DRAFT
Programmatic Environmental Impact Statement

Hawaiian Monk Seal Recovery Actions

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3.0 AFFECTED ENVIRONMENT

3.1 INTRODUCTION

This chapter provides a description of the physical, biological and socioeconomic environment within the project area that may be affected by research and enhancement on Hawaiian monk seals (*Monachus schauinslandi*) or that may be a factor in the species' decline. The objective of this section is to provide a baseline against which the alternatives may be evaluated and compared (Chapter 4).

The project area for the analysis encompasses the Hawaiian Archipelago and Johnston Atoll as shown in Figure 1.3-1. The time frame for this analysis is defined as 1958 through approximately 2020. As described in more detail in Section 3.3.1, 1958 marks the point in time when the first beach counts of Hawaiian monk seals were conducted in all the primary Northwestern Hawaiian Islands. That year is considered a benchmark for the species' known historic high point of abundance. By the year 2020, National Marine Fisheries Service (NMFS) will have completed two more permit cycles for authorizing Hawaiian monk seal research and enhancement activities; in addition, 10 years is considered a reasonable amount of time for the life of an Environmental Impact Statement (EIS) document.

3.2 PHYSICAL ENVIRONMENT

The Hawaiian Archipelago is a part of the Hawaiian Ridge-Emperor Seamounts chain in the central North Pacific Ocean. The Hawaiian Ridge-Emperor Seamounts chain is comprised of more than 80 volcanoes and is the result of the Pacific Plate traveling northward then northwestward over the stationary Hawaiian oceanic "hot-spot" (currently located underneath the Island of Hawai`i) over the past 70 million years (United States Coast Guard [USGS] 1999). The Hawaiian Ridge-Emperor Seamounts chain extends approximately 6,000 kilometers from the main Island of Hawai`i (the youngest of the islands) to the Aleutian Trench, which parallels the Aleutian Islands of Alaska. The Hawaiian Ridge section of this chain is approximately 2,600 kilometers in length (the equivalent distance of Washington D.C. to Denver, CO) extending from the Island of Hawai`i to Kure Atoll (USGS 1999).

The Archipelago is comprised of two island groups: The "Main" Hawaiian Islands (MHI) and the "Northwestern" (or "Leeward") Hawaiian Islands (NWHI). The eight Main Islands are grouped at the southeastern end of the Archipelago and occupy about 600 km (approximately 373 miles) of its total length, while the NWHI extend another 1,100 km (approximately 684 miles) to the west-northwest. The capital city of Hawai`i, Honolulu, on the island of O`ahu, is located 3,800 kilometers (km) (approximately 2,361 miles) from the west coast of the Unites States (U.S.) mainland, about 6,000 km (approximately 3,728 miles) east of Japan, and 4,400 km (approximately 2,734 miles) due south of Anchorage, Alaska (Friedlander *et al.* 2009; USGS 1999).

3.2.1 *Main Hawaiian Islands*

The MHI are the youngest of the Hawaiian Island Archipelago. The MHI are comprised of eight large islands (O`ahu, Kaua`i, Maui, Hawai`i, Moloka`i, Lāna`i, Ni`iahu, Kaho`olawe) as well as numerous minor islands, islets and stacks (Hawaii Department of Business, Economic Development and Tourism [DBEDT] 2010). The MHI comprise approximately 12,548 square kilometers of land and 1,431 km of coastline (Coastal Geology Group 2011; DBEDT 2010). Hawaiian monk seals can be found in small numbers throughout MHI (Antonelis *et al.* 2006). Physical attributes of the MHI are presented in Table 3.2-1 below.

Table 3.2-1 Key Physical Attributes of the Main Hawaiian Islands

Island	Land area (miles^2)	Shoreline (miles)	Max Elevation (feet) (location on island)	Lat/Long	Special Features
O`ahu	597	112	4,003 (Mt. Ka`ala)	21°28'North (N) 157°59'West (W)	Most populous island; 3rd largest; Waianae and Koolau, mountain ranges
Kaua`i	562	136	5,243 (Kawaikini)	22°05′N 159°30′W	4th largest island; Waimea Canyon; "Barking Sands" Pacific Missile Range
Maui	727	86	10,238 (Haleakalā)	20°48′N 156°20′W	2nd largest island; wintering area for humpback whales in Au`au Channel
Hawai`i	4028	266	13,796 (Mauna Kea)	19°34′N 155°30′W	Largest island; The Great Crack 9 8 mi long deep fissure; active volcano, Kilauea
Moloka`i	206	88	4961 (Kamakou)	21°08′N 157°02′W	5th largest island
Lāna`i	141	121	3,366 (Lānaihale)	20°50′N 156°56′W	6th largest island

Island	Land area (miles²)	Shoreline (miles)	Max Elevation (feet) (location on island)	Lat/Long	Special Features
Niʻiahu	70	90	1250 (Mt. Pānīʻau)	21°54′N 160°10′W	7th largest island; mostly private with limited public access
Kahoʻolawe	45	30	1,438 (Puʻu Moaulanui [Lua Makika])	20°33′N 156°36′W	8th largest island; Kahoʻolawe Island Reserve; commercial uses are prohibited

All data approximate
Source:
Coastal Geology Group (2011)
Website: http://www.soest.hawaii.edu/coasts/data/

3.2.2 *Northwestern Hawaiian Islands*

The NWHI extend from Nihoa Island (located 249 km [approximately 155 miles] Northwest [NW] of Kauaʻi) for 1,931 km (approximately 1,200 miles) to Kure Atoll. The NWHI are a conglomerate of atolls, shoals, and emergent land totaling 13.6 square kilometers (km^2) (approximately 5.2 $miles^2$) with none of the island groups totaling more than 6 km^2 (approximately 4 miles).

The mean elevation of the islands is less than 33 feet (ft) (10 meters [m]) with the highest point on Nihoa Island (275 m) (Juvik and Juvik 1998). The NWHI are surrounded by over 30 submerged ancillary banks and seamounts. The majority of the islands are uninhabited, with the exception of Midway Atoll, Kure Atoll, Laysan Island, and French Frigate Shoals, which have been occupied by various government agencies for extended periods over the last century (Friedlander *et al.* 2009).

Hawaiian Monk Seals are found predominantly throughout the NWHI with six of the population's reproductive sites being located at Kure Atoll, Midway Atoll, Pearl and Hermes Reef, Lisianski Island, Laysan Island, and the French Frigate Shoals (Antonelis *et al.* 2006; Reeves *et al.* 2002). Key physical attributes of the NWHI are presented in Table 3.2-2.

Table 3.2-2 Key Physical Attributes of the Northwestern Hawaiian Islands

Island/ Atoll	Area (mi²)	Area (mi²) < 10 fathoms	Max Elevation (feet)	Lat/Long	Special Features
Nihoa Island	<1	2.0	903 (Miller's peak)	23°03′38″N 161°55′W	Much of the shoreline is rocky and inaccessible due to turbulent nearshore waters, but there is a small sandy beach with suitable habitat for Hawaiian monk seal (NMFS 2007; United States Fish and

Island/ Atoll	Area (mi²)	Area (mi²) < 10 fathoms	Max Elevation (feet)	Lat/Long	Special Features
					Wildlife Service [USFWS] 2008)
Necker Island (Mokumanamana)	<2	4.0	102 (Summit Hill)	23°34′N 164°42′W	Rocky inaccessible shoreline; turbulent nearshore waters (NMFS, 2007; USFWS, 2008). Surrounded by 603 miles² (1,558 km²) of reef habitat; second largest in NWHI ([PIBHMC] 2009)
French Frigate Shoals	<3	181.0	-	23°52.134′N 166°17.16′W	Enclosed by an 18 mile (28.9 kilometers [km]) long crescent-shaped reef. Provides highly important habitat for the largest breeding colony of Hawaiian monk seals (NMFS 2007; USFWS 2008)
Gardner Pinnacles	<4	<1	190	25°01′N 167°59′W	Oldest high islands in Hawaiian chain; access limited to calm ocean conditions.
Maro Reef	(open atoll; awash)	84.0	(Awash)	25° 30.2′N 170° 38.34′W	One of the largest reef habitats in NWHI covering 582 miles² (1,508 km²)
Laysan Island	2.0	10.0	40	25° 0.04′N 167° 59.82′W	Partially surrounded by fringing reef (NMFS 2007; USFWS 2008) surrounded by extensive sand beds
Lisianski Island	<1	83.0	40	26° 4.2′N 173° 58.12′W	Surrounded by extensive reef, Neva Shoals; open atoll with surface area of 378 miles² (979 km²)
Pearl and Hermes Reef	<1	145.0	10	27° 51.37′N 5° 51.09′W	True atoll fringed with shoals, permanent emergent islands, and ephemeral sandy islets which provide essential dry land for Hawaiian monk seal (NMFS 2007; USFWS 2008)
Midway Atoll	25.0	33.0	12	28° 14.28′N 177°22.01′W	Consists of three sandy islets: Sand, Eastern and Spit which lie within an elliptical barrier reef measuring approximately 5 miles (8 km)
Kure Atoll	<1	35.0	20	28° 25.28′N 178° 19.55′W	World's northernmost coral atoll; Consists of two islets; atoll is circular with a reef 6 miles (9.6 km) in diameter (NMFS 2007; USFWS 2008) covering approximately 64 miles² (167 km²) (PIBHMC 2009)

Source:
Friedlander et. al. (2009);
County of Hawai`i Data Book Retrieved from http://www.co.hawaii.hi.us/databook_current/Table%205/5.5.pdf. March 2011

3.2.3 *Meteorology and Air Quality*

The so-called "Trade Winds," which blow from northeast to east-northeast direction, account for about 70 percent (%) of all winds in Hawai`i. Winds blow from each of the other quadrants (Northwest [NW], Southwest [SW], and Southeast [SE]) about 10% of the time. During summer trade winds may prevail as much as 90% of the time, while in winter they may occur only 40-60% of the time, giving way stormy and rainy weather.

Concentrations of pollutants fall well below the state and federal ambient air quality standards and air quality in the Hawaiian Islands is better than most other parts of the nation (Department of Health [DOH], 2007). Hawai`i's clean air can be attributed partially to abundant wind and rain, as well as a relatively low population and lack of heavy industry (Rubin 2009).

3.2.4 *Pacific Ocean Around the Hawaiian Archipelago*

The islands of Hawai`i are set in a dynamic oceanographic and meteorological regime in the northern/central subtropical region of the Pacific Ocean and, as such, are influenced by the transition zone between the nutrient-poor surface waters of the North Pacific Subtropical Gyre and the nutrient–rich surface waters of the North Pacific Subpolar Gyre (Kazmin and Rienecker 1996; Leonard *et al.* 2001; Polovina *et al.* 2001; Friedlander *et al.* 2009). Colder, nutrient-rich waters are brought to the region by seasonal shifts and interannual migrations of this front. These waters are important to the productivity and ecology of the region (Polovina and Haight 1999; Nakamura and Kazmin 2003; Polovina 2005; Friedlander *et al.* 2009).

Low day-to-day and month-to-month variability in climate is characteristic of the Hawaiian Archipelago. The climate features mild year-round temperatures, moderate humidity, persistent northeasterly trade winds and infrequent severe storms (Giambelluca and Schroeder 1998; USFWS 2008a). The climate is influenced by either marine tropical or marine Pacific air masses, depending on the season. During summer, the Pacific High Pressure System dominates, placing the region under the influence of easterly winds with marine tropical and trade winds prevailing. In winter, the area is influenced by the southward movement of the Aleutian Low over the North Pacific (Grigg *et al.* 2008; USFWS 2008a). The surrounding ocean has a dominant effect on the weather of the entire archipelago.

