining was introduced to the Territory by Western Samoan fishermen in 1995. Local fishers have found longlining worthwhile as they land more lbs. with less effort and use less gasoline for trips.

Participation in pelagic fisheries

American Samoa longline fleet operates under a limited entry system with 60 total permits and 46 current permits. Permits are issued by vessel size class and permit holders are restricted to using vessels within their size class or smaller. Among the 44 permits that are current, three are Class A vessels (40 ft or smaller), four are Class B (longer than 40 ft, but no longer than 50 ft), twelve are Class C (longer than 50 ft, but no longer than 70 ft), and 27 vessels are Class D (longer than 70 ft) (https://www.fisheries.noaa.gov/permit/american-samoa-longline-limited-entry-permit accessed April 03, 2020). Figure 3-11 depicts recent trends in the number of the active vessel size classes.



Source: WPFMC 2019a.

Note: Class A < 40 ft, Class B 40-50 ft, Class C 51-70 ft, Class D >70 ft.

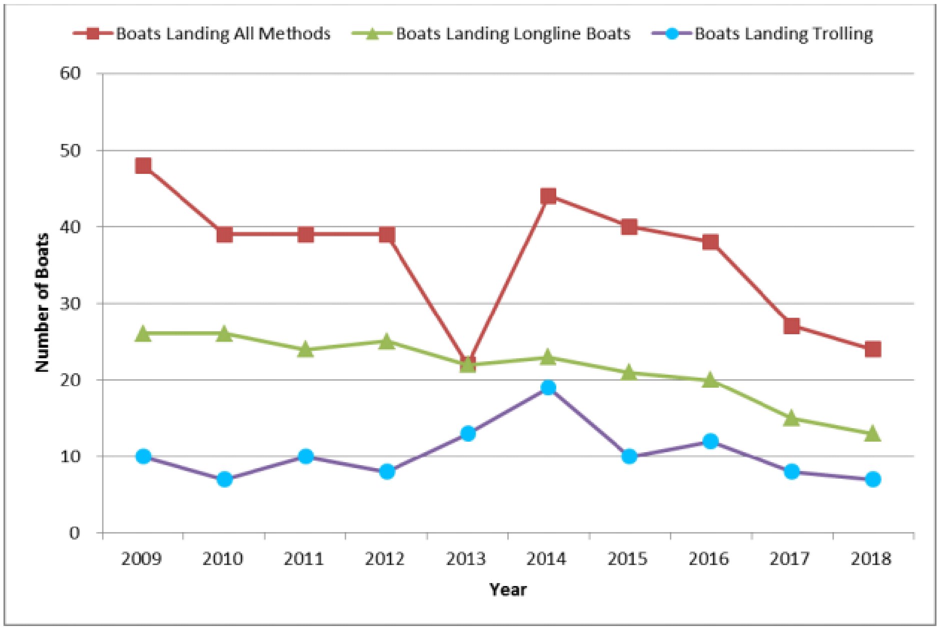
Commented [MF98]: Can probably pull this same updated table and associated data from the AS section of the 2018 Pelagic SAFE Report.

Commented [TS99R98]: done

Figure 1-13. Number of Active Longline Fishing Vessels in American Samoa by Size

The American Samoa fleet had 20 active vessels in 2016, down from a peak of 70 active vessels in 2001. Pan (2015) noted that the small-scale alia fleet has almost disappeared in recent years, due in part from a combination of thin profit margins and the damage of many boats as a result of the 2009 tsunami. This fishery has been operating on a very thin profit margin and among those surveyed by NOAA economists, almost half operated at a net loss. Rising fuel costs and relatively low revenues, as a result of reduced albacore catch per unit effort (CPUE), were major factors leading to poor economic performance. Compared with 2001, average 2009 revenues are 32% lower while average annual expenditures increased by 33%. Annual labor costs per vessel declined 56% compared to 2001, suggesting that crew received lower payments in 2009, compared with 2001 (Pan, 2015).

As for non-longline vessels, in 2016, there were 12 troll vessels in American Samoa. Skipjack and yellowfin tuna dominated troll catch. Figure 3-12 below depicts the recent trend in number of fishing vessels by gear type. Figure 3-12 shows that the number of American Samoa boats landing pelagic species have generally declined overall for the longline boats, but almost every year, more participants used longline gear rather than troll to catch pelagic species. According to Levine and Allen (2009), until 1995, boat-based fishing in was primarily trolling and bottomfish handlining, with the pelagic fishery in American Samoa being largely troll-based. In 1996, the majority of trolling fishermen converted their alias to longlining, especially larger commercial trollers, although some continued to troll occasionally. Consequently, the fishery has experienced a decline in its catch and effort. In 1996, 7 of the 35 trolling vessels rarely sold catch; their captains primarily fished for recreation on weekends, holidays, or competed in fishing tournaments. By 2001, longlining became the dominant fishing method in American Samoa and the number of trolling boats and their total catch dropped dramatically.



Source: WPFMC 2019a.

Figure 1-14. Number of American Samoa Boats Landing Any Pelagic Species (2007-2016)

Table 3-7 provides an overview of pelagic landings by all fisheries in American Samoa.

Table 1-9. American Samoa Estimated Total Pelagic Species Landings by Gear Type (2018)

Species	Longline Pounds	Troll Pounds	Other Pounds	Total Pounds
Skipjack tuna	147,758	8,414	0	156,172
Albacore tuna	3,122,082	339	0	3,122,421
Yellowfin tuna	542,078	10,344	0	552,422
Kawakawa	0	266	0	266
Bigeye tuna	103,391	0	0	103,391
Bluefin tuna	1,428	0	0	1,428
Tunas (unknown)	0	0	0	0
TUNAS TOTAL	**3,916,737**	**19,363**	**0**	**3,936,100**
Mahimahi	9,881	954	0	10,835
Black marlin	0	629	0	629
Blue marlin	69,721	1,107	0	70,827

Striped marlin	3,234	0	0	3,234
Wahoo	72,172	1,154	0	73,326
Swordfish	13,434	0	0	13,434
Sailfish	1,702	0	0	1,702
Spearfish	2,024	0	0	2,024
Moonfish	2,766	0	0	2,766
Oilfish	95	0	405	499
Pomfret	378	0	58	436
Pelagic thresher shark	0	0	0	0
Thresher shark	1,163	0	0	1,163
Shark (unknown pelagic)	0	0	0	0
Snake mackerel	0	0	0	0
Bigeye thresher shark	0	0	0	0
Silky shark	715	0	0	715
White tip oceanic shark	0	0	0	0
Blue shark	6,972	0	0	6,972
Shortfin mako shark	723	0	0	723
Longfin mako shark	0	0	0	0
Billfishes (unknown)	0	0	0	0
NON-TUNA PMUS TOTAL	**184,980**	**3,844**	**463**	**189,285**
Pelagic fishes (unknown)	0	0	0	0
Double-lined mackerel	0	0	0	0
Mackerel	0	0	0	0
Long-jawed Mackerel	0	0	0	0
Barracudas	891	0	0	891
Great barracuda	0	193	88	280
Small barracudas	0	0	0	0
Rainbow runner	0	173	50	223
Dogtooth tuna	0	464	649	1,113
OTHER PELAGICS TOTAL	**891**	**830**	**787**	**2,507**
TOTAL PELAGICS	**4,102,608**	**24,037**	**1,250**	**4,127,892**

Source: WPRFMC 2019a

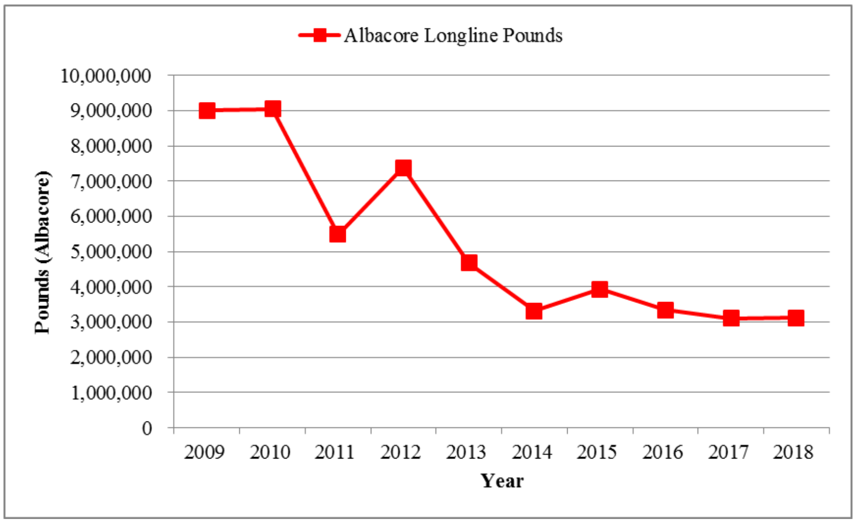
American Samoa bottomfish fisheries

American Samoa's bottomfish industry was relatively large in the 1980s, however has since declined. Beginning in 1988, the nature of American Samoa's fisheries changed dramatically with a shift in importance from bottomfishing to trolling. Since 2010, the dominant fishing method has been longlining (by weight). Bottomfishing has been in decline for years, but it was dealt a final devastating blow by the impacts of the 2009 tsunami. A fishery failure was declared, and the U.S. Congress allocated $1 million to revive the fishery. This fund has been used to repair boats damaged by the tsunami, maintain the floating docks used by the alia boats, and build a boat ramp. In 2013, the American Samoan government also implemented a subsidy program that provided financial relief associated the rising fuel prices; the fuel price has since become notably lower (WPRFMC 2019b).

Commercial Catch and Landings of Species with Aquaculture Potential

Historical catch, landings and/or pounds kept, in some cases by gear type, for species with the greatest potential to be grown and harvested in an aquaculture operations in American Samoa are presented in Figure 3-13 (albacore) Figure 3-14 (yellow fin tuna), Figure 3-15 (big eye tuna), Figure 3-16 (mahi mahi), Figure 3-17 (amberjack), Figure 3-18 (giant trevally), Figure 3-19 (blue fin trevally), and Figure 3-20 (pacific threadfin). Numbers on the figures are in 1,000s of lbs. except where noted.

Commented [TS100]: in each of the subregional sections, these graphs are ordered by largest catch in the fishery, then all others. If it makes sense to put them in a different order (e.g. alphabetical or something to match the order they're covered in the PIR section I'm happy to do it.



Source: WPFMC 2019a.

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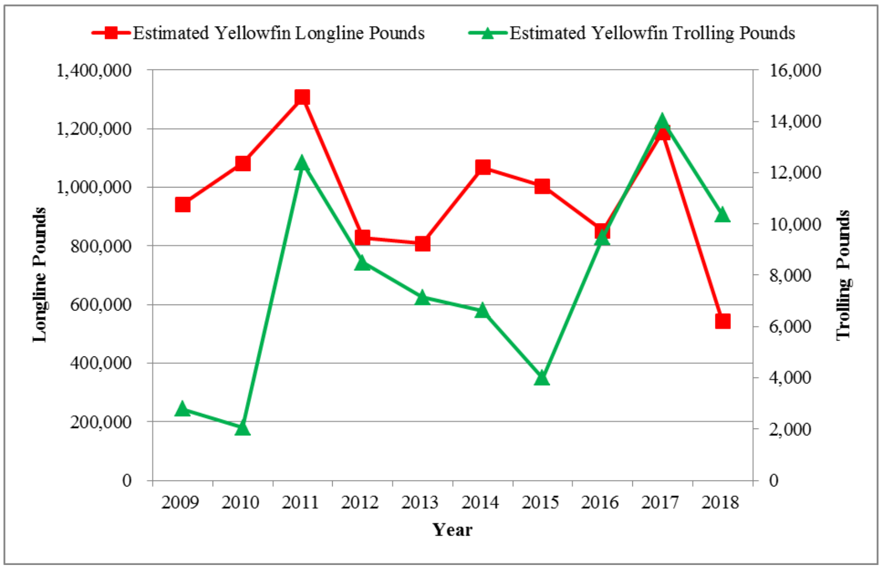
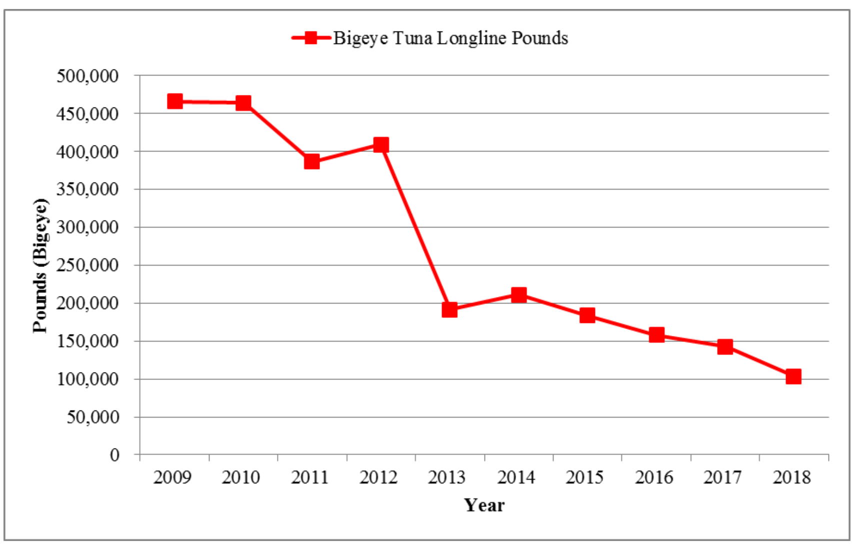
Figure 1-15. American Samoa Annual Estimated Albacore Total Landings By Longliners (2009-2018)



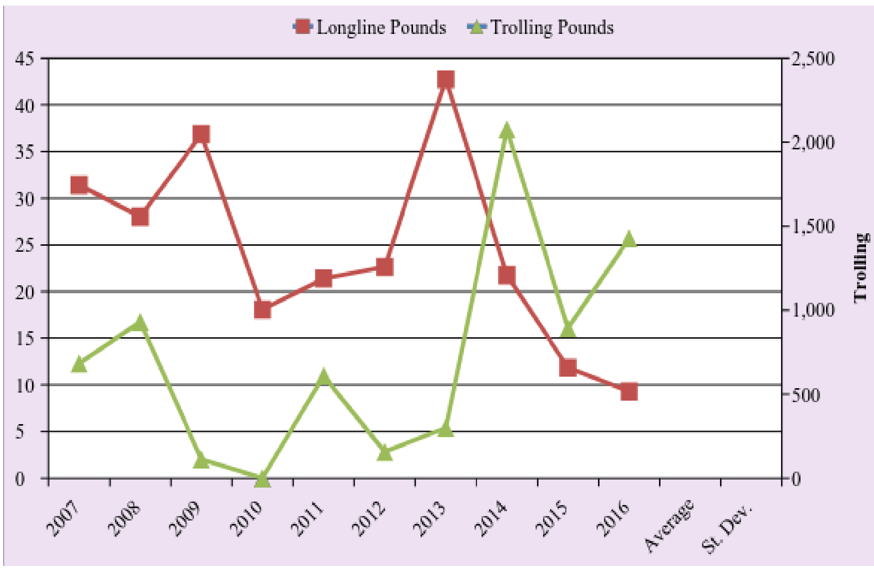
Source: WPFMD 2019a.

Figure 1-16. American Samoa Estimated Annual Total Yellowfin Tuna Landings by Longline and Troll (2009-2018)



Source: WPFMC 2019a

Figure 1-17. American Samoa Estimated Annual Total Bigeye Tuna Landings by Longline (2009-2018)



Commented [TS101]: uh-oh! The relevant figure in the 2018 SAFE report is actually a repeat of the Wahoo one right above it! HALP?! Pasted a screenshot into the text to illustrate this

Figure 8. American Samoa annual estimated total landings of wahoo from 2009-2018
n unrepresentative amount of wahoo were caught on one day in the troll fishery in 2016. The supporting data
shown in Table A-8.

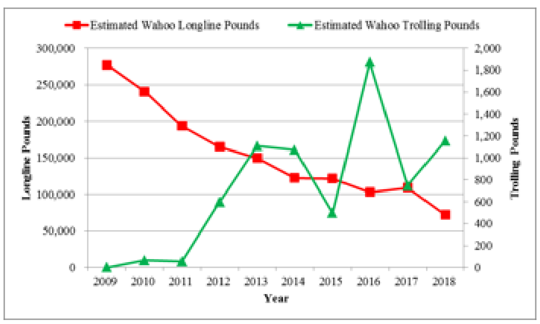
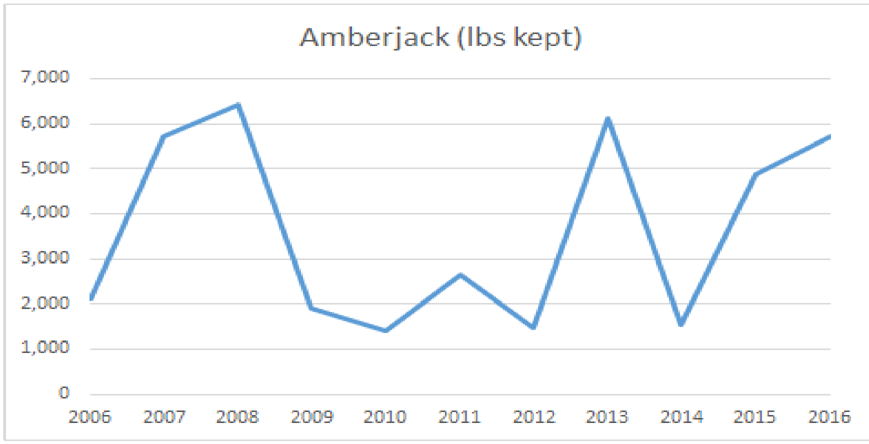


Figure 9. American Samoa annual estimated total landings of mahimahi from 2009-2018
upporting data shown in Table A-9.

27

Source: WPFMC 2017a.
Note: Left y axis is longline catch in 1,000's of lbs., right y axis is troll catch in lbs.

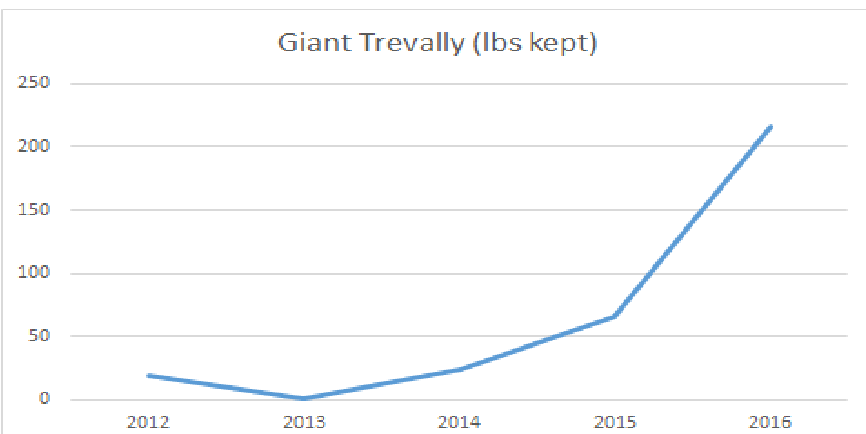
Figure 1-18. American Samoa Estimated Annual Total Mahi Mahi Landings by Longline and Troll (2007-2016)



Commented [TS102]: would need to spend some time going through the CREEL data to make new graphs (gonna try to consolidate wherever possible)

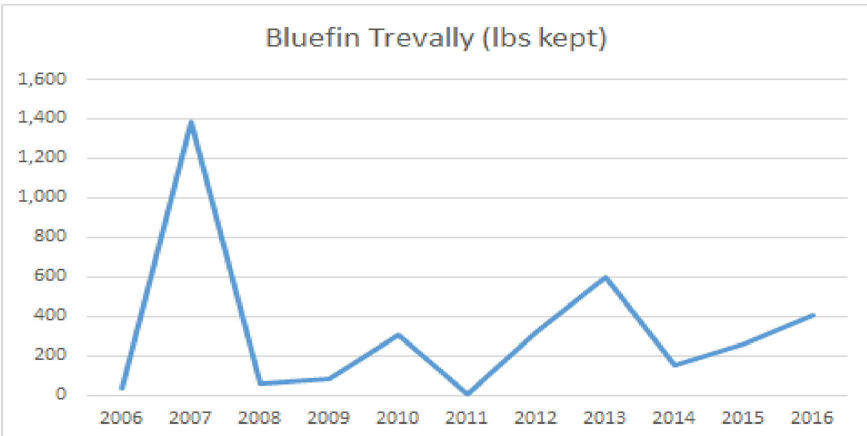
Note: Amberjack species include *Seriola dumerili, S. lalandi, and S. rivoliana,*
Source: American Samoa Department of Marine & Wildlife Resources Creel Survey Data.

Figure 1-19. American Samoa Estimated Annual Amberjack Total Pounds Kept (2006-2016)



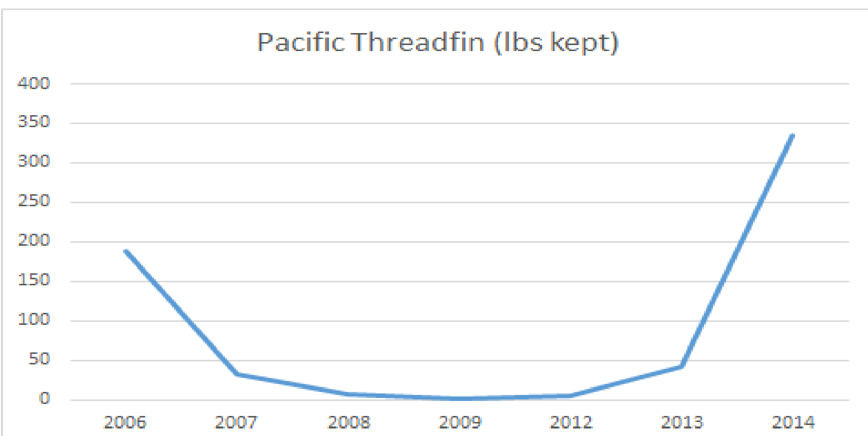
Source: American Samoa Department of Marine & Wildlife Resources Creel Survey Data

Figure 1-20. American Samoa Annual Giant Trevally Estimated Total Pounds Kept (2012-2016)



Source: American Samoa Department of Marine & Wildlife Resources Creel Survey Data

Figure 1-21. American Samoa Estimated Annual Bluefin Trevally Total Pounds Kept (2006-2016)



Source: American Samoa Department of Marine & Wildlife Resources Creel Survey Data.
Note: Pacific threadfin, Polydactylus sexfilis also includes unspecified threadfins (Polydactylus spp.)

Figure 1-22. American Samoa Estimated Annual Pacific Threadfin Total Pounds Kept (2006-2014)

Revenue from Commercial Fisheries

Commented [TS103]: From Colby: It might be important to include some brief assessment of the status of the canary, and frequent reports in the media that they might be closing (I think in part to tax exempt status potentially changing), especially if it is assumed that aquaculture products would go to the cannery, and not a fresh fish export market

The estimated annual pelagic landings have varied widely, from 4.1 to nearly 11 million lbs. since 2009. The total estimated 2018 landings were approximately 4.1 million lbs., the lowest in the past decade, which contributes to the declining trend since recent peak landings in 2009-2010 (Figure 4). Pelagic landings consist mainly of five tuna species including albacore, yellowfin, skipjack, mackerel, and bigeye, which made up approximately 95% of the total estimated landings when combined with other tuna species. Albacore made up 79% of the tuna species total estimated landings. Wahoo, blue marlin, swordfish, and mahimahi made up most of the non-tuna species landings.

The following tables provide annual estimated revenue information for amberjack (Table 3-8), bluefin trevally (Table 3-9), giant trevally (Table 3-10), threadfin (Table 3-11), and rabbitfish (Table 3-12) sold to commercial vendors in American Samoa. The source for these tables is the American Samoa Department of Marine & Wildlife Resources Creel Survey Data (PIFSC 2018), pounds are X 1,000 and all tables also show estimated revenue adjusted by the Consumer Price Index (CPI).

Table 1-10. American Samoa Amberjack Estimated Pounds Kept and Estimated Total Pounds Sold to Commercial Vendors (2006-2016)

Year	Estimated Pounds Kept	Estimated Pounds Sold	Estimated Revenue	CPI Adjusted Revenue
2006	2,125	1,693	$404	$552
2007	5,728	958	$649	$839
2008	6,422	1,785	$588	$708
2009	1,901	1,293	$526	$609
2010	1,409	343	$318	$355
2011	2,633	620	$493	$510
2012	1,484	1,052	$368	$367
2013	6,124	1,045	$1,008	$987
2014	1,550	804	$930	$913
2015	4,890	524	$341	$336
2016	5,723	363	$423	$423

Note: Amberjack species include *Seriola dumerili, S. lalandi, and S. rivoliana.*

Commented [TS104]: Need src

Commented [MF105]: Are these revenue numbers in the last two columns correct, i.e., just a few to several hundred dollars? Or, are they thousands, i.e., ___,000?

Commented [TS106R105]: Great question. Will look into it when I go into CREEL data to update; assuming that's where this came from?

Table 1-11. American Samoa Bluefin Trevally Estimated Pounds Kept and Estimated Total Pounds Sold to Commercial Vendors (2006-2016)

Commented [TS107]: Need src

Year	Estimated Pounds Kept	Estimated Pounds Sold	Estimated Revenue	CPI Adjusted Revenue
2006	38	0	$0	0
2007	1,381	0	$0	0
2008	58	48	$133	160
2009	81	74	$191	221
2010	309	54	$100	112
2011	1	1	$0	0
2012	322	0	$0	0
2013	600	93	$174	170
2014	150	98	$185	182
2015	255	10	$29	28
2016	405	171	$280	280

Table 1-12. American Samoa Giant Trevally Estimated Pounds Kept and Estimated Total Pounds Sold to Commercial Vendors (2012-2016)

Commented [TS108]: Need src

Year	Estimated Pounds Kept	Estimated Pounds Sold	Estimated Revenue	CPI Adjusted Revenue
2012	18	18	$64	64
2013	0	0	$0	0
2014	23	23	$100	98

2015	65	65	$100	99
2016	216	216	$300	300

Table 1-13. American Samoa Pacific Threadfin Estimated Pounds Kept and Estimated Total Pounds Sold to Commercial Vendors (2006-2014)

Commented [TS109]: Need src

Year	Estimated Pounds Kept	Estimated Pounds Sold	Estimated Revenue	CPI Adjusted Revenue
2006	188	0	$0	0
2007	32	23	$46	59
2008	6	0	$0	0
2009	1	0	$0	0
2012	5	0	$0	0
2013	41	10	$41	40
2014	334	8	$25	25

Note: Pacific threadfin, *Polydactylus sexfilis* also includes unspecified threadfins (*Polydactylus* spp).

Table 1-14. American Samoa Rabbitfishes (including juveniles) Estimated Pounds Kept and Estimated Total Pounds Sold to Commercial Vendors (2006-2016)

Commented [TS110]: Need src

Year	Estimated Pounds Kept	Estimated Pounds Sold	Estimated Revenue	CPI Adjusted Revenue
2006	87	14	$25	34
2007	118	6	$13	16
2008	129	87	$208	250
2009	20	2	$5	6
2010	40	17	$47	52
2011	44	22	$64	67
2012	18	1	$3	3
2013	31	25	$70	69
2014	30	25	$62	61
2015	147	141	$200	197
2016	1128	12	$36	36

Note: Rabbitfishes include *Siganus argenteus, S. guttatus, S. punctatus, S. spinus, S. stellatus, S. vermiculatus, and Siganus spp*. (juv).

Commercial Fishery Suppliers and Markets

The pelagic fishery in American Samoa continues to be an important component of the American Samoan domestic economy. American Samoa is a landing and canning port for the U.S. Purse seine fishery for skipjack and yellowfin tuna, with the largest catch of all U.S. pelagic fisheries in the region. The U.S. longline fishery for South Pacific albacore conducted primarily in the American Samoa EEZ comprises the second-largest of the U.S. longline fisheries in the FEP (after Hawaii). Albacore is the primary longline species, with the bulk of the longline catch sold to the Pago Pago cannery. The remaining catch is sold to stores, restaurants and local residents or donated for customary trade or traditional functions. Pago Pago Harbor on the island of Tutuila is a regional base for the trans-shipment and processing of tuna taken by domestic fleets from other South Pacific nations, the distant-waters longline fleets, and purse seine fleets in part due to its exemption from the Nicholson Act, which prohibits foreign ships from landing their catches in U.S. ports (WPFMC 2019b). American Samoa is unique in the Western Pacific Region in its development of domestic industrial-scale fisheries, including tuna processing, transshipment, and home port industries. Purse seine vessels land skipjack, yellowfin and other tunas, with little albacore. Please refer to the 2016 Stock Assessment and Fishery Evaluation Report Pacific Islands Pelagic Fisheries for more details (WPFMC 2019a).

Commented [MF111]: Just one remaining cannery is AS

The vast majority of American Samoans consume fish or seafood at least once a week, mostly purchased from stores or restaurants, but some obtained from roadside vendors or caught by family members. With the enhanced operating costs associated with more technologically advanced and larger fishing boats that allow American Samoan boats to travel further, boat owners and operators have found it necessary to sell a portion of their catch to pay for fuel and engine maintenance.

Non-commercial Fishing Considerations

Fishing, either for subsistence or recreation, continues to be an important activity throughout the Western Pacific Region including American Samoa. Catch-and-release recreational fishing is virtually unknown in American Samoa, and providing fish to meet cultural obligations is very important (Tulafono 2001). Fishermen occasionally fish for cultural purposes, although cultural, subsistence, and recreational fishing categories can be difficult to distinguish, as fishermen's trips might have more than one source of motivation.

Tournament fishing for pelagic species began in American Samoa in the 1970s, and between 1974 and 1998, a total of 64 fishing tournaments have been held in American Samoa (Tulafono 2001). Most participants fished using alia catamarans and small skiffs and tournament catches were often sold. More recently, recreational fishing has undergone a renaissance in American Samoa through the establishment of the Pago Pago Game Fishing Association (PPGFA), founded in 2003. The PPGFA has hosted international fishing tournaments in each of the past five years with fishermen from neighboring Samoa and Cook Islands attending. The vessels use anchored FADs extensively and venture out to various outer banks.

There is no full-time regular charter fishery in American Samoa similar to Hawaii or Guam, although Pago Pago Marine Charters does include fishing charters in its suite of services (WPFMC 2019a).

Commented [TS112]: FYI the table that is supposed to have estimates of non-commercial pelagic catch only contains info for Hawaii ("Table 29. Estimated boat-based non-commercial pelagic fish catches in the four principal island groups of the Western Pacific Region in 2018')

In addition to the 2018 Pelagics SAFE report (WPFMC 2019a), and the 2018 American Samoa SAFE report (WPFMC 2019b), Levine and Allen (2009) and Grace-McCaskey (2015) provide additional background on subsistence, cultural and recreational fishing in American Samoa.