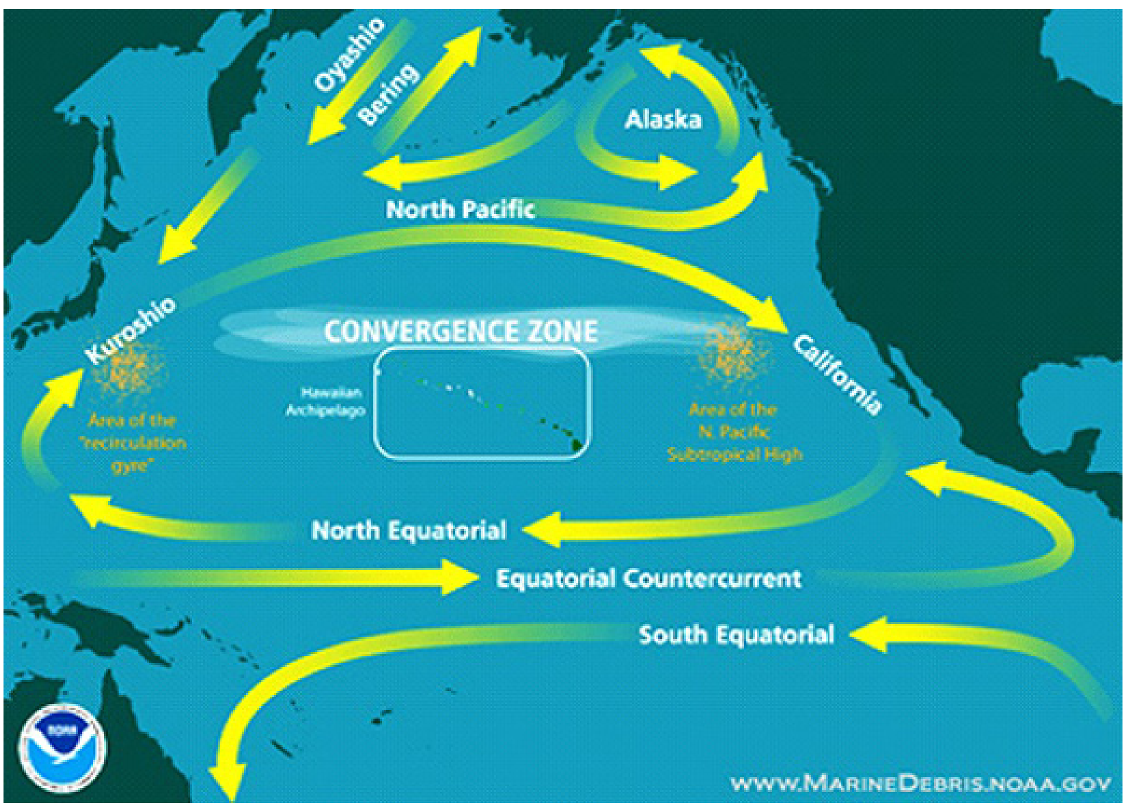
3.2.4.1 *Ocean Circulation and Currents*

Surface currents in the Pacific Ocean are driven by the trade winds and westerlies, such that surface flows are predominantly westward in low latitudes and eastward in high latitudes. When these flows encounter the continents they are diverted both north and south to form coastal currents, which further serve to establish rotating water masses ("gyres") that characterize the overall circulation patterns of the ocean.

The Hawaiian Archipelago is in the central subtropical region of the North Pacific Ocean, near the middle of the North Pacific gyre. In this region the large-scale circulation is generally clockwise (*i.e.*, anti-cyclonic) as depicted in Figure 3.2-1. Near the Hawaiian Islands, oceanic flows are generally from east to west, with vigorous eddies forming on the leeward side of the islands (Flament *et al.* 1998). To the south of Hawai`i, the North Equatorial current flows westward, completing the circuit of the North Pacific gyre.

Eastward-flowing currents carry planktonic larvae from the species-rich western Pacific, and the eastward-spiraling Kuroshio Current facilitates the natural transport of many Japanese organisms to Hawaiian waters (Juvik and Juvik 1998). The archipelago spans such a great distance that its opposite ends often experience different oceanographic and meteorological conditions (Friedlander *et al.* 2009). Surface currents in the NWHI are highly variable in both speed and direction (Firing and Brainard 2006) with the average long-term surface flow being from east to west due to the prevailing northeasterly winds. Eddies created by local island effects on large-scale circulation contribute to the highly variable nature of the surface currents (USFWS 2008a).

Figure 3.2-1 North Pacific Ocean Circulation and Major Currents



Seas offshore of the Hawaiian Islands can be rough, with wave heights of several meters and winter large swell events having waves up to 10 – 12 m in height. The seas are rougher between the islands due to the funneling of wind, and calmer on the leeward side where the surface is shielded from the winds (Flament *et al.* 1998). The Hawaiian Islands are typically not impacted by tropical storms, but do experience annual extratropical storms (storms that originate outside of tropical latitudes) creating high waves during winter. These waves shape the ecosystem by limiting the growth and abundance of coral communities, and lead to species and growth forms that are adapted to these dynamic wave energy environments (Grigg *et al.* 2008).

The transition zone between the nutrient-poor surface waters of the North Pacific Subtropical Gyre and the nutrient-rich surface waters of the North Pacific Subpolar Gyre shifts 15 degrees (°) (between 30° and 45°N) seasonally. This shifts far enough south in winter that it encompasses the three northern most atolls (Kure Atoll, Midway Atoll, and Pearl and Hermes Reef). The front brings colder and nutrient rich waters into the area that are important to the productivity and ecology of the ecosystems (Leonard *et al.*, 2001; Polovina *et al.* 2001; Friedlander *et al.* 2009).

3.2.5 *Water Column*

Biological productivity in the pelagic zone is highly dynamic. Physical conditions present in the water column, such as isotherm and isohaline (temperature and salinity) boundaries, often determine what species will be present in the surrounding waters (USFWS 2008a). A mixed layer is present below the surface and ranges in depth from 120 m (400 ft) in winter to less than 30 m (100 ft) in summer. Below this layer there is a thermocline (sharp decrease in temperature) from 25° Celsius (C) at the surface to 5°C at 700 m (2,300 ft), then decreases to 1.5°C at the bottom.

Surface salinities range from 35.2 parts per thousand (ppt) at 26°N to 34.3 ppt at 10°N. Salinity reflects the balance between precipitation and evaporation so the decrease in salinity at the southern end of the Hawaiian Islands reflects the higher amount of precipitation near the Inter-Tropical Convergence Zone. Salinity tends to decrease with depth, indicating the sinking of lower salinity water from the northern ocean. Higher salinity water (35.2 ppt) is present at the surface down to 150 m (500 ft), lower salinity (34.1 ppt) down to 500 m (1670 ft), and then the salinity increases slightly to 34.7 ppt for very deep abyssal waters (Flament *et al.* 1998).

3.2.6 *Temperature and Nutrient Regimes*

The distribution of many species is influenced by the temperature gradient along the Hawaiian Archipelago (DeMartini and Friedlander 2004; Friedlander *et al.*

2009). Water temperatures in the area are several degrees lower than in the tropical western Pacific, leading to a decrease in diversity of aquatic species (Juvik and Juvik 1998). Average water temperatures surrounding the Hawaiian Archipelago vary from 22° C (71.6° Fahrenheit [F]) in March to 27 °C (80.6°F) in September. The northernmost atolls of the islands are occasionally affected by an eastward expansion of the Western Pacific warm pool, which can cause higher ocean temperatures during the summer at Kure Atoll than the more "tropical" waters of the islands further south (USFWS 2008a). Therefore, the temperature variation at French Frigate Shoals (74 to 81.5°F [23.3 to 27.5°C]) is much less than at Kure Atoll, in the northernmost part of the chain (66.2 to 80.6°F [19 to 27°C]).

Nutrient conditions in the Hawaiian Islands are influenced by both local and regional factors. The concentration of nutrients (such as nitrate, nitrite, phosphate, silicate) is small at the surface, but increases with depth (Flament *et al.* 1998). Localized wind and bathymetric features may cause upwelling to occur, bringing the cooler, nutrient-rich deep water closer to the surface. Circulation cells and wake eddies found downstream of oceanic islands may concentrate plankton, enhancing productivity near those islands (Ashmole and Ashmole 1967; Boehlert 1993; USFWS 2008). Regional factors include subtropical fronts and the high chlorophyll content of the associated waters north of the front. A major ecological transition zone in the northern Pacific known as the "Transition Zone Chlorophyll Front" seasonally migrates and influences the primary productivity of the northern portion of the NWHI (Polovina et al. 2001; Bograd et al. 2004). This influx of nutrients increases ocean productivity and therefore recruitment of aquatic life, such as Hawaiian monk seals (Polovina *et al.* 1994; USFWS 2008).

3.2.7 *Marine Water Quality*

While water offshore around Hawai`i is remarkably clean, nearshore localized concentrations of pollutants occur near populated areas due to stormwater discharges and permitted sanitary outfalls.

Water quality has been assessed in 99% of Hawaiian estuaries. Of this percentage, 57% are impaired and 43% are fully supporting designated uses. Eighty-three percent of shoreline waters have been assessed. Two percent of shoreline waters are impaired, 1 % is threatened, and 97% is fully supporting designated uses (EPA 2005, National Oceanic and Atmospheric Administration [NOAA] 2009a).

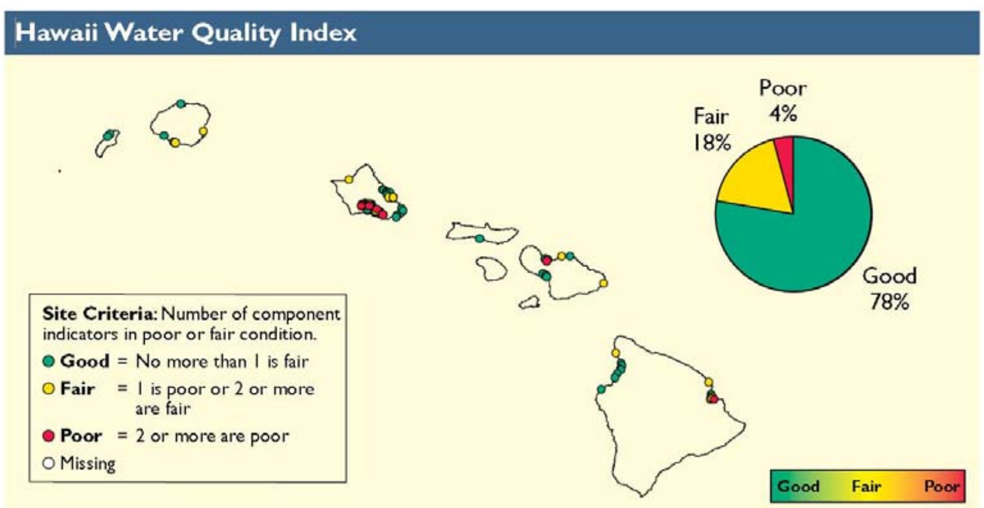
Hawai`i does not monitor all coastal areas. However, the Clean Water Branch (CWB) of the State of Hawai`i's DOH is responsible for monitoring the State's waters, identifying sources of water pollution, and evaluating the data (CWB 2011). The Polluted Runoff Control Program (PRCP) administers grant money it receives from the Environmental Protection Agency (EPA) through Section 319(h) of the federal Clean Water Act to address Hawai`i's polluted runoff (CWB

2011). Key PRCP coastal priority projects monitoring sites include (CWB 2010 PRCP):

- Kaua`i
  - Port Allen Pier
  - Nawiliwili Harbor
- Island of Hawai`i
  - Wailoa River Mouth
  - Hilo Bay Lighthouse
  - Pelkane Bay
  - Waiulaula Bay

According to the latest available data from Environmental Protection Agency's (EPA's) National Coastal Assessment program, the overall quality of Hawai`i 's coastal waters, based on the Water Quality Index, is rated 78% good, 18% fair and 4% poor (EPA 2008) (Figure 3.2-2).

Figure 3.2-2 Hawai'i Water Quality Index



Source:
National Coastal Condition Report III. Chapter 8 Part B Alaska, Hawaiian Island Territories (EPA 2008).

3.2.8 *Climatic Variability and Change*

3.2.8.1 *Atmosphere-Ocean Time Scales and Forcing Mechanisms*

Atmospheric and oceanic parameters in the North Pacific vary on several time scales and are due to many different forcing mechanisms (Table 3.2-3). Short-term (daily to annual) fluctuations in atmospheric and oceanic conditions are familiar and generally well-understood, to the extent that cause-and-effect relationships are generally well-established. Fluctuations having longer (interannual) time scales are becoming better documented, thanks to extensive environmental monitoring activities, but definition of causal relationships for most remains an elusive challenge. The focus of this section is on atmosphere-ocean interactions that occur on time scales of several months to several years, or even decades. No attempt is made to catalogue all possible sources of variability. Rather, only the few that are well-known are identified and their possible influences are described.

Table 3.2-3 Atmosphere-Ocean Variability – Time Scales and Forcing Mechanisms

Period	**Forcing Mechanism**
Diurnal/Semidiurnal	Lunar & solar tides
3-10 days	Atmospheric storms
Seasonal	Solar declination
Interannual (years)	
0.5 – 1+	Mesoscale ocean eddies
3-7	El Niño – Southern Oscillation (ENSO) events
6-7	Mid-latitude atmospheric events
10+	"Regime shift"
11	Sunspots
18.6	Lunar Declination
22	Sunspots

*After National Research Council 1996. The Bering Sea Ecosystem

3.2.9 *Interannual Variability*

The phenomenon known as El Niño – Southern Oscillation (ENSO) has long been recognized as a significant factor in the interannual variability of atmospheric-oceanic response. ENSO events radiate from the equatorial regions at irregular intervals, which range most commonly from three to seven years between events. The two distinct forms of ENSO in the Pacific Ocean are known as El Niño and La Niña. During El Niño events, the Aleutian Low pressure system tends to be more intense and is positioned further to the south (closer to the NWHI), thereby producing stronger winds, larger waves and cooler water temperatures in the NWHI (Bromirski *et al.* 2005). Large-scale oceanographic events such as El Niño change the characteristics of water temperature and productivity across the Pacific, and these events have a significant effect on the habitat range and movements of pelagic species (USFWS 2008). During La Niña, sea surface temperatures in the eastern tropical Pacific are below average, and temperatures in the western tropical Pacific are above average (Friedlander *et al.* 2009).

3.2.9.1 *Interdecadal Variability*

A chronology of interdecadal climatic changes affecting the North Pacific Ocean was compiled from available measured atmospheric pressure data by Minobe (1997) for the period 1899-1997. A climatic regime shift was defined as a transition from one climatic state to another within a period substantially shorter than the lengths of the individual epochs of each of the (two) climatic states. Data used by Minobe included the North Pacific index, the area- and time-averaged sea level pressure anomalies in the region of 160°E to 140°W by 30° to 60°N for winter to spring (December to May), which provided examples of rapid strength changes in the Aleutian Low in the winter and spring seasons. Bidecadal pressure averages during 1899-1924 showed that the Aleutian Low was about 1 millibar (mb) weaker than average, then strengthened to 1 mb below normal during 1925-1947. Similar behavior occurred in the latter part of the 20th century as the Aleutian Low shifted back to 1 mb above normal from 1948 to 1976, then strengthened back to 1 mb below normal during 1977-1997.

Using late-nineteenth century data for spring air temperature in western North America, Minobe (1997) then identified 1890 to be the first regime shift. This extended the length of the first period to 34 years in comparison to the 22-, 26-, and 20+ year regimes to follow. The 50- to 70-year interdecadal variability (a two-regime cycle) has been prevalent from the nineteenth century to the present in North America. Minobe (1997) speculated that the likely cause of this variability is an internal oscillation in the coupled atmosphere-ocean system.

Long-term changes in fish populations around the North Pacific have apparently been influenced by climatic change of the same 50- to 70-year variability. Alaska salmon catches decreased in the 1940s and increased in the 1970s. Larger Japanese sardine catch amounts occurred in the regimes with the deepened Aleutian Low. Baumgartner *et al.* (1992) found evidence of an approximately 60-year variability in sardine and anchovy populations in eastern North Pacific from sediments in the Santa Barbara basin dating back to A.D. 270.

Dubbed the Pacific Decadal Oscillation (PDO), this cyclical behavior is an El Niño-like pattern of Pacific climate variability. PDO differs from ENSO in that it persists for much longer (20 to 30 years versus 6 to 8 months) and is most visible in the North Pacific with secondary signatures in the tropics, while the opposite happens during ENSO (Friedlander *et al.* 2009).

3.2.9.2 *Regime Shifts*

In the late 1970s a step change in climate, referred to as a "regime shift," occurred in the North Pacific Ocean. While there is evidence to suggest that there have been previous regime shifts, as noted above, it was the 1970s regime shift that stimulated extensive research on the topic and, especially, how oceanic ecosystems were responding to these phenomena. Although more than a decade was required to recognize the pattern, the regime shift of 1976/1977 is now widely acknowledged, as well as its associated far-reaching consequences for the large marine ecosystems of the North Pacific Ocean.

The most recent regime shift (1989) has been studied extensively by Hare and Mantua (2000), who assembled and examined 100 environmental time series of indices (31 climatic and 69 biological) to obtain evidence of regime shift signals. Although their focus was on the Gulf of Alaska and Bering Sea, there is no reason to preclude the applicability of their findings as far south as the Hawaiian Archipelago.

Abundant evidence suggests that the coupled atmospheric-oceanic system of the North Pacific is subject to multiple forcing factors, each having characteristic behaviors and different frequencies of occurrence. The evidence also indicates that, rather than there being a single average or "normal" condition, the overall system appears to stabilize periodically around two or more "normal" states, changing from one to another abruptly in what has been termed a "regime shift." These are the characteristics of systems whose dynamics are addressed by "chaos" theory, which is a body of mathematical theory that focuses on systems that have multiple states of equilibrium. Chaos theory attempts to define the mechanisms that cause the systems to change from one equilibrium state to another and to predict all such equilibrium conditions.

Use of the word "chaos" in this context is not to imply the more common definition of great confusion or disorder. Rather, its use invokes the mathematical implication that there is order behind the irregularity of the system. A chaotic model may lead to a better understanding of the low-frequency relationship between the physical and biological systems in the North Pacific. One characteristic of a chaotic system is that, near the time of major interdecadal transition, there could be several years of extreme and perhaps opposite, anomalies in the physical system. These extremes provide opportunities for change in the biological system. Recent experience with North Pacific fisheries and marine mammal populations may provide examples of such transition periods.

3.3 *BIOLOGICAL ENVIRONMENT*

3.3.1 *Hawaiian Monk Seals*

3.3.1.1 *Distribution*

Hawaiian monk seals occur on lands (islands, atolls, emergent reefs) throughout the Hawaiian Archipelago, from Kure Atoll to Hawai`i Island, a distance of over 2,500 km (approximately 1,553 miles). Seals forage in (search for food) and transit, the waters surrounding and between all land areas. Additionally, intermittent sightings of Hawaiian monk seals have occurred at remote Johnston Atoll approximately 800 km (about 500 miles) south of the Hawaiian Archipelago. Although seals are perhaps not continuously present at this site, they do occur there naturally so Johnston Atoll is considered part of the species range. Historically, most Hawaiian monk seals have been located in the remote NWHI, with subpopulations at Kure Atoll, Midway Atoll, Pearl and Hermes Reef, Lisianski Island, Laysan Island, French Frigate Shoals, Necker Island and Nihoa Island. Seals are also seen at Gardner Pinnacles and Maro Reef in the NWHI; however, these sites have limited areas where seals can haul out. A historically small, but currently growing portion of the seals occur in the MHI, including the islands of Ni`ihau, Kaua`i, O`ahu, Molokai`i, Lāna`i, Kaho`olawe, Maui, and Hawai`i. Seals also land on smaller islands (for example, Kaula Rock, Lehua Rock) and offshore islets that occur throughout the MHI. A research report released at the time this Draft PEIS was being prepared for printing offers additional information on the historical distribution and occurrence of Hawaiian monk seals in the NWHI and MHI. The 2011 report, *Historical and Contemporary Significance of the Endangered Hawaiian Monk Seal in Native Hawaiian Culture*, is included as Appendix K.

The species is structured in a metapopulation consisting of multiple subpopulations, which display varying degrees of demographic independence but are linked through regional environmental correlation as well as migration (Baker *et al.* 2007; Baker and Thompson 2007; Schultz *et al.* in press).

Hawaiian monk seal population monitoring is based upon long-term marking and resighting of individuals. This is a powerful approach, which facilitates tracking abundance, age and sex structures (because age and gender of most individuals are known), survival rates, reproductive rates and movement between subpopulations.

3.3.1.2 *Physical Description and Life Cycle*

Male and female Hawaiian monk seals are similar in size. Sex is determined by observing the ventral side of a seal (Kenyon and Rice 1959). Females have two pairs of teats, often appear larger and fatter than adult males (Kenyon and Rice

1959), and may have dorsal mating scars (Hiruki *et al.* 1993). Males have a penile opening, often have scars along their necks inflicted by other males (Hiruki *et al.* 1993), and may be darker than females (Kenyon and Rice 1959). Adults weigh up to 270 kilograms (kg) and may be more than 7 ft long (Kenyon and Rice 1959).

Hawaiian monk seals do not form dense breeding colonies (Kenyon and Rice 1959; Johanos *et al.* 1994); rather, they tend to haul out alone or in sparse clusters on the beach. Mating, which occurs in the water and is rarely observed, is inferred from male-female association patterns and from mounting injuries (Johanos *et al.* 1994). Hawaiian monk seal births may occur any time of year, but there is a broad peak in pupping from March to August (Johanos *et al.* 1994). The mean interval for births in consecutive years is 381 days, which results in the prolonged pupping season (Johanos *et al.* 1994). When females give birth in consecutive years they do so later each season. When they skip a year or more their subsequent birth occurs earlier in the year. Birth rates vary depending on breeding location and year, with approximately 30-70% of all adult females giving birth in any given year (Johanos *et al.* 1994; Harting *et al.* 2007). Hawaiian monk seals tend to give birth on secluded beaches adjacent to shallow, protected waters, apparently to afford protection to the pup (Westlake and Gilmartin 1990).

Newborn pups weigh 15-17 kg and measure 95-100 centimeters (cm) long (Kenyon and Rice 1959). Pups are black at birth and undergo a post-natal molt (shedding) late in the nursing period. Nursing lasts, on average, 39 days (Johanos *et al.* 1994), during which time the mother remains constantly near her pup in and out of the water (Kenyon and Rice 1959). The mother apparently fasts and rapidly loses weight through lactation. At the end of lactation, she leaves her pup and swims offshore to feed (Kenyon and Rice 1959; Wirtz 1968; Johnson and Johnson 1984). At weaning, pups normally weigh between 59-90 kg (Kenyon and Rice 1959).

3.3.1.3 Population Status and Trends

The Hawaiian monk seal was listed as endangered throughout its range under the Endangered Species Act (ESA) in 1976 (41 Federal Register [FR] 51611; November 23, 1976). The Hawaiian monk seal is the most endangered pinniped species in U.S. waters and the second most endangered pinniped in the world; only the Mediterranean monk seal, also critically endangered, is rarer. Their cousin, the Caribbean monk seal, is extinct.

Hawaiian monk seals probably occurred throughout the Hawaiian Archipelago when Polynesian colonizers arrived 1500–1600 years ago, after which the seals were likely extirpated from the MHI (Bellwood 1978; Baker and Johanos 2004). The NWHI provided a refuge for the species until European sailors arrived in the 19th century and hunted subpopulations to near extinction (Ragen 1999).

Although historical counts of total population size are not available, records indicate an abundance of seals up to the year 1857 (Hiruki and Ragen 1992), no or few seals at most islands by 1893 (Ragen 1999), and a ''large number'' at Kure Atoll and Pearl and Hermes Reef by 1915 (Hiruki and Ragen 1992). In 1958, mean counts of seals on the beach at the six main NWHI subpopulations (French Frigate Shoals, Laysan Island, Lisianski Island, Pearl and Hermes Reef, Midway Atoll and Kure Atoll) had recovered to 916 individuals, age 1 year or older (non-pups; Rice 1960). A "beach count" is an index of abundance, rather than total abundance as it represents the average number of seals counted on the beach at any given time, thereby it doesn't include seals in the water. Because total abundance was not estimable until the past decade or so at most sites, the beach count index provides the best indicator of abundance trends over time.

The counts conducted in 1958 are a benchmark for the species' known historic high point of abundance. Certainly it is likely that the species was far more abundant prior to human contact, but there is no reliable figure for abundance or even an abundance index prior to 1958. Though 1958 was unique in that counts were conducted at all six main subpopulations in that year, counts at individual subpopulations within a few years of 1958 substantiate the relatively high abundance in that period. The mean of comparable counts summed for the same six locations in 2010 was 268 non-pups, representing a decline of over 70% in just over five decades. The most recent (2009) best estimate of total abundance is 1,125 seals (Carretta *et al.* 2011 SAR draft), and the number is declining at approximately 4.5% per year.