Commented [MF113]: There are 2018 SAFE reports available. http://www.wpcouncil.org/annual-reports/

Boat-based recreational fishing revolves primarily around fishing clubs and fishing tournaments, with most participants operating 28-foot alia catamarans and small skiffs (Tulafono 2001). In recent years, 7 to 14 local boats carrying a total of 55 to 70 fishermen participated in each tournament, held two to five times per year (Craig et al. 1993). The PPGFA is the driving force for recreational fishing, with a membership that includes approximately 15 recreational fishing vessels ranging from 10-foot single engine dinghies to 35-foot twin diesel engine cabin cruisers. The recreational vessels use anchored FADs extensively, and on tournaments venture to the various outer banks which include the South Bank (35 mi [56 km] S), North East Bank (40 mi [64 km] NE), South East bank (37 mi [60 km] SE), Two Percent Bank (40 mi), and East Bank (24 mi [39 km] E).

1.3.3.5 Relevant Socio-economic Profile

American Samoa population is about 49,437 (July 2020 estimate) composed of about 92.6% Pacific Islanders (the vast majority of whom are Samoan), 3.6% Asian, 2.7% mixed (2010 estimate). The Samoan language is the primary language spoken at 88%, but most people are bilingual. The median age is 27.2 years old. Almost 90% of the total population lives in urban areas and the rate of urbanization is increasing, while the overall population size is declining. Agriculture comprised 27.4% of the GDP, with products including bananas, coconuts and other crops. The estimated GDP per capita in 2016 was $11,2000. In 2013, American Samoa exported an estimated $428 million in products, primarily canned tuna (93%) and imported an estimated $615 million, primarily raw materials for canneries, food and petroleum. (CIA World Factbook https://www.cia.gov/library/publications/the-world-factbook/geos/print_aq.html, accessed April 03, 2020).

Commented [TS114]: I swear, that's what the CIA factbook says..

The two most important economic sectors of the American Samoa economy are the American Samoa Government, which receives income and capital subsidies from the federal government, and tuna canning. Although the vast majority of cannery workers are not American Samoa citizens, the canneries play a large role in the economy through delivery of goods or services to tuna processors, as well as cannery employee income and local expenditures. The viability of the American Samoa cannery has been questionable in recent years as American Samoa experienced several cannery closures over the past decade.

Fishing and other marine resources have played a crucial role in cultural, economics and subsistence aspects of Samoan village life. Fishing had been held in high esteem in traditional Samoan culture, with fishing skill bringing high social status. The tautai, or master fisherman, of the village was a key decision maker who was awarded higher status than others (who might otherwise outrank him) when it came to matters of fishing. Village-level systems of governance and resource tenure are still largely intact. Reciprocity is emphasized over individual accumulation and gifts of food (especially fish and other marine resources) mark every occasion and maintain Samoan social structure to this day.

Over the last fifty or so years, fishing has become less prominent as a central and organizing community force. During this time, modern fishing gear had been introduced and tuna canneries became a major economic force, along with a rapid increase in population. As a result, American Samoa has experienced a shift from a subsistence-oriented economy where sharing of fish catch was extremely important, to a cash-based economy, where fishing is often viewed as a more commercial venture.

Additional information about the role of fishing and marine resources across American Samoa, as well as information about the people who engage in fishing or use fishing can be found in the American Samoa FEP SAFE Report (WPFMC 2019b), Pelagics FEP SAFE Report (WPFMC 2019a) and Grace-McCaskey (2015).

1.3.4 American Samoa Administrative Environment

Federally managed sanctuaries, monuments and wildlife refuges

On April 2, 1900 Chiefs of the islands of Tutuila and Anuu ceded and swore allegiance to the United States of America. On July 16, 1904 the island of Manua was ceded to the United States of America. The islands now form American Samoa (Gurr n.d.). The Deeds of Cession of Tutuila and Aunuu and Deed of Cession of Manua are treaties or international agreements accepted by a Congressional act in 1929 with special guarantees of protection of ceded waters and their marine resources for the American Samoan people (Sagapolutele 2016).

The National Marine Sanctuary (NMS) of American Samoa, originally designated in 1986 as the Fagatele Bay NMS, was expanded from its 0.25 mi^2 (0.65 square km^2) site at Fagatele Bay to an additional five additional discrete units: Fagalua/Fogamaa, Swains Island, Tau, Aunuu and Muliāva (Rose Atoll), totaling 13,581 mi^2 (35,175 km^2) with the Rose Atoll unit accounting for 99% of the expansion (77FR43942). Within the Sanctuary, commercial fishing is not explicitly prohibited.

The Rose Atoll MNM was designated by President G.W. Bush in 2009, and encompasses 13,436 mi^2 (34,800 km^2) of pelagic habitat surrounding the 0.08 mi^2 (0.214 km^2) Rose Atoll. All extraction is prohibited within 12 nm of the atoll and all commercial fishing is prohibited within the boundaries of the MNM. The Monument is cooperatively managed by the Secretary of Commerce (NOAA), the Secretary of the Interior in cooperation with the Department of State, the Department of Defense, and the Government of American Samoa. The Monument also encompasses the Rose Atoll National Wildlife Refuge and is part of the National Marine Sanctuary of American Samoa.

Department of Defense Jurisdictions

State Management

American Samoa is an unincorporated, unorganized, and self-governing territory of the U.S. and remains administered by the Office of Insular Affairs, U.S. Department of the Interior. It is "unincorporated" because it is excluded from some provisions of the U.S. Constitution and Congress has not provided it with an organic act, which would organize the government in the same manner as a constitution would. (Future Political Status Study Commission 2007). Instead, Congress gave plenary authority over the territory to the President of the U.S., who then delegated that authority to the Department of the Interior. The Secretary of the Interior enabled American Samoans to draft a constitution under which the American Samoa Government functions (Office of Insular Affairs 2017; USDOL 2017).

American Samoans are classified as U.S. nationals rather than as full citizens. Consequently, they cannot vote in national elections, but have freedom of entry into the United States. American Samoa has had an elected, nonvoting Member of Congress in the U.S. House of Representatives since 1981 (USDOL 2017).

Commented [TS115]: From Colby: This sanctuary section should be elaborated upon to outline the steps required for potential support from, or opposition against commercial enterprise such as aquaculture, within any sanctuary. The assumption that since fishing is allowed, aquaculture would be allowed as well, is a poor, and very likely a totally inaccurate connection. In my experience working with the Olympic Coast National Marine Sanctuary, is that sanctuary staff (and supporting legal regulations) are strongly opposed to commercial projects, especially those with any benthic anchoring structure of any sort. I would imagine trying to site an aquaculture project within the National Marine Sanctuary of American Samoa would be next to near impossible, so the statement is very likely, very misleading.

Commented [MF116]: The last sentences of this and the subsequent paragraph could be deleted from this affected environment section and be taken up later when discussing potential effects of the alternatives?

Commented [MF117]: I wonder if there is anything at all that needs to be said of DoD jurisdictions? Not sure if there are any military installations on AS.

Commented [TS118R117]: Haven't gotten around to researching these. We could go the easy route, and indicate that there are apparently 2 formerly used defense sites (via ocean reports; but that's a really coarse tool). Otherwise would need some guidance on whether to dig into this, or whether to say 'none here. NEXT'

Primary management of marine resources within territorial waters is provided by the Department of Marine Wildlife Resources with assistance from NMFS. Activities include conducting creel surveys, enforcing territorial fishing regulations, conducting water quality surveys, and participating in various marine wildlife and habitat research and monitoring projects.

1.4 Mariana Archipelago (Guam, CNMI)

The Mariana Archipelago composed of 15 volcanic islands with a total land area of 396 mi^2 (1026 km^2) that are part of a submerged mountain chain that stretches nearly 1,500 mi (2,414 km) from Guam to Japan. Politically, the Mariana Archipelago is split into the Territory of Guam and the CNMI (WPFMC 2009b).

Guam is located at 13° 28' N latitude and 144° 45' E longitude and has a total land area of 216 mi^2 (560 km^2). It is the southernmost and largest island in the Mariana Archipelago. Guam is the closest island to the Mariana Trench that lies east of the island chain (WPFMC 2009b).

The Commonwealth of Northern Mariana Islands stretches over 400 nm (741 km) between 14-21°N latitude and 144-146°E longitude. The total land area of CNMI is approximately 179 mi^2 (453 km^2). The CNMI is made up of fourteen islands in the Archipelago. The southern islands are limestone and the northern islands are volcanic with several active volcanoes (WPFMC 2009b).

The following is information relevant to the proposed action, a full description of the affected environment can be found in the Marianas FEP.

Commented [TS119]: From Colby . I'd throw in a map here of where CNMI is located in relation to the other areas. Come to think of it, I'd do the same for American Samoa in that section as well. Since the PIR action areas under consideration are so vastly separated from one another across the Pacific, it would help the reader conceptualize it all.

Commented [MF120R119]: Agree, though maybe one good map early in this affected environment section and/or at the action area section at the very beginning of the PEIS is sufficient.

1.4.1 Physical Environment

1.4.1.1 Geological Features

Coastline

Coastlines within Marianas are generally lined with rocky intertidal areas, steep cliffs and headlands, and the occasional sandy beach or mudflat (Eldredge 1983). The water erosion of rocky coastlines in the islands has produced cliffs and sea-level benches (Eldredge 1979, 1983). For Guam, the majority of the coastline is comprised of rocky intertidal regions, with some beaches composed of calcareous and volcanic sands (Eldredge, 1983). The island of Saipan is lined with fine sand beaches protected by two barrier reefs (Scott 1993). On the western coastline of Saipan, the barrier reefs form two additional lagoons, creating the largest lagoon system in the Mariana Islands (Environmental Services Duenas & Associates 1997).

Open Ocean

Commented [TS121]: FC Again, it seems relevant to include some maps of the area most prominent sea mounts, troughs, guyots, trenches, and vents. Furthermore, it seems relevant to include information to how these features contribute to ecological (baseline) integrity.

The Mariana Archipelago is a chain of volcanic islands, and due to its topography has relatively steep profile. This limits the neritic zone, or the zone where sunlight reaches the ocean floor, in the open ocean areas and EEZ. The waters surrounding the islands and that make up the EEZ are generally greater than 10,000 ft (3,050 m) deep, but are scattered with different bottom habitats.

The soft bottom habitat in the Mariana Archipelago is the Mariana Trough found in the open ocean around the islands. The Mariana Trough is comprised of an abyssal plain (large and relatively flat regions covered in a thick layer of fine silty sediments) with water depths ranging from approximately 11,500 to 13,100 ft (3,505 to 3,993 m) (Kennett 1982; Thurman 1997). While biomass is low in abyssal plains, research indicates they harbor thousands of species of invertebrates and fish (NOAA 2016).

There are two types of hard-bottom habitats found in the open ocean of the Mariana Archipelago - seamounts and flat-topped seamounts known as guyots. Seamount and guyot topography is a contrast to the Mariana Trough. Guyots are also undersea mountains except with a flat top of over 984 ft (300 m) below the surface and have been above the surface at some time, however due to erosion have been worn down.

Seabanks also occur throughout the Marianas. Banks are generally volcanic structures of various sizes and occur both on the continental shelf and in oceanic waters. These are generally shallower areas of the seafloor, creating deep offshore reef habitat (Levington 1995). Seabanks found around the Mariana Archipelago include: Galvez bank located 12 mi (19.3 km) south of Guam, Santa Rosa Reef located 25 mi (40.2 km) south-southwest of Guam, Arakane Bank located 200 mi (321.9 km) west-northwest of Saipan, Tatsumi Reef located 1.2 mi (1.93 km) southeast of Tinian, Pathfinder Bank located 170 mi (273.6 km) west of Anahatan, and Supply Reef located 11.5 mi (18.5 km) northwest of Maug Island (Starmer 2005). There is also a large shallow (< 330 ft [100 m] deep) bank offshore the west coast of Saipan approximately 5 mi (8 km) long by 1 m (1.6 km) wide.

The Marianas Trench is the deepest part in the world's ocean and lies about 124 mi (200 km) east of the Marianas Islands. It is nearly 36,000 ft (11 km) at its deepest point of the seafloor. The trench was created by the convergence of the Pacific Plate and Philippine Plate (Paulay 2003).

Hydrothermal vents are also found surrounding the Mariana Archipelago and are common in the Mariana Trench. Hydrothermal vents are created from seawater permeating through the crust and upper mantle of the earth. As seawater percolates downward through the oceanic crust, it becomes super-heated and chemically rich, eventually reaching the seafloor surface. When the super-hot vent fluid, meets with cold deep-sea water, minerals that are carried in the fluid precipitate out, forming vent chimneys (Amon and Glickson, 2016). On the Mariana Ridge there are three known hydrothermal vent fields: Forecast Vent site (13°24'N, 143°55'E), TOTO Caldera (12°43'N, 143°32'E) and the 13°N Ridge (13°05'N, 143°41'E) (Kojima 2002).

1.4.1.2 Oceanographic Features

Commented [TS122]: FC A map of these predominant currents seems relevant, and even necessary for the reader to conceptualize.

Surface temperatures are relatively constant at 83°F (28.2°C), and decrease rapidly through a thermocline layer between water depths of approximately 490 to 1,310 ft (150 to 400 m). Salinity concentrations are constant in the mixed surface layer at 34.5 ppt. Turbidity values are relatively constant throughout the entire water column with minor changes. Turbidity ranged from 43.5 Nephelometric Turbidity Units (NTU) to 44.9 NTU in surface waters. DO concentrations in surface waters averaged approximately 5.98 mg/L, declining to 2.21 mg/L at a depth of 1,800 ft (549 m) (DOD 2015).

The major surface current affecting CNMI and Guam is the North Equatorial Current, which flows westward through the islands. The Subtropical Countercurrent affects the Northern Islands and generally flows in an easterly direction (Eldredge, 1983). Seamounts and guyots affect the upwelling of nutrients to the surface, creating a hotspot of biodiversty (Rogers 1994; Lalli and Parsons 1997).

1.4.1.3 Extreme Weather

The Mariana Archipelago has a tropical marine climate, with seasonal northeast trade winds from November to March and easterly winds from May to October. The average year-round temperature is 84°F (28.9°C) with an average humidity of 79% (USDOI 2006). The Mariana Archipelago is located 600 mi (966 km) east of an area where cyclonic disturbances typically begin to form. As a result, the region remains in a weather condition "four" at all times, indicating 40 mph (64 km/hr) winds are possible within 72 hours. Cyclonic disturbances come quickly with winds up to 120 mph (193 km/hr) or greater (Northern Mariana Islands, n.d, USDOI, 2006).

Typhoon season is from July to January. CNMI is located in "Typhoon Alley" and is subject to at least one typhoon each year (Northern Mariana Islands, n.d., USDOI, 2006). Typhoons are also frequent on Guam with up to five typhoons per year (Birkeland 1997, Eldredge, 1983, USDA 1995).

1.4.2 Biological Environment

The biological environment of the Mariana Archipelago, including the species addressed in this PEIS, is described in detail in the FEP for the Mariana Archipelago which is incorporated here by reference (WPFMC 2009b). Specific resources of concern, identified during scoping and interagency informal consultations are described to the level necessary for appropriate analysis.

1.4.2.1 Benthic and Sessile Organisms

See Section 3.3.2.1 for the general biology of benthic and sessile organisms in the nearshore and offshore habitat. This section covers the only life history information specific to the Marianas Archipelago.

Nearshore Reefs

The total coral reef area in CNMI is estimated at 48 mi^2 (124 km^2) of shallow reef habitat within the 10-fathom (18 m) contour. The older southern islands have fringing and barrier reefs, while the northern islands, which are still volcanically active, have minimal coral reef coverage (Eldredge, 1983). Approximately 50 percent of Guam's 95-mi (153-km) shoreline is surrounded by well-developed coral reefs within the 108 square kilometers of habitat within a 10-fathom curve (Myers 1997; Randall and Myers 1983). Coral reefs also occur at offshore banks located in federal waters. The total coral reef area in Guam is estimated at between 42 and 107 mi^2 (108 and 276 km^2) (Rohmann et al. 2005).

The differences in coral reef development between islands in the archipelago are due to the age and geology of the islands. Faulting of large areas in the older islands has created oblique, shallow-water areas that support reef growth. While the younger islands have a vertical profile that is not conducive to reef development (Birkeland, 1997).

CNMI's coral reefs have experienced some damage from typhoons in the area and coral bleaching in 1994, 2001, and 2003. Some of the coral reefs also appear to be affected by human activity (WPFMC 2009b).

The health of Guam's coral reefs vary considerably with impacts ranging from anthropogenic to natural sources (WPFMC 2009b).

Commented [TS123]: •FC It seems relevant to include a map of "Typhoon Alley" while also including a table of historical major storm events, including ecological, and economic impacts.

Commented [TS124]: FC Yet no specific information here is included on benthis and sessile organisms specifically as it pertains to the more micro-scale of CNMI. I'd suggest elaborating substantially, even if weakly incorporating by reference above.

Commented [TS125]: FC Borrow some tables and maps on coral bleaching events from this, or other sources.

Then it seems particularly relevant to include maps of known healthy coral reef areas so that aquaculture actions under consideration are properly sited so as not to adversely affect the remaining healthy reef systems.

Offshore Reefs

Deep sea corals likely occur in suitable habitats across the archipelago. The Mariana Archipelago FEP identifies eleven federally managed species: three pink coral, three gold coral, two bamboo coral, and three black coral species (WPFMC 2009b).

1.4.2.2 Significant Aquaculture Species and the Status of those Stocks in Federal Waters

Full descriptions of Mariana Archipelago MUS are available in the Fishery Ecosystem Plan for the Mariana Archipelago (WPFMC 2009b). In addition, species with the highest potential for aquaculture (i.e., almaco jack, Bluefin trevally, giant trevally, moi) are described in Section 3.2.2.2. Stock assessments have not been completed for these species and ACLs have only been determined for the jack family, which are also outlined in Section 3.2.2.2

1.4.2.3 Protected Species

Most of the protected species that occur in the Mariana Archipelago occur elsewhere in the PIR. Full descriptions of these species are provided in Section 3.2 and only details specific to the Mariana Archipelago are included here.

Marine Mammals

The three endangered marine mammals that occur within the Mariana Archipelago are, the humpback whale, sei whale and sperm whale.

The humpbacks that winter in the Mariana Archipelago are believed to be part of the endangered Western North Pacific stock, which migrate from the Bonin (Ogasawara) Islands (Eldregde 2003). Humpback whales have been sighted around Guam and CNMI (Eldredge 2003), however the number of whales that winter in the Mariana Archipelago each year is unknown (Fulling et al., 2011).

According to the International Whaling Commission, there is one stock of sei whales in the North Pacific, but some evidence exists for multiple populations (Forney et al. 2000). Sei whale sightings are associated with steep bathymetric relief (e.g., steeply sloping areas), including sightings adjacent to the Chamorro Seamounts east of the CNMI (Fulling et al. 2011). All sightings in a 2007 survey were south of Saipan, indicating that this species occurs south of 20°N in the winter (Fulling et al. 2011).

Information is minimal for the sperm whale stock in the Mariana Islands. Kasuya and Miyashita (1988) suggest that that there are two stocks of sperm whales in the western North Pacific, a northwestern stock with females that summer off the Kuril Islands and winter off Hokkaido and Sanriku, and the southwestern North Pacific stock with females that summer in the Kuroshio Current System and winter around the Bonin Islands. There have been only a few reported sightings over the years in the Marianas, including around Guam in the 1980s, two individuals around Guam and Saipan in 2010, and a group of 10 whales off western Guam in 3,949 feet (1,200 m) deep waters in 2012 (HDR EOC 2012).

Sightings of other marine mammals are outlined in table XX. A single dugong (*Dugon dugong*) was observed in Cocos Lagoon, Guam in 1975 (Randall et al 1975). Dugongs are members of the Sirenia order, which include sea cows and manatees, and have a distribution from the east African coast to islands in the southwestern Pacific. Several sightings were reported in 1985 on the southeastern side of Guam (Eldredge 2003). Since that time, however no reports of dugong sightings have been made. No observations of dugongs have been reported for CNMI.

Commented [TS126]: .FC It seems crazy to me to not include a table (and maps) of known species abundance percentage comparisons between species from any available surveys (dive, ROV, etc.). I could show you some examples of this in other areas if interested

Commented [TS127]: FC In Federal Waters, regarding stock assessments of these species in CNMI. Perhaps there are some data poor estimates specifically to this region for aquaculture non-jack family species of interest within the Federal CNMI action area?

Commented [TS128]: FC There is a PBR estimate for this stock of FKW. I'd include that, along with some discussion of how the PBR was derived, here.

Table 1-15 non-ESA listed marine mammals found in the Mariana Archipelago (source: DOD 2015)

Common Name	Scientific Name	Common Name	Scientific Name
Blainsville beaked whale	*Mesoplodon densirostris*	pygmy killer whale	*Feresa attenuata*
bottlenose dolphin	*Tursiops truncatus*	Risso's dolphin	*Grampus griseus*
Bryde's whale	*Balaenoptera edeni*	rough-toothed dolphin	*Steno bredanensis*
Cuvier's beaked whale	*Ziphius cavirostris*	short-finned pilot whale	*Globicephala macrorhynchus*
false killer whale	*Pseudorca crassidens*	spinner dolphin	*Stenella longirostris*
melon-headed whale	*Peponocephala electra*	spotted dolphin	*Stenella attenuata*

Sea Turtles

All five Pacific sea turtle species can occur throughout the Pacific and in all sub-regions of the PIR, however there have been no reports of loggerhead sea turtles or olive ridley sea turtles in the Marianas. A full description of each sea turtle species is provided in Section 3.2.2.3. The following provides Marianas-specific information on these species.

Commented [TS129]: FC The CNMI-specific discussion of sea turtles is completely absent, even though it states "the following provides Marianas-specific information on these species. This section needs a substantial amount of work added to it.

Leatherback Sea Turtles

There have been occasional sightings of leatherback turtles around Guam (Eldredge 2003); however, to what extent (i.e., preferred location, abundance, seasonality) leatherback turtles are present around Guam and CNMI is unknown.

Green Sea Turtles

Based on nearshore surveys conducted jointly between the CNMI–DFW and the NMFS around the Southern Islands (Rota and Tinian 2001; Saipan 1999), an estimated 1,000 to 2,000 green sea turtles forage in these areas (NOAA 2005b). The green sea turtle is a traditional food of the native population and although harvesting them is illegal, divers have been known to take them at sea and others have been taken as nesting females (NMFS and USFWS 1998b). Turtle eggs are also harvested in the CNMI. Nesting beaches and seagrass beds on Tinian and Rota are in good condition but beaches and seagrass beds on Saipan have been impacted by hotels, golf courses and general tourist activities.

Nesting surveys for green sea turtles have been done on Guam since 1973 with the most consistent data collected since 1990. There have been up to 60 nesting females observed annually, with a generally increasing trend over the past 12 years aerial surveys done in 1999–

2000 also found an increase in green sea turtle sightings around Guam (Cummings 2002).

Hawksbill Sea Turtles
Although hawksbill turtles have occasionally been sighted in the past around the CNMI they were not observed in a detailed assessment conducted in 1999, nor were they observed in 10 aquatic surveys along the shores of Tinian in 1995. According to the 1998 Pacific Sea Turtle Recovery Team Recovery Plan for the hawksbill turtle (NMFS and USFWS, 1998b), there are no reports of nesting in the CNMI. This does not rule out the possibility of a few hawksbill nests, as nesting surveys on small pocket beaches in remote areas of CNMI have never been done. A single hawksbill sighting occurred in 1996 during the detonation of an unexploded ordinance off of Rota. The turtle was recovered near the explosion sight and subsequently died, apparently from internal injuries incurred from the blast (Trianni, 1998a). One hawksbill sea turtle nest was found in November 1991 on Guam (NMFS and USFWS 1998c); however this was highly unusual as nesting individuals are otherwise virtually unknown on Guam (Eldredge 2003)**.**

Seabirds

The following seabirds are considered residents of the CNMI: wedge-tailed shearwater, white-tailed tropicbird, red-tailed tropicbird, masked booby, brown booby, red-footed booby, white tern, sooty tern, brown noddy , black noddy , and the great frigatebird (WPFMC 2009b).

The following seabirds have been sighted and are considered visitors (some more common than others) to CNMI; short-tailed shearwater (common visitor), Newell's shearwater (rare visitor), Audobon's shearwater, Leach's storm-petrel, and the Matsudaira's storm-petrel. Of these, only the Newell's shearwater is listed as endangered. There have been no sightings of the endangered short-tailed albatross in the CNMI although the CNMI is within the range of the primary breeding colony on Torishima, Japan (WPFMC 2009b).

According to Wiles (2003), the only resident seabirds on Guam are the brown noddy and the white tern. Common visitors to Guam include the following seabirds: black noddy the shorttailed shearwater. Other less common or rare visitors include: brown and red-footed boobies, wedge-tailed shearwater, Matsudaira's storm-petrel, white-tailed and red-tailed tropicbirds, great frigatebird, gulls, and terns.

Sharks and Rays

All sharks and rays that occur in the Marianas occur elsewhere in the PIR. Thorough descriptions of each species are provided in Section 3.2 (Protected Species).

1.4.3 Social and Economic Environment

In the Marianas, the following species are most likely to be cultured under this action: yellowfin tuna, bigeye tuna, mahi mahi, almaco jack, giant trevally, bluefin trevally, pacific threadfin, and rabbitfish. Section 3.3.2.2. describes the life history characteristics of Pacific pelagic MUS (yellowfin tuna, bigeye tuna, and mahi mahi) and Section 3.5.2.3. describes that of species managed under the Marianas FEP. The focus of the discussion with regard to the economic and social environment potentially affected by this

Commented [TS130]: FC Actually, I think there is another species of Albatross in this area that we do not see in Hawaiian waters. I could dig that up if interested.

Commented [TS131]: Assuming there aren't specifics for this region, but need to check the ESA docs action will be fisheries that catch these species, supporting industries and surrounding fishing communities. The potential for rabbitfish as an aquaculture species is specific to CNMI due to strong local demand for rabbitfish, which is only available seasonally. A rabbitfish aquaculture program is currently being developed at the Northern Marianas College, in part to provide alternative economic opportunities for a community which had suffered through recent losses of garment making industry and downturn in tourism (Secretariat of the Pacific Community 2011).

1.4.3.1 Past and Present Commercial Offshore Aquaculture Operations

Section 3.1.1 provides information on the state of the industry. Commercially, Guam's aquaculture activity is more developed, producing 122 tons (111 t) of eel, carp, catfish, marine shrimp and tilapia in 2012. The CNMI has only recently started the Saipan rabbitfish aquaculture project in 2015. Both Guam and the CNMI have developed academic and government support structure, including the CNMI *Aquaculture Strategic Plan*, the Northern Marianas College aquaculture development center, and the Guam Aquaculture Development Training Center.

State of aquaculture industry

Until 2011, most aquaculture activity in CNMI focused on tilapia and marine shrimp farming (SPC Aquaculture Portal, 2011). In an effort to promote aquaculture in the region, specifically finfish aquaculture, CNMI launched an Aquaculture Strategic Plan (2011-2015), which identified potential and emerging commodities for further development in CNMI. Funding under the USDA provided finfish aquaculture training at the Oceanic Institute, Hawaii, where individuals from Saipan came and studied finfish aquaculture techniques (Ogo, 2015). This launched the Saipan rabbitfish aquaculture project (2015-2018) with the goal to establish a commercially available rabbitfish product to the markets of CNMI (Ogo, 2015). Most recently in February of 2017, the Northern Marianas College Cooperative Research, Extension, and Education Service program (CREES) officially opened a new aquaculture development center. This center is currently the second in the world to perform rabbitfish aquaculture research and also offers training services (Encinares, 2017).

There is one aquaculture facility on Guam, located at the University of Guam in Mangilao. The Guam Aquaculture Development and Training Center currently cultures tilapia, marine shrimp and catfish, though in the past it has also cultured eel, freshwater prawn, carp, milkfish, mangrove crab, mullet and ornamental carp (CTSA 2012; Jiang n.d.). As with the facility in CNMI, the Guam Aquaculture Development and Training Center is also associated with extension activities and can provide training services.

Commented [MF132]: May need to find out if any businesses have been set up on Guam or in CNMI independently of the College and University operations.

Commented [TS133R132]: Reaching out today

1.4.3.2 Relevant Fisheries and Communities

The islands of the CNMI are identified as a single fishing community, and fishing is important both in contributing to the subsistence needs of the Chamorro people and in preserving their history and identity. Fishing has assisted in perpetuating the traditional knowledge of marine resources and maritime traditions of the Chamorro (and Carolinian) cultures and has helped them maintain their connection to the sea and its resources (WPFMC 2009b).

1.4.3.3 Characteristics and Economic Feasibility of Aquaculture Operations that May Operate in Offshore-waters of Guam and the CNMI

While there have been no offshore aquaculture projects in the Marianas Archipelago, important support structure for development currently exists. Guam has a relatively large, part-time fishing fleet that could provide services to offshore cages, including deployment, facility maintenance, stocking and harvesting, feeding, and cage retrieval. The University of Guam and local environmental consulting operations may be able to provide environmental services, including surveys and monitoring, as well as facilitate hatchery technology and the development of a dependable source of broodstock. As described above, both the University of Guam and the Northern Marianas College have aquaculture training services. While some of these services are in early development, they are likely to grow with the growing interest in aquaculture.

The area should be well situated to accommodate both local and export demand for aquaculture products, with a relatively high annual seafood consumption rate (56 lbs. (25 kg) per capita in Guam and 51 lbs. (23 kg) per capita in the CNMI, (WPFMC 2009b and Rhodes et al. 2011, respectively) and proximity to Japanese and other Asian markets. Guam's status as a major regional fish transshipment center (WPFMC 2018d) is also useful for developing and meeting export demand.

1.4.3.4 Scope of Fishing Industry - Wild Stocks

Description of Commercial Fisheries

CNMI pelagic fisheries

Commercial fishing in the Mariana Archipelago is primarily trolling with small boats in nearshore waters. The CNMI's pelagic troll fishery occurs primarily from the island of Farallon de Medinilla south to the Island of Rota, mostly by vessels less than 24 feet in length, that generally take one-day trips within 30 nm (56 km) to primarily target skipjack tuna (WPFMC 2019a).

Participation in pelagic fisheries

The number of boats involved in CNMI's pelagic fishery has been steadily decreasing since 2001, when there were 113 fishermen reporting commercial pelagic landings. In 2016, a decade-high 72 fishermen reported landings, a significant increase from 12 in the previous year but nearly twice as much as the 40 fishers in 2018 (Figure 3-44). Figure 3-45 shows the annual estimated pelagic landings for charter and non-charter boats.

Commented [TS134]: FC Is there a bottomfish fishery in this region? Surely there are some additional commercial fisheries and gear types that are not included here.

Commented [TS135]: FC By charter and non-charter landings, what is this in reference to regarding charter? For example, is recreational charter being included here (section 3.7.1.11.2) as commercial? Is it something else entirely? Define.