The general decline in total abundance since the late 1950's masks complex spatial dynamics in population trends. Regional trends are described separately in the following sections.

NWHI Abundance and Trends

The six NWHI subpopulations listed above have been the subject of consistent, thorough long-term monitoring. Beach counts have been conducted in most years at these sites since 1958 and since the early to mid-1980's more thorough population studies have been conducted annually. Necker and Nihoa Islands have historically hosted a relatively small portion of the total species abundance and are especially logistically difficult places to work, therefore the data from these sites is mostly limited to zero to a few opportunistic counts per year.

Figure 3.3-1 shows the trend in mean non-pup beach counts at the various sites in the NWHI. While the other main subpopulations had their documented high counts in the late 1950's, French Frigate Shoals was highly reduced at that time, likely due to human impacts and harassment. However, after human disturbance was curtailed that population grew rapidly and reached a peak in the late 1980's, followed by a dramatic crash which continues to the present. Laysan and Lisianski Islands have demonstrated an overall declining trend since the late

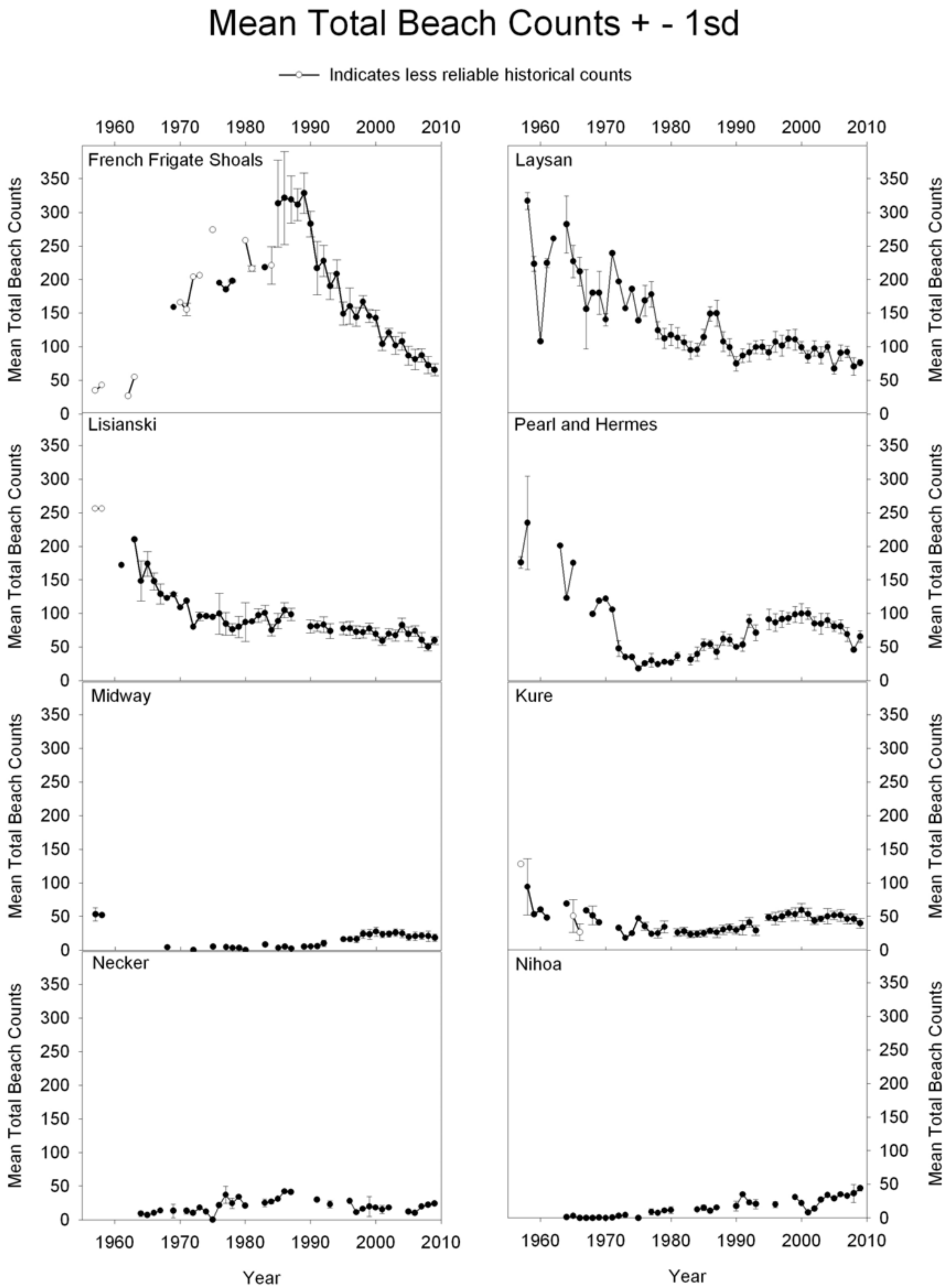
1950's, though the rate of decline was most rapid in the early part of the time series. The three western subpopulations (Pearl and Hermes Reef, Midway Atoll and Kure Atoll) all declined precipitously after the late 1950's and then at different time points ranging from the 1970's to the 1990's, each subpopulation began to recover, but then each experienced renewed decline over approximately the past decade. Finally, Necker and Nihoa Islands counts remained very low into the 1970's, and thereafter have been fairly stable at Necker Island, whereas Nihoa Island has demonstrated increasing trends over the past decade.

Total population abundance is estimated in a variety of ways; each year, the most appropriate method for each site is determined according to the available data for that site. For example, at some sites and years, total enumeration is achieved (Baker *et al.* 2006). If all seals are not demonstrably identified, then capture-recapture methods are used as an alternate method (Baker 2004). If no capture-recapture estimator is appropriate for the data available, minimum abundance estimates are used. Finally, at Necker and Nihoa Islands, where at most a few beach counts are available each year, a correction factor is applied to counts to estimate abundance (Carretta *et al.* 2011 SAR draft). Table 3.3-1 presents the most recent abundance estimates in the NWHI. The abundance of the six thoroughly monitored NWHI subpopulations has been falling 4.5% per year during recent years (Carretta *et al.* 2011 SAR draft).

Table 3.3-1 Abundance Estimates of Hawaiian Monk Seals in the NWHI in 2009 and Method Used to Estimate Abundance At Each Site As Indicated

Location	Abundance	Method
Kure Atoll	93	Capture-recapture
Midway Atoll	50	Minimum
Pearl and Hermes Reef	156	Minimum
Lisianski Island	159	Capture-recapture
Laysan Island	193	Total enumeration
French Frigate Shoals	198	Capture-recapture
Necker Island	51	Corrected counts
Nihoa Island	93	Corrected counts

Figure 3.3-1 Hawaiian Monk Seal Mean Total Beach Counts 1960 - 2010



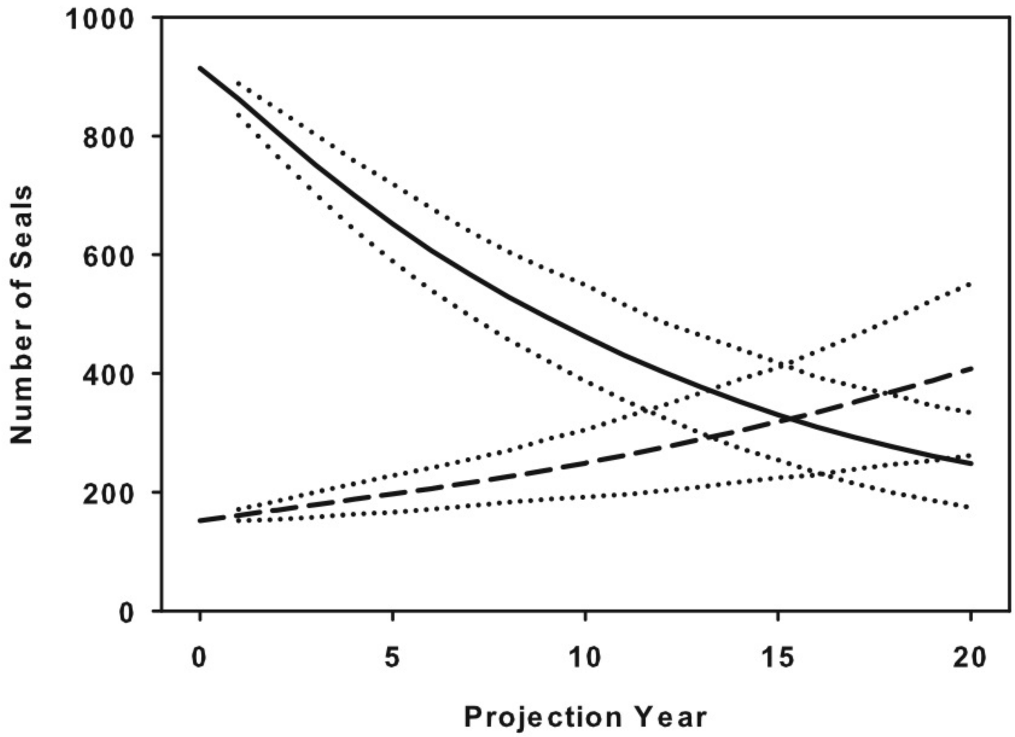
MHI Abundance and Trends

While most of the existing Hawaiian monk seals still live in the NWHI where abundance is falling, a smaller portion lives in the in MHI, and numbers in this region are on the rise. Prior to 2000, no systematic surveys of seals had been conducted in the MHI owing to the rarity of seals in the region. Kenyon and Rice

(1959) present a handful of MHI seal sightings from the first half of the 20th century. The earliest seal documented in the MHI was reportedly killed in Hilo Bay on the island of Hawai`i, and subsequently eaten (H.W. Henshaw in Dill and Bryan 1912), though Rosendahl (1994) reported finding monk seal remains dating to between 1400 and 1760 on the island of Hawai`i. Reports of seal sightings and births were increasing by the mid-1990's, which motivated the first systematic surveys in 2000 and 2001, when 45 and 52 seals, respectively, were counted from aircraft in the MHI (Baker and Johanos 2004). These counts were considered well below total abundance because like the beach counts described above, they did not account for animals in the water, and not every seal on land could be detected.

More recently, MHI monk seal population data have been collected by a network of individual volunteers, volunteer groups, partner agencies, and directed efforts by NMFS. Total seal abundance in the MHI is still not reliably estimated; however, the most recent published estimate was 152 seals in 2008 (Baker *et al.* 2011). A population model estimates that the MHI population may be growing at 7% per year (Baker *et al.* 2011). While the MHI monk seals still comprise a relatively small portion of the total species, their numbers are on the rise, whereas NWHI abundance is falling. Projections using a stochastic simulation model indicate that if current demographic trends continue, abundance in the NWHI and MHI will equalize in approximately 15 years (see Figure 3.3-2).

Figure 3.3-2 Stochastic Projection Simulation - Dotted lines indicate 95% confidence intervals for projections



Key: ▬▬▬ NWHI Projection
▬ ▬ ▬ MHI Projection

Survival Rates

Survival rates of Hawaiian monk seals in the NWHI are very well-characterized because for well over two decades, most of the seals born have been tagged in their year of birth and resighted throughout their lives. Baker and Thompson (2007) characterize temporal and spatial variation in survival rates at six NWHI subpopulations. Because Necker and Nihoa Islands have been rarely visited, minimal marking and resighting of seals means that no survival rate information is available for these sites. Recently, sufficient numbers of seals have been studied in the MHI to obtain reliable estimates of survival in this region (Baker *et al.* 2011).

The general lifetime pattern of survival for Hawaiian monk seals is as follows. After they are born, pups spend 5-7 weeks being nursed and cared for by their mothers. Pups are weaned abruptly when the mother leaves the pup on the birth island. From weaning on, the pups are entirely independent. Thus, the first interval for which survival is measured is from birth to weaning. Throughout most of the species range, pup survival during the nursing period is quite high—over 90% of pups born survive to weaning. The exception is at French Frigate Shoals, where for over a decade, typically a quarter to a third of pups has died each year prior to weaning. This anomalously high mortality is largely attributed to Galapagos shark predation (Gobush 2010).

In order to survive the first year after weaning, monk seal pups must learn to forage successfully, while avoiding predators and other risks. The first few years post-weaning is when survival rates are lowest, and in fact juvenile survival rates exert the most influence on overall population trends in the long term (Harting 2002).

First year cohort survival (the survival of a group of seals born all in the same year) in Hawaiian monk seals are highly variable, with observed rates spanning from only a few percent to 100 percent at given sites and year. Survival tends to rise as seals mature until they reach a peak "adult" survival rate at approximately age 3 years or older (this varies over space and time). Thereafter, seals enjoy high survival rate (typically over 90%) for most of the rest of their lives. After approximately age 17 years, a drop in survival rates, or senescence, occurs. Unlike in many other species, male and female monk seals tend to have equal survival. The one exception is that historically, survival rates of female seals at French Frigate Shoals tend to be slightly higher than that of males.

The foregoing describes the general pattern for the species; however, there has been a great deal of variability observed in survival rates over time and between subpopulations. At present, of utmost importance is that while juvenile survival rates are variable, they have been chronically low at all of the six best-studied NWHI subpopulations, which comprise the majority of the species. The low juvenile survival in the NWHI has indirectly contributed to further declines in abundance through a degradation of the age structure -- because few seals are maturing to reproductive age, the number of pups born has also been falling. Further, because low juvenile survival has prevailed sufficiently long to winnow the age structures, these declining trends will continue for years into the future even if juvenile survival improves.

In contrast to the low juvenile survival rates in the NWHI, young seals in the MHI are doing much better. For example, in recent years, survival from weaning to age 1 year in the MHI has averaged 77%, compared to only 0.42-0.57 in the NWHI (Baker *et al.* 2011). It is important to note that, while this discrepancy in juvenile survival exists, adult survival rates are comparable and relatively high throughout the species range.

Reproductive Rate

As noted above, Hawaiian monk seals, like all pinnipeds, give birth annually to a single pup at most. Seals do have twins on rare occasions, though one or both twins typically do not survive (Schultz *et al.* 2011). Gross reproductive rates (the ratio of number of pups to number of adult females) vary from about 30% to 70%, and there is considerable variability between years and subpopulations (Harting *et al.* 2007). Age-specific reproductive (or fecundity) curves have been estimated for three NWHI subpopulations. Females in the NWHI typically have their first pup when they are 5 to 9 years old. Pupping rates rise to a plateau after about age 10 years, and then begin to decline in the late teens or later (Harting *et al.* 2007). Some variability in the age-specific curves amongst subpopulations appears to correlate with growth rates. That is, at sites where female seals grow to adult size more slowly, the onset of reproduction is also delayed. Consistent with this pattern, in the MHI where body condition and growth tends to be superior to the NWHI, sparse data suggest that females begin reproducing at a younger age and may achieve higher reproductive rates (Baker *et al.* 2011).

<u>Genetics, stock structure, site fidelity and movement among subpopulations</u>

Hawaiian monk seals exhibit extremely low genetic diversity according to a variety of measures (Schultz *et al.* 2008). This is probably due in part to a population bottleneck associated with overexploitation in the 19th Century, but genetic diversity appears to have been low even prior to that time (Schultz *et al.* 2008). There is little indication of contemporary inbreeding, and Hawaiian monk seal subpopulations have exhibited robust growth at various times despite their low genetic diversity. Further, although the species is distributed in a metapopulation, there is no evidence of genetic population structure. That is, the species is comprised of a single, panmictic (unstructured) population (or "stock") (Schultz *et al.* 2011).

The lack of genetic population structure is consistent with movement patterns of seals amongst subpopulations. While the majority of seals prefer to stay in the subpopulation where they were born, some 4% to 18% of seals born in the NWHI have been observed at more than one subpopulation (Schultz *et al.* 2011). Seals tend to move more between relatively nearby subpopulations than between distant ones. Also, juveniles appear to range less widely compared to adults (Schultz *et al.* 2011). Though data are limited, there have been several observations of individual seals moving between the NWHI and MHI, and also the NWHI to Johnston Atoll (NMFS unpublished data). This mixing of seals from different subpopulations has resulted in sufficient gene flow to maintain panmixia (in other words, the species genes are fully mixed throughout its range) (Schultz *et al.* 2011).

3.3.1.4 Habitat Requirements

The Hawaiian monk seal requires both marine and terrestrial environments. While Hawaiian monk seals spend a majority of their time in the water, the terrestrial component of their habitat plays a vital role throughout all life stages. Monk seals use terrestrial habitat to haul-out for resting, molting, parturition (birthing), nursing and avoiding predators. Since monk seals may remain at sea for several days or more at a time, resting on land is essential to conserve energy. Resting commonly occurs on sandy beaches, but may also occur on rocky shores, rock ledges, emergent reefs, and even shipwrecks (Antonelis *et al.* 2006). While on shore, monk seals may take shelter from wind and rain under shoreline vegetation. Resting on land may last from a few hours to several days at a time (Antonelis *et al.* 2006).

Terrestrial habitat is essential for parturition (pupping) and nursing of pups. Pupping and nursing areas are usually sandy beaches adjacent to shallow protected water (Westlake and Gilmartin 1990). Individual females appear to favor certain pupping locations, returning to them year after year. Although the pup is able to swim at birth, nursing occurs on land and the mother-pup pair usually remains on land for the first few days after the pup is born. The mother gradually begins swimming with her pup in the shallows, returning to the general area around the pupping site. As weaning approaches, the mother-pup pair spends more time in the water, venturing further away from the pupping site. After weaning, pups typically remain in the shallows near their nursing areas for several weeks before venturing into deeper foraging areas (Kenyon and Rice 1959; Henderson 1988). During the annual one- to two-week molt period, seals spend most of their time on land shedding their skin and fur (Kenyon and Rice 1959).

Hawaiian monk seals use the marine environment for foraging, resting, thermoregulation, and social interaction, including mating. Observation of seals with animal-borne video cameras showed that nearly one-half of the time spent underwater was spent resting or interacting with other seals (Parrish *et al.* 2000). Resting may occur at sea or in shallow, submerged caves. Satellite-linked and other tracking technology indicate that monk seals are primarily, though not exclusively, benthic (bottom) foragers. They forage in marine habitats anywhere from 1-500 m depth and seem to prefer low-relief substrates such as sand and talus in areas of habitat uniformity. The seals appear to use all submerged habitat at least up to 500 m depth, including sea mounts, banks, marine terraces and a variety of reef habitats.

<u>Critical Habitat</u>

In 1986, critical habitat for the Hawaiian monk seal was designated at all beach areas, sand spits and islets, including all beach crest vegetation to its deepest extent inland, lagoon waters, inner reef waters, and ocean waters out to a depth of 10 fathoms (18.3 m) around Kure Atoll, Midway Atoll (except Sand Island), Pearl & Hermes Reef, Lisianski Island, Laysan Island, Gardner Pinnacles, French Frigate Shoals, Necker Island, and Nihoa Island in the NWHI (51 FR 16047; April 30, 1986). In 1988, critical habitat was expanded to include Maro Reef and waters around previously designated areas out to the 20 fathom (36.6 m) isobath (53 FR 18988; May 26, 1988).

In 2008, NMFS received a petition to revise the Hawaiian monk seal critical habitat designation under the ESA. The petitioners sought to revise critical habitat by adding the following area types in the MHI: key beach areas, sand spits and islets, including all beach crest vegetation to its deepest extent inland, lagoon waters, inner reef waters, and ocean waters out to a depth of 200 m. In addition, the petitioners requested that designated critical habitat in the NWHI be extended to include Sand Island at Midway Atoll, as well as ocean waters out to a depth of 500 m (Center for Biological Diversity 2008).

On October 3, 2008, NMFS announced in its 90-day finding that the petition presented substantial scientific information indicating that a revision to the current critical habitat designation may be warranted (73 FR 57583; October 3, 2008). On June 12, 2009, in a 12-month finding, NMFS announced that a revision to critical habitat is warranted on account of new information available regarding habitat use by the Hawaiian monk seal and also announced the Agency's intention to proceed towards a proposed rule (74 FR 27988; June 12, 2009).

3.3.1.5 Foraging Ecology

<u>Foraging Behavior</u>

Hawaiian monk seals feed on the sea floor from the shallows to over 500 m depths. Seal-mounted video camera ("Crittercam") images reveal that adult seals move large, loose talus fragments to capture prey underneath (Parrish *et al.* 2000). Seals appear to prefer this type of uniform habitat because of the prey available in those areas (Parrish *et al.* 2000). Studies in the NWHI (Parrish *et al.* 2002; Stewart 2006) have also shown that adult monk seals may forage at 300 – 500 m, sometimes visiting patches of deep corals (Parrish *et al.* 2002). The use of these deeper habitats may reflect monk seals taking advantage of readily available prey in a habitat with decreased interspecific competition (Parrish *et al* 2008).

Juvenile monk seals (1 – 3 years old) in the NWHI exhibit foraging behavior similar to that of adult monk seals. Feeding occurs both within shallow atoll lagoons (10 – 30 m) and on deep reef slopes (50 – 100 m), usually over sand rather than talus (Parrish *et al.* 2005). Video footage of juvenile seal foraging showed seals moving along the bottom flushing prey with a variety of techniques including probing the bottom with their nose, using their mouth to squirt streams of water at the substrate, and flipping small rocks with their heads and shoulders (Parrish *et al.* 2005). While juvenile seals are able to dive to depths similar to adults, the smaller seals likely do not yet have the size or experience to engage in the successful large talus-foraging behavior exhibited by adults (Parrish *et al.* 2005).

Use of satellite-linked telemetry and time-depth recorders has shown that Hawaiian monk seals primarily forage in areas of high bathymetric relief within 40 km (approximately 25 miles) of the atoll or island center and there is substantial overlap in the habitat use of monk seals at each site (DeLong *et al*. 1984; Abernathy and Siniff 1998; Parrish *et al*. 2000, 2002; Stewart *et al*. 2006).

Submerged banks and reefs 24-322 km away from the breeding sites also are used by monk seals (Stewart *et al*. 2006). Foraging monk seals typically have dive durations of less than 8 minutes but some dives exceeding 20 minutes also have been observed (Abernathy and Siniff 1998; Littnan *et al*. 2004; Stewart and Yochem 2004a, b, c; Stewart *et al*. 2006). Foraging trip durations are highly variable with ranges from 13 hours to around 3 wks (Abernathy and Siniff 1998, Littnan *et al*. 2004).

Telemetry studies have revealed that seals in the MHI exhibit similar foraging behavior and habitat selection as seals in the NWHI (Littnan *et al*. 2006). However, MHI seals appear to have smaller home ranges, travel shorter distances to feed and spend less time foraging on average compared to NWHI seals.

<u>Prey Species and Size</u>

Hawaiian monk seals are foraging generalists, with a wide variety of prey taxa identified from fecal (scat) and regurgitate analysis. Some 31 families of teleost (bony) fishes and 13 families of cephalopods (octopus, squids and related species) were identified by Goodman-Lowe (1998) in monk seal scat. The prey families Congridae, Muraenidae, Holocentridae, Labridae, Scaridae, Acanthuridae, Balistidae, and Tetraodontidae are the most frequently occurring in monk seal scat and regurgitate samples (Goodman-Lowe 1998; Longenecker 2010). Monk seals consume a variety of crustaceans including multiple species of crab and lobster.

Fatty acid analysis of the monk seal diet has begun to identify an even broader number of prey species consumed by the Hawaiian monk seal (Iverson 2006). Fatty acid analysis studies have also demonstrated substantial variation in diet among individuals, demographic groups (between juveniles and adults/sub adults) and locations (Iverson 2006); indicating that individual monk seal foraging preferences and capabilities play a role in selection of foraging habitat. Scat and regurgitate analysis from the MHI indicate that the prey taxa selected by seals is similar throughout the archipelago (Cahoon MSc thesis).

Studies of monk seal prey selection based upon scat/spew analysis and seal-mounted video revealed some evidence that monk seals fed on families of bottomfish which include commercial species (many prey items recovered from scats and spews were identified only to the level of family; Goodman-Lowe 1998; Longenecker *et al*. 2006; Parrish *et al*. 2000). Recent quantitative fatty acid signature analysis results support previous studies illustrating that monk seals consume a wide range of species (Iverson 2006). However, deepwater-slope species, including two commercially targeted bottomfishes and other species not caught in the fishery, were estimated to comprise a large portion of the diet for some individuals. Similar species were estimated to be consumed by seals regardless of location, age or gender, but the relative importance of each species varied. Diets differed considerably between individuals.