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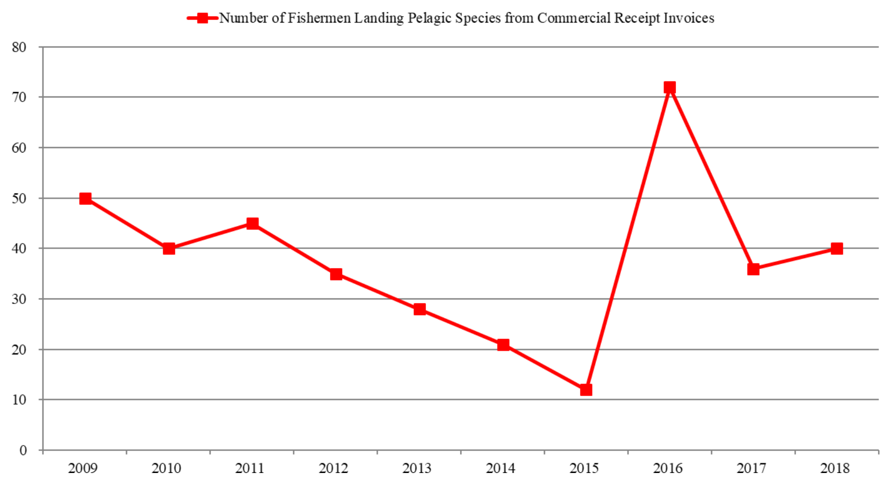
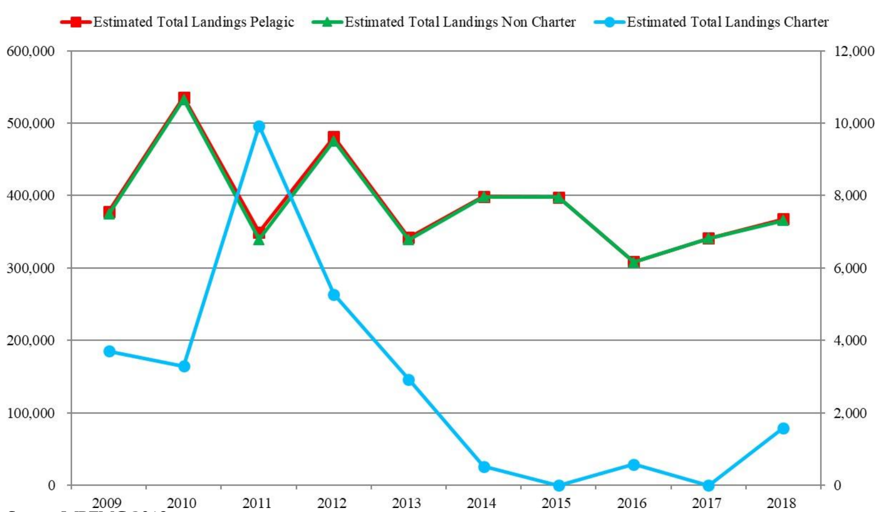


Source: WPFMC 2019a.

Figure 1-23. Number of CNMI Fishermen (Boats) Making Commercial Pelagic Landings (2007-2018)

Landings for pelagic fisheries

Total landings for pelagic fisheries in the CNMI are summarized in figure 3-24.



Source WPFMC 2019a.
Note: Left y axis is non-charter boats and right Y axis is charter boats.

Figure 1-24. CNMI Annual Estimated Total Pelagic Landings, Non-Charter and Charter (2009-2018)

Table 1-16 Pelagic species composition from creel surveys performed in the CNMI in 2018

Species	Total Landings	Non Charter	Charter
SKIPJACK TUNA	291,854	290,681	1,173
YELLOWFIN TUNA	9,694	9,694	0
SABA (KAWAKAWA)	460	460	0
TUNAS (MISC.)	1,325	1,325	0
TUNAS Total	**303,333**	**302,160**	**1,173**
MAHIMAHI	54,903	54,708	196
WAHOO	5,849	5,654	196
BLUE MARLIN	2,467	2,467	0
SAILFISH	0	0	0
SPEARFISH	0	0	0
SHARKS	0	0	0
SICKLE POMFRET (W/WOMAN)	0	0	0
NON-TUNA PMUS Total	**63,219**	**62,829**	**392**
DOGTOOTH TUNA	0	0	0
RAINBOW RUNNER	699	699	0
BARRACUDA	222	198	24
TROLL FISH (MISC.)	0	0	0
OTHER PELAGICS Total	**921**	**897**	**24**
TOTAL PELAGICS	**367,473**	**365,886**	**1,589**

Source WPFMC 2019a.

CNMI bottomfish fisheries

Two distinct types of bottomfish fisheries are identified in the CNMI: shallow-water bottom fishing, which targets fish at depths down to 150 m, and deepwater bottom fishing, which targets fish at depths greater than 150 m. Relatively small (<25ft) fishing vessels are still being used to access bottom fishing grounds around Saipan and Tinian, while the larger (>25ft) vessels are used to access bottomfish resources in the Northern Islands. Only a handful of these larger bottom fishing vessels are operating within the CNMI. Most of the small bottomfishing vessels are owned by vendors; there are, however, a few subsistence bottomfishers that participate in the fishery intermittently. More recently, improved technologies, such as sophisticated electronics to locate fish and various types of reels replacing handlines, have entered the CNMI bottomfish fishery (WPFMC 2019d).

Participation in bottomfish fisheries

The number of boats participating in CNMI's bottomfish fishery peaked in 2010 at 6,300 fishers, saw a marked decrease to roughly 600-800 fishers from 2012-2017, and in 2018 increased to 1,195 fishers. The coral reef boat-based troll fisheries have remained fairly steady in the same timeframe, with roughly 600-

Commented [TS137]: There aren't already figures for this in the CNMI report; only tables.

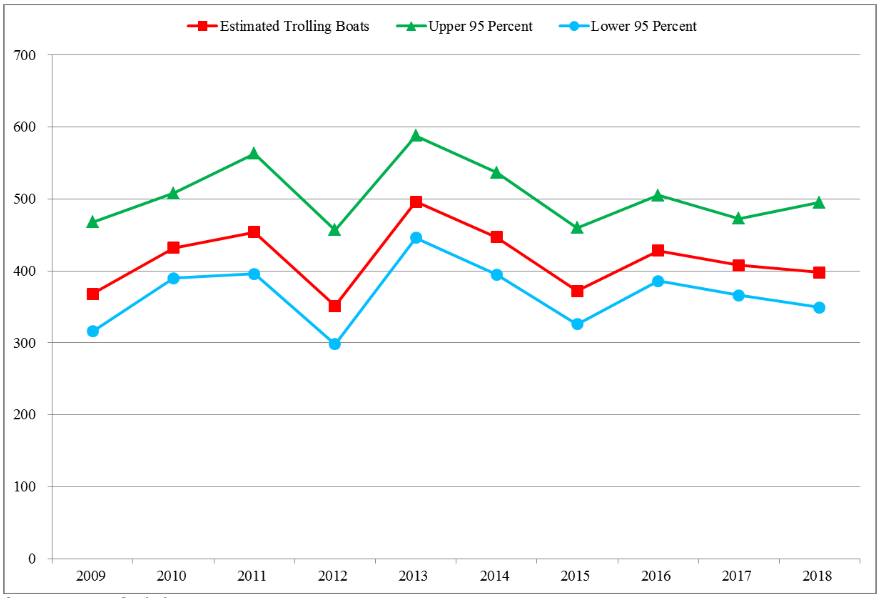
800 fishers between 2010 and 2018. Cast net and atulai fisheries have ranged from 0 to 1,281 fishers in the same timeframe.

Guam pelagic fisheries

Guam's pelagic fishery consists of approximately 400 small, primarily recreational, trolling boats that fish within the local waters of Guam's EEZ or the adjacent EEZ of the Northern Mariana Islands. The majority of the fishing boats are less than 10 m (33 ft) in length and are usually owner-operated by fishermen who earn a living outside of fishing. Most fishermen sell a portion of their catch and it is difficult to make a distinction between recreational, subsistence, and commercial fishers. A small (~5%), but economically significant, segment of the pelagic group is made up of marina-berthed charter boats that are operated primarily by full-time captains and crews. Data and graphs for non-charters, charters, and bycatch are represented in this report. The catch for each area comprises mostly tuna species, particularly skipjack, and mahi mahi.

Participation in pelagic fisheries

The number of boats involved in Guam's pelagic fishery gradually increased from 193 in 1983 to a high of 496 in 2013. There were 398 boats involved in Guam's pelagic fishery in 2018, a decrease of 2.45% from 2017. The majority of the fishing boats are less than 10 m (33 ft.) in length and are usually owner-operated by fishermen who earn a living outside of fishing. Most fishermen sell a portion of their catch, and it is difficult to make a distinction between recreational, subsistence, and commercial fishers. A small but economically significant segment of the pelagic group (~5%) is made up of marina-berthed charter boats that are operated primarily by full-time captains and crews.



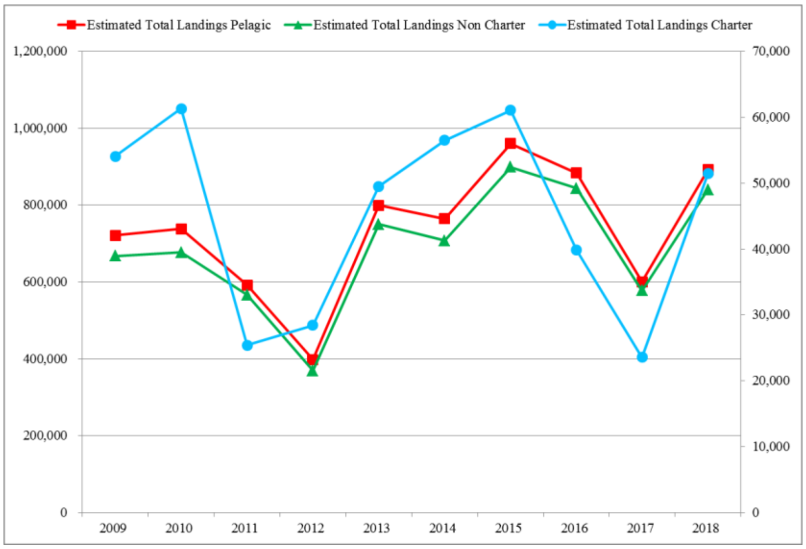
Source: WPFMC 2019a.

Figure 1-25. Estimated Number of Trolling Boats in Guam (2009-2018)

Landings for pelagic fisheries

Skipjack tuna is the principal species landed in Guam, comprising nearly 70% of the entire pelagic landings in 2018 based on creel survey data. Wahoo (Figure 3-55), and mahi mahi (Figure 3-56) Yellowfin tuna (Figure 3-57) ranked second and third, respectively, by weight of landings in 2018. Figure 3-53 shows non-charter and charter pelagic landings over the period 2005 to 2016; Table 3-21 breaks out the total number of non-charter and charter pelagic landings by species.

Commented [TS138]: FYI there are some errors in table 16 of the 2018 pelagics report (page 61); some of the 'totals' lines are inaccurate or missing info



WPFMC 2019a.
Note: Left y axis is charter boats, right y axis is non-charter boats.

Figure 1-26. Guam Annual Estimated Total Pelagic Landings, Non-Charter and Charter (2009-2018)

Table 1-17 Total estimated, non-charter, and charter landings for Guam in 2018

Species	Total Landings	Non-Charter	Charter
Skipjack Tuna	610,751	603,412	7,339
Yellowfin Tuna	52,555	51,433	1,122
Kawakawa	511	511	0
Albacore	0	0	0
Bigeye Tuna	0	0	0
Other tuna PMUS	0	0	0
Total PMUS Total (lbs.)	**663,817**	**655,356**	**8,461**
Mahi mahi	88,817	77,314	11,503
Wahoo	96,035	81,248	14,787
Blue Marlin	24,516	12,754	11,763
Black Marlin	0	0	0

Striped Marlin	0	0	0
Sailfish	4,374	0	4,374
Shortbill Spearfish	0	0	0
Swordfish	0	0	0
Oceanic Sharks	0	0	0
Pomfrets	296	296	0
Oilfish	130	130	0
Non-Tuna PMUS (lbs.)	**214,168**	**171,742**	**42,427**
Rainbow Runner	2,700	2,419	282
Barracudas	5,336	5,120	216
Double- Lined Mackerel	5,727	5,669	58
Troll fish (misc)	0	0	0
Non-PMUS Pelagics Total (lbs)	0	0	0
Total Pelagics (lbs.)	**13,763**	**13,208**	**556**

Source: WPFMC 2019a.

Guam bottomfish fisheries

Bottomfishing in Guam is a combination of recreational, subsistence, and small-scale commercial fishing. It can be separated into two distinct fisheries separated by depth and species composition. The shallow water complex (< 500 feet) comprises the largest portion of the total bottomfish harvest and effort, though in recent years deep water species (>500 feet) have made up a significant portion of the total expanded bottomfishing catch. The majority of bottomfishing around Guam takes place on offshore banks, though practically no information exists on the condition of the reefs on offshore banks (WPFMC 2019d). On the basis of anecdotal information, most of the offshore banks are in good condition due to their isolation. At present, the banks are fished using two methods: bottomfishing by hook and line, and jigging at night for bigeye scad (*Selar crumenophthalmus*; Myers 1997).

Shore-based fishing accounts for most of the fish and invertebrate harvest from coral reefs around Guam. Hook and line is the most common method of fishing for coral reef fish on Guam. In 2018, hook and line fishing accounted for around 75% of fishers and gear. Throw net (talaya) is the second most common method, accounting for about 10% of fishers and gear. Other methods include gill net, snorkel spearfishing, SCUBA spearfishing, surround net, drag net, hooks and gaffs, and gleaning (WPFMC 2019d).

Currently, Guam and the Northern Mariana Islands maintain several fish aggregating devices within 20 nm of the shoreline (WPFMC 2019a, Chapman 2004; Guam Department of Agriculture Division of Aquatic and Wildlife 2004).

Participation in bottomfish fisheries

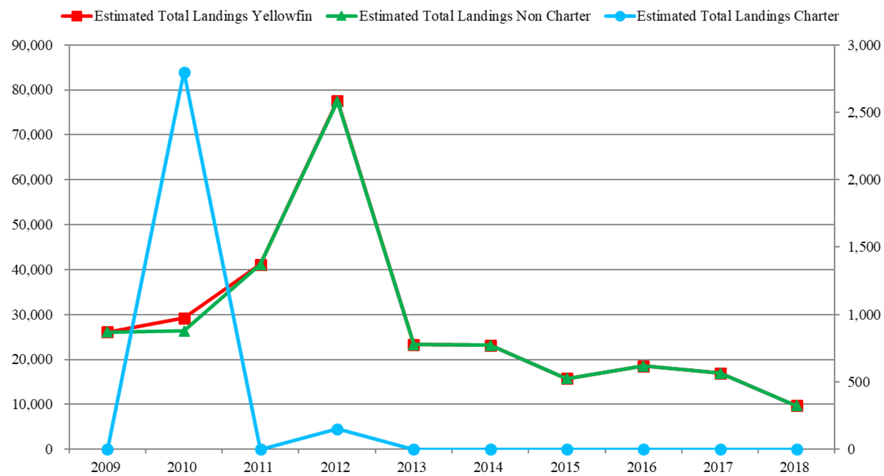
The number of boats participating in Guam's bottomfish fishery peaked in 2010 at 6,300 fishers, saw a marked decrease to roughly 600-800 fishers from 2012-2017, and in 2018 increased to 1,195 fishers. The coral reef boat-based troll fisheries have remained fairly steady in the same timeframe, with roughly 600-800 fishers between 2010 and 2018. Cast net and atulai fisheries have ranged from 0 to 1,281 fishers in the same timeframe.

Commented [TS139]: There aren't already figures for this in the CNMI/Guam SAFE report; only tables.

Commercial Catch and Landings of Species with Aquaculture Potential

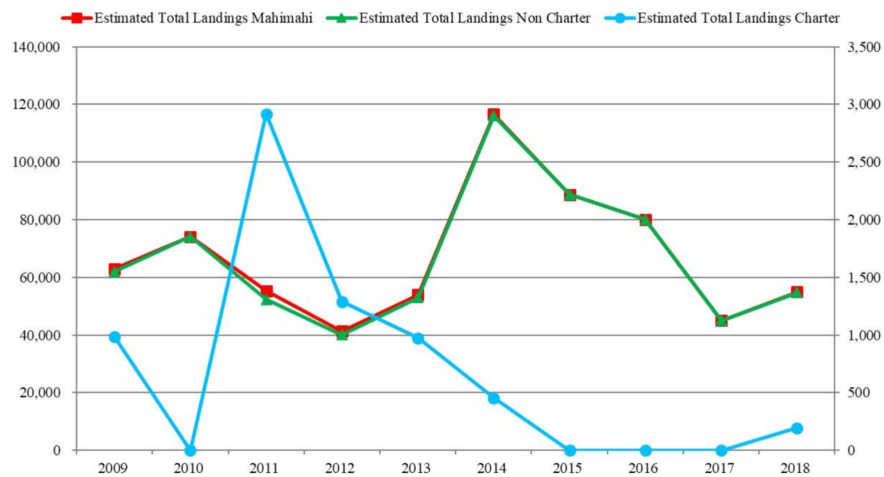
CNMI

Skipjack tuna is the principal species landed in CNMI, comprising nearly 80% of the entire pelagic landings in 2018 based on creel survey data. Yellowfin tuna (Figure 3-46) and mahi mahi (Figure 3-47) ranked second and third, respectively, by weight of landings in 2018.



Source WPFMC 2019a.
Note: Left y axis is charter boats and right y axis is non-charter boats.

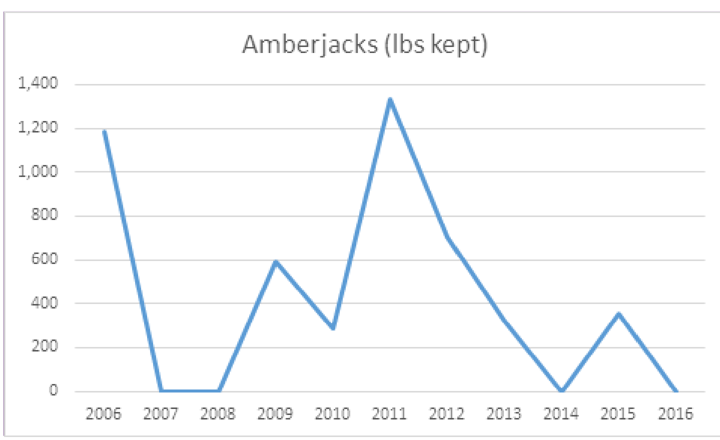
Figure 1-27. CNMI Annual Estimated Total Yellowfin Landings, Non-Charter and Charter (2009-2018)



Source WPFMC 2019a
Note: Left y axis is non-charter boats and right y axis is charter boats.

Figure 1-28. CNMI Estimated Annual Total Mahi Mahi Landings, Non-Charter and Charter (2009-2018)

Figure 3-48 through Figure 3-51 show the amount of pounds kept for amberjacks, giant trevally, bluefin trevally, and rabbitfishes. The source for these figures is the CNMI DFW Boat+Shore-Based Creel Survey Data.



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Note: Amberjack species include Seriola dumerili, S. lalandi, and S. rivoliana.

Figure 1-29. CNMI Estimated Annual Amberjack Total Pounds Kept (2006-2016)

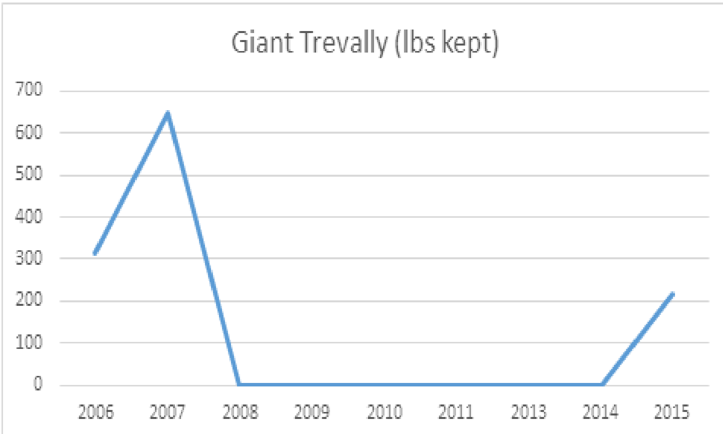


Figure 1-30. CNMI Estimated Annual Giant Trevally Total Pounds Kept (2006-2015)

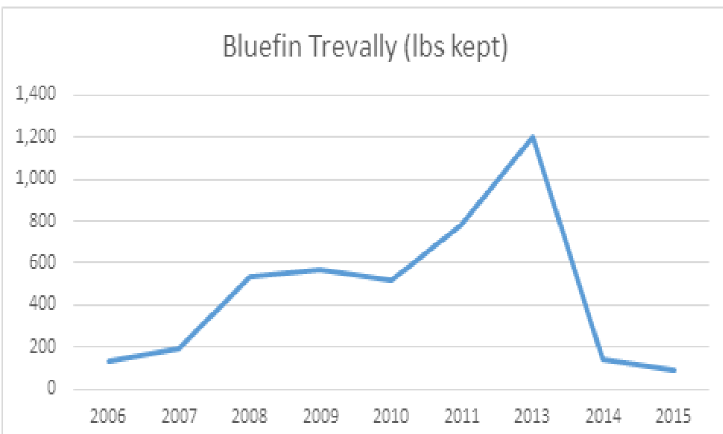
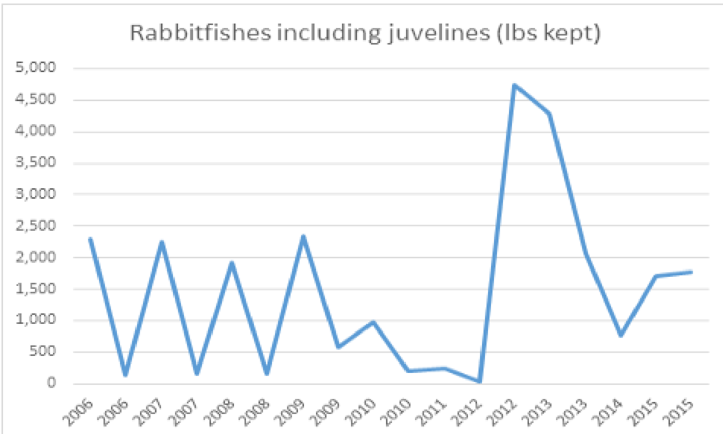


Figure 1-31. CNMI Estimated Annual Bluefin Trevally Pounds Kept (2006-2015)

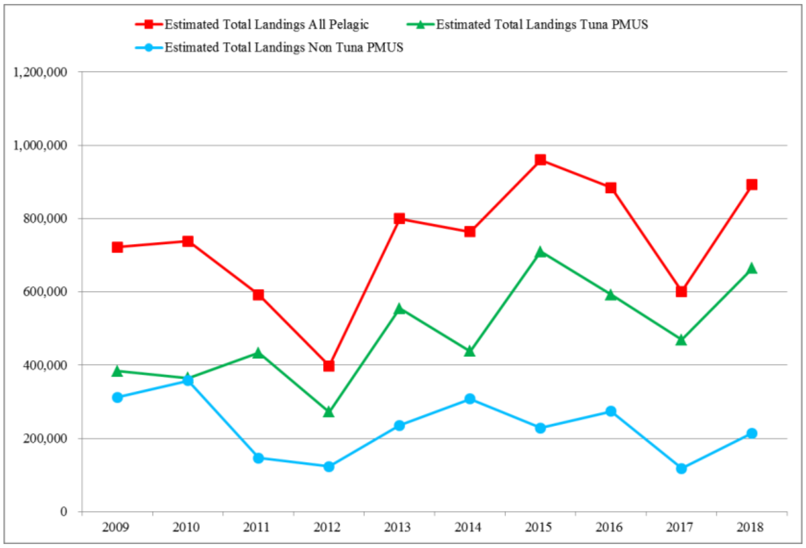


Note: Rabbitfishes include Siganus argenteus, S. guttatus, S. punctatus, S. spinus, S. stellatus, S. vermiculatus, and Siganus spp. (juv).

Figure 1-32. CNMI Estimated Annual Rabbitfishes Total Pounds Kept (2006-2015)

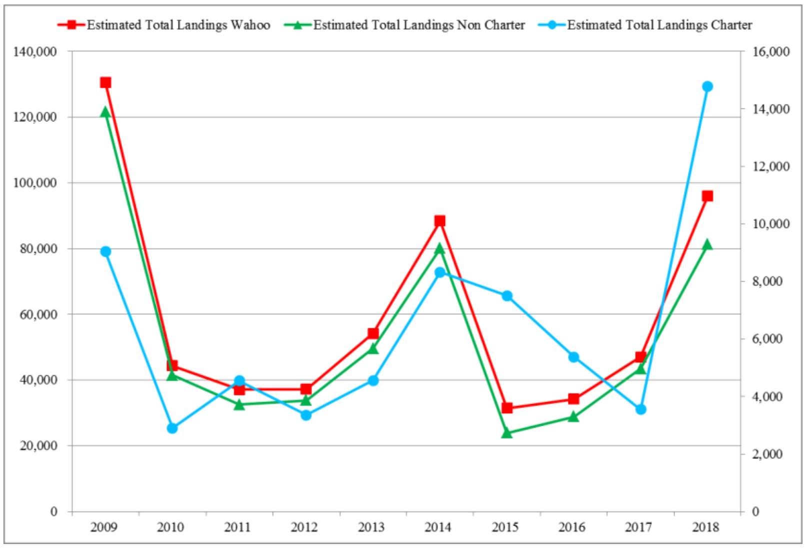
Guam

Figures 3-57 shows commercial landings for all pelagics and breaks out tuna and non-tuna species. Figure 3-55 and Figure 3-56 show non-charter and charter landings for yellowfin and mahi mahi, respectively. Figure 3-58 through Figure 3-62 show the amount of pounds kept for amberjacks, giant trevally, bluefin trevally, pacific threadfin and rabbitfishes. The source for Figure 3-57 through Figure 3-61 is Guam Division of Aquatic & Wildlife Resources Creel Survey Data. Except where noted, numbers on each graph are in 1000s of pounds.



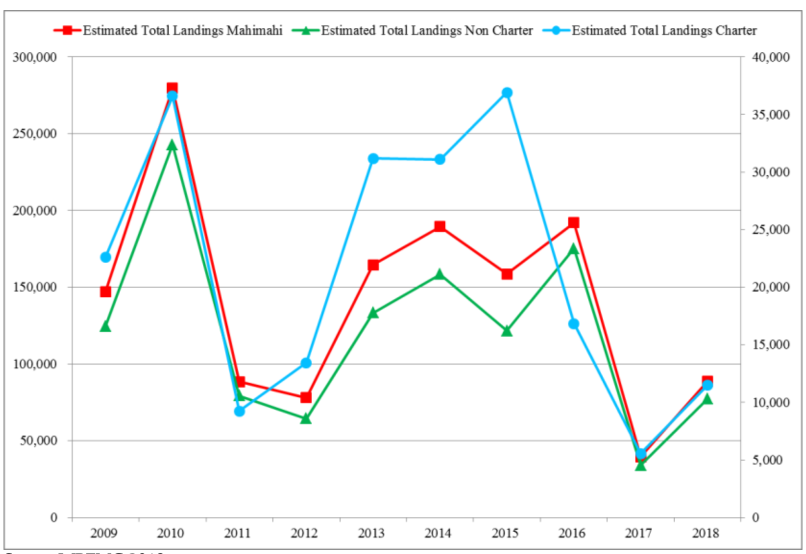
Source: WPFMC 2019a.

Figure 1-33. Guam Estimated Annual Commercial Landings for All Pelagics, Tuna PMUS, and Non-Tuna PMUS (2009 to 2018)



Source: WPFMC 2019a.

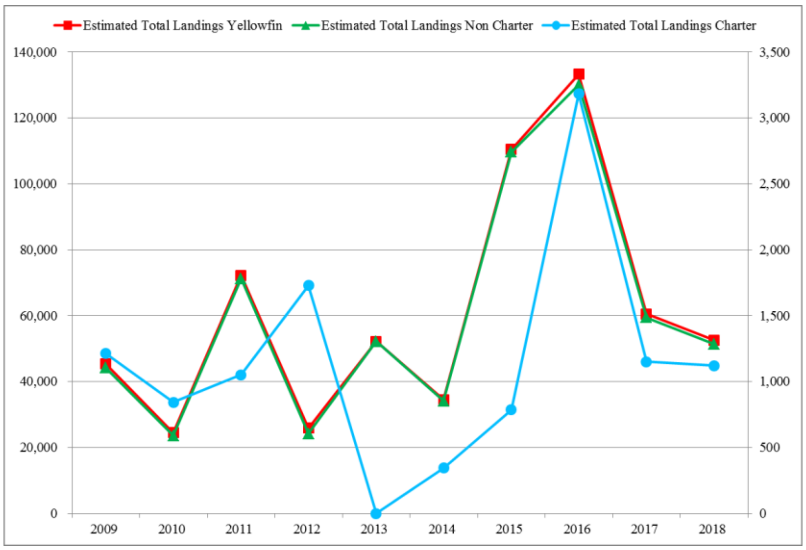
Figure 34 Total estimated annual wahoo landings in Guam from 2009-2018



Source WPFMC 2019a

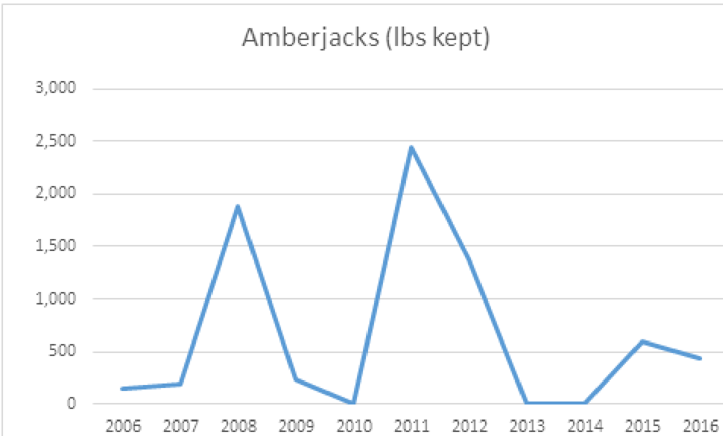
Note: Left y axis is non-charter boats and right y axis is charter boats.

Figure 1-35. Guam Estimated Annual Total Mahi Mahi Landings, Non-Charter and Charter (2009-2018)



Source: WPFMC 2019a.

Figure 1-36. Guam Annual Estimated Total Yellowfin Landings, Non-Charter and Charter (2009-2018)



Note: Amberjack species include Seriola dumerili, S. lalandi, and S. rivoliana.

Figure 1-37. Guam Estimated Annual Amberjack Total Pounds Kept (2006-2016)

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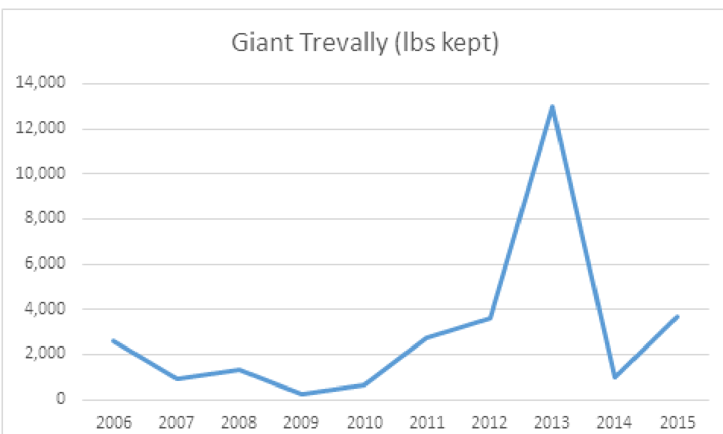


Figure 1-38. Guam Estimated Annual Giant Trevally Total Pounds Kept (2006-2015)

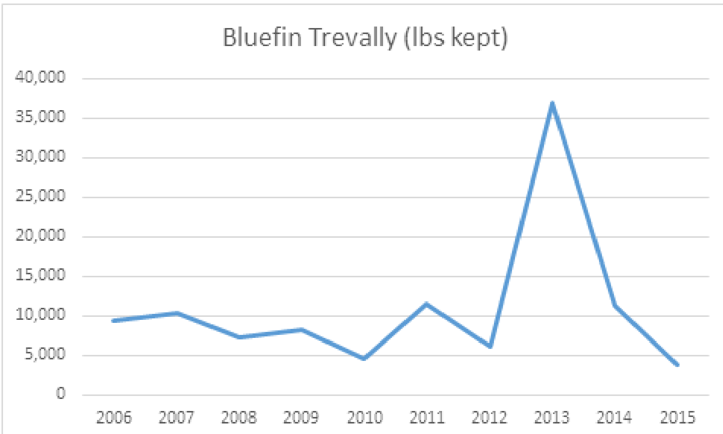
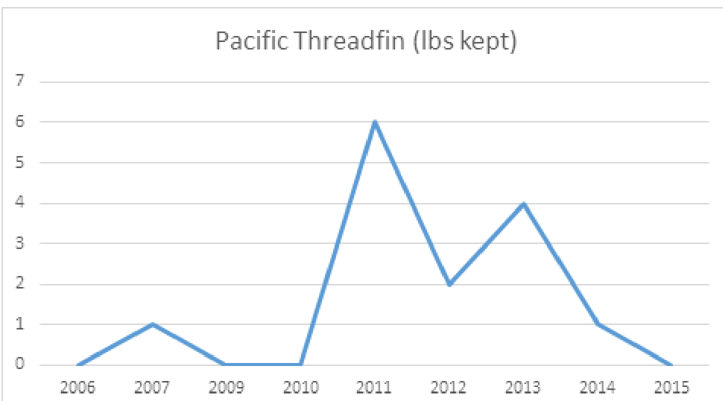
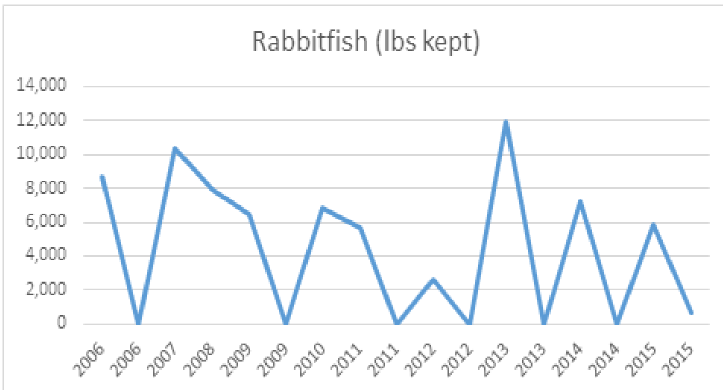


Figure 1-39. Estimated Annual Bluefin Trevally Pounds Kept (2006-2015)



Note: Pacific threadfin, Polydactylus sexfilis also includes unspecified threadfins (Polydactylus spp.

Figure 1-40. Guam Estimated Pacific Threadfin Pounds Kept (2006-2015)



Note: Rabbitfishes include Siganus argenteus, S. guttatus, S. punctatus, S. spinus, S. stellatus, S. vermiculatus, and Siganus spp. (juv).

Figure 1-41. Guam Estimated Annual Rabbitfishes Total Pounds Kept (2006-2015)

Revenue from Commercial Fisheries

CNMI

The primary target and most marketable species for the pelagic fleet in CNMI is skipjack. Schools of skipjack tuna have historically been common in near shore waters, providing an opportunity to catch numerous fish with a minimum of travel time and fuel costs. Skipjack is readily consumed by the local populace and restaurants, primarily as sashimi. Yellowfin tuna and mahimahi are also easily marketable species but are seasonal. During their seasonal runs, these fish are usually found close to shore and provide easy targets for the local fishermen.

Table 3-20 summarizes commercial landings, revenue and prices for pelagic fisheries in 2018.

Table 1-18. CNMI Commercial Pelagic Landings, Revenues, and Prices (2018)

Species	Pounds	Value	Average Price
SKIPJACK TUNA	125,009.5	296,182.8	2.37
YELLOWFIN TUNA	13,179.0	34,857.1	2.64
SABA (KAWAKAWA)	141.3	306.3	2.17
TUNAS (MISC.)	4,646.9	11,219.1	2.41
TUNAS TOTAL and AVERAGE PRICE	**142,976.6**	**342,565.2**	**2.40**
MAHIMAHI	14,271.0	40,133.0	2.81
WAHOO	686.9	1,969.4	2.87
BLUE MARLIN	373.8	971.9	2.60
SAILFISH	108.8	271.9	2.50
SICKLE POMFRET (W/WOMAN)	29.4	80.0	2.72
NON-TUNA PMUS TOTAL and AVERAGE PRICE	**15,469.8**	**43,426.1**	**2.81**
DOGTOOTH TUNA	1,558.8	4,174.4	2.68
RAINBOW RUNNER	1,384.1	3,431.3	2.48
TROLL FISH (MISC.)	6,365.0	17,189.4	2.70
OTHER PELAGICS TOTAL and AVERAGE PRICE	**9,307.8**	**24,795.0**	**2.66**
PELAGICS TOTAL and AVERAGE PRICE	**167,754.2**	**410,786.3**	**2.45**

Source: WPFMC 2019a

Note: Total pelagic landings is greater than the sum of the individual species due to an artifact in reporting process, where the difference accounts for non-PMUS reported as part of the creel survey.

Table 3-21 through Table 3-24 represent estimated revenue of amberjacks, giant trevally, bluefin trevally, and rabbitfishes in CNMI over the period 2006 to 2016. The sources for the tables are the Boat+Shore-Based Creel Survey Data for pounds kept and the CNMI DFW Vendor Purchase Data for estimated pounds sold. All tables also show estimated revenue adjusted by the CPI.

Table 1-19. CNMI Amberjack Estimated Pounds Kept and Estimated Total Pounds Sold to Commercial Vendors (2006-2016)

Commented [TS143]: Will be updated with the other CREEL stuff as noted previously

Year	Estimated Pounds Kept	Estimated Pounds Sold	Estimated Revenue	CPI Adjusted Revenue
2006	1,184	170	$534	$676
2007	NULL	329	$925	$1,111
2008	NULL	548	$1,362	$1,540
2009	588	326	$868	$966
2010	287	658	$1,991	$2,055
2011	1,329	NULL	NULL	NULL
2012	702	809	$2,358	$2,314
2013	323	527	$1,542	$1,520
2014	NULL	916	$2,366	$2,325
2015	355	68	$239	$239
2016	NULL	911	$2,418	$2,418

Note: Amberjack species include Seriola dumerili, S. lalandi, S. rivoliana.

Table 1-20. CNMI Bluefin Trevally Estimated Pounds Kept (2006-2015)

Year	Estimated Pounds Kept
2006	134
2007	189
2008	538
2009	572
2010	515
2011	780
2013	1,201
2014	141
2015	93

Table 1-21. CNMI Giant Trevally Estimated Pounds Kept and Estimated Total Pounds Sold to Commercial Vendors (2006-2015)

Year	Estimated Pounds Kept	Estimated Pounds Sold	Estimated Revenue	CPI Adjusted Revenue
2006	313	NULL	NULL	NULL
2007	648	137	$342	$411
2008	NULL	24	$48	$54
2009	NULL	55	$136	$152
2010	NULL	64	$177	$183

2011	NULL	96	$168	$168
2013	NULL	22	$56	$55
2014	NULL	4	$17	$17
2015	215	NULL	NULL	NULL

Table 1-22. CNMI Rabbitfishes (including juveniles) Estimated Pounds Kept and Estimated Total Pounds Sold to Commercial Vendors (2006-2016)

Year	Estimated Pounds Kept	Estimated Pounds Sold	Estimated Revenue	CPI Adjusted Revenue
2006	2,299	8,374	$26,725	$33,856
2006 juv	130	NULL	NULL	NULL
2007	2,250	5,957	$19,104	$22,938
2007 juv	164	NULL	NULL	NULL
2008	1,924	2,641	$8,026	$9,075
2008 juv	161	92	$300	$339
2009	2,349	1,312	$4,157	$4,631
2009 juv	586	NULL	NULL	NULL
2010	968	2,602	$7,881	$8,133
2010 juv	209	NULL	NULL	NULL
2011	253	3,043	$9,535	$9,493
2012	41	1,605	$4,929	$4,837
2012 juv	4,757	NULL	NULL	NULL
2013	4,291	2,404	$7,652	$7,544
2013 juv	2,067	NULL	NULL	NULL
2014	769	2,370	$7,611	$7,480
2015	1,706	1,941	$6,439	$6,439

2015 juv	1,765	NULL	NULL	NULL
2016	1,528	9,252	$30,958	$30,958
2016 juv	466	NULL	NULL	NULL

Note: Rabbitfishes include Siganus argenteus, *S. guttatus, S. punctatus, S. spinus, S. stellatus, S. vermiculatus*, and *Siganus* spp. (juv).

Guam

Table 3-25 and Table 3-26 represent estimated revenue of amberjacks and rabbitfishes in Guam over the period 2006 to 2016. The sources for the tables are the Guam Division of Aquatic & Wildlife Resources Creel Survey Data for pounds kept and the DAWR Vendor Purchase Data, with Value Sold and Price per Pound for Selected Species. All tables also show estimated revenue adjusted by the CPI. There is no revenue information for bluefin trevally, giant trevally or Pacific threadfin, (which include *Polydactylus sexfilis* and unspecified threadfins (Polynemidae family)

Commented [TS144]: Why doesn't the Marianas SAFE report contain a table for Commercial Pelagic Landings, Revenues, and Prices in Guam, as it does for CNMI? If we had one, I'd place it here

Table 1-23. Guam Amberjack Estimated Pounds Kept and Estimated Total Pounds Sold to Commercial Vendors (2006-2016)

Commented [TS145]: As with the others, these will all be updated when I go through the CREEL data

Year	Estimated Pounds Kept	Estimated Pounds Sold	Estimated Revenue	CPI Adjusted Revenue
2006	144	626	$1,923	$2,525
2007	187	697	$1,914	$2,354
2008	1,885	154	$416	$491
2009	232	296	$780	$901
2010	NULL	127	$347	$391
2011	2,451	382	$1,027	$1,120
2012	1,370	78	$239	$253
2013	NULL	131	$408	$432
2014	NULL	71	$216	$227
2015	590	NULL	NULL	NULL
2016	437	NULL	NULL	NULL

Note: Amberjack species include *Seriola dumerili, S. lalandi, S. rivoliana*.

Table 1-24. Guam Rabbitfishes (including juveniles) Estimated Pounds Kept and Estimated Total Pounds Sold to Commercial Vendors (2006-2016)

Year	Estimated Pounds Kept	Estimated Pounds Sold	Estimated Revenue	CPI Adjusted Revenue
2006	8,736	611	$1,781	$2,338
2006 juv	NULL	71	$318	$418
2007	10,346	2,444	$7,284	$8,959
2008	7,936	427	$1,281	$1,510
2009	6,438	95	$254	$294
2009 juv	NULL	22	$152	$175
2010	6,854	NULL	NULL	NULL
2011	5,687	241	$787	$858
2011 juv	NULL	335	$1,963	$2,140
2012	2,618	11	$35	$37
2012 juv	NULL	185	$1,113	$1,177
2013	11,949	145	$579	$612
2013 juv	NULL	1,296	$4,608	$4,874
2014	7,211	931	$3,095	$3,249
2014 juv	NULL	19	$63	$66
2015	5,899	NULL	NULL	NULL
2015 juv	630	NULL	NULL	NULL

2016	9,338	NULL	NULL	NULL

Note: Rabbitfishes include Siganus argenteus, S. guttatus, S. punctatus, S. spinus, S. stellatus, S. vermiculatus, and Siganus spp. (juv).

Commercial Fishery Suppliers and Markets

The CNMI government's volunteer data base collection system records 36 fish vendors in Saipan in 2019. More broadly, 10 commercial harvesters, 12 Fish Markets including mobile vendors, and 185 restaurants in the CNMI in 2019. Fisheries managers report that the system of seafood distribution has undergone significant changes in the past decade because of the establishment of large seafood vendors. In contrast to individual fishermen/vendors who only market their own catch, large vendors typically own and operate a number of vessels and purchase catch from independent fishermen to sell. Large vendors offer a wide selection of fish from 10 to 15 coolers, rather than the typical 2 to 3 coolers of the individual fisherman. Competition between vendors is reportedly depressing prices (Allen and Amesburyl 2012).

Commented [TS146]: Checking with a few folks at PIFSC to see whether this needs an update

Commented [TS147R146]: The database count 36 vendors in 2019, (from Michael Quach), however the broader CNMI info is from Jude Lizama, based in CNMI and it's based on number of valid licenses for restaurants (rather than whether they're active businesses). This info doesn't appear to be in a SAFE report

The Guam Fishermen's Cooperative Association (GFCA) is a central component of Guam's contemporary offshore fishing industry that continues to pursue and broaden its original mission of providing marketing services, fuel, and ice for its small-boat fishermen members. A primary GFCA service is the retailing and wholesaling of ocean-caught fish and aquaculture products of local origin to the general public (cash sales), local restaurants, and government institutions (credit sales). GFCA's influence has become pervasive, providing a variety of benefits not just to its members, but for fisheries conservation, marine education, and the greater Guam community. Prior to the establishment of the GFCA, which was formed in 1976 and incorporated in 1977, commercial fishermen sold fish catches at farmers markets and roadside in various locations. The cooperative was formed to assist its small-scale fishermen members in marketing their catch. From the 1980s to the present, imported shallow-water reef and bottomfish from other islands throughout Micronesia were priced lower than that for local fish in the Guam market. The GFCA counters this price competition from imported fish by emphasizing the higher quality of fresh local fish landed by GFCA members. The GFCA purchases all of the fish caught by its members, as long as the catch meets established standards for quality and safety (Allen and Bartram 2008).

Non-commercial Fishing Considerations

Commented [TS148]: FC Why aren't the charter tables and figures from above included here instead, and separated out from the commercial catch? Even if recreational catch is sold to the commercial market, bifurcating and including charter landings here just makes more sense to me personally.

CNMI has few fishing clubs. The Saipan Sports-fishing Association (SSA) has been in existence for at least 16 years, and is the sponsor of the annual Saipan International Fishing Tournament which is usually held in August or September. Charter fishing in the CNMI is limited, with about ten boats operating on Saipan, and a few vessels on Tinian conducting occasional fishing charters. Based on landings and sales data, 1% of CNMI's catch is considered recreational (WPFMC 2019a).

Commented [TS149]: I'm not completely sure what to do here. Most of the info that's currently in this section doesn't appear in the 2018 SAFE report, nor does it appear in the FEP. Charters are included in the stats, but not explicitly mentioned much otherwise. Additionally, there's a big section on survey data about cultural uses for fishing (2.3.2.2. People who Fish)- should I paste some of that in?

Recreational fishing is more common in Guam. In Guam, fishing clubs have been founded along ethnic lines by Japanese and Korean residents, with a dozen or so members, and generally short-lived (WPRFMC 2019a). There was also a Guam Boating Association with several hundred members, most of which were fishermen, but has since disbanded. There are limited fishing tournaments on Guam, including a fishing derby for children organized by the local Aquatic and Wildlife Resources Division. Based on landings and sales data, approximately 36% of Guam's trolling catch is recreational (WPFMC 2019a).

Guam has a charter fishing sector for both pelagic and bottomfish fishing that comprises about 11% of the commercial troll fleet fishing effort.

1.4.3.5 Relevant Socio-economic profile

CNMI population is about 51,433 (July 2020 estimate) composed of about 50% Asian (including 35.3% Filipino), 34.9% Pacific Islander (including 23.9% Chamorro), and 12.7% mixed (2010 estimate). English and Chamorro are the official languages, but more residents (32.8%) primarily speak Tagalog compared with Chamorro (24.1%) or English (17%). The median age is 33.6 years old. Almost 90% of the total population lives in urban areas and the rate of urbanization is increasing, while the overall population size is declining. The Northern Mariana Islands' economy benefits from financial assistance from the US. In fiscal year 2016, federal grants accounted for 26% of the Commonwealth's total revenues. A small agriculture sector consists of cattle ranches and small farms producing coconuts, tomatoes, breadfruit, and melons. Tourism continues to grow with the tourist industry employing approximately a quarter of the work force and accounts for roughly a quarter of the gross domestic production (GDP). The estimated GDP per capita in 2016 was $24,500. In 2016, CNMI exported an estimated $914 million in products, primarily garments and imported an estimated $893 million, primarily food and construction equipment and materials, and petroleum products (CIA World Factbook https://www.cia.gov/library/publications/the-world-factbook/geos/cq.html, accessed April 08, 2020).

Commented [MF150]: I don't think calling out Native Hawaiians (who aren't indigenous to this area) is relevant, especially when the large majority of Pacific Islanders (23.9%) are Chamorro who are the indigenous people of the Mariana Archipelago.

The population of Guam is about 168,485 (July 2020 estimate) composed of about 37.3% Chamorro and 26.3% Filipino (2010 estimate). English, Filipino, and Chamorro are the primary languages. The median age is 29.4 years old. Almost 95% of the total population lives in urban areas (large villages or municipalities) and the rate of urbanization is increasing, as is the overall population. The main driver of Guam's economy is defense spending, followed by tourism and other services. The estimated GDP per capita in 2016 was $35,600. In that same year, Guam exported an estimated $1.124 billion in products, primarily transshipments of refined petroleum products, construction materials, and fish. Imports for 2016 are estimated at $2.964 billion, primarily petroleum and petroleum products. (CIA World Factbook, https://www.cia.gov/library/publications/the-world-factbook/geos/gq.html, accessed April 08, 2020).

In both Guam and CNMI, fish and marine resources have played a central role in shaping the social, cultural, and economic fabric that continues today. Residents fish for both reef and pelagic species, collect mollusks and other invertebrates, and historically caught sea turtles.

Additional information about the role of fishing and marine resources across the Marianas Archipelago, as well as information about the people who engage in fishing or use fishing can be found through the Marianas FEP 2018 SAFE Report (WPFMC 2019d), Pelagics FEP 2018 SAFE Report (WPFMC 2019a), Allen and Bartram (2008) and Allen and Amesbury (2012).

Commented [MF151]: Check 2018 SAFE report and maybe substitute that reference

Commented [TS152R151]: done

1.4.4 CNMI Administrative Environment

Politically, the Mariana Islands are split into the Territory of Guam and the Commonwealth of Northern Mariana Islands, both of which are U.S. possessions.

Federally managed sanctuaries, monuments and wildlife refuges

The CNMI management subarea includes all federal waters of the U.S. EEZ from 3 to 200 nm (6 to 370 km) around the CNMI, except for the three northern most islands of Uracus, Maug, and Asuncion, and the island of Farallon de Medinilla, where federal jurisdiction extends to the shoreline. At Tinian, federal waters also extend to the shoreline around certain lands leased by the U.S. government.

There are two National Wildlife Refuges (NWRs) in the Mariana Archipelago – the Mariana Arc of Fire NWR and the Mariana Trench NWR. These designations were created following the establishment of the MNM, per Secretarial Order 3284. Boundaries and regulations are identical to the MNM.

In January 2009, President G.W. Bush created the Marianas Trench MNM, encompassing three units: the Islands, Trench, and Volcanic Units (Figure 3-62). The Islands Unit includes the waters and submerged lands of the three northernmost Mariana Islands of Farallon de Pajaros (also known as Uracus), Maug, and Asuncion. The Trench Unit/Refuge encompasses the submerged lands extending from the northern limit of the CNMI EEZ to the southern limit of the Guam EEZ. The Volcanic Unit/Arc of Fire Refuge includes the submerged lands within 1 nm (1.9 km) of 21 designated volcanic sites. The waters above the seafloor in the Volcanic and Trench Units are not included in the MNM and the CNMI Government maintains all authority for managing the terrestrial environment of the three islands within the Islands Unit. The total Monument area consists of approximately 96,714 mi^2 (250,487 km^2) of submerged lands and waters of the Mariana Archipelago. The Monument is cooperatively managed by NOAA and the USFWS, in cooperation with the DOD and the CNMI Government. No commercial fishing, including commercial aquaculture, is permitted within the MNM. Regulations allow for non-commercial fishing by permit and customary exchange in non-commercial fisheries in the Islands Unit. Additionally, FDM nearshore waters within 3 nm are restricted from public access at all times due to safety reasons based on military activities.

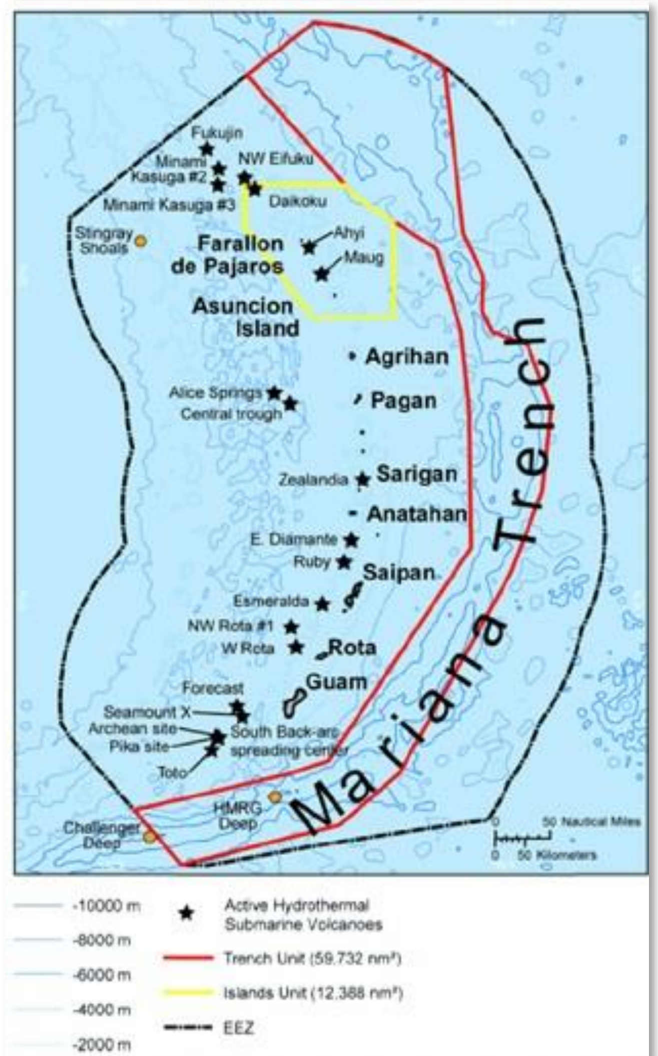


Figure 1-42. Mariana Trench Marine National Monument

Department of Defense Jurisdictions

The Department of Defense major planning activities in the region are summarized in Table 3-24. Activities that are no longer reasonably foreseeable or have been replaced with another planning activity were removed from the report, though may occur in previous SAFE reports (WPRFMS 2019d)

Commented [MF153]: This will need to be added in, right? Lots of DoD jurisdiction and properties on Guam. Not exactly sure what's in CNMI.

Commented [TS154R153]: This is what I've got from the SAFE report

Table 1-25 Department of Defense major planning activities (Source WPRFMC 2019d)

Action	Description	Phase	Impacts
Guam and CNMI Military Relocation SEIS	Relocate Marines to Guam and build a cantonment/family housing unit on Finegayan/AAFB, a live-fire individual training range complex at the Ritidian Unit of the Guam National Wildlife Refuge.	ROD published August 29, 2015. Suit filed for segmentation and range of reasonable alternatives under NEPA, requesting that DON vacate the ROD. DOJ asked US District Court for the NMI to dismiss the plaintiff's complaint with prejudice to prevent refiling (http://www.saipantribune.com/index.php/doj- federal-court-lacks-jurisdiction/).	Surface danger zone established at Ritidian – access restricted during training. Access will be negotiated between the Navy and USFWS. Northern District Wastewater Treatment Plant is non-compliant with NPDES permit; until plant is upgraded, increased wastewater discharge associated with buildup will significantly impact nearshore water quality. DOD to fund plant upgrades – see Economic Adjustment Committee Implementation Plan.

Mariana Islands Training and Testing – Supplemental	The supplement to the 2015 Final EIS/OEIS is being prepared to support ongoing and future activities conducted at sea and on Farallon de Medinilla (FDM) beyond 2020. New information, including an updated acoustic effects model, updated marine mammal density data, and evolving and emergent BSIA, will be used to update the MITT.	The 2019 MITT Final Supplemental EIS/OEIS is expected in spring 2020. Public Comment and Open House Public Meetings to take place in March and April of 2019.	Likely access and habitat impacts similar to previous analysis.

Territorial Management

The CNMI was part of the U.S. Pacific Trust Territory since 1947, and has been a U.S. commonwealth since 1986. The island of Guam has been an unincorporated U.S. territory since 1949 (CIA 2017). The CNMI Department of Lands and Natural Resources, Division of Fish and Wildlife. The Division is tasked with conserving, protecting and enhancing the fish, game and wildlife resources of our islands for the benefit of the citizens of the CNMI. This is accomplished through scientific research, monitoring, regulation, enforcement, planning and management activities that seek to ensure the long-term survival and sustainability of marine and terrestrial wildlife resources.

In Guam, the Department of Agriculture, Division of Aquatic and Wildlife Resources is comprised of three sections, Wildlife, Fisheries, and Law Enforcement. The Law Enforcement section is comprised of Conservation officers mandated to enforce the natural resources laws and regulations of Guam. The Division continues to improve in the management of natural resources and enforcement of related laws. They continue to work to maintaining Guam's marine preserves, and other management actions that are crucial to sustaining and recovering natural fish and wildlife resources.

1.5 Hawaii

The Hawaiian Islands are comprised of 137 islands, islets, and coral atolls that are part of a great undersea mountain range known as the Hawaiian-Emperor Seamount Chain. The Hawaiian Islands extend for nearly 1,500 mi (2,414 km) from Kure Atoll in the northwest to the Island of Hawaii in the southeast. The

Hawaiian Islands are often grouped into the Northwestern Hawaiian Islands (NWHI; Nihoa to Kure) and the Main Hawaiian Islands (MHI; Hawaii to Niihau). The total land area of the 19 primary islands and atolls is approximately 6,423 mi^2 (16,600 km^2) and over 75 % of the 1.42 million population resides on the island of Oahu.

1.5.1 Physical Environment

1.5.1.1 Geological Features

Coastline

Most coastline areas in the state are exposed to the open ocean, and the reefs in these areas are frequently disturbed by wave induced mortality. The only significant buildup of reefs in the MHI is found in areas that are reasonably sheltered from open-ocean swells and at depths that are not constrained by sea level, examples include Kona Coast of Hawaii island , Kaneohe Bay and Barbers Point on Oahu, and the North shores of Kauai and Lanai (Friedlander 1996).

Open Ocean

Within the Hawaii Archipelago, there are numerous banks and seamounts, with more observed in the NWHI rather than in the MHI. In the MHI, the largest bank is Penguin Bank which is located southeast of Oahu.

1.5.1.2 Oceanographic Features

Large scale ocean currents generally run east to west near the Hawaiian Archipelago, as it sits toward the southern edge of the north Pacific Sub-tropical gyre (WPFMC 2009d). Overall the ocean currents and wind run from east to west. However, the Hawaiian Islands act as barriers disrupting those currents and winds. These disruptions create chaotic mesoscale oceanic and atmospheric eddies. These eddies have relatively high velocities in the lee of the islands (WPFMC 2009d, Jia et al. 2011, and Woodworth et al. 2011). Eddies vertically displace underlying nutrient rich waters, causing mixing with nutrient poor waters, thus creating localized favorable biological conditions. Once established, these areas of increased productivity allow zooplankton to flourish, which then attract mid-trophic level species, which then become prey top-level predators (Seki et al. 2002, Woodworth et al. 2011). The area in the lee of the Island of Hawaii is marked by an abundance of eddies (Jia et al. 2011).

Due to the geography of the islands, several channels experience strong winds, strong currents, and rough seas. The Alenuihaha Channel, between the island of Hawaii and the island of Maui has a significant funnel effect with incredibly strong winds. The Kalohi Channel, which separates Lanai and Molokai, typically experiences strong winds and choppy seas. The Pailolo Channel, which separates Molokai and Maui is one of the windiest and roughest channels in the Hawaiian Islands (Mehaffy and Mehaffy 2006).

1.5.1.3 Extreme Weather

Hawaii’s climate consists of mild temperatures throughout the year and moderate humidity. Across the islands, trade winds averaging 8 to 12 kts (15 to 22 km /hr) blow from the northeast about 80% of the time. For the other 20% of the time, the islands experience Kona wind conditions, in which the wind blows from the southeast or southwest (Juvik and Juvik 1998).

Commented [TS155]: From Colby: It seems like a relavant point of discussion, which this draft omits, to include consideration of whether aquaculture enterprises would be sited in areas of lower or higher natural productivity. I could imagine one way to reduce adverse impacts, might be to site aquaculture facilities in the least productive sites, since they are somewhat controlled by human-induced dynamics (automated feeding, etc). This might leave the more highly productive areas for natural stocks and ecosystem dynamics, further reducing risk of disease/pathogen/parasite transfer, and reducing alteration of ecological migration/behavior transfer of natural stocks.

Commented [TS156R155]: Gonna save this comment for Ch 4

Commented [TS157]: From Colby: A map of these HI predominant eddies, perhaps bifurcated between winter and summer would be very useful here.

The Hawaii Archipelago is subject to high wave energy produced from weather systems generated off the Aleutian Islands and other areas of the North Pacific. Such waves can have major effects on the nearshore environment. For example, high wave energies can break off pieces of coral, move underwater boulders, shift large volumes of sand, and erode islands (Grigg 2002).

The Northwest Hawaiian Islands are only rarely in the path of tropical storms and hurricanes but the impacts of large wave events from extra-tropical storms each winter are thought to be significant.

1.5.2 Biological Environment

The biological environment of Hawaii, including the species addressed in this PEIS, are described in detail in the FEP for Hawaii Fisheries of the Western Pacific Region, which is incorporated here by reference (WPRFMC 2009c). Specific resources of concern, identified during scoping and interagency informal consultations are described to the level necessary for appropriate analysis.

1.5.2.1 Benthic and Sessile Organisms

See Section 3.1.2.5 for the general biology and threats to benthic and sessile organisms in the nearshore and offshore habitat. This section covers the only life history information specific to Hawaii.