3.3.1.6 *Carrying Capacity*

The concept of carrying capacity (also known as K), refers to the stable number of individuals that a habitat or area is capable of supporting on a relatively long-term basis. In the classical sense, a population will begin to decline in abundance when it exceeds K and will grow when it is below K, thereby maintaining an average carrying capacity abundance of approximately K. A related concept, "density dependence", refers to changes in survival or reproductive rates that cause the population to grow or decline, respectively, when it is below or above K.

The ability of an area to support a population is a function of all of the resources and environmental attributes that characterize the habitat. For the Hawaiian monk seal, this would include terrestrial and marine foraging habitats, predator abundance, competition from other species, and all other factors that jointly influence the ability of an area to support seals.

There is a considerable body of scientific theory and literature pertaining to the concepts of carrying capacity and density dependence. However, with most species, including the monk seal, it can be exceedingly difficult to determine K with confidence. One approach is to observe how the population has historically grown or declined at various population sizes and infer where carrying capacity lies based on those observations. Alternatively, if much is known about the habitat requirements of a species, it may be possible to quantify habitat resources in terms of their ability to support that species (for example, the prey biomass required to sustain each seal) and estimate how many individuals can be supported by the available resources in a given area. This approach requires a very complete knowledge about the resource requirements of the species. Much is known about monk seal resource use from observation, at-sea tracking and dietary studies. Yet, there is insufficient knowledge to reliably predict how many seals can be supported in either the NWHI or the MHI.

Another factor which can confound estimation of carrying capacity is that it can change over time due to environmental fluctuations, human manipulation or other factors. Historically, we have seen a number of phases of growth and decline at all of the NWHI breeding sites. It is normal to expect some variation in how well a population performs due to random chance or normal environmental events. This is often referred as stochastic variation. However, extended periods of population growth or decline may reflect a long-term, persistent change in habitat capability or carrying capacity. This may be what has happened in the NWHI, where demographic rates, especially juvenile survival, have declined and remained low on average over the last decade. The environmental drivers responsible for these trends appear to be expressed most strongly through effects on juvenile survival.

Although carrying capacity of monk seals cannot be reliably estimated, observing certain indicators can suggest whether a population's size is above or below K. Eberhardt (1977) suggested a pattern in how long-lived species, such as the monk seal, regulate their abundance in accordance with habitat capability:

- The first demographic to change as a population approaches the size where it is limited by available resources is newborn or juvenile survival.
- This is followed by changes in the age of first birth, changes in the reproductive rates of mature animals, and finally changes in adult survival rates.

Whether monk seal populations fully adhere to this pattern is uncertain, but several observations do seem consistent with it. Survival of young animals has been the most volatile feature of the species' demographics. Age of first birth and reproductive rates have also varied among sites. Finally, adult survival is the one demographic measure that does not seem to have varied markedly; it is fairly good system-wide and it has historically been relatively stable. Consistent monitoring of all of these variables can suggest whether a population is above or below K and thereby help determine what interventions are most appropriate. Gradual changes in any of these population measures may suggest that population abundance is nearing K, but it can be difficult to distinguish normal annual variability from density dependent regulation of population size.

3.3.1.7 Crucial and Serious Environmental and Anthropogenic Stressors/Threats

<u>Prey Limitation</u>

Numerous lines of evidence indicate that prey limitation is the primary cause of poor juvenile survival in the NWHI, which is driving the current population decline. Phocid pup condition at weaning reflects how much mass and energy mothers are able to impart to their offspring both *in utero* and during the nursing period. Hawaiian monk seal girth at weaning indicates body condition at this key life stage. Larger girth (fatter) pups have a higher probability of surviving their first year of life post-weaning (Craig and Ragen 1999; Baker 2008). The monk seal population on French Frigate Shoals began to exhibit declining and then chronic poor juvenile survival by the early 1990's. Craig and Ragen (1999) found that pups weaned at French Frigate Shoals were smaller in girth and mass than those at Laysan Island, indicating that perhaps their mothers were not able to forage as efficiently. Weaned pups in the MHI, where food limitation is not thought to be a problem for seals, tend to be very much larger than those weaned in the NWHI (Baker and Johanos 2001).

Thin and emaciated juvenile seals are commonly observed in the NWHI indicating that these seals are unable to forage successfully. Most seal carcasses are not recovered; however when juvenile seals are found dead, they are often in poor body condition indicating food stress. Baker (2008) presented evidence that in years with poor survival of NWHI subpopulations, size-selective mortality was intensified, also suggesting that poor juvenile survival is related to food limitation of juveniles.

It is counterintuitive that seals should starve in this large no-take marine protected area known for its abundant and diverse marine life. There are a number of hypotheses regarding why juvenile monk seals struggle to find sufficient prey in the NWHI. Climate-ocean conditions appear to lead to variable primary productivity and, consequently, variable prey for top predators such as monk seals (Polovina *et al*. 1994; Antonelis *et al*. 2003; Baker *et al*. 2007; Polovina *et al*. 2008a).

In addition to the possibility that less total prey is available, it has been hypothesized that juvenile monk seals may be disadvantaged by competition with other species of top predators. Large sharks and jacks (*Caranx sp.*) are extremely abundant in the NWHI compared to the MHI (Friedlander and DeMartini 2002). There is a dietary overlap between these apex predator fishes and monk seals, and direct competition of seals and these fishes has been documented on video (Parrish *et al*. 2008). Baker and Johanos (2004) hypothesized that both low intra- and inter-specific competition might explain why monk seals in the MHI seem to enjoy higher juvenile survival and better body condition.

Food limitation may limit monk seal populations not only through its effects on survival, but also through reproductive effects. It is thought that when food is more limited, animals grow more slowly and reach maturity at a later age. They may also continue to reproduce at a lower frequency when food is limited. Observed monk seal reproductive patterns are consistent with food limitation in the NWHI. Harting *et al*. (2007) found that patterns in age-specific reproductive curves amongst NWHI subpopulations were coherent with overall population trends. For example, at French Frigate Shoals (rapidly declining population), female seals start having pups later and achieve lower reproductive rates than at Laysan Island (until recently a more stable population). More recent evidence suggests that seals in the MHI mature earlier and may have higher reproductive rates than in the NWHI (Baker *et al*. 2011). Consistent with this, seals in the MHI tend to grow to adult size at a younger age than those in the NWHI (Baker *et al*. 2011).

Entanglement

Most of the derelict fishing gear and marine debris collected and documented in the NWHI is from fishing or other maritime industries, and most net debris appears to be trawl webbing. Because no trawl or gillnet (other than reef lay gillnet) fishing occurs in the NWHI, it is assumed that virtually all derelict fishing debris has been transported by ocean currents from distant fisheries around the North Pacific Ocean. The Hawaiian Archipelago is situated in the convergence zone of the North Pacific subtropical gyre, and debris is carried towards the islands by wind-driven currents and circulation of water from the eastward flowing North Pacific Current to the westward flowing North Equatorial Current (Donohue *et al*. 2001). More debris is deposited by a strengthening of the convergence zone in Hawaiian waters during ENSO events (Donohue and Foley 2007).

Marine debris and derelict fishing gear have been well documented to entangle monk seals, and monk seals have one of the highest documented entanglement rates of any pinniped species (Henderson 2001). Entangled seals may drown, strangle, sustain severe wounds, or be immobilized by debris anchored to substrate. Entangled seals also experience increased hydrodynamic drag when traveling and foraging, thus increasing their energy use and reducing foraging efficiency. They may also be more vulnerable to shark attack. Some seals free themselves or are disentangled by human responders. Estimates of entanglement rates are based almost exclusively on observations of animals encountered on shore. However, interactions between monk seals and marine debris occur at sea and at times of the year when researchers are not in the field. Therefore, observed entanglement rates underestimate the actual rate.

Proportionally, pups and juveniles, probably because of their inquisitive nature, are more likely than older seals to become entangled (Henderson 2001). Through 2008, a total of 289 cases of seals entangled in fishing gear or other debris have been observed, many of which involved injuries and eight of which resulted in confirmed mortalities (Carretta *et al*. 2011 SAR draft). Most of the entangled seals were either released by researchers or escaped on their own. As there is no basis for estimating the frequency of undetected entanglements, it is not possible to estimate total mortality attributable to entanglement.

Despite ongoing efforts to remove entanglement hazards from the beaches and waters of Hawai`i, entanglement rates remain variable but show no signs of declining. Of the six main NWHI subpopulations, Lisianski Island tends to suffer the highest rates of entanglement, whereas debris entanglement in the MHI appears to be rarer. Though over 500 metric tons of marine debris has been removed from the reefs and beaches in the NWHI, accumulation of incoming debris poses a persistent hazard for monk seals and other NWHI biota (Dameron *et al*. 2007).

<u>Shark Predation</u>

Sharks are the only known predators of Hawaiian monk seals. Shark injuries and scars from old injuries can be seen on many monk seals, and shark predation has been observed occasionally (Bertilisson-Friedman 2006; Wirtz 1968; Balazs and Whittow 1979; Alcorn and Kam 1986; Hiruki *et al*. 1993a). These incidents of predation or wounding of monk seals of all ages have been attributed to tiger sharks. Because tiger shark predation on monk seals occurs at sea, where the prey is also consumed, it is not possible to quantify the amount of mortality attributable to tiger sharks. Seals that survive attacks and are wounded and observed on shore constitute the only observable evidence of tiger shark predation.

However, beginning in 1997 a marked increase in shark predation on nursing and recently weaned monk seal pups at French Frigate Shoals has been noted. At Trig and Whaleskate Islands (small islets within French Frigate Shoals), the number of predation mortalities from sharks (including both confirmed and inferred losses) peaked between 1997 and 1999 (Gobush 2010). Additional pups were permanently maimed by severe shark bites that likely reduced the seals' ability to dive, forage and reproduce. After 1999, pre-weaned pup mortalities from sharks declined but pups were still being killed at an unsustainable level. Between 2000 and 2009, the number of pup losses (confirmed and inferred) at French Frigate Shoals atoll-wide was at 6–11 pups per year. As fewer pups have been born each year for the last several years, the numbers of pups lost to predation has exacted an increasingly heavy toll. Since 2000, 15–28% of the incoming French Frigate Shoals cohort has been lost each year to shark predation. From 1997 through 2009, 205 of 835 pups born at French Frigate Shoals (24.6%) were involved in shark incidents (Gobush 2010). Periods of intensive observation over more than a decade have confirmed that the Galapagos shark is the primary species predating nursing monk seal pups at French Frigate Shoals although some pups may also be taken by tiger sharks (Gobush 2010).

Observations at other subpopulations in the NWHI indicate that shark related injury and mortality of nursing and recently weaned pups occurs primarily at French Frigate Shoals. As was noted, the degree of threat posed by tiger shark predation is unknown, but prevailing levels of Galapagos shark predation are a severe threat to the French Frigate Shoals subpopulations. The number of seals at this atoll has been declining for over 20 years due to poor juvenile survival, largely attributable to food limitation. As recruitment of new adults has been chronically low, the number of pups born at French Frigate Shoals has fallen from nearly 120 per year to less than 40 per year. NMFS has pursued a variety of means of reducing Galapagos shark predation at this atoll, including deterrence, harassment, targeted removals of sharks preying on seals, and within-atoll translocation of weaned pups to areas where predation is rare (Gobush 2010). Nevertheless, unsustainable levels of predation continue.

Climate Change

Sea-level rise poses the most compelling threat to Hawaiian monk seals that is associated with climate change. Terrestrial habitats in the NWHI consist largely of low-lying oceanic sand islands (cays) and atolls, which are required for monk seal pupping, nursing, resting and molting.

The low-lying land areas of the NWHI are highly vulnerable to sand erosion due to storms and sea-level rise. Global sea-level rise reduces cays by passive flooding, active coastal erosion, and in concert with seasonal high swell. As a result, the subaqueous land area supporting these important littoral and coastal ecologies is at risk. Demonstrating this, islands at one NWHI atoll, French Frigate Shoals, have been greatly reduced in size during roughly the past 40 years for reasons not well understood, as this occurred during a period when sea level rose relatively little (Antonelis *et al*. 2006). An example of this is the effective disappearance of Whaleskate Island, which had been important habitat for turtles and seals.