Nearshore Reefs

The total potential coral reef area in Hawaii (MHI and NWHI) is estimated to be 1,100 mi^2 (2,826 km^2) within the 10-fathom (18-m) curve, and 20,437 mi^2 (5,300 km^2 within the 100-fathom (183 m) curve, respectively (Rohmann et al., 2005). The MHI represent the younger portion of the Hawaii Archipelago, with less well-developed fringing reefs that have not subsided as far below sea level as those in the NWHI (Smith 1993). The potential coral reef area surrounding the MHI is estimated at 475 $mi^{2.}$ (1,231 km^2) within the 10-fathom contour (Rohmann et al. 2005).

The main Hawaiian Islands have an estimated 475 mi^2 (1,231 km^2) of shallow reef habitat within the 10-fathom (18-m) contour (WPFMC 2009c). The condition of the coral reef system across the archipelago ranges from fair to excellent. Population growth, overfishing, and urbanization, runoff and development threaten many of these reefs. Research indicates that populations of reef-building corals around the archipelago continue to be spared from epidemic disease outbreaks seen in other reefs around the world (WPFMC 2009c).

Offshore Reefs

Deep sea corals likely occur in suitable habitats across the archipelago. The most studied deep-sea coral bed, the Makapuu bed, lies in the channel between Molokai and Oahu 6 mi (9 km) off the coast of Oahu (Grigg 1993, WPFMC 2009c). Five other known beds with specific coordinates are Keahole Point, Kaena Point, Brooks Banks, 180 Fathom Bank, and the Wespac bed. The last three beds occur in the Northwest Hawaiian Islands (Grigg 1993, WPFMC 2009c). Two beds have been recently discovered, one near French Frigate Shoals in the NWHI and one on Cross Seamount 150 nm (279 km) south of Oahu (WPFMC 2009c). The Hawaiian Archipelago FEP identifies eleven federally managed species: three pink coral, three gold coral, two bamboo coral, and three black coral species (WPFMC 2009d).

In addition to threats discussed in Section 3.1.2.5, a specific threat to black coral in Hawaii is the invasive snowflake coral, first discovered in Pearl Harbors in 1972. It has rapidly spread to deep waters where is settles on and eventually smothers black coral colonies (Lumsden 2007).

Commented [TS158]: From Colby: It seems totally relevant to map out the areas within the HI portion of the action area that are particularly prone to wave events. I'm sure this is all available in terms of areas along the coast that are most prone to erosion. However, some areas outside of 3 miles that would be considered in this DEIS, but which may not be immediately thought of because the inlying coastal areas nearby may be blocked by coastal features (points, etc.), should be considered. Buoy data should be able to capture this, and the analysis has already probably been conducted to some extent. It should be mapped out and included here. The potential environmental impacts depend largely on whether these areas with intermittent annual and inter-annual large wave events might result in a facility structure failure, and subsequent escapements of aquaculture product.

Commented [TS159]: From Colby: It seems relevant to include a map of what HI areas are determined to be fair, and which are determined to be excellent, and those that moderately fill the gap in between regarding condition of coral reef health

Commented [MF160R159]: Is going to that level of detail relevant when nearshore reefs are well inside 3 nm – them primary subject area of this PEIS? Would it be sufficient to just note a couple of examples of each of fair and excellent reefs in HI? E.g., Kona Coast.

Commented [TS161]: From Colby: How is there no map of these deep-sea coral beds included in here?

Commented [MF162R161]: Again, is going to that level of detail necessary?

Commented [TS163]: From Colby: How is there no table of known percentages of each native and invasive coral species from survey results, ideally with accompanying maps

Commented [MF164R163]: Necessary or unnecessary detail?

1.5.2.2 Significant Aquaculture Species and the Status of those Stocks in Federal Waters

Full descriptions of Hawaii MUS are available in the *Fishery Ecosystem Plan for the Hawaiian Archipelago* (WPFMC 2009c). In addition, species with the highest potential for aquaculture (i.e., almaco jack, Bluefin trevally, giant trevally, moi) are described in Section 3.2.2.2. Stock assessments have not been completed for these species and ACLs have only been determined for the jack family. In Hawaii the 2018 ACL for jacks is 161,200 lbs (73,120 kg).

1.5.2.3 Protected Species

Marine Mammals

Cetaceans listed as endangered under the ESA and that have been observed in the Western Pacific Region include the humpback whale, sperm whale, blue whale, fin whale, sei whale and the Hawaiian Insular false killer whale. As noted in Section 3.2.2.3.1, the Hawaiian stock of the humpback whale was recently delisted (NMFS 2016c). In addition, one endangered pinniped, the Hawaiian monk seal (*Monachus schauinslandi*), occurs in the region. Of these, the Hawaiian Insular false killer whale and the Hawaiian Monk seal only occur within the Hawaiian Island Archipelago and will be discussed in depth in this section.

Humpback whales migrate through waters around the NWHI and occur off all eight Hawaiian Islands during the winter breeding season, but particularly within the shallow waters of the “four-island” region (Kahoolawe, Molokai, Lanai, Maui); the northwestern coast of the island of Hawaii; and the waters around Niihau, Kauai, and Oahu (WPFMC 2009d). Breeding season occurs from the first arrivals in September and ends with the last departures in May or June. The greatest numbers of humpback whales around the MHI occur in February and March. In 2015, the total population in Hawaii was estimated at 10,103 individuals with the total Central North Pacific Population estimated at 21,808 individuals (Muto et al. 2015).

Sperm whales have been sighted around several of the NWHI (Rice 1960) and off the MHI (Lee 1993) and sounds have been recorded throughout the year off Oahu (Thompson and Freidl 1982). The population status in Hawaii waters relative to the optimum population is unknown, and though there are insufficient data to evaluate trends in abundance, the most recent estimate for the Hawaiian islands EEZ is 4,559 individuals (Bradford et al. 2013).

Blue whales occur in all oceans, typically along a continental shelf. No sightings or strandings of blue whales have been reported in Hawaii, but acoustic recordings made off Oahu and Midway Atoll reported blue whales somewhere within the EEZ around Hawaii (Thompson and Freidl 1982).

Fin whales occur throughout the world’s oceans (NMFS 2015a). Although it is generally believed that fin whales make poleward feeding migrations in summer and move toward the equator in winter, few actual observations of fin whales in tropical and subtropical waters have been documented, particularly in the Pacific Ocean away from continental coasts (Reeves et al. 1999). There have only been a few sightings of fin whales in Hawaii waters.

Sei whales have a worldwide distribution, but are mainly found in cold temperate to subpolar latitudes rather than the tropics or near the poles (Horwood 1987). Two sei whales were tagged in the vicinity of the Northern Mariana Islands (Reeves et al. 1999). Sei whales are rare in Hawaiian waters.

Commented [TS165]: From Colby: Some of my earlier comments apply here, but it seems like there should be some mention and inclusion of a map of known HI island humpback migrations and known breeding sites included here.

Commented [TS166]: From Colby: Marine Mammal Surveys: Regarding previous mention of acoustic recordings of whales such as blue and others, I would cite some very relevant facts from Bradford et al. (2017) here (**Abundance estimates of cetaceans from a line-transect survey within the U.S. Hawaiian Islands Exclusive Economic Zone**). I requested and received a PDF I could share if interested, and it is a solid read

Commented [TS167]: From Colby: Should check the observer database regarding blue whale sightings. However, potentially unlikely, I thought I saw the fluke of a juvenile blue whale while observing in the area once. It was the only whale species that keyed out

Commented [TS168]: Bradford. A.L., K.A. Forney, E.M. Oleson, and J. Barlow. 2013. Line-transect abundance estimates of cetaceans in the Hawaiian EEZ. PIFSC Working Paper WP-13-004

Commented [TS169]: From Colby: We’ve actually had an observed Fin whale interaction with LL gear in HI in the last ten years, and I think a few more sightings. It seems relevant to include that information here.

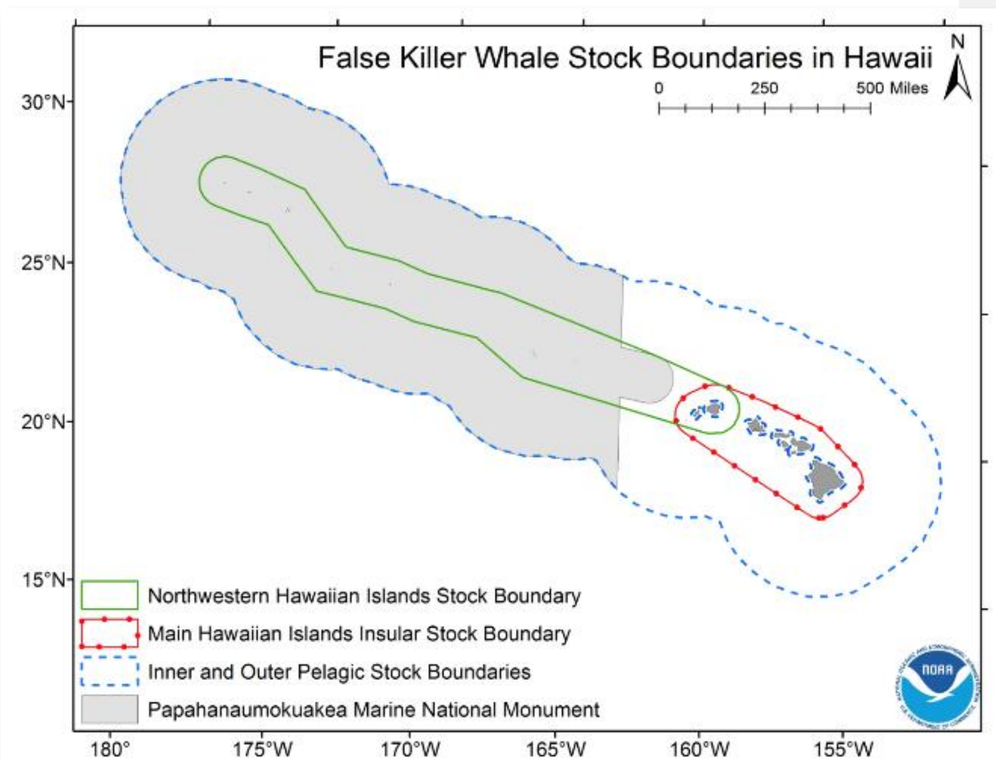
Commented [MF170R169]: Is the last sentence of this paragraph sufficient to respond to this comment?

Commented [TS171R169]: I think so

Hawaiian Insular False Killer Whale (*Pseudorca crassidens*)

There are three separate stocks of false killer whales located in Hawaiian waters. One of those stocks, the Hawaiian insular false killer whale, is genetically different from the pelagic false killer whale population observed elsewhere within the PIR and is currently ESA-listed. The Hawaiian stock has significant differences in both mitochondrial and nuclear DNA, therefore it is managed separately under the ESA (Carretta et al. 2014). In 2012, the Hawaiian insular false killer whale population was listed as endangered under the ESA (Baird et al. 2012). The population is estimated at 150 individuals (Baird et al. 2012). This is the only stock listed as endangered, and is the one that will be the focus for this PEIS. This species travels up to 78 mi (125 km) offshore to feed, and has been documented to move between islands and back within a day. The population utilizes the waters surrounding the Hawaiian Islands, but remains close within the islands boundaries and does not migrate to other areas in the Pacific (Figure 3-22) (Carretta et al. 2014). NOAA reports the Hawaiian Insular False Killer Whale and other toothed dolphins to be in the mid-frequency hearing range from 150 Hz to 160 kHz (NMFS 2016g).

Commented [MF172]: I wonder if there is a more current citation for the current population. ☺



Source: NMFS 2017c

Figure 1-43. Range of the Hawaiian Insular False Killer Whale in Hawaii

On July 24, 2018, NOAA Fisheries published a final rule (83 FR 35062) to designate critical habitat under the Endangered Species Act for main Hawaiian Islands insular false killer whales (MHI IFKWs) in waters from 45 meters to 3,200 meters (49 to 3,500 yards) in depth surrounding the main Hawaiian Islands (from Niʻihau to Hawaiʻi Island). This designation does not include most bays, harbors, or coastal in-water structures. Within this larger area, NOAA Fisheries excluded 10 areas from the designation due to economic and national security impacts. In addition, two areas are ineligible for designation because they are managed under the Joint Base Pearl Harbor-Hickam Integrated Natural Resources Management Plan that was found to benefit main Hawaiian Islands insular false killer whales. The total area proposed includes approximately 49,948 km² (19,280 mi²) of marine habitat.

Hawaiian Monk Seal (*Neomonachus schauinslandi*)

The Hawaiian monk seal is one of the most endangered marine mammals in the world, and is also classified as depleted under the MMPA. This species is endemic to Hawaii, meaning it is found nowhere else in the world. The population is distributed throughout the MHI and the NWHI, though they are considered two separate subpopulations. These seals inhabit 113,100 mi^2 (293,000 km^2) around the Hawaiian Island chain (Figure 3-23). The current estimate for the total Hawaiian monk seal population is 1,112 individuals, with a current best minimum abundance estimate of 179 residing in the MHI, and 1,100 residing in the NWHI (NMFS 2015b). The subpopulation on the MHI has seen a 3% annual increase in numbers from 2013-2016, however, the subpopulation on the NWHI has seen a steady decrease in numbers. The decline in the NWHI population decline is attributed to food limitation, as they must compete for food with large apex predator populations, and shark predation on pre-weaned or recently weaned seal pups (NMFS 2015b).

Commented [TS173]: From Colby: It would be good to include a map of the longline MHI and SEZ intermittent closure (with explanation of when SEZ is instigated), and a discussion of the false killer whale take reduction team to help reduce questions related to cumulative impacts from other baseline concerns of the stock.

Commented [TS174]: From Colby: I would at least speak to the PBR estimates for the other two species; NWHI (~7.6), pelagic (~10).

Commented [MF175]: Might be something more current.

Source: Littnan et al. 2015

Figure 1-44. Range of the Hawaiian Monk Seal

In September, 2015 NMFS issued a final rule to revise the critical habitat for the Hawaiian monk seal (*Neomonachus schauinslandi*) pursuant to the Endangered Species Act. Specific areas for designation include sixteen occupied areas within the range of the species: ten areas in the Northwestern Hawaiian Islands (NWHI) and six in the main Hawaiian Islands (MHI). These areas contain one or a combination of habitat types: preferred pupping and nursing areas, significant haul-out areas, and/or marine foraging areas, that will support conservation for the species. Specific areas in the NWHI include all beach areas, sand spits and islets, including all beach crest vegetation to its deepest extent inland; lagoon waters; inner reef waters, and including marine habitat through the water's edge; and the seafloor and all subsurface waters and marine habitat within 10 meters (m) of the seafloor, out to the 200-m depth contour line aroundKure Atoll, Midway Islands, Pearl and Hermes Reef, Lisianski Island, Laysan Island, Maro Reef, Gardner Pinnacles, French Frigate Shoals, Necker Island, and Nihoa Island.

Commented [TS176]: •From Colby I would imagine that aquaculture facilities will not be sited in the NWHI area, and commercial interests would be more interested in the MHI where there is better access to port infrastructure and airports, but perhaps some discussion on this is warranted. If my assumption is correct, then it would make sense to include maps of significant critical habitat areas in the MHI. If my assumption is incorrect, include maps of critical habitat in both the MHI and NWHI areas.

Commented [MF177R176]: I suppose maps could be useful since the descriptions below are so complex.

Specific critical habitat areas in the MHI include marine habitat from the 200-m depth contour line, including the seafloor and all subsurface waters and marine habitat within 10 m of the seafloor, through the water's edge 5 m into the terrestrial environment from the shoreline between identified boundary points on the islands of Kauai, Niihau, Kauai, Oahu, Maui Nui (including Kahoolawe, Lanai, Maui, and Molokai), and Hawaii. In areas where critical habitat does not extend inland, the designation ends at a line that marks mean lower low water. Some terrestrial areas in existence prior to the effective date of the rule within the specific areas lack the essential features of Hawaiian monk seal critical habitat because these areas are inaccessible to seals for hauling out (such as cliffs) or lack the natural areas necessary to support monk seal conservation (such as hardened harbors, shorelines or buildings) and, therefore, do not meet the definition of critical habitat and are not included in the designation.

Other Marine Mammals

Other marine mammals protected under the MMPA that occur within the Hawaiian Archipelago are the Blainsville beaked whale, bottlenose dolphin, Bryde's whale, common dolphin, Curvier's beaked whale, dwarf sperm whale, Fraser's dolphin, killer whale, Longman's beaked whale, melon-headed whale, minke whale, pygmy killer whale, pygmy sperm whale, Risso's dolphin, rough-toothed dolphin, short-finned pilot whale, spinner dolphin, striped dolphin, Pacific white-sided dolphin, and Longman's beaked whale (WPFMC 2009d).

Sea Turtles

All five Pacific sea turtle species can occur throughout the Pacific and in all sub-regions of the PIR. A full description of each sea turtle species is provided in Section 3.2.2.3.2. The following provides Hawaii specific information on these species.

The green sea turtle accounts for more than 98 percent of all sea turtles in Hawaii and the Hawaiian population is federally listed as threatened (Chaloupka et al. 2008). The Hawaiian population is composed of a single genetic stock (Dutton et al. 2008), with individuals spending most of their lives in the Hawaii ecoregion. This population appears to have increased gradually over the past 30 years, with near capacity nesting at French Frigate Shoals (Balazs and Chaloupka 2006; Chaloupka et al. 2008). On April 6, 2016, NOAA issued a final rule separating the global population into eight individual stocks, called DPSs. The Hawaiian stock, referred to as the Central North Pacific population, maintained its threatened status under the ESA (81FR20058). No critical habitat has been designated for the green sea turtle in Hawaii.

Commented [TS178]: From Colby Same comment as in 3.2.2.3.2; I would add a map of the satellite tracks from G.S.T.'s in our DPS. You might also want to mention that offshore, longline vessels actually only interact with 1% of GST from our DPS, and 66% of the offshore GST's are actually from the mainland DPS, and 33% are from the Western Pacific DPS in Asia

From Colby There is some excellent, recent green sea turtle satellite tracking information that you might want to drop in here for HI, further demonstrating the HI stock nearshore, and direct island hopping pattern. I'm not aware of something similar in the other PIR action areas. See https://www.fisheries.noaa.gov/feature-story/motherload-story-fertile-turtle-hawaiian-islands

Hawksbill sea turtles are the second most common species in the waters of the Hawaiian Islands, as reflected by the stranding records, yet they are far less abundant than green sea turtles (Chaloupka et al. 2008; Seitz et al. 2012). The relatively small hawksbill population appears to be concentrated around Hawaii Island and Maui. The lack of hawksbill sightings during aerial and shipboard surveys and no recorded interaction with the Hawaii longline fishing fleet likely reflects the species' small size and difficulty in identifying from a distance.

The other three species of turtle (loggerhead, olive ridley, leatherback) that can occur in Hawaiian waters are all primarily pelagic species. Satellite tracking data of both loggerhead and leatherback sea turtles indicate that they migrate across the Pacific Ocean primarily north of the Hawaiian EEZ (Benson et al. 2011; Kobayashi et al. 2008), but may transit through occasionally. Olive ridley sea turtles generally occur south of the Hawaiian Islands, preferring warmer tropical waters, although there have been at least three documented nestings of olive ridleys in the Hawaiian Islands (Kelly 2010).

Seabirds

Seabirds listed as endangered or threatened that are present within the Hawaiian Archipelago are banded-rumped storm petrel, Hawaiian petrel, Newell's shearwater, and the short-tailed albatross. Of those, the Hawaiian petrel and Newell's shearwater are only found in Hawaii and will be discussed in detail in this section (WPFMC 2009d).

Other seabirds that occur within the Hawaiian Archipelago are the black-footed albatross, Laysan albatross, masked booby, brown booby, red-footed booby, wedge-tailed shearwater, Christmas shearwater, petrels, tropicbirds, frigatebirds, and noddies (WPFMC 2009d).

Hawaiian Petrel (*Pterodroma sandwichensis*)

The Hawaiian or dark-rumped petrel, listed as endangered under the ESA, is a small pelagic seabird with a primary range around the Hawaiian Islands (Figure 3-24). Adults have a dark gray head, wings and tail, with a white forehead and belly, and measure 16-17 in. (40-43 cm) in length with a wingspan of 32 in. (81 cm). The population is estimated at 19,000, with 4,500-5,000 breeding pairs (BirdLife International, 2016c). A 2007 report indicated that populations have declined due to predation by introduced species at nesting colonies (i.e., mongoose, rats, feral cats), urbanization, and collisions with power lines. More recent reports state that conservation efforts have slowed the overall population decline (BirdLife International 2016c).

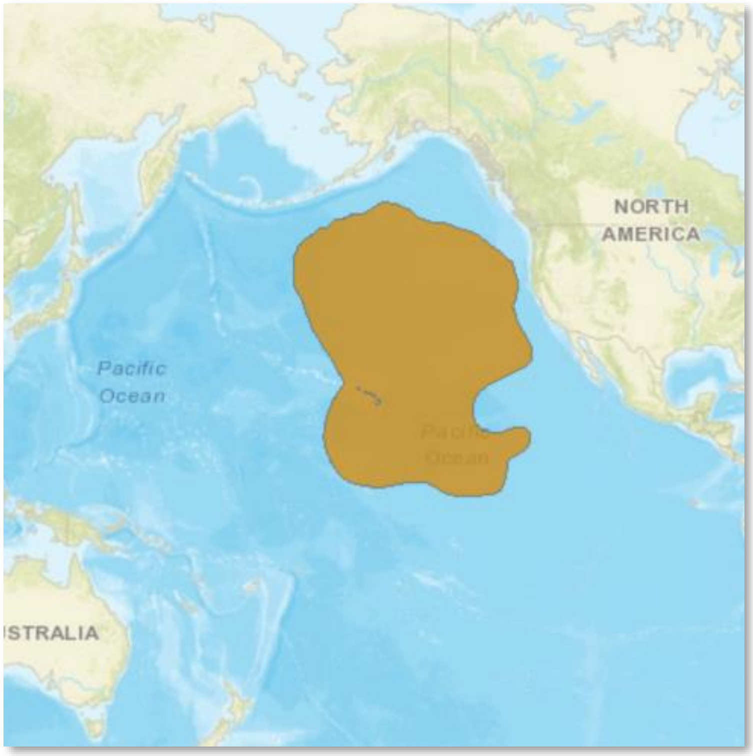
Nesting occurs in cavities up to 2 meters deep in the lava fields, burrowed beneath rocks, or at the base of cliffs. Hawaiian petrels reach reproductive maturity at about six years, and have a 13-18 year life span. Nesting pairs lay a single egg between May and June, with the chick leaving the nest around late December (BirdLife International 2016c). The Hawaiian petrel forages at night with flocks of other seabirds, preying on lanternfish, goatfish and squid. They capture prey by seizing it while sitting on the water or picking it off the surface with its feet. The Hawaiian petrel does not dive for food (BirdLife International 2016c).

Commented [TS179]: •From Colby ; There are somewhat recently discovered nesting sites on Molokai. All of these known nesting sites, and any available satellite tracks should be included here to keep in context with aquaculture siting considerations. Also, it should be mentioned that in HI they are like the HI GST DPS, in that the HI Hawksbill populations are nearshore. For example, there hasn't been a single Hawksbill sea turtle interaction in HI LL fisheries.

Commented [TS180]: From Colby Similar comments as in 3.2.2.3.2; We should include satellite tracking maps of these species and discuss what DPS populations HI aquaculture activities could potentially impact.

From Colby: Also, we have Olive Ridley sea turtle satellite tagging data from HI observed LL trips that demonstrate a preponderance of migration south of the Hawaiian Islands that you might want to include here. I'd ask Irene Kelly for the maps and sources.

Commented [TS181]: From Colby Similar comments as in 3.2.2.3.2; Also, do we need to mention the Migratory Bird Treaty Act in here? Seems relevant since we recently lost a case on it in regards to our HI LL fishery



Source: BirdLife International, 2016c

Figure 1-45. Range of the Hawaiian Petrel

Sharks and Rays

All sharks and rays that occur in Hawaii occur elsewhere in the PIR. Thorough descriptions of each species are provided in Section 3.2 (Protected Species).

Commented [TS182]: From Colby This should be Giant Manta Ray, not Manta Ray. Actually, we have longline observer data on Giant Manta rays that you might want to include. If I remember correctly, the interactions have been observed SE of the Big Island, which could be informative for aquaculture site considerations/impacts.

Commented [TS183]: Assuming there aren't specifics for this region, but need to check the ESA docs

1.5.3 Social and Economic Environment

1.5.3.1 Past and Present Commercial Offshore Aquaculture Operations

Section 3.1 contains a description of the current state of the aquaculture industry in Hawaii. As mentioned in Section 3.3.2.2.1, in the near term, culture of oysters, algae, and aquarium fish in the western Pacific region is expected to occur nearshore or on land, rather than through offshore aquaculture operations.

State of aquaculture industry

Within the PIR, Hawaii has the longest history, largest industry, and most extensive technical capacity for both marine and freshwater aquaculture ventures. The value of the Hawaiian aquaculture industry has held steady since a peak of roughly $78 million in 2014. In 2017, aquaculture sales reached $76.4 million, of which algae contributed $35.2 million (46%). Currently, the aquaculture industry in Hawaii produces a wide variety of crustaceans, finfish, mollusks, and algae for food (USDA 2018).

Commented [TS184]: https://www.nass.usda.gov/Statistics_by_State/Hawaii/Publications/Livestock,_Poultry_and_Dairy/201810HawaiiAquaculture.pdf

In 1999, with assistance from NOAA's National Marine Aquaculture Initiative (NMAI), Hawaii became the first place in the world with a commercially operating ocean-lease, offshore cage system. This began as a public-private partnership known as the Hawaii Open Ocean Aquaculture Research Project (HOARP), where environmental research and commercial production of moi (Pacific threadfin, *Polydactylus sexfilis*) were conducted off Ewa Beach, Oahu. By 2006, the private venture partner, Cates International, Inc. (CII), produced as much as 8,000 lbs. (3,630 kg) of moi per week. After being sold to Grove Farm Fish & Poi, LLC, operating as Hukilau Foods, the company declared bankruptcy in 2010. CII's founder has since begun a new venture, Mamala Bay Seafoods, and intends to produce moi in a 10-cage facility over 75 acres in the nearshore waters of south Oahu. The final Environmental Assessment for this proposed project was completed in 2014 and the construction permit was extended in 2018, however this venture has not yet been constructed.

Commented [TS185]: https://dlnr.hawaii.gov/wp-content/uploads/2018/01/K-2.pdf

In addition to Mamala Bay Seafoods, Kona Blue Water Farms began harvesting commercial quantities of the amberjack (*Seriola rivoliana*), also known as "kampachi", in September 2005 in state waters off the Kona coast of the Big Island. A year later, the company produced up to 10,000 lbs. (4,536 kg) per week of hatchery-produced sashimi-grade fish (Toth 2014). In 2012, Blue Ocean Mariculture acquired the hatchery and offshore assets of Kona Blue Water Farms and is currently the only active commercial aquaculture venture utilizing submersible sea cages in Hawaii. Blue Ocean Mariculture continues to culture amberjack (*Seriola rivoliana*) and in 2014 they applied to the State for permission to increase production capacity from 550 U.S. tons(tons) (500 metric tons [t]) to 1,212 tons (1,100 t) of fish annually (Blue Ocean Mariculture 2014). The permit was approved and allows Blue Ocean Mariculture to culture kahala (*Seriola rivoliana*), moi (*Polydactylus sexfilis*), mahi mahi (*Coryphaena hippurus*), and giant ulua (*Caranx ignobilis*).

In 2011, the founders of Kona Blue Water Farms founded Kampachi Farms, LLC, primarily a research venture to investigate and address the challenges of open ocean aquaculture. That year, NMFS issued a permit to Kampachi Farms to test the potential for untethered cages drifting in large-scale eddies that persist in the lee of the Island of Hawaii, known as the Velella Project (Figure 3-1). The goal was to farm fish as sustainably as possible by moving cages offshore to reduce many of the environmental impacts of aquaculture. As such, the system was the first American project to raise fish in cages untethered from the ocean bottom.

In July 2016, NMFS issued a Special Coral Reef Ecosystem Fishing Permit to Kampachi Farms, LLC to culture and harvest of *S. rivoliana* using a net pen system. The permit for this project describes a net pen tethered to an existing mooring located in federal waters approximately 5.5 nm (9.3 km) west of Keauhou Bay on the Island of Hawaii. This two-year permit was transferred in March 2017 to Forever Oceans Corporation and authorizes the culture and harvest of a maximum amount of 30,000 kampachi or approximately 120,000 lbs. (54,431 kg) during the permit's two-year duration (NOAA 2015). Because of the delay in beginning culture activities, NMFS has extended the permit to 2022. The operations and processes of the permitted activity remain the same (30,000 kampachi, same location, gear, etc.).

Figure 1-46. Velella Project Ocean Sphere

At least three other offshore aquaculture ventures have been pursued in Hawaii over the past decade, although none expanded beyond the proposal stage. One of these, Hawaii Oceanic Technology, under the name King Kona Ahi, received a 35-year lease in 2011 from the State of Hawaii, and a required Army Corps of Engineers permit in 2013, to develop and operate a geostatic, untethered offshore cage system to raise bigeye and yellowfin tuna. This venture intended investigate technology that would allow open ocean aquaculture siting in waters of limitless depth. This technology, in collaboration with technology for automated feeding systems and other remotely-operated systems, could provide for expansion of the aquaculture industry to all federal waters (i.e., EEZ, 3- 200 nm [5.6 to 370 km] from shore) of the Pacific and elsewhere. Hawaii Oceanic Technology has since withdrawn from this lease, citing difficulties in raising money for a prototype cage and delays in obtaining permits. The company was dissolved in January 2017 (Gomes 2017).

The Oceanic Institute, a research facility of Hawaii Pacific University, provides research for aquaculture from their land based aquaculture facility in Waimanalo, Oahu. The researchers have provided technical support to numerous ventures in open ocean aquaculture technology, but currently focus on marine ornamentals, shrimp and feed technology (Additional information on hatchery science is found in Appendix D).

Commented [MF186]: For many years, OI had federal USDA funding to support moi (Pacific threadfin) stock enhancement. They would culture them at their Makapuu facility then release them to the wild. Not sure if that program still exists.

Commented [TS187R186]: True, I think that's not active anymore. Since it's not directly related to open ocean aquaculture, I'm not sure if it should be included here.

1.5.3.2 Relevant Fisheries and Communities

In Hawaii, of the wild-caught species, yellowfin tuna, bigeye tuna, mahi mahi, almaco jack, giant trevally, bluefin trevally, and pacific threadfin are most likely to be cultured under this action. Section 3.3.2.2.1. describes the life history characteristics of Hawaii MUS that are most likely to be cultured under this action: almaco jack (kahala), giant trevally, bluefin trevally, and Pacific threadfin (moi). Section 3.2.2.2.1. describes the life history characteristics of Pacific pelagic MUS (yellowfin tuna, bigeye tuna, and mahi mahi) and Section 3.3.2.2 describes the species managed under the Hawaii FEP. Fisheries that catch these species, supporting industries and surrounding fishing communities, are the focus of the following subsections.

Each of the inhabited Hawaiian Islands (Kauai, Niihau, Oahu, Maui, Molokai, Lanai, and Hawaii) has been characterized as a separate fishing community (WPFMC 2009d). Shore-side activities associated with the large-vessel fisheries are mostly concentrated in the vicinity of Honolulu. Although many people participate in those fisheries and related activities, Honolulu is a large city with a large economy, so its dependency on those fisheries is relatively small. Activities associated with the small vessel fisheries, in contrast, are fairly widely dispersed within and among islands (WPFMC 2009d).

1.5.3.3 Characteristics and Economic Feasibility of Aquaculture Operations that May Operate in Offshore-waters of Hawaii

Section **Error! Reference source not found.** provides an overview of economic feasibility of aquaculture for all areas covered by this PEIS including Hawaii.

1.5.3.4 Scope of Fishing Industry - Wild Stocks

Description of Commercial Fisheries

Pelagic fisheries

Hawaii's commercial pelagic fisheries are diverse, and include longlining, MHI trolling, MHI handlining, offshore handlining, and aku boat fishing. Pelagic longlining constituted roughly 90% of landings and revenue, making it the most significant fishery in the region for 2018 (WPRFMC 2019a). The entire commercial pelagic fishery is valued at $114.8 million. Commercial fisheries landed 37.7 million lbs. (17.1 million kg) in 2018. The primary target species in the longline fishery is tuna, specifically bigeye and yellowfin, with some vessels targeting billfish, primarily swordfish. Longline vessels are prohibited from fishing within 50 mi (80 km) of the islands of Hawaii, Maui, Kahoolawe, Lanai and Molokai, and within 75 mi (121 km) of the islands of Oahu, Kauai and Niihau (57FR7661).

Hawaii-based U.S. longline vessels operate under a limited entry program, with 164 total permits, 146 of which are current (https://www.fisheries.noaa.gov/pacific-islands/resources-fishing/pacific-islands-permit-holders#hawaii-longline-limited-entry, accessed April 09, 2020). Hawaii longline vessels set shallow longlines to target swordfish or deep to target bigeye tuna. (see WPRFMC [2019a] for more information)

Participation in pelagic fisheries

A total of 3,308 fishermen were licensed in 2018, including 1,982 (60%) who indicated that their primary fishing method and gear were intended to catch pelagic fish. This is a 12% decrease in fishing licenses from the previous year. Most licenses that indicated pelagic fishing as their primary method were issued to longline fishermen (45%) and trollers (42%). The remainder was issued to ika shibi and palu ahi (handline) (13%).

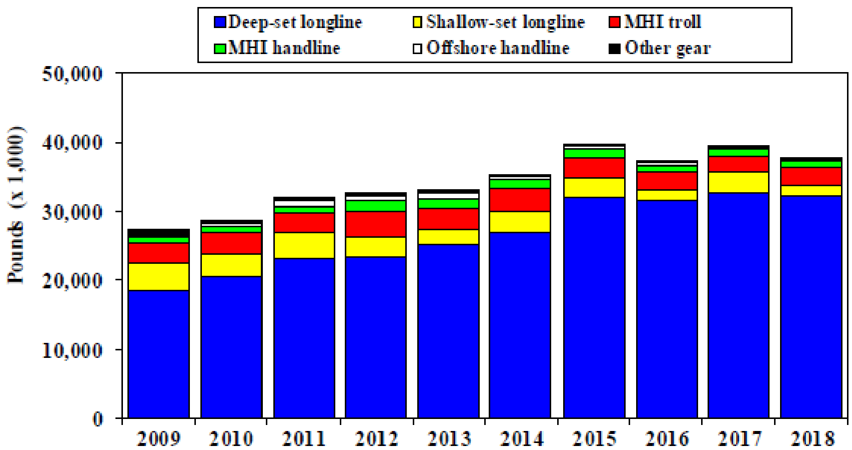
Landings in pelagic fisheries

Commented [TS188]: From Colby Hawaii commercial bottomfish gear is not listed here, and it an important fishery. There is a lot of relevant information in that fishery (see, file:///C:/Users/colby.brady/Downloads/noaa_17543_DS1.pdf), and Brett would be an excellent POC. Also, Kona crab fishery, however small, should be included. Furthermore, other important fisheries that should definitely be included are HI squid jig, HI shrimp trap, HI lobster (even if closed, this should be explained). Logbook data (including effort and depths fished) as well as maps of known effort (protecting for confidentiality) for all these fisheries should be included here. If these important fishing areas are not included for aquaculture siting concerns, controversy, and therefore, NEPA significance ramps up considerably.

Commented [MF189R188]: Agree, should probably at least include the bottom fish gear along with the others in the first sentence.

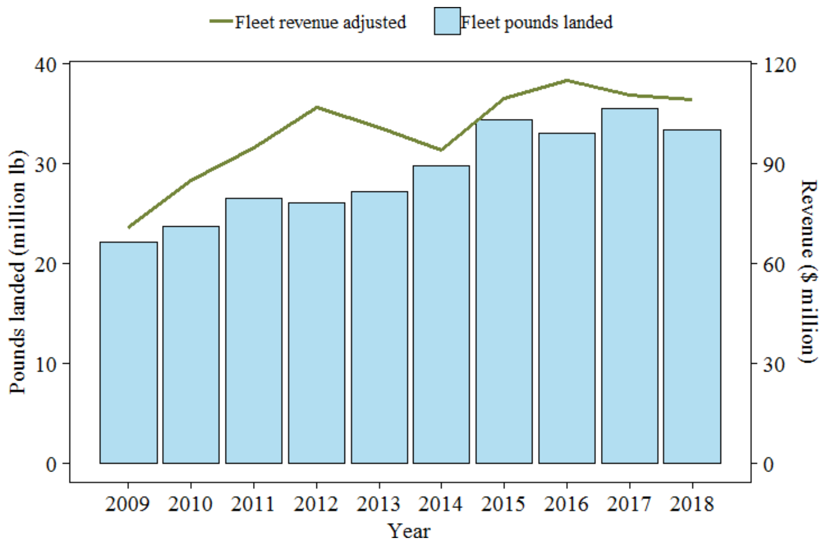
Commented [MF190]: It appears that most -- nearly all -- of this data and the associated figures below come from prior SAFE Reports. The figures are cut and pasted directly from SAFE reports. It all could probably be updated by using the 2018 SAFE reports (esp. 2018 Pelagic FEP SAFE Report) found at this link: http://www.wpcouncil.org/annual-reports/

Hawai`i commercial fisheries caught and landed 37,718,000 pounds of pelagic species in 2018, a decrease of 4% from the previous year. Although each fishery targets or intends to catch a particular pelagic species, a variety of other species were also caught. The deep-set longline fishery targeted bigeye and yellowfin tuna. This was the largest of all pelagic fisheries and its total catch comprised 86% (32,318,000 pounds) of all pelagic fisheries. The shallow-set longline fishery targeted swordfish and its catch was 1,438,000 pounds, or 4% of the total catch. The main Hawai'i Islands troll fishery targeted tunas, marlins and other PMUS caught 2,715,000 pounds or 7% of the total. MHI handline fishery targeted yellowfin tuna while the and offshore handline fishery targeted bigeye tuna. The MHI handline fishery accounted for 776,000 pounds (2% of the total). The offshore handline fishery was responsible for 366,000 pounds or 1% of the total catch.



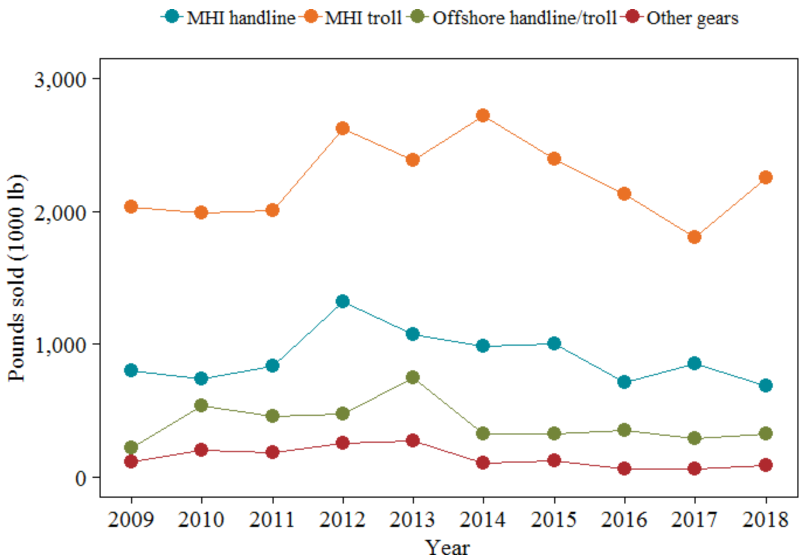
Source: WPRFMC 2019a.

Figure 47 Total commercial pelagic catch by gear type, 2009-2018



Source: WPRFMC 2019a.

Figure 48 Commercial landings and revenue of Hawaii-permitted longline fleet from Hawaii 2009-2018 adjusted to 2018 dollars



Source: WPRFMC 2019a.

Figure 49 Pounds sold of various MHI commercial non-longline gears from 2009-2018

Table 1-26 Released catch, retained catch, and total catch for the Hawai`i-permitted deep-set longline fishery, 2018

	Deep-se t longline fishery			
	Released catch	**Percent released**	**Re tained catch**	**Total Catch**
Tuna				
Albacore	43	1.2	3,558	3,601
Bigeye tuna	5,052	2.3	213,524	218,576
Bluefin tuna	2	40.0	3	5
Skipjack tuna	401	2.2	17,690	18,091
Yellowfin tuna	997	1.6	60,692	61,689
Other tuna	0	0.0	0	0
Total tunas	**6,495**	**2.2**	**295,467**	**301,962**
Billfish				
Swordfish	248	4.1	5,864	6,112
Blue marlin	131	1.7	7,429	7,560
Striped marlin	213	1.4	15,514	15,727
Spearfish	283	1.8	15,194	15,477
Other marlin	8	1.7	461	469

Total billfish	883	1.9	44,462	45,345
Othe r PMUS				
Mahimahi	576	1.3	43,545	44,121
Wahoo	165	0.5	31,084	31,249
Moonfish	356	1.1	32,515	32,871
Oilfish	2,251	13.4	14,507	16,758
Pomfret	462	0.8	55,438	55,900
Total othe r PMUS	**3,810**	**2.1**	**177,089**	**180,899**
Non-PMUS fish	**3,752**	**86.6**	**579**	**4,331**
Total non-shark	**14,940**	**2.8**	**517,597**	**532,537**
PMUS Sharks				
Blue shark	91,648	100.0	0	91,648
Mako shark	4,257	86.4	668	4,925
Thresher shark	5,471	99.6	22	5,493
Oceanic Whitetip shark	399	100.0	0	399
Silky shark	236	100.0	0	236
Total PMUS sharks	**102,011**	**99.3**	**690**	**102,701**
Non-PMUS sharks	**362**	**100.0**	**0**	**362**
Grand Total	**117,313**	**18.5**	**518,287**	**635,600**

Source: WPRFMC 2019a.

Table 1-27 Released catch, retained catch, and total catch for the Hawai`i-permitted shallow- set longline fishery, 2018

	Shallow-se t longline fishery			
	Released catch	**Percent released**	**Retained catch**	**Total Catch**
Tuna				
Albacore	1	0.7	136	137
Bigeye tuna	70	5.4	1,221	1,291
Bluefin tuna	0	0.0	2	2
Skipjack tuna	0	0.0	16	16
Yellowfin tuna	17	2.2	761	778
Other tuna	0	0.0	0	0
Total tunas	**88**	**4.0**	**2,136**	**2,224**
Billfish				
Swordfish	466	7.6	5,644	6,110
Blue marlin	3	60.0	2	5
Striped marlin	21	33.9	41	62
Spearfish	5	11.4	39	44
Other marlin	0	0.0	0	0
Total billfish	**495**	**8.0**	**5,726**	**6,221**

Other PMUS				
Mahimahi	13	2.0	626	639
Wahoo	2	7.7	24	26
Moonfish	15	8.7	157	172
Oilfish	103	60.9	66	169
Pomfret	7	29.2	17	24
Total othe r PMUS	**140**	**13.6**	**890**	**1,030**
Non-PMUS fish	**0**	**0.0**	**0**	**0**
Total non-shark	**723**	**7.6**	**8,752**	**9,475**
PMUS Sharks				
Blue shark	2,538	100.0	0	2,538
Mako shark	283	81.8	63	346
Thresher shark	24	96.0	1	25
Oceanic Whitetip shark	0	0.0	0	0
Silky shark	0	0.0	0	0
Total PMUS sharks	**2,845**	**97.8**	**64**	**2,909**
Non-PMUS sharks	1	100.0	0	1
Grand Total	**3,569**	**28.8**	**8,816**	**12,385**

Source: WPRFMC 2019a.

Bottomfish fisheries.

Bottomfish fishing was a part of the economy and culture of the indigenous people of Hawaii long before European explorers first visited the islands. Descriptions of traditional fishing practices indicate that Native Hawaiians harvested the same deep-sea bottomfish species as the modern fishery and used some of the same specialized gear and techniques employed today. The State of Hawaii, Department of Land and Natural Resources, Division of Aquatic Resources manages the deep-sea bottomfish fishery in the Main Hawaiian Islands (MHI) under a joint management arrangement with the National Marine Fisheries Service (NMFS), Pacific Islands Regional Office (PIRO), and the Western Pacific Regional Fishery Management Council (WPRFMC).

The bottomfish fishery is split into two groups: the Deep-7 and the non-Deep-7 species. The Deep-7 species group consists of eteline snappers (e.g., opakapaka), carangids (e.g., jacks), and a single species of grouper (hapuupuu) concentrated at depths of 30–150 fathoms.The non-Deep-7 species group is characterized by three jacks: the white/giant ulua (*Caranx ignobilis*), gunkan/black ulua (*Caranx lugubris*), and butaguchi/pig-lip ulua (*Pseudocaranx dentex*). The group is similarly characterized by two snappers: the uku (*Aprion virescens*) and yellowtail kalekale (*Pristipomoides auricilla*). All three jack species have been identified in local catch records since 1981.

Participation in bottomfish fisheries

In 2018, the Main Hawaiian Island Deep 7 bottomfish fishery was characterized by decreasing trends in catch and effort relative to measured averages. This decline can likely be attributed to trends in the portion of the fishery that harvests using deep-sea handline, which is responsible for a majority of Deep 7 bottomfish catch in the main Hawaiian Islands (MHI). Though the effort, participation, and the pounds landed all decreased, effort and participation decreased to the extent that CPUE for the fishery increased relative to short- and long-term averages for the gear type. The non-Deep 7 bottomfish fishery was dominated by uku (Aprion virescens) with a smaller contribution from white ulua (Caranx ignobilis). The total number of non-Deep 7 fish caught was higher than the short- and long-term averages, though the pounds caught was lower than the decadal average. Each of the major gear types used in the fishery (i.e., deep-sea handling, inshore handline, and trolling) all showed notable decreases in effort and participation relative to their short-term averages, however all gears had increasing trends for CPUE. Trolling with bait showed increases for participation, effort, number of fish caught, and pounds landed relative to both ten- and twenty-year trends (WPRFMC 2019c).

Table 1-28 Annual fishing parameters for the 2018 fishing year in the MHI Deep 7 bottomfish fishery compared with short-term (10-year) and long-term (20-year) averages

Fishery	Parameters	2018 Values	2017 Comparative Trends	
			Short-Term Avg. (10-year)	Long-Term Avg. (20-year)
BMUS Deep 7	No. License	340	↓ 20.0%	↓ 18.7%
	Trips	2,165	↓ 19.2%	↓ 27.0%
	No. Caught	59,112	↓ 16.3%	↓ 11.4%
	Lbs. Caught	235,898	↓ 6.84 %	↓ 4.31%

Source: WPRFMC 2019c

Table 1-29 Annual fishing parameters for the 2018 fishing year in the MHI non-Deep 7 bottomfish fishery compared with short-term (10-year) and long-term (20-year) averages

Fishery	Parameters	2018 Values	2018 Comparative Trends	
			Short-Term Avg. (10-year)	Long-Term Avg. (20-year)
BMUS Non-Deep 7	No. License	368	↓ 18.2%	↓ 10.0%
	Trips	1,699	↓ 16.6%	↓ 5.34%
	No. Caught	15,131	↑ 4.40%	↑ 28.0%
	Lbs. Caught	112,966	↓ 2.74%	↑ 9.30%

Source: WPRFMC 2019c

Landings in bottomfish fisheries

Table 1-30 Annual fishing parameters for the 2018 fishing year in the MHI Deep 7 bottomfish fishery compared with short-term (10-year) and long-term (20-year) averages

Methods	Fishery indicators	2018 values	2018 Comparative Trends: Short-Term Avg. (10-year)	2018 Comparative Trends: Long-Term Avg. (20-year)
Deep-Sea Handline	Opakapaka	113,746 lbs.	↓ 19.5%	↓ 16.9%
	Onaga	65,742 lbs.	↑ 5.13%	↓ 2.00%
	Ehu	21,346 lbs.	↓ 8.05%	↓ 0.55%
	Hapuupuu	9,593 lbs.	↑ 7.29%	↓ 0.15%
	No. Lic.	326	↓ 19.3%	↓ 17.5%
	No. Trips	2,065	↓ 24.9%	↓ 28.0%
	Lbs. Caught	232,081 lbs.	↓ 6.68%	↓ 4.45%
	CPUE	112.4 lbs./trip	↑ 23.1%	↑ 30.9%
Inshore Handline	Opakapaka Ehu Lehi Onaga	Insufficient data to report trends		
	No. Lic. No. Trips Lbs. Caught CPUE	Insufficient data to report trends		
Palu-ahi	Opakapaka	1,386 lbs.	↑ 14.93%	↑ 95.2%
	Ehu	Insufficient data to report trends		
	Lehi	959 lbs.	↓ 5.42%	↑ 35.6%
	Hapuupuu	Insufficient data to report trends		
	No. Lic.	20	↓ 16.7%	↑ 5.26%
	No. Trips	87	↓ 2.25%	↑ 33.9%
	Lbs. Caught	2,418 lbs.	↓ 0.62%	↑ 55.3%
	CPUE	27.8 lbs./trip	↑ 5.75%	↑ 34.8%

Source: WPRFMC 2019c

Table 1-31 Annual fishing parameters for the 2018 fishing year in the MHI Deep 7 bottomfish fishery compared with short-term (10-year) and long-term (20-year) averages

Methods	Fishery indicators	2018 values	2018 Comparative Trends: Short-Term Avg. (10-year)	2018 Comparative Trends: Long-Term Avg. (20-year)
	Uku	59,044 lbs.	↓ 16.6%	↓ 54.0%
	White Ulua	1,742 lbs.	↓ 4.89%	↓ 33.2%

Deep-Sea Handline	No. Lic. No. Trips Lbs. Caught CPUE	183 700 61,232 lbs. 87.6 lbs./trip	↓ 10.3% ↓ 20.7% ↓ 18.9% ↑ 2.17%	↓ 8.50% ↓ 15.9% ↓ 7.83% ↑ 9.69%
Inshore Handline	Uku White Ulua	16,304 lbs. 3,411 lbs.	↑ 9.50% ↑ 27.2%	↑ 30.9% ↑ 75.6%
	No. Lic. No. Trips Lbs. Caught CPUE	51 355 19,760 lbs. 55.6 lbs./trip	↓ 44.0% ↓ 5.84% ↑ 12.2% ↑ 20.6%	↓ 50.5% ↓ 6.82% ↑ 32.9% ↑ 41.7%
Troll with Bait	Uku White Ulua	10,605 lbs. 816 lbs.	↑ 39.0% ↓ 52.4%	↑ 52.3% ↓ 47.7%
	No. Lic. No. Trips Lbs. Caught CPUE	34 161 11,452 lbs. 71.13 lbs./trip	↓ 10.5% ↓ 10.6% ↑ 22.3% ↑ 38.2%	↑ 36.0% ↑ 36.4% ↑ 78.6% ↑ 29.7%
Troll (Misc.)	Uku White Ulua	Insufficient data to report trends		
	No. Lic. No. Trips Lbs. Caught CPUE	Insufficient data to report trends		

Source: WPRFMC 2019c

Crustacean fisheries

Ula (lobster) was a traditional source of food for Native Hawaiians and was sometimes used in early religious ceremonies (Titcomb 1978). After the arrival of Europeans in Hawaii, the lobster fishery became by far the most productive of Hawaii's commercial shellfish fisheries. Crustacean fisheries in MHI are comprised of the Heterocarpus deep water shrimps (*H. laevigatus* and *H. ensifer*), spiny lobsters (*Panulirus marginatus* and *P. penicillatus*), slipper lobsters (*Scyllaridae haanii* and *S. squammosus*), kona crab (*Ranina ranina*), kuahonu crab (*Portunus sanguinolentus*), Hawaiian crab (*Podophthalmus vigil*), opaelolo (*Penaeus marginatus*), and ʻaʻama crab (*Grapsus tenuicrustatus*). The main gear types used are shrimp traps, loop nets, miscellaneous traps, and crab traps.

Participation in crustacean fisheries

In 2018, the MHI crustacean fishery showed an overall decline relative to available short- and long-term trends. Effort, participation, and catch values for species harvested by shrimp trip were not disclosed due to data confidentiality. Deepwater shrimp (Heterocarpus laevigatus) had an 80-90% decline from its short- and long-term averages, with only 2,916 lbs. harvested. Kona crabs harvested by loop net (2,561 lbs.) also had notable decreases in all available fishery parameters. Data were unavailable to report for crab traps in the MHI. The fishery for hand grabbing lobsters also had observable declines in effort, participation, and catch in the over the last decade despite comprising the most active portion of the crustacean fishery in the MHI (WPRFMC 2019c).

Table 1-32 Annual fishing parameters for the 2018 fishing year in the MHI crustacean fishery compared with short-term (10-year) and long-term (20-year) averages

Fishery	Parameters	2018 Values	2018 Comparative Trends	
			Short-Term Avg. (10-year)	Long-Term Avg. (20-year)
Crustacean	No. License	43	↓ 36.8%	↓ 57.7%
	Trips	460	↓ 36.6%	↓ 34.7%
	No. Caught	50,773	↓ 74.6%	↓ 58.1%
	Lbs. Caught	24,948	↓ 60.0%	↓ 65.0%

Source: WPRFMC 2019c

Landings in crustacean fisheries

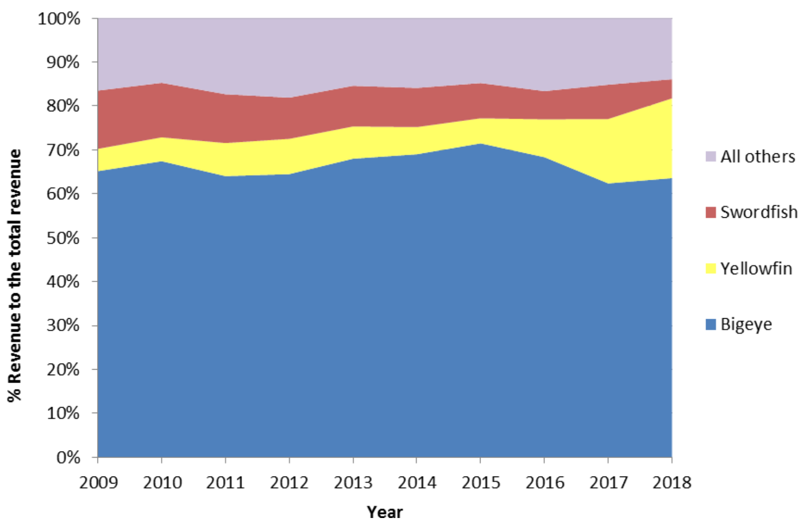
Table 1-33 Annual fishing parameters for the 2018 fishing year in the MHI crustacean fishery compared with short-term (10-year) and long-term (20-year) averages

Methods	Fishery indicators	2018 values	2018 Comparative Trends	
			Short-Term Avg. (10-year)	Short-Term Avg. (20-year)
Shrimp trap	*H. laevigatus*	2,916 lbs.	↓ 80.2%	↓ 89.1%
	No. Lic. No. Trips Lbs. Caught CPUE	3 59 2,932 49.69	↓ 25.0% ↓ 53.9% ↓ 81.2% ↓ 57.6%	↓ 25.0% ↓ 40.4% ↓ 89.4% ↓ 80.9%
Loop Net	Kona crab	2,561 lbs.	↓ 65.3%	↓ 78.7%
	No. Lic. No. Trips Lbs. Caught CPUE	22 57 2,586 lbs. 45.37 lbs./trip	↓ 50.0% ↓ 53.7% ↓ 58.9% ↓ 18.7%	↓ 63.2% ↓ 63.2% ↓ 75.8% ↓ 29.5%
Crab Trap	No. Lic. No. Trips Lbs. Caught CPUE	Insufficient data to report trends		
Hand Grab (Lobster)	Green spiny Red spiny	5,453 lbs. 5,841 lbs.	↓ 44.5% ↓ 37.3%	↓ 0.6% ↓ 14.9%
	No. Lic. No. Trips Lbs. Caught CPUE	13 195 6,642 lbs. 34.06 lbs./trip	↓ 31.6% ↓ 16.3% ↓ 30.7% ↓ 16.7%	↓ 50.0% ↓ 17.0% ↓ 26.4% ↓ 11.7%

Source: WPRFMC 2019c

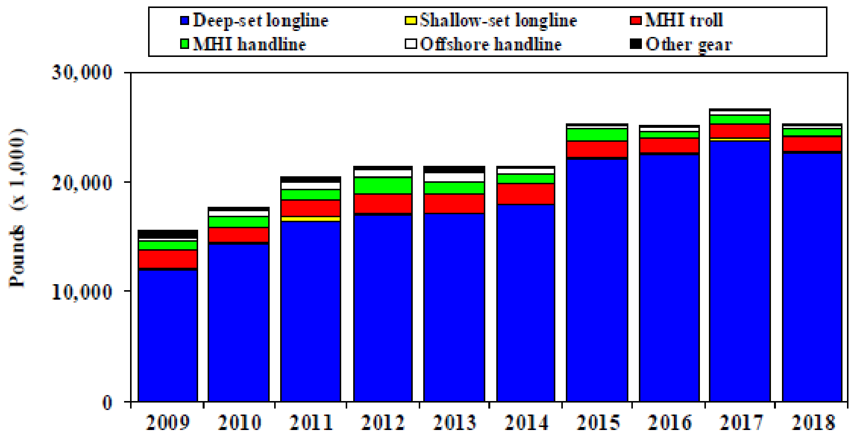
Commercial Catch and Landings of Species with Aquaculture Potential

Historical catch, landings and/or pounds kept, in some cases by gear type, for species with the greatest potential to be grown and harvested in aquaculture operations in Hawaii are presented in Figure 3-27 (yellowfin tuna), Figure 3-28 (big eye tuna), Figure 3-29 (mahi mahi), Figure 3-30 (amberjack), Figure 3-31 (giant trevally), Figure 3-32 (blue fin trevally), and Figure 3-33 (Pacific threadfin). All figures show pounds X 1,000.



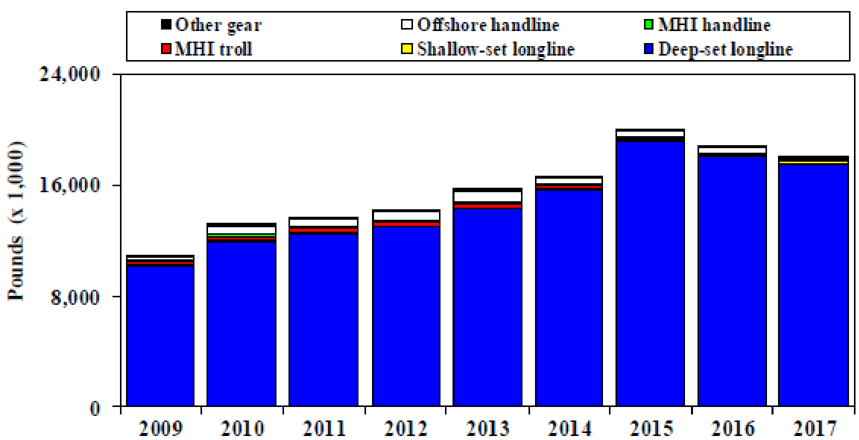
Source: WPFMC 2019a.

Figure 50 Trends in Hawaii longline revenue species composition from 2009-2018



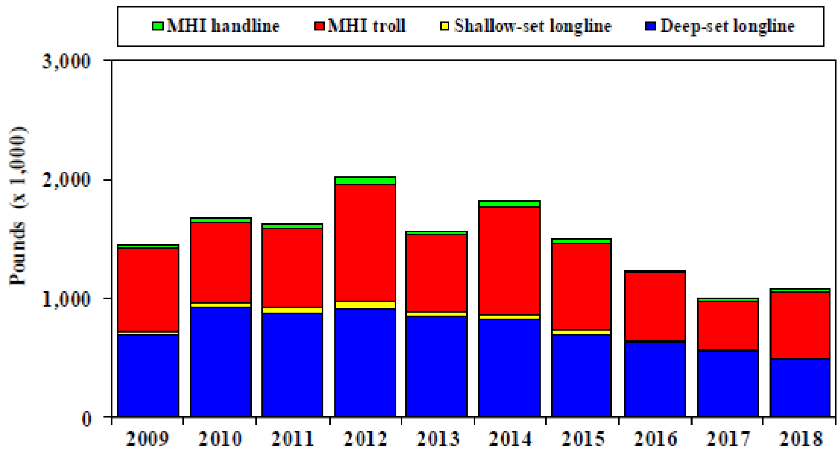
Source: WPFMC 2019a.

Figure 1-51. Hawaii Yellowfin Tuna Catch by Gear Type (2009-2018)



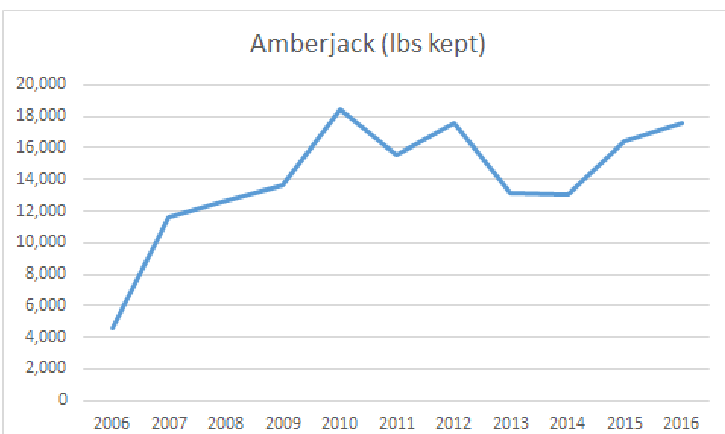
Source: WPFMC 2019a.

Figure 1-52. Hawaii Bigeye Tuna Catch by Gear Type (2009-2018)



Source: WPFMC 2019a.