Concerns about sea level rise in the NWHI motivated a study to project what might happen as global sea level increases in the future. Baker *et al*. (2006b) produced the first NWHI topographic maps in three locations (Lisianski Island, Pearl and Hermes Reef, and French Frigate Shoals). They then used passive flooding scenarios to estimate the area that would be lost if islands maintained their current topography and the sea were to rise by various amounts predicted by the Intergovernmental Panel on Climate Change (IPCC) (Church *et al*. 2001). The projected effects of sea level rise on surface area varied considerably among the islands examined and depending upon the sea level rise scenario. For example, Lisianski Island is projected to be the least affected of the islands surveyed, losing only 5% of its area even under the maximum rise scenario examined. In contrast, the islets at French Frigate Shoals and Pearl and Hermes Reef are projected to lose between 15 and 65% of their area under the median sea level rise scenario.

The uncertainty of predictions increases over time, but the expectation is that sea level will continue to rise beyond 2100 (Church *et al*. 2001). Moreover, recent evidence suggests that sea level may rise more rapidly than previous models have predicted, due in part to an accelerated rate of ice loss from the Greenland Ice Sheet (Rignot and Kanagaratnam 2006). The loss of key terrestrial habitats could lead to declines and shifts in distribution of monk seals in the NWHI.

Other aspects of climate change could impact Hawaiian monk seals either positively or negatively, and the balance of future such effects cannot be predicted at this time. However, some effects of climate-ocean variability on monk seals have been documented. Antonelis *et al*. (2003) found evidence that El Niño events may enhance foraging conditions for monk seals as reflected in weaned pup condition. However, Donohue and Foley (2007) found that monk seal entanglement rates tended to increase in El Niño years. Baker *et al*. (2007) found that juvenile monk seal survival in the northern portion of the NWHI was related to variability in the southern extent of the Transition Zone Chlorophyll Front, a large-scale seasonal oceanographic feature that brings relatively productive waters into the region in winter. Polovina *et al*. (2008b) present evidence that low productivity areas of the worlds oceans, including a region encompassing the NWHI, appear to have expanded in recent years.

Male Aggression

During the 1980s and early 1990s, injuries and deaths of female monk seals caused by multiple-male aggression (or "mobbing") attacks inhibited population recovery at Laysan Island (Banish and Gilmartin 1992). These attacks occur when several adult males aggregate and attempt to mount and mate with a single seal. The frequency of multiple-male aggression appears to be related to an imbalance in adult sex ratios, with males outnumbering females. Prior to 1994, the sex ratio at Laysan Island was skewed to males at a time when Hiruki *et al*. (1993a) showed females at Laysan Island were injured by males at three to four times the frequency of that observed at French Frigate Shoals. Hiruki *et al*. (1993b) reported that adult male inflicted injuries on females resulted in increased mortality. Additionally, a wounded female's reproductive success in the year of injury appeared to be influenced by the severity of her injuries.

To mitigate multiple-male aggression, two groups of adult male seals were translocated from Laysan Island (Johanos *et al*. 2010). During 1984-1994, a total of 37 adult males were selectively removed and either translocated to Johnston Atoll, taken into permanent captivity or translocated to the MHI (two of the males died either in the capture or holding process at Laysan Island). Mitigation of male aggression may also involve researchers intervening to drive a male off if an attack is observed and judged to pose sufficient risk to the pup. Three males known to have killed one or more pups at French Frigate Shoals have been removed (one male lethally removed in 1991, two males translocated to Johnston Atoll in 1998). None of the translocated males have returned to their original locations (Baker *et al*. in review). Following the 1998 translocations, a marked drop in pup losses to male aggression occurred (Baker *et al.* in review).

Another mitigation approach for multiple male aggression using a drug to reduce testosterone levels in males was investigated in both captive and field settings (Atkinson and Gilmartin 1992; Atkinson *et al*. 1993, 1998). Captive trials demonstrated effective testosterone suppression and a pilot field trial was subsequently performed (Atkinson *et al*. 1998). However, translocation was chosen as the preferred mitigation measure for a number of reasons. Each male had to be captured and injected a number of times over the course of the breeding season in order to maintain low testosterone levels, which would have resulted in an unacceptable level of disturbance to the general seal population. Also, it was not determined whether the reduction in testosterone led to the desired reduction in aggression. This approach may be pursued further, perhaps with more long-acting drugs in the future.

Prior to 1984, there were more than two adult males for each adult female at Laysan Island. Male removals and natural processes reduced the sex ratio to just under one male per female after 1994. Before the removals, an average of 4.1% (range 0 to 12.9%) of adult females died from male aggression annually. Up to eight females were being killed per year. Both the proportion and the absolute number of injuries and deaths declined after this date. Although some adult females continue to sustain severe mounting injuries, the proportion of females that were lost decreased to 0.3% per year (range 0 to 2.6%), and only three females are believed to have been killed through 2005. From 2008 to 2010 one or two adult females per year apparently died due to male aggression at Laysan Island. The loss of any adult females is considered a serious threat to population recovery and death due to male aggression are still occurring at Laysan Island. Even though the sex ratio is approximately even at this time, multiple male aggression remains a concern.

Attacks by single adult males have resulted in several monk seal mortalities. This form of single male aggression occurs at most or all locations and appears to involve behavior which ranges from normal pinniped male harassment of younger animals, to an aberrant level of focused aggression, especially directed toward weaned pups. This was most notable at French Frigate Shoals in 1997, where at least eight pups died as a result of adult male aggression (Carretta *et al*. 2005). Many more pups were likely killed in the same way, but the cause of their deaths could not be confirmed. When single male aggression results in deaths, it is typically due to drowning when pups are mounted in the water, or from infection of bite wounds.

<u>Infectious Disease and Parasites</u>

<u>Infectious Disease</u>

Historically, infectious diseases have not been recognized as a major mortality factor for Hawaiian monk seals. NWHI baseline epidemiological surveys were conducted between 1997 and 2001 at all six major sub-populations (Gilmartin *et al*. 1980; Aguirre *et al*. 1999; Aguirre 2000; NMFS unpublished data). Biomedical sampling and epidemiological investigations through 2001 have demonstrated evidence of exposure to some potential pathogens. Annual monitoring of seal survival, as well as evaluation of pathology through necropsies and histology, have not identified evidence of significant infectious disease related mortality.

To date, there has been limited investigation of the health and disease of monk seals in the MHI (Littnan *et al*. 2006). Relative to the NWHI, Hawaiian monk seals in the MHI may be at risk of increased exposure to several infectious disease agents associated with terrestrial animals that are known to cause disease in other marine mammals and to contaminate marine habitats via runoff. Infectious diseases considered to pose the highest risk to the MHI monk seal population are toxoplasmosis, *Leptospira sp*., marine *Brucella spp*. and possibly canine distemper virus. The emergent threat of West Nile Virus (WNV) is a serious concern: although this disease has yet to be detected in Hawai`i. There remains a high risk for exposure and there is a case report of WNV killing a captive monk seal in Texas. Other phocids are also susceptible to WNV morbidity and mortality. *Salmonella* and several potentially pathogenic agents found in domestic animals also could have the capacity to infect monk seals in the MHI. Further, seals overlap substantially in their use of coastal habitats and are seen on beaches near each other. For example, adult male seals cruise shorelines in search of potential female mates. This suggests that diseased seals could infect healthy seals throughout the MHI.

Monk seals at any location in the archipelago could be exposed to diseases such as morbilliviruses via contact with infected marine mammals. Migrating cetaceans, Pacific humpback whales, pilot whales, as well as killer whales are known to travel from areas of endemic morbillivirus to monk seal habitat and one recently stranded cetacean in Hawai`i tested positive for morbillivirus (NMFS unpublished data). There are two confirmed records of juvenile northern elephant seals in the MHI, one in the NWHI (Midway Atoll) and other reported sightings (Tomich, 1986; NMFS unpublished data). Elephant seals are known to carry lungworm and other parasites and pathogens that could result in disease in monk seals.

In summary, infectious diseases do not appear to be currently limiting recovery of the monk seal. However, the threat they pose has high potential for causing devastating impacts should a disease outbreak occur. Monk seals and Hawaiian hoary bats are the only native mammals that occur on the islands. Until humans and the mammals they brought with them arrived, monk seals had likely been isolated from many terrestrial mammalian diseases. This fact, plus the lack of genetic variation in the monk seal (Schultz *et al*. 2009), may make the species highly vulnerable to new disease outbreaks (Yochem *et al*. 2004). Coupled with this, the mobility of seals could facilitate the spread of any outbreak of a disease or pathogen transmissible from seal to seal throughout the archipelago.

To prepare for an infectious disease outbreak or other contingencies, an Unusual Mortality Even (UME) plan has been prepared (Yochem *et al*. 2004). Protocols have been developed for a variety of procedures including anesthesia, sample collection and banking, and necropsy examinations, and training has been instituted for field staff. Archives of tissues and samples have been developed by sampling all animals sedated for research purposes and by performing complete necropsies on all dead animals found. Cell cultures of skin, brain, lung, kidney and spleen have been established in laboratories for potential future analysis and isolation of pathogens.

Parasites

The predominant parasites identified in monk seals are gastrointestinal: tapeworms (*Diphyllobothrium spp.*), nematodes (*Contracaecum spp.*), and an acanthocephalan species (Rausch 1969; Dailey *et al*. 1988). Gastrointestinal parasites are very common in wildlife, including pinnipeds, and their presence is not necessarily indicative of poor health. However, Reif *et al*. (2006) reported that young seals infected with *Diphyllobothrium spp*. (tape worms) tended to be in poorer body condition than those uninfected, and proposed that "intervention strategies to reduce the gastrointestinal parasitic worm (helminth) burdens in immature animals should be considered as a conservation measure." Ulceration of the stomach associated with nematode infection has been reported (Whittow *et al*. 1980) and is a common finding (Braun, NMFS, personal communication). Even though internal parasites are not identified as a cause of death, they have been shown to be significant stressors in many other species, and survival rates as well as body condition are known to improve in most domestic species with anthelminic treatment. In 2009, field studies to test the effectiveness of deworming medications to reduce parasite burden, improve body condition and ultimately improve survival of juvenile seals were initiated.

Contaminants

Persistent organic pollutants (POPs) originate from anthropogenic substances such as pesticides, industrial chemicals, and flame retardants, or occur as chemical byproducts (Bard *et al*. 1999). Although many POPs have been banned from use in North America and Western Europe, some nations still use these substances. POPs are persistent in the environment due to their long half-lives and resistance to degradation. POPs are lipophilic and tend to accumulate in the blubber and other fatty tissues of animals. Contaminants are often measured in blubber, liver, and blood of animals because these are tissues in which the contaminants concentrate or which are relatively easy to obtain from live animals. Hawaiian monk seals, like other mammals, accumulate POPs such as polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane (DDT), and polybrominated diphenyl ethers (PBDEs) in their tissues through nursing when young and through their diet later in life.

Two studies have quantified POPs in Hawaiian monk seal tissue but none have yet assessed effects of these compounds on the seals. The first study investigated PCB and DDT levels in the serum and blubber of 46 individual seals from French Frigate Shoals (Wilcox *et al*. 2004). The presence and levels of 14 PCB congeners, DDT and DDT metabolites was examined. This study found patterns in contaminant level associated with the sex and age-class of the seals. Adult males had significantly higher PCB levels than reproductive adult females and immature seals of both sexes. Only one DDT metabolite (p,p'-DDE) was detected in the blubber, and none in any serum samples. Age, sex, reproductive history, and minimum number of pups were not significantly correlated with PCB levels in the blood or blubber (Wilcox *et al*., 2004). The second study investigated contaminant levels in whole blood and blubber of 158 individual seals from four NWHI populations (French Frigate Shoals, Laysan Island, Pearl and Hermes Reef, and Midway Atoll). This study also found patterns in contaminant levels relating to life history traits of the seals. Adult males and juveniles from Midway Atoll were found to have higher total PCB levels compared to individuals of the same age and sex from the three other NWHI sites tested (Ylitalo *et al*. 2008).

Multiple studies have shown links between contaminant exposure and detrimental health effects such as reproductive impairment, immune dysfunction, and cancer in several pinniped species (northern fur seals: Beckmen *et al*. 2003, harbor seals: De Swart *et al*. 1994, California sea lions: Ylitalo *et al*. 2005a and DeLong *et al*. 1973). Although contaminant exposure is often discussed as a correlate to these sub-lethal effects, a causative relationship can be difficult to determine without experimental data. Of the studies above in which contaminant effects (or correlations with contaminant levels) were detected, only the Ylitalo (2005) study was comparable (in terms of tissue, age class, and units measured) to the monk seal studies. Summed PCB and DDT levels were approximately one or two orders of magnitude higher in the California sea lions Ylitalo (2005) analyzed compared to the contaminant levels measured in the two NWHI monk seals studies.