Figure 1-53. Hawaii Mahi Mahi Catch by Gear Type (2009-2018)



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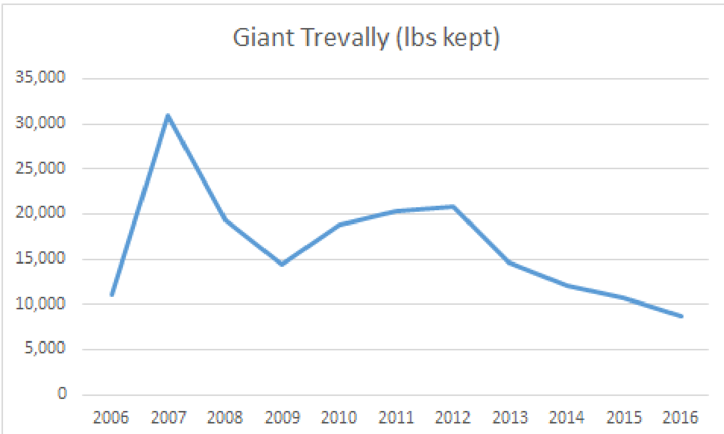
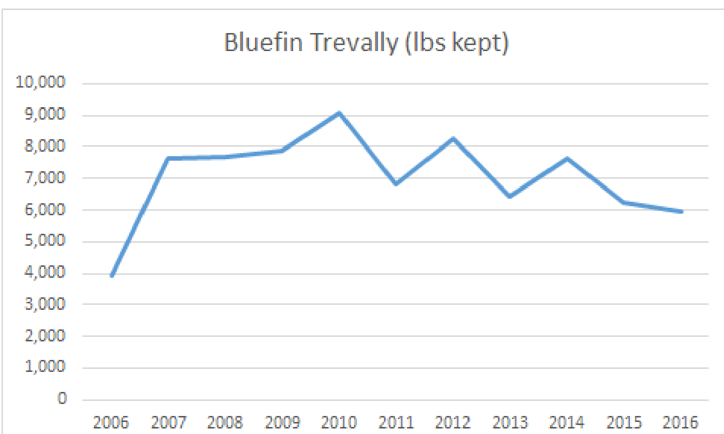
Source: Hawaii Division of Aquatic Resources FRS Data.
Note: Amberjack species include Seriola dumerili, S. lalandi, and S. rivoliana.

Figure 1-54. Hawaii Estimated Annual Amberjack Total Pounds Kept (2006-2016)



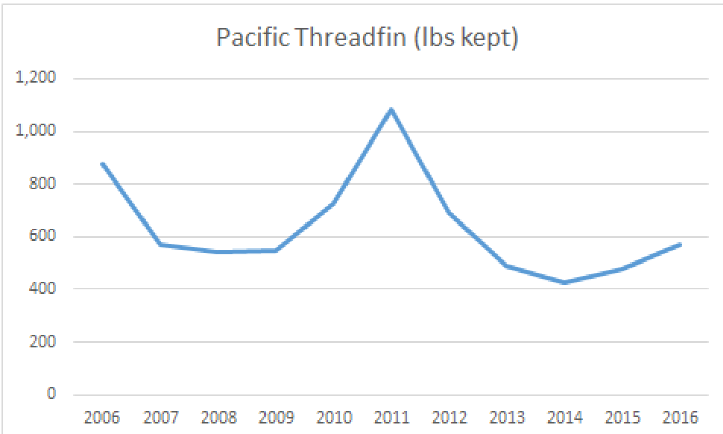
Source: Hawaii Division of Aquatic Resources FRS Data.

Figure 1-55. Hawaii Estimated Annual Giant Trevally Total Pounds Kept (2012-2016)



Source: Hawaii Division of Aquatic Resources FRS Data.

Figure 1-56. Hawaii Estimated Annual Bluefin Trevally Total Pounds Kept (2006-2016)



Source: Hawaii Division of Aquatic Resources FRS Data.
Note: Pacific threadfin, Polydactylus sexfilis also includes unspecified threadfins (Polydactylus spp.)

Figure 1-57. Hawaii Estimated Annual Pacific Threadfin Total Pounds Kept (2006-2014)

Revenue from Commercial Fisheries

The total revenue from Hawaii's pelagic fisheries was $110.8 million in 2017, a decrease of 4% from the previous year. The deep-set longline revenue was $96.1 million in 2017. This fishery represented 87% of the total revenue for pelagic fish in Hawaii. The shallow-set longline fishery increased to $4.2 million and accounted for 4% of the revenue. The MHI troll revenue was $6.4 million or 6% of the total in 2017 and was followed by the MHI handline fishery at $2.8 million (3%). The offshore handline fishery was worth $891,000 in 2017. The trend for revenue from the deep-set longline and offshore handline fisheries was increasing while revenue of the shallow-set longline and MHI troll fisheries was decreasing. The revenue from the offshore handline fishery was steady for the past four years (WPRFMC 2019a).

The total revenue from all fish in the bottomfish fishery (Deep-7 and non-Deep-7) in 2018 was $2.23 million, which is steady with the previous four years. There is currently no socioeconomic information for the crustacean fishery (WPRFMC 2019c).

Commented [TS192]: There just doesn't seem to be similar info in the 2018 SAFE report for bottomfish and crustaceans. There are a few graphs of price per vessel or trip but I don't really think that's relevant here.

Table 1-34. Hawaii Commercial Pelagic Catch, Revenue, and Average Price by Species (2017-2018)

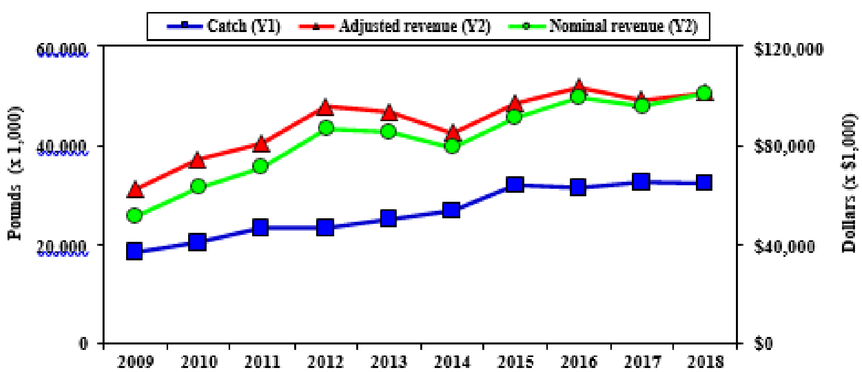
	2017			2018		
Species	Catch (1,000 lbs)	Ex-vessel revenue ($1,000)	Average price ($/lb)	Catch (1,000 lbs)	Ex-vessel revenue ($1,000)	Average price ($/lb)
Tuna PMUS						
Albacore	287	$514	$1.86	236	$393	$1.79
Bigeye tuna	17,955	$65,764	$3.89	17,045	$66,510	$4.16
Bluefin tuna	3	$3	$8.40	1	$13	$8.40
Skipjack tuna	732	$785	$1.60	527	$650	$1.76
Yellowfin tuna	7,596	$21,576	$2.97	7,542	$26,621	$3.63
Other tunas	11	$27	$2.83	10	$18	$2.97
Tuna PMUS subtotal	**26,584**	**$88,670**	**$3.56**	**25,360**	**$94,205**	**$3.94**
Billfish PMUS						
Swordfish	3,582	$5,926	$2.32	2,330	$3,698	$2.12
Blue marlin	1,833	$2,157	$1.40	1,806	$1,615	$1.22
Spearfish (hebi)	688	$802	$1.17	504	$577	$1.19
Striped marlin	910	$1,715	$1.68	1,050	$1,701	$1.35
Other marlins	46	$82	$1.49	39	$57	$1.26
Billfish PMUS subtotal	**7,060**	**$10,682**	**$1.82**	**5,728**	**$7,648**	**$1.57**
Other PMUS						
Mahimahi	1,003	$3,515	$3.69	1,074	$3,493	$3.46
Ono (wahoo)	984	$3,031	$3.17	1,173	$3,039	$2.65
Opah (moonfish)	2,293	$3,252	$1.80	3,039	$3,300	$1.42
Oilfish	338	$267	$0.84	314	$235	$0.77
Pomfrets (monchong)	925	$3,328	$3.41	878	$2,854	$3.07
PMUS Sharks	166	$73	$0.79	139	$62	$0.67
Other PMUS subtotal	**5,709**	**$13,466**	**$2.64**	**6,617**	**$12,983**	**$2.24**
Other pelagics	**11**	**$15**	**$1.20**	**12**	**$12**	**$0.78**
Total pelagics	**39,364**	**$112,832**	**$3.14**	**37,718**	**$114,848**	**$3.32**

Source: WPMFC 2019a

Table 1-35. Hawaii Commercial Pelagic Catch, Revenue, and Average Price by Fishery (2017-2018)

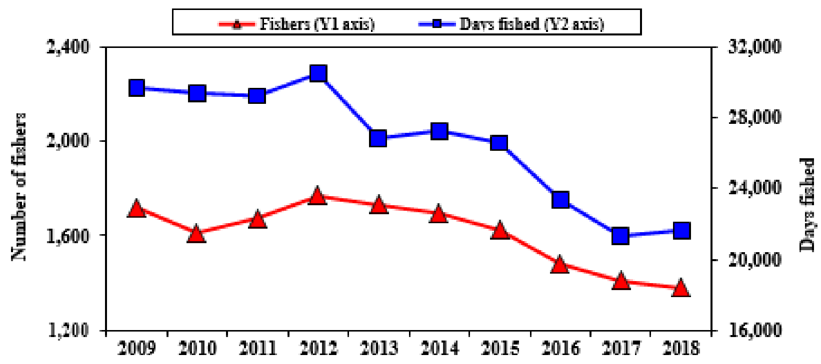
	2017			2018		
Fishery	Catch (1,000 lbs)	Ex-vessel revenue ($1,000)	Average price ($/lb)	Catch (1,000 lbs)	Ex-vessel revenue ($1,000)	Average price ($/lb)
Deep-set longline	32,760	$97,927	$3.16	32,318	$101,259	$3.34
Shallow-set longline	3,007	$4,309	$2.43	1,438	$1,538	$2.08
MHI trolling	2,209	$6,493	$3.44	2,715	$8,171	$3.46
MHI handline	975	$2,944	$3.31	776	$2,493	$3.46
Offshore handline	323	$911	$2.94	366	$1,055	$3.01
Other gear	89	$250	$3.05	105	$331	$3.41
Total	**39,364**	**$112,832**	**$3.14**	**37,718**	**$114,848**	**$3.32**

Source: WPFMC 2019a



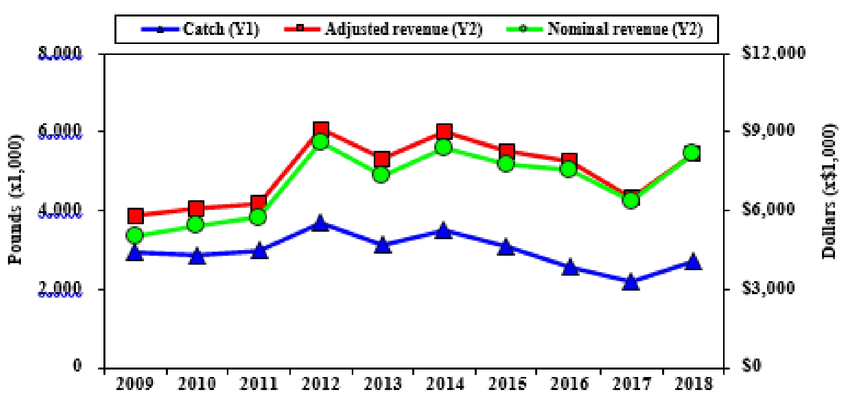
Source: WPRFMC 2019a

Figure 1-58. Catch and Revenue for the Hawaii-Permitted Deep-Set Longline Fishery (2009-2018)



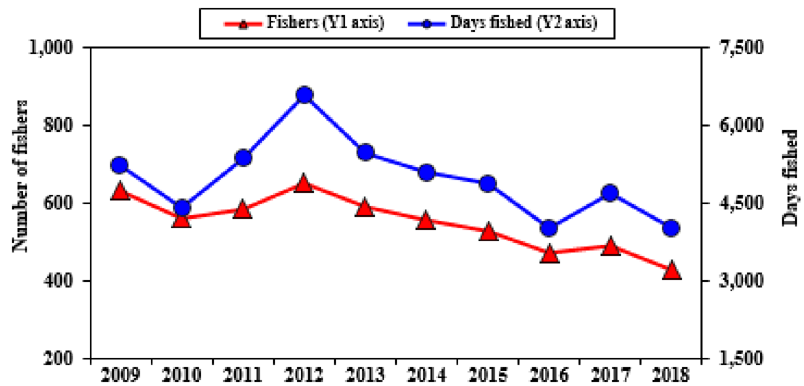
Source: WPRFMC 2019a.

Figure 1-59. Number of MHI Troll Fishers and Days Fished (2009 - 2018)



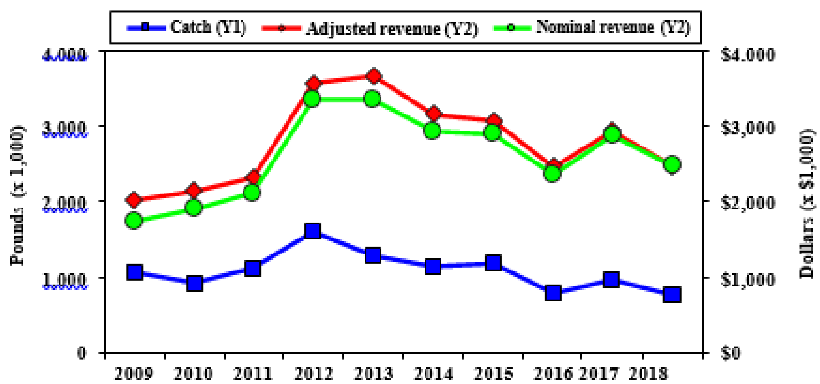
Source: WPRFMC 2018a

Figure 1-60. Catch and Revenue for the MHI Troll Fishery (2009 - 2018)



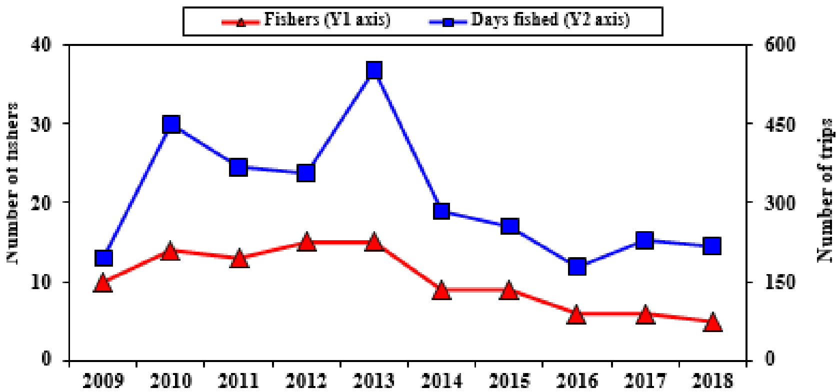
Source: WPRFMC 2019a

Figure 1-61. Number of MHI Handline Fishers and Days Fished (2009 – 2018)



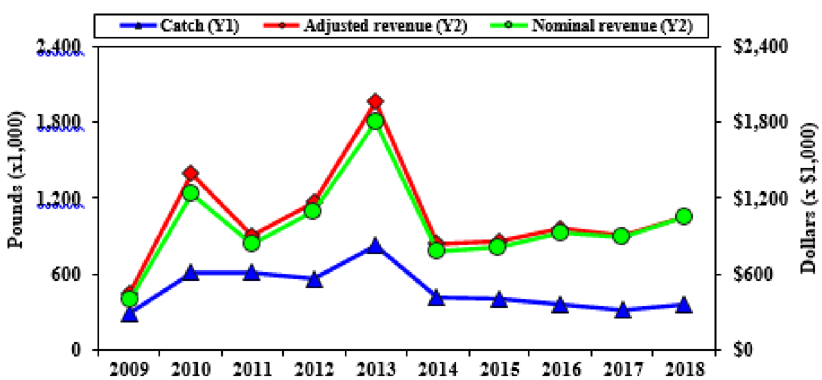
Source: WPFMC 2019a.

Figure 1-62. Catch and Revenue for the MHI Handline Fishery (2009-2018)



Source: WPRFMC 2019a.

Figure 1-63. Number of Hawaii Offshore Handline Fishers and Days Fished (2009-2018)



Source: WPFMC 2019a

Figure 1-64. Catch and Revenue for the Hawaii Offshore Tuna Handline Fishery (2009-2018)

The following tables provide annual estimated revenue information for amberjack (Table 3-15), bluefin trevally (Table 3-16), giant trevally (Table 3-17), threadfin (Table 3-18), and rabbitfish (Table 3-19) sold to commercial marine vendors in Hawaii. The source for the 'pounds kept' data is the Hawaii Division of Aquatic Resources FRS Data, and the source for the estimated total pounds sold data is DAR Integrated Dealer Data. All tables also show estimated revenue adjusted by the CPI pounds are X 1,000.

Commented [TS193]: Incorporate into the tables once we clean up/update data here.

Table 1-36. Hawaii Amberjack Estimated Pounds Kept and Estimated Total Pounds Sold to Commercial Marine Dealers (2006-2016)

Note:

Year	Estimated Pounds Kept	Estimated Pounds Sold	Estimated Revenue	CPI Adjusted Revenue
2006	4,576	337	$557	$706
2007	11,642	1,007	$1,959	$2,367
2008	12,669	784	$993	$1,151
2009	13,641	518	$721	$831
2010	18,485	1,597	$2,727	$3,080
2011	15,593	2,931	$5,224	$5,689
2012	17,593	2,331	$4,392	$4,670
2013	13,195	1,626	$3,817	$3,988
2014	13,027	2,698	$5,614	$5,782
2015	16,415	2,920	$5,492	$5,600
2016	17,604	3,208	$6,439	$6,439

Amberjack species include *Seriola dumerili, S. lalandi*, and *S. rivoliana.*

Table 1-37. Hawaii Bluefin Trevally Estimated Pounds Kept and Estimated Total Pounds Sold to Commercial Marine Dealers (2006-2016)

Year	Estimated Pounds Kept	Estimated Pounds Sold	Estimated Revenue	CPI Adjusted Revenue
2006	3,930	2,291	$4,702	$5,957
2007	7,638	3,661	$8,959	$10,828
2008	7,689	5,244	$11,788	$13,664
2009	7,882	3,983	$9,108	$10,503
2010	9,067	3,809	$8,657	$9,778
2011	6,800	2,928	$7,178	$7,816
2012	8,265	2,889	$8,928	$9,494
2013	6,439	2,264	$6,729	$7,030
2014	7,618	2,800	$8,412	$8,663
2015	6,242	2,330	$7,643	$7,793
2016	5,953	2,841	$9,563	$9,563

Table 1-38. Hawaii Giant Trevally Estimated Pounds Kept and Estimated Total Pounds Sold to Commercial Marine Dealers (2006-2016)

Year	Estimated Pounds Kept	Estimated Pounds Sold	Estimated Revenue	CPI Adjusted Revenue
2006	11,065	5,863	$13,701	$17,357
2007	30,917	8,346	$20,123	$24,319
2008	19,397	10,969	$27,666	$32,068
2009	14,348	8,419	$18,336	$21,144
2010	18,776	11,767	$26,186	$29,577
2011	20,350	8,412	$20,037	$21,818
2012	20,881	12,675	$33,169	$35,271
2013	14,591	7,024	$19,039	$19,890
2014	12,023	7,901	$22,830	$23,512
2015	10,716	8,055	$22,650	$23,096
2016	8,714	5,769	$16,922	$16,922

Table 1-39. Hawaii Pacific Threadfin Estimated Pounds Kept and Estimated Total Pounds Sold to Commercial Marine Dealers (2006-2016)

Year	Estimated Pounds Kept	Estimated Pounds Sold	Estimated Revenue	CPI Adjusted Revenue
2006	875	404	$1,945	$2,464
2007	569	228	$1,373	$1,659
2008	542	425	$2,679	$3,106
2009	548	458	$3,241	$3,737
2010	723	510	$3,402	$3,842
2011	1,082	512	$3,776	$4,112
2012	689	199	$1,291	$1,373
2013	490	68	$453	$474
2014	428	181	$1,338	$1,378
2015	478	133	$1,023	$1,043
2016	568	265	$2,134	$2,134

Note: Pacific threadfin, *Polydactylus sexfilis* also includes unspecified threadfins (*Polydactylus* spp).

Commercial Fishery Suppliers and Markets

The pelagic longline catch, which represents more than 86% of annual commercial landings and revenue, is primarily sold at the United Fishing Agency auction in Honolulu. Other commercial fishermen have many options in terms of where to sell their catch including the Honolulu auction, directly to dealers/wholesalers, markets/stores, restaurants, and roadside, or even sell or give fish to friends and others in their network. Much like other Pacific Island communities, a majority of this latter group of fishermen report selling their fish simply to recover costs, rather than as a primary source of income. Many also place importance of sharing fish as a part of maintaining relationships within their network of friends and family.

In 2010, 75% of all seafood consumed in the State of Hawaii was imported from either the U.S. mainland or foreign markets, as local supply is not sufficient to meet the high seafood demand in Hawaii, as Hawaii

Commented [MF194]: Probably a more current number in SAFE Report or elsewhere.

Commented [TS195R194]: The 2018 SAFE for Hawaii actually has this same stat referenced residents' average seafood consumption is about two to three times more than other U.S. residents (WPFMC 2019a).

Non-commercial Fishing Considerations

In Hawaii, recreational shoreline fishing was more popular than boat fishing in the earlier part of the 20th century. A major period of expansion of small vessel recreational fishing occurred between the late 1950s and early 1970s, with the availability of both enhanced technology and small vessel construction. There are about 30 fishing clubs in Hawaii and the state hosts between 150 and 200 boat-based fishing tournaments. In 2018, the recreational catch is an estimated 43.7 million lbs (19.8 million kg), which accounts for approximately 15% of the total catch.

Recreational fisheries are also extremely important in the State of Hawai`i economically, socially, and culturally. The total estimated pelagic recreational fisheries production in 2018 was 6.57 million lbs. The number of small vessels in Hawai`i has declined to approximately 11,000 since a peak of over 16,000 vessels in 2008. Boat-based anglers took 231,551 fishing trips in 2016, with only 7,670 designated charter vessel trips. Although unsold or not entering the typical commercial channels for fish sales, the total estimated value of the recreational catch was approximately $20 million based on an average of $3.00/lb. (WPRFMC 2019c)

Recreational fishing has significantly greater participation in Hawaii than elsewhere in the PIR. In 2015, residents and visitors booked more than 8,000 charter fishing trips (WPFMC 2017b). NMFS estimated that Hawaiians conducted nearly 270,000 recreational boat-fishing trips in 2015, landing more than 13 million lbs. (5.9 million kg), with yellowfin tuna comprising 8 million of the total landings (WPFMC 2017b).

1.5.3.5 Relevant Socio-Economic Profile

The population of the state of Hawaii is about 1,427,538 (July 2017 estimate). This is a slight decrease from 2016 population of 1,428,557 composed of about 37.7% Asian alone, 25.8% Caucasian alone, 23.7% mixed, 10.2% Native Hawaiian and other Pacific Islanders (2016 estimate). While the English language primary language spoken, roughly 25% of residents speak another language at home (https://www.census.gov/quickfacts/fact/table/HI/PST045216, accessed 1/2/2018). The median age of Hawaii residents is 38.5 years old (https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml?src=bkmk, accessed 1/2/2018).

In 2016, GDP for the state of Hawaii was an estimated $83,917,000. The industry category comprised of the federal civilian, military, and state and local government contributed the most to the state GDP at $17,698 million (21%), followed by real estate, rental, and leasing industry category at $15,987 million (19%). The agriculture, forestry, fishing and hunting category by comparison directly contributed $365 million (0.4%) to the GDP (Hawaii Department of Business, Economic Development and Tourism, 2017).

With regard to the role of fishing in Hawaii, historically, Native Hawaiian subsistence relied heavily on fishing, trapping shellfish, and collecting seaweed to supplement land-based diets. Native Hawaiians also maintained fishponds, some of which date back thousands of years and are still in use today. Fishing

Commented [TS196]: From Colby Non-harvest uses should be included and considered, such as diving (including shark-centric operations), sightseeing, dinner cruises, including spatial ocean areas of interest for each.

Commented [TS197]: From Colby: If ports and ocean areas of high recreational fishing activity are not considered in this EIS, gear conflicts with sited aquaculture areas could pretty much be guaranteed. Recreational fisheries are well represented in lobbying efforts, and when agitated, can quick ramp up NEPA controversy/significance. Furthermore, recreational charter business landings are substantial, and should be fully considered, economically, ecologically, and spatially

Commented [MF198]: The 2018 Hawaii State Data Book will have the most current numbers for the next two paragraphs. https://dbedt.hawaii.gov/economic/databook/

Commented [TS199R198]: These numbers differ a little from the US Census data; which source should we use? All other sources in this doc are from the CIA world Factbook-should we stick with Fed data or trust the states?

continues to play a central role in local Hawaiian culture, diet, and economy. In 2015, with total revenue from commercial fishing of $110.9 million, the commercial fishing and seafood industry in the state of Hawaii generated additional impacts to seafood processors and dealers, seafood wholesalers, seafood distributors, and retail. These total impacts, which exclude impacts from imports, were estimated to be $411.13 million in sales impacts, $162.7 million in income impacts, and 6,802 full- and part-time jobs in 2015 (NMFS 2017b). In Hawaii, consumers prefer fresh seafood, and while most is purchased at markets or restaurants, much of the seafood consumed in Hawaii were caught by friends, neighbors, or extended family. Because of the high demand for seafood, most seafood consumed in Hawaii is imported from either the U.S. mainland or foreign markets.

Hawaii residents regularly consume fresh bigeye tuna and yellowfin tuna. These are often consumed as poke (small cubed pieces of seasoned raw tuna) or enjoyed as a part of celebrations (e.g. from Thanksgiving to New Year and Chinese New Year). Tuna wholesale prices increase dramatically at the end of the year as a result of the concentrated demand for fresh fish for the holiday season.

Additional information about the role of fishing and marine resources across Hawaii, as well as information about the people who engage in fishing or use fishing can be found through the Hawaii FEP 2018 SAFE Report (WPFMC 2019c) and Pelagics FEP 2018 SAFE Report (WPFMC 2019a). An interactive online tool created by NMFS- Pacific Islands Fisheries Science center depicts snapshots of Hawaii communities with information on fisheries involvement and demographics (https://www.pifsc.noaa.gov/socioeconomics/hawaii-community-snapshots.php)

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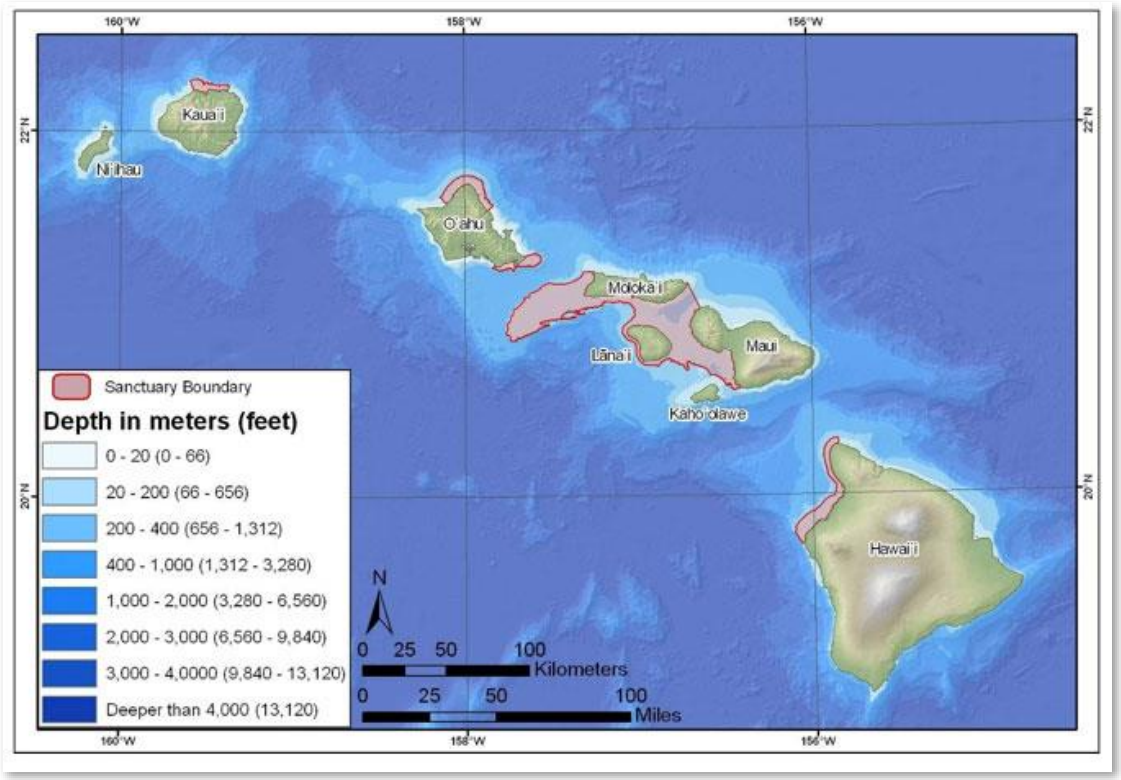
1.5.4 Hawaii Administrative Environment

Federally managed sanctuaries, monuments and wildlife refuges

The Hawaiian Islands Humpback Whale National Marine Sanctuary, authorized by Congress in 1992, is located from the shoreline to the 100-fathom isobath (600-ft depth [183 m]) in the four-island area of Maui; Penguin Bank; and off the north shore of Kaua‘i, the north and south shores of Oahu, and the north Kona and Kohala coast of Hawaii Island (Figure 3-41). The sanctuary encompasses approximately 1,218 nm^2 (4780 km^2). The sanctuary is managed via a cooperative federal-state partnership between NOAA’s Office of National Marine Sanctuaries (ONMS) and the State of Hawaii through the DLNR.



Source: HIHWNMS Website.

Figure 1-65. Hawaiian Islands Humpback Whale National Marine Sanctuary

The sanctuary's advisory council prepared an *Offshore Development and Aquaculture Report* (SAC 2012). In this report, the advisory council did not recommend banning aquaculture in the sanctuary, but if considered, the sanctuary must take an active role in its development. They also listed five concerns related to aquaculture development: aversion, attraction, entanglement, habitat degradation, and habitat loss, and measures to address and study these concerns.

The NWHI are subject to a series of management measures and jurisdictional authorities, including 1) a 1909 bird reserve which converted into the Hawaiian Islands NWR, 2) a Protected Species Zone (PSZ) that has prohibited longlining within 50 nm (93 km) of the islands since 1991, 3) a Coral Reef Ecosystem Reserve in 2000, that mirrors the boundaries of the PSZ and prohibits all commercial fishing, 4) and an MNM, the largest marine wildlife reserve in the world.

On June 15, 2006, President G.W. Bush created the Papahānaumokuākea MNM under the Antiquities Act of 1906. The Monument spans the entire NWHI, encompasses the islands and 139,797 mi^2 (362,073 km^2) of surrounding ocean waters. On August 26, 2016, President Obama expanded the MNM to 582,578 mi^2 (1,508,870 km^2), nearly the size of the Gulf of Mexico (Figure 3-42). All commercial fishing, including commercial aquaculture is prohibited within the MNM.

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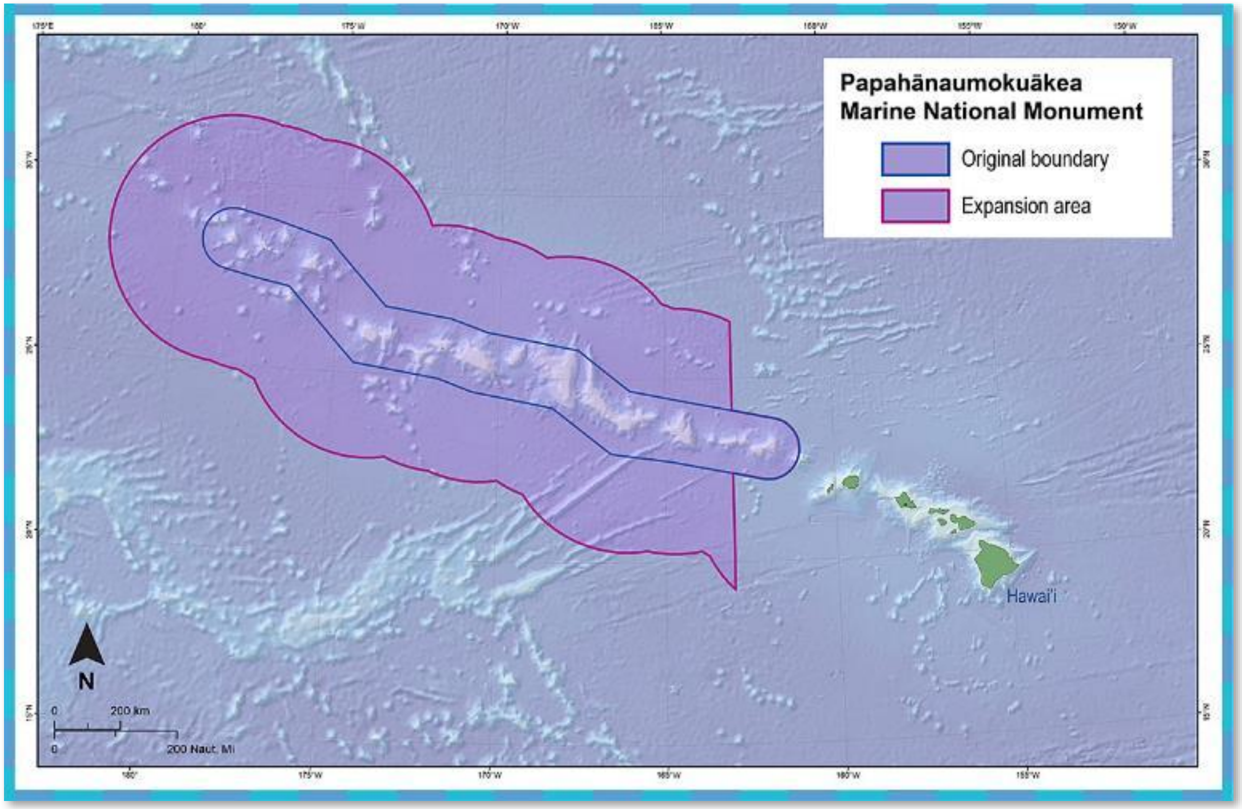


Source: ONMS Website

Figure 1-66. Papahanaumokuakea Marine National Monument

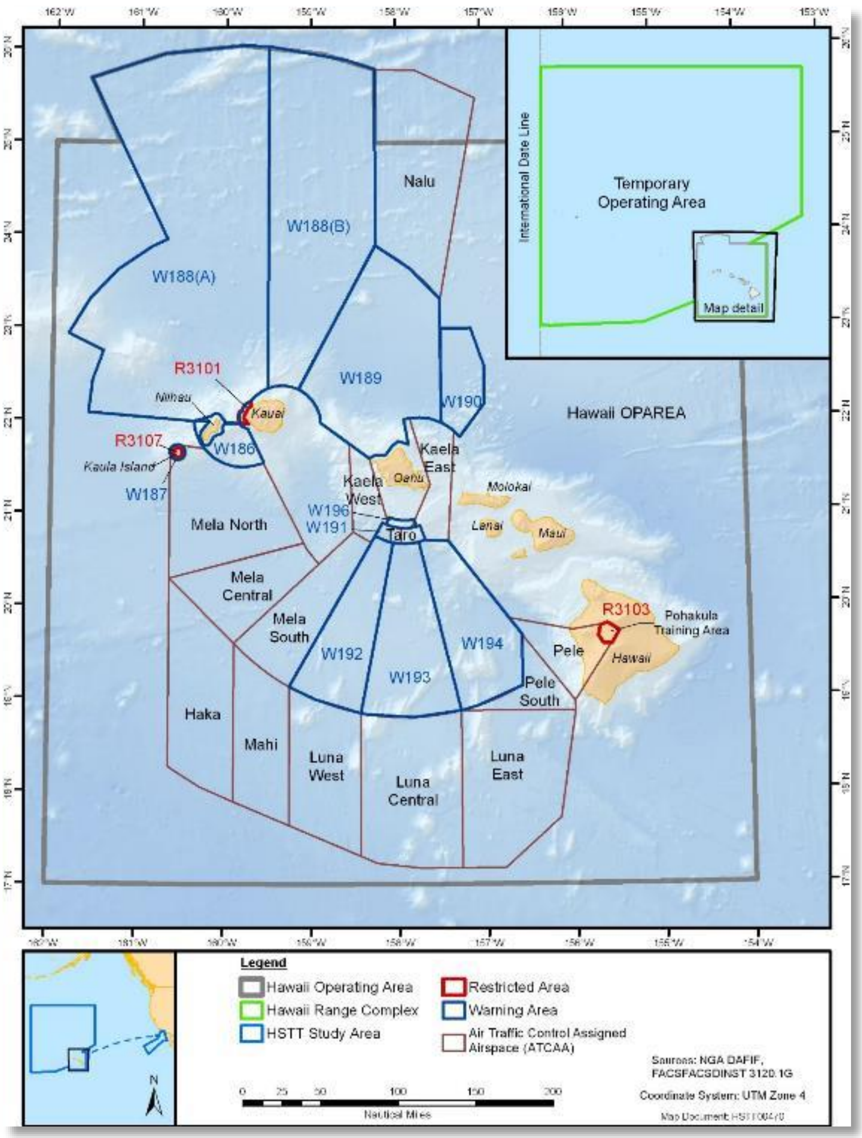
Department of Defense Jurisdictions

With the large military presence in Hawaii, there are numerous restricted areas and other training zones. Figure 3-43 provides the 2013 Hawaii Training and Testing map, showing that restricted zones are confined to State waters, while warning and operating areas run across the EEZ and beyond into international waters (U.S. Navy 2013).

Commented [MF202]: Could probably say something very similar for each of the territories and include related maps – to the extent there are DoD restricted and training areas. They definitely exist for Guam, possibly CNMI. Don't think there are any military bases in AS but not sure if there are any DoD restricted zones.
https://www.cnic.navy.mil/regions/jrm.html

Commented [TS203R202]: true. We could download this dataset and create a bunch of maps ourselves:
https://catalog.data.gov/dataset/military-installations-ranges-and-training-areas

Or we might be able to find someone who has that at the ready. Or we could ask Jame Morris' team at NCCOS to provide this for us.



Source: U.S. Navy 2013

Figure 1-67. Hawaii Navy Testing and Training Zones (2013)

The Department of Defense major planning activities in the region are summarized below. Maps of the Hawaii-Southern California Range Complex from the Hawaii Range Complex FEIS are included in the maps section.

Commented [TS204]: from the 2018 SAFE report

Table 1-40 Military training and testing activities offshore of Hawaii

Action	Description	Phase	Impacts

Hawaii-Southern California Training and Testing (HSCTT)	Increase naval testing and training activities.	Record of Decision available in December 2018 to conduct training and testing activities as identified in Alternative 1 of the HSTT Final EIS/OEIS published in October 2018 (83 FR 66255).	EFH consultation has not been initiated. Likely access and habitat impacts similar to previous analysis.
Long Range Strike Weapon Systems Evaluation Program (WSEP)	Conduct operational evaluations of Long Range Strike weapons and other munitions as part of Long Range Strike WSEP operations at the Pacific Missile Range Facility at Kauai, Hawaii	Comment period closed Feb. 6, 2017 on NMFS authorization to take marine mammals incidental to conducting munitions testing for their Long Range Strike Weapons Systems Evaluation Program (LRS WSEP) over the course of five years, from September 1, 2017 through August 31, 2022 (82 FR 1702).	Access – closures during training.

State Management

In 1978, the State of Hawaii developed the first formal aquaculture development plan in the United States. In 1993, the State updated the aquaculture plan and transferred responsibilities for aquaculture development from the Hawaii Department of Land and Natural Resources to the Hawaii Department of Agriculture. In 1999, the Hawaii legislature approved ocean leasing for aquaculture (Buttner and Karr 2009). These efforts have led to a growing aquaculture industry in State waters, previously described in Section 1.5.3.1 above.

1.6 Pacific Remote Island Areas

The PRIA is an unorganized group of seven islands and atolls throughout the Central Pacific that are under U.S. jurisdiction. Baker, Howland, and Jarvis Islands, Johnston Atoll, Palmyra Atoll and Kingman Reef lie between Hawaii and American Samoa, and Wake Island is located between the NWHI and Guam. Broadly, much of the PRIA are incorporated into the Pacific Remote Islands Marine National Monument, which prohibits commercial fishing, including commercial aquaculture, within its limits. Commercial fishing and aquaculture are also prohibited within the EEZ for Jarvis Island, Johnston Atoll and Wake Island, but are allowed outside the seaward boundary of the Monument at Baker Island, Howland Island, Palmyra Atoll and Kingman Reef. Because commercial aquaculture has been prohibited throughout the EEZ of Jarvis, Johnston and Wake, these areas will not be described in this document.

A detailed description of the physical and biological habitat of the PRIA is provided in the associated FEP (WPFMC 2009e). This section summarizes important information relevant to the analysis of the alternatives.

1.6.1 Physical Environment

Coastline

Open ocean

Howland and Baker Islands are located within the Phoenix archipelago, approximately 1,830 nm (3390 km) southwest of Honolulu, about halfway between Hawaii and Australia. Palmyra Atoll and Kingman Reef are located at the northern end of the Line Island Archipelago, approximately 1,050 nm (1,945 km) south of Honolulu.

Howland and Baker Islands are both emergent, coral-topped seamounts, fringed by narrow, relatively flat coral reefs that drop off sharply very close to shore (CIA 2017). Palmyra Atoll comprises approximately 52 islets surrounding three central lagoons surrounded on all sides by extensive reef flats. The atoll is 753 mi^2 (1,949 km^2), of which 1.5 mi^2 (3.9 km^2) are emergent land (CIA 2005). Kingman Reef is located 33 nm northwest of Palmyra Atoll, consisting of 756 mi^2 (1,958 km^2) of fringing reefs around a central lagoon, with only 0.004 mi^2 (0.01 km^2) of permanent land (CIA 2005).

1.6.1.1 Oceanographic Features

Howland Island lies within the margins of the eastward flowing North Equatorial Counter Current and the margins of the westward flowing South Equatorial Current. Sea-surface temperatures of pelagic EEZ waters around Howland Island are often near 86°F (30°C). The depth of the mixed layer in the pelagic waters around Howland Island is seasonally variable, average mixed layer depth is around to 230 to 295 ft (70 to 90 m) (WPFMC 2009e).

Baker Island lies within the westward flowing South Equatorial Current. Baker Island also experiences an eastward flowing Equatorial Undercurrent that causes upwelling of nutrient rich and plankton rich waters on the west side of the island (Brainard et al. 2005). Sea surface temperatures of pelagic EEZ waters around Baker Island are often near 86°F. Although the depth of the mixed layer in the pelagic waters around Baker Island is seasonally variable, average mixed layer depth is around 330 ft (100 m) (WPFMC 2009e).

Palmyra Atoll lies in the North Equatorial Counter Current, which flows in eastward direction. Sea-surface temperatures of pelagic EEZ waters are often 80-86°F (27°-30°C). Although the depth of the mixed layer is seasonally variable, the average mixed layer depth is around 295 ft (90 m) (WPFMC 2009e).

Kingman Reef lies in the North Equatorial Countercurrent, which flows in a west to east direction. Sea-surface temperatures of pelagic EEZ waters around Kingman Reef are often 80-86°F. The depth of the mixed layer in the pelagic waters around Kingman Reef is seasonally variable, average mixed layer depth is around 265 ft (80 m) (WPFMC 2009e).

1.6.1.2 Extreme Weather

Howland Island is an equatorial climate, with little annual rainfall, constant wind and sun. There are no natural freshwater sources on the island (CIA https://www.cia.gov/library/publications/the-world-factbook/geos/hq.html, accessed April 10, 2020).

Baker Island is an equatorial climate, with little annual rainfall, constant wind and sun. There are no natural freshwater sources on the island (CIA https://www.cia.gov/library/publications/the-world-factbook/geos/fq.html, accessed April 10, 2020).

Palmyra Atoll is an equatorial climate, but is located within the Intertropical Convergence Zone (ITCZ), where the northeast and southeast tradewinds meet. Each year Palmyra Atoll received 400-500 cm each year (CIA https://www.cia.gov/library/publications/the-world-factbook/geos/lq.html, accessed April 10, 2020).

Rainfall at Kingman reef is similar to Palmyra, but as there is virtually no emergent land, rainfall statistics are not provided (CIA, https://www.cia.gov/library/publications/the-world-factbook/geos/kq.html, accessed April 10, 2020).

1.6.2 Biological Environment

The biological environment of the PRIA, including the species addressed in this PEIS, is described in detail in the FEP for the PRIA which is incorporated here by reference (WPFMC 2009e). Specific resources of concern, identified during scoping and interagency informal consultations are described to the level necessary for appropriate analysis.

1.6.2.1 Benthic and Sessile Organisms

See Section 3.3.2.1 for the general biology of benthic and sessile organisms in the nearshore and offshore habitat. This section covers the only life history information specific to the PRI.

Nearshore Reefs

The coral reef systems around the PRIA are generally healthy and productive. A mass bleaching event took place in 2004, but the reefs appeared to be recovering. In 2015-16 major heat stress events led to bleaching, as well as a minor event in 2018, however the coral health is still considered to be in 'good' condition (WPRFMC 2019e, NOAA 2018). Due to the high latitude of Johnston Atoll, the reefs are periodically exposed to hurricanes and significant wave events, affecting the surrounding ecosystem (WPFMC 2009e).

Commented [MF205]: Should check if there was bleaching in the PRIA and NWHI in 2014 and 2015 that is worth mentioning. There were large bleaching events in the Main Hawaiian Islands in those years. And, there was a lesser event in the MHI during the late summer-early fall 2019. https://dlnr.hawaii.gov/blog/2019/11/05/nr19-186/

Commented [TS206R205]: it does sound like there was a bleaching event, but the coral reefs are still rated 'good'

https://www.coris.noaa.gov/monitoring/status_report/docs/PRI_status_report_forweb.pdf

Offshore Reefs

Data on precious corals around PRIA are lacking, though they likely occur in suitable habitats across the archipelago. The FEP identifies eleven federally managed species: three pink coral, three gold coral, two bamboo coral, and three black coral species (WPFMC 2009e).

1.6.2.2 Significant Aquaculture Species and the Status of those Stocks in Federal Waters

Full descriptions of PRIA MUS are available in the FEP for the PRIA (WPFMC 2009e). In addition, species with the highest potential for aquaculture (i.e., almaco jack, Bluefin trevally, giant trevally, moi) are described in Sections 3.2.2.2. Stock assessments have not been completed for these species and ACLs have only been determined for the jack family. ACLs have not been established for any other species in the PRIA.

1.6.2.3 Protected Species

Protected species include species listed as threatened or endangered under the ESA as well as all species protected under the MMPA, MBTA, and other conservation laws. More details are provided for those species listed under the ESA.

Marine Mammals

All mammals that occur in the PRIA, occur elsewhere in the PIR. Thorough descriptions of all of these species are provided in Section 3.2 (Pelagic) and only details specific to the PRIA are included here.

A resident population of bottlenose dolphins is reported to occur near Howland and Baker Islands (Brainard et al. 2005). Although other cetaceans found throughout the PIR are believed to occur around Baker Island, information on the types of species and their abundance in the PRIA is currently unknown (WPFMC 2009e).

Pacific bottlenose dolphins, spinner dolphins and melon-head whales frequent the waters of the Palmyra Atoll, while Kingman Reef supports a sizable population of bottlenose dolphins and melon-headed whales (USFWS 2011e).

Sea Turtles

There are no known reports of olive ridley, loggerhead, or leatherback sea turtles in any of the PRIA, although these waters are within the habitat of these species. The lack of observation may be due to their relatively rare occurrence and the largely uninhabited nature of the PRIA. Both green and hawksbill sea turtles have been observed in the nearshore waters of most of the PRIA.

Green sea turtles and hawksbill turtles have been observed foraging offshore (USFWS 2011e) and Green sea turtles are reported to nest at Palmyra and Jarvis Islands. Resident turtles inhabit the lagoon waters at Wake and Palmyra. Green turtles have also been seen in the marine environment around Howland, Baker, Kingman and Johnston but nesting at these areas is unknown. According to the 1998 Recovery Plan for the green sea turtle, seawall construction at Johnston Atoll negates the potential for nesting while military hazardous and toxic wastes have contaminated the coastal waters. Beach erosion has been targeted as a problem at Palmyra Atoll, causing barriers to adult and hatchling turtle movements, and degrading nesting habitat. When the U.S. military occupied Palmyra during World War II, their base was along the coast of a northern island about 5 kilometers from known turtle nesting and feeding areas (WPRFMC 2019.

The hawksbill sea turtle is regularly sighted in the waters of Palmyra Atoll and has been reported from Baker, Howland and Jarvis Islands. The Recovery Plan indicates that waters around the PRIA may provide marine feeding grounds for this species.

Commented [TS207]: FC I think this might potentially be inaccurate. I'd double check with Irene Kelly on this.

Seabirds

Many of the islands in the PRIA host seabird colonies. Eleven seabird species occur on Howland Island: brown booby, masked booby, red-foot booby, great frigatebird, lesser frigatebird, blue noddy, brown noddy, gray-backed tern, sooty tern, white tern, red-tailed tropicbird. The most numerous breeding species are the lesser frigatebird, masked booby, and sooty tern (USFWS 2017a).

Ten seabird species nest on Baker Island: brown booby, masked booby, red-foot booby, great frigatebird, lesser frigatebird, blue noddy, gray-backed tern, sooty tern, white tern, red-tailed tropicbird (USFWS 2017a).

Seven seabird species are found on Palmyra Atoll: brown booby, masked booby, red-footed booby, black noddy, brown noddy, great frigatebird, and sooty tern. Brown boobies roost on the ground at the Fighter Causeway, regularly foraging in the lagoon. Masked boobies are sited at Whippoorwill, Portsmouth, Holei, Tanger, and the Fighter Causeway, with 35 pairs counted in 2002. The red-footed boobies nesting colony on Palmyra Atoll is the second largest population in the world, with an estimated 6,250 pairs. These birds are found around the water's edge in Tournefortia argentea (USFWS 2017a).

Commented [MF208]: We could probably get much more current data from USFWS. I know the FWS refuge and monuments staff here that oversee Palmyra Atoll NWR.

At Kingman reef, the brown booby is the only seabird recorded, using the emergent reef for roosting during the year (USFWS 2017a).

Sharks and Rays

All sharks and rays that occur in the PRIA occur elsewhere in the PIR. Thorough descriptions of each species are provided in Section 3.2 (Protected Species).

Commented [TS209]: Assuming there aren't specifics for this region, but need to check the ESA docs

1.6.3 Social and Economic Environment

1.6.3.1 Past and Present Commercial Offshore Aquaculture Operations

There have been no commercial aquaculture operations in the PRIA.

State of aquaculture industry

There have been no commercial aquaculture operations in the PRIA.

1.6.3.2 Relevant Fisheries and Communities

With the exception of Palmyra Atoll, these four islands and atolls are uninhabited. When operating as an active military installation, Johnston Atoll averaged 1,100 U.S. military and civilian contractor personnel. As of May 2005, all U.S. Government personnel have vacated the island. Since 2000, a group of four to twenty Nature Conservancy staff, USFWS staff, and researchers temporarily reside at Palmyra Atoll (CIA https://www.cia.gov/library/publications/the-world-factbook/geos/lq.html, accessed April 10, 2020). Fishing, when conducted, is strictly recreational, with some fish kept for on-island consumption.

Commented [MF210]: This has actually been the case since 2000 when TNC acquired Palmyra and shortly thereafter sold a portion to USFWS.

1.6.3.3 Characteristics and Economic Feasibility of Aquaculture Operations that May Operate in Offshore-waters of the PRIA

The PRIA are unlikely locations for aquaculture operations. There are virtually no services at any of the locations, access to the islands and even within the MNM waters is restricted, and grow-out facilities would need to be sited outside of the MNM that surrounds all of the islands. In addition, these islands are among the most remote locations on the planet, 1,000 mi (1610 km) from the nearest commercial harbor or airport. Prior to or during WWII, runways were constructed on Baker, Howland and Johnston Islands. These runways are no longer serviceable. Palmyra Atoll has one 6056 ft (1,846 m) unpaved runway that is privately owned (CIA https://www.cia.gov/library/publications/the-world-factbook/geos/lq.html, accessed April 10, 2020). Baker, Howland, and Jarvis Islands, and Kingman Reef do not have harbors, and vessels must anchor offshore. Johnston and Palmyra Atolls do have harbors for anchorage (CIA https://www.cia.gov/library/publications/the-world-factbook/geos/hq.html, accessed April 10, 2020).

1.6.3.4 Scope of Fishing Industry - Wild Stocks

Description of Commercial Fisheries

Commercial U.S. fisheries that occur within the PRIA EEZ are described in the Section 3.2 Pelagics, and consist entirely of pelagic longline fisheries. In 2015, 0.6% of the entire Hawaii pelagic longline fishery effort, 300,000 hooks, occurred within the PRIA (WPFMC 2017e).

Commented [TS211]: I'm having trouble finding this info. It's referenced to the 2017 SAFE report for PRIA, but I'm having trouble finding the info in the 2018 SAFE report for PIRA. Also checked pelagics, since I think it was probably in there, but not finding it yet;...

The record of fishing at the PRIA is somewhat limited. Hawaii-based vessels previously made sporadic commercial fishing trips to Palmyra Atoll and Kingman Reef. Commercial data held by the State of Hawaii for the years 1988-2007 indicates that over this period a total of 51,740 lbs. (23,500 kg) non-longline caught pelagic fish, and 19,095 lbs. (8,660 kg) of bottomfish and reef fish were caught at Palmyra Atoll, Kingman Reef and Johnston Island. This is equivalent to 1,293 lbs./year (586 kg/yr) non-longline pelagic fish and 477 lbs./year (216 kg/yr) of bottomfish and reef fish. However, currently there are no bottomfish, crustacean, coral reef or precious coral fisheries operating in the PRIA, and no historical observer data are available for fisheries under the PRIA FEP (WPFMC 2017e). Currently, about 11 fishermen hold permits to harvest troll and handline pelagic fish in the PRIA, though none have been active in recent years. (WPFMC 2017e).

The largest volume of fish commercially harvested from the PRIA in recent years is pelagic fish caught by longliners based in Hawaii and tuna purse seiners based in American Samoa.

Recreational Fishing

There are no permanent residents on any of these islands, although there are temporary work forces, primarily related to military and refuge management on Johnston Atoll. These temporary work forces have a history of recreational fishing and shell collecting.

Some recreational catch and release, research and subsistence fishing continues at Palmyra, which was acquired by The Nature Conservancy (TNC) in 2000. In 2001, TNC conveyed 439 acres of the property to the USFWS. The entire atoll, including the main Cooper islet retained by TNC, are included within the Palmyra Atoll National Wildlife Refuge.

1.6.3.5 Relevant Socio-economic profile

Additional information about the role of fishing and marine resources across PRIA, as well as information about the people who engage in fishing or use fishing can be found through the PRIA FEP 2018 SAFE Report (WPFMC 2019e) and Pelagics FEP 2018 SAFE Report (WPFMC 2019a).

Commented [MF212]: Likewise edit to refer to 2018 SAFE Reports

1.6.4 Pacific Remote Islands Areas Administrative Environment

All of the PRIA are under federal management, and are not associated with any State or territory. All of the areas have been designated National Wildlife Refuges, including all land, reef and waters out to 12 nm (3.7 km), administered either solely or jointly by the USFWS. Table 3-27 shows the individual and overlapping management regime.

Commented [TS213]: FC It seems relevant, given that this is a NOAA document, that some mention of why NOAA/DOC does not have jurisdiction, or is not included.

Table 1-41. Administrative Boundaries and Jurisdictions in the PRIA

Island	NWR	Land Management	MNM
Baker	To 12 nm	USFWS	50 nm from land
Howland	To 12 nm	USFWS	50 nm from land
Jarvis	To 12 nm	USFWS	Entire EEZ
Johnston	To 12 nm	DOD/USAF	Entire EEZ
Palmyra	To 12 nm	USFWS/TNC	50 nm from land
Kingman	To 12 nm	No emergent land	50 nm from land
Wake	To 12 nm	DOD/USAF	Entire EEZ

Federally managed sanctuaries, monuments and wildlife refuges

The PRIA fishery management area is the EEZ seaward of Palmyra Atoll, Kingman Reef, Jarvis Island, Baker Island, Howland Island, Johnston Atoll, and Wake Island, PRIA with the inner boundary a line coterminous with the seaward boundaries of the above atolls, reefs and islands PRIA and the outer boundary a line drawn in such a manner that each point on it is 200 nm from the baseline from which the territorial sea is measured, or is coterminous with adjacent international maritime boundaries. All of the islands and atolls are designated National Wildlife Refuges (NWRs), with primary management of the lands and waters to 12 nm by the USFWS.

The following U.S. EEZ waters are no-take MPAs: Landward of the 50-fathom (91-m) curve at Jarvis, Howland, and Baker Islands, and Kingman Reef; as depicted on National Ocean Survey Chart Numbers 83116 and 83153. In addition, all fishing for CRECS is prohibited within 12 nm of the islands in the PRI Monument, subject to U.S. Fish and Wildlife Service authority to allow noncommercial fishing in consultation with NMFS and the Council. All commercial fishing is prohibited within the PRIMNM.

On June 27, 1974, the Secretary of the Interior created Jarvis Island, Howland Island, and Baker Island National Wildlife Refuges. These refuges were expanded in 2009 to add submerged lands within 12 nm (22 km) of the island. The Jarvis refuge includes 1,273 acres (5.15 km^2) of land and 428,580 acres (1,734.4 km^2) of water. Howland Island includes 648 acres (2.62 km^2) of land and 410,351 acres (1,660.6 km^2) of water. The Baker refuge includes 531 acres (2.15 km^2) of land and 409,653 acres (1,654 km2) of water (CIA 2017).

The Wake Island NWR includes 495,515 acres (2,005 km^2) of submerged lands and waters surrounding Wake Atoll out to 12 nm. The atoll was designated a National Historic Landmark in 1985 in recognition of its role in World War II. The Secretary of Defense continues to manage the emergent lands of Wake Atoll under an existing agreement between the Secretary of the Interior and the Secretary of the Air Force.

In 1926, Johnston Atoll was designated as a federal bird refuge. In 1934, President Roosevelt placed the atoll under U.S. Navy control, but retained its status as a refuge. The Johnston Atoll NWR includes 660 acres (267 km^2) of land, of which 90% was artificially created by the military through coral dredging as well as the associated reef and nearshore waters.

In January 2001, the Secretary of the Interior designated the Palmyra Atoll and Kingman Reef NWR. The Palmyra Atoll NWR includes 4.6 mi^2 (12 km^2) of land and nearly 500,000 acres (2,000 km^2) of water of water out to 12 nm. The Kingman Reef NWR includes 3 acres (0.01 km^2) of emergent reef 483,754 acres (1,958 km^2) of submerged reefs and associated waters, out to 12 nm (USFWS).

In 2009, President George W. Bush created the PRI Marine National Monument (MNM) incorporating 86,888 mi^2 (225,000 km^2) within its boundaries, which extended 50 nm (93 km) from the mean low water line (Proclamation 8336). In 2014 President Barack Obama extended the monument to the extent of the US EEZ (200 nm) at Jarvis, Johnston and Wake, increasing the size of the monument by 408,299 mi^2 (1,057,000 km^2) to a total size of 495,187 mi^2 (1,283,000 km^2) (Proclamation 9173). The Pacific Remote Islands MNM includes 33 seamounts across the 7 areas shown in Figure 3-63. There are approximately 132 additional seamounts within the EEZ and outside of the monument boundaries (Proclamation 9173).

Department of Defense Jurisdictions

A number of Executive Orders have given administrative to the DOD for use as military airfields and for weapons testing. Executive Order 8682 of 1941 authorizes the Secretary of the Navy to control entry into Naval Defensive Seas Areas (NDSAs) around Johnston Atoll, Wake Island, and Kingman Reef, which include “territorial waters between the extreme high-water marks and the three-mile marine boundaries surrounding.” In addition, the Navy has joint administrative authority with the USFWS of Johnston Atoll and has recently transferred administrative authority over Kingman Reef to the USFWS. The Wake Island NDSA has been suspended until further notice.

Table 1-42 Marine Resource Management Boundaries Within the PRIA

Island or Area	State/ Territory	Dept. of Commerce	Dept. of the Interior and Dept. of Defense (as noted)
Howland I.	-	WPRFMC/NMFS 0-200 nm	FWS: 0-3 nm
Baker I.	-	WPRFMC/NMFS 0-200 nm	FWS: 0-3 nm
Jarvis I.	-	WPRFMC/NMFS 0-200 nm	FWS: 0-3 nm
Johnston A.	-	WPRFMC/NMFS 0-200 nm	FWS/US Navy: 0-3 nm
Kingman R.	-	WPRFMC/NMFS 0-200 nm	FWS: 0-12 nm[1]
Palmyra A.	-	WPRFMC/NMFS 0-200 nm	FWS: 0-12 nm[2]
Wake I.*	-	WPRFMC/NMFS 0-200 nm	DOI/US Army: 0-3 nm

[1] Boundary formerly 0-3 miles under the jurisdiction of the U.S. Navy. Secretarial Order 3223 extended Department of the Interior's jurisdiction to 12 nm.
[2] Secretarial Order 3224 (Palmyra Atoll) extended USFWS' administrative authority from 3 to 12 nm.
* As of 1962, the jurisdiction over Wake Island has been vested with the Department of the Interior. Since 1994, the Department of the Army has maintained administrative use of Wake Island.
Source: WPRFMC 2019e

Territorial Management

There is no territorial authority at any of the PRIA.

2 Additional refs

Commented [TS214]: Not currently organized or formatted; just a catch-all as I'm adding info

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