<u>Human –Caused Mortality and Serious Injury</u>

Human-related mortality has caused two major declines of the Hawaiian monk seal (Ragen 1999). In the 1800s, this species was decimated by sealers, crews of wrecked vessels, and guano and feather hunters (Dill and Bryan 1912; Wetmore 1925; Bailey 1952; Clapp and Woodward 1972). Following a period of at least partial recovery in the first half of the 20th century (Rice 1960), most subpopulations again declined. This second decline has not been fully explained, but trends at several sites appear to have been determined by human disturbance from military or USCG activities (Ragen 1999; Kenyon 1972; Gerrodette and Gilmartin 1990). Currently, human activities in the NWHI are limited and human disturbance is relatively rare, but human-seal interactions have become an important issue in the MHI. Three seals (including a pregnant female) were shot and killed in the MHI in 2009 (Baker *et al*. 2011). This level of intentional killing is unprecedented in recent decades and represents a disturbing new threat to the species.

In contrast to directed killing, repeated disturbance of seals on MHI beaches might cause individuals to avoid habitats they might otherwise use. Seals have also been attacked by pet dogs, posing a risk of trauma to both animals as well as a risk of disease transmission. Finally, at least three young Hawaiian monk seals in the MHI became socialized to humans to the point where they sought out people in the water and on land for social interaction, including play. Seals have also been fed by people. When these situations became unmanageable risks to public safety, two of the seals were translocated away from the MHI, and a third was placed in captivity (Baker *et al*. in review). In each case, the seals involved were lost from the MHI population. Many other stories of these and other types of human-seal interactions in the MHI have been reported, though the frequency and nature of these events is essentially unknown.

Fishery interactions with monk seals can include direct interaction with gear (hooking or entanglement), seal consumption of discarded catch, seals being fed by divers, and seals taking fishers' catch from lines, nets and spears. Entanglement of monk seals in derelict fishing gear, which is believed to originate outside the Hawaiian Archipelago, was already described above. Fishery interactions are a serious concern in the MHI, especially involving State of Hawai`i managed nearshore fisheries. Three seals have been found dead in nearshore (non-recreational) gillnets (in 1994, 2006, and 2007), and a seal was found dead in 1995 with a hook lodged in its esophagus. A total of 64 seals have been observed with embedded hooks in the MHI during 1989-2009 (including 12 in 2009, four of which resulted in serious injuries). Several incidents, including the dead hooked seal mentioned above, involved hooks used to catch ulua (jacks, *Caranx spp.*). Interactions in the MHI appear to be on the rise, as most reported hookings have occurred since 2000, and five seals have been observed entangled in nearshore gillnets during 2002-2009 (NMFS unpublished data). In addition, NMFS received public comments during the scoping period for this Programmatic Environmental Impact Statement (PEIS) stating that monk seal interactions with fisheries or fishing gear are on the rise in the MHI (see Appendix B, Scoping Report).

No mortality or serious injuries have been attributed to the MHI bottomfish handline fishery. Total fishery mortality and serious injury cannot be considered to be insignificant and approaching a rate of zero. Monk seals are being hooked and entangled in the MHI at a rate which has not been reliably assessed. The information above represents only reported direct interactions, without purpose-designed observation effort the true interaction rate cannot be estimated.

There are currently no fisheries operating in or near the NWHI. In the past, interactions between the Hawai`i -based domestic pelagic longline fishery and monk seals were documented (NMFS 2002). This fishery targets swordfish and tunas and does not compete with Hawaiian monk seals for prey. In October 1991, in response to 13 unusual seal wounds thought to have resulted from interactions with this fishery, NMFS established a Protected Species Zone extending 50 nautical miles around the NWHI and the corridors between the islands. Subsequently, no additional monk seal interactions with either the swordfish or tuna components of the longline fishery have been observed. Possible reduction of monk seal prey by the NWHI lobster fishery has also been raised as a concern, though whether the fishery indirectly affected monk seals remains unresolved. However, the NWHI lobster fishery closed in 2000. In 2006, the NWHI (later renamed Papahānaumokuākea) Marine National Monument was established. Subsequent regulations prohibited commercial fishing in the Monument, except for the bottomfish fishery (and associated pelagic species catch), which is authorized until June 2011 but has been voluntarily closed since 2009.

Hawaiian monk seal research and enhancement efforts have also resulted in mortalities. From 1982 to 1994, 23 seals died during rehabilitation efforts. Most of these involved seals brought into captivity for rehabilitation when they were already in exceedingly poor health. Thus, some portion of these seals would have certainly also died if they had not been brought into captivity. Additionally, two other seals have died in captivity, two adult males died when captured for translocation to mitigate male aggression, one was euthanized (an aggressive male known to cause mortality), four died during captive research and four died during field research (Baker and Johanos 2002; Carretta *et al*. 2011 SAR draft.).

3.3.1.8 Hawaiian Monk Seal Recovery Plan

In 1976, the Hawaiian monk seal was listed depleted under the MMPA of 1972 and as endangered under the ESA of 1973. Section 4(f) of the ESA directs the responsible agency to develop and implement a Recovery Plan, unless such a plan would not promote the conservation of a species. NMFS determined that a recovery plan would promote the conservation of the Hawaiian monk seal. The first recovery plan was completed in March 1983 (Gilmartin 1983) by the Hawaiian Monk Seal Recovery Team (HMSRT), which included experts on marine mammals from the private sector, academia, and government, as well as experts on endangered species conservation and other stakeholders such as fisheries managers. In 1989, the HMSRT was reconstituted and reconvened, and it met nearly every year through spring 2001, with its primary function to review management and research activities aimed at recovery and to make recommendations to NMFS. A new HMSRT was appointed in fall 2001 and charged with preparing a revised recovery plan (NMFS 2007).

1983 Hawaiian Monk Seal Recovery Plan

The 1983 Hawaiian Monk Seal Recovery Plan (Gilmartin 1983) outlined five objectives: 1) identification and mitigation of factors causing decreased survival and productivity; 2) characterization of habitat, including foraging areas; 3) assessment and monitoring of population trends; 4) documentation and mitigation of negative effects from human activities; 5) implementation of conservation oriented management actions; and 6) development of educational programs to enhance public conservation efforts. The plan also assessed the threats and set research priorities.

Despite these efforts, the population continued to decline and the plan was revised in 2007.

2007 Revised Hawaiian Monk Seal Recovery Plan

The 2007 Recovery Plan contains: 1) a comprehensive review of Hawaiian monk seals status and ecology; 2) a review of previous conservation actions; 3) a threats assessment; 4) biological and recovery criteria for downlisting and delisting; 4) actions necessary for the recovery of the species; and 5) estimates of time and cost to recovery.

The threats impacting Hawaiian monk seals were assessed based on severity and magnitude, as well as the scope and geographic range and have been described in more detail in Section 3.3.1.7. Determining which threat had higher concern regarding its current and potential impact to Hawaiian monk seals was intended to improve the ability to implement effective management actions and increase the probability for a successful recovery. Threats were classified into the following categories:

Crucial threats are ongoing sources of mortality that are apparent at most sites in the NWHI, and include:

- Food limitation;
- Entanglement; and
- Shark predation.

Serious threats are ongoing impacts with the potential for a range-wide concern, and include:

- Infectious diseases;
- Habitat loss;
- Fishery interaction;
- Male aggression; and
- Human interaction.

Moderate threats have possible, localized impacts, but are not considered to be a serious or immediate cause of concern.

- Biotoxins;
- Vessel groundings; and
- Contaminants.

The Recovery Program identified over 100 actions required to alter the trajectory of the Hawaiian monk seal population, grouped into 14 categories (Table 3.3-2). Please see the executive summary of the 2007 Hawaiian Monk Seal Revised Recovery Plan, as well as the document itself, for further details.

Priorities were assigned to each action in the implementation schedule. In compliance with NMFS' Endangered and Threatened Species Listing and Recovery Priority Guidelines (55 FR 24296), all recovery actions were assigned priorities based on three categories: (P) actions necessary for protection; (I) interventions, and; (R) research needs.

Priority 1 actions are, by definition, those actions "that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future." Priority 2 actions are defined as "an action that must be taken to prevent a significant decline in species population/habitat quality or some other significant impact short of extinction." Priority 3 actions are defined as "all other actions necessary to provide for full recovery of the species."

The implementation schedule identified 57 Priority 1 actions: 28 research, 23 intervention, and 14 protection. (Some actions are assigned to more than 1 or more categories). For a complete list of the actions and priorities, please see the table in Section V of the 2007 Hawaiian Monk Seal Revised Recovery Plan.

<u>Current Research and Enhancement Priorities</u>

Table 3.3-2 lists the 14 major recommended action categories identified in the 2007 Recovery Program. Each recommended action has a number of sub-actions that detail specific research programs, intervention actions and/or protection measures for that action. Actions 1-11 are short-term actions; Actions 12 and 13 are recommended essential long-term actions. The 2007 Revised Hawaiian Monk Seal Recovery Plan provides a narrative description of each action/sub-action and a discussion of the issues for each.

Table 3.3-2 All Recovery Action Categories for Hawaiian Monk Seals

Action Number	Action Description
1)	**Investigate and Mitigate Factors Affecting Food Limitation**
2)	Prevent entanglements of monk seals
3)	**Reduce shark predation**
4)	**Prevent introduction and spread of infectious decrease**
5)	**Conserve Hawaiian monk seal habitat**
6)	**Reduce Hawaiian monk seal interactions with fisheries**

Action Number	Action Description
7)	**Reduce male aggression toward pups/immature seals and adult females**
8)	Reduce the likelihood and impact of human disturbance
9)	Investigate and develop response to biotoxin impacts
10)	Reduce impacts from compromised and grounded vessels
11)	Reduce the impact of contaminants
12)	**Continue population monitoring and research**
13)	**Create a Main Hawaiian Islands Hawaiian Monk Seal Management Plan**
14)	Implement the Hawaiian Monk Seal Recovery Program

Notes:
Actions in **BOLD** type have sub-actions with Research Priority 1. See text for description of priority level.
Source:
NMFS 2007

3.3.1.9 *Field Camps Associated with Hawaiian Monk Seal Research and Enhancement Activities*

NMFS conducts Hawaiian monk seal research and enhancement activities at remote field stations in the NWHI (Papahāunamokuākea Marine National Monument [Monument]), typically between April and August each year, though timing varies depending on program funding, logistics and program goals. There are a total of six field stations located at Kure Atoll (Green Island), Midway Atoll (Sand Island), French Frigate Shoals (Tern Island), Pearl and Hermes Reef (Southeast Island), Lisianski Island and Laysan Island (see Figure 3.3-4). The field camps located at Pearl and Hermes Reef, French Frigate Shoals, and Laysan and Lisianski Islands are operated out of temporary seasonal tents while camps at the other locations are operated out of permanent buildings that were previously used for other purposes. The number of people at each location varies from project to project and year to year but the total number in all camps averages approximately 15 – 17 people total.

Figure 3.3-3 Seasonal Field Camp of South East Island Pearl & Hermes Reef

Source:
Jessica Lopez, NMFS 2010

Transportation of personnel, equipment, and supplies to and from the field camps is usually provided by one of two vessels (based on availability), NOAA ship Oscar Elton Sette or the M.V. Kahana. Visits by these large (approximately 200 ft) ships to the NWHI field camps are typically limited to twice per year, deployment (April or May) and demobilization (August), except for special projects and emergencies. In case of an emergency, vessels or a charter plane may be used. There are air strips located on Midway Atoll, and Tern Island (French Frigate Shoals).

Access to the Monument requires a permit issued by the Monument's Co-trustees. NMFS conducts research and enhancement in the Monument under permit PMNM-2011-001 (see Appendix G). The Monument permit General Terms and Conditions sets out protocols and procedures to ensure protection of the Monument and specified Best Management Practices (BMPs) are employed by NMFS staff according to directives provided by the Monument. Copies of the BMPs relevant to Hawaiian monk seal research are also included in Appendix G. NAO 217-103 (Management of NOAA Small Boats) sets the policy and requirements for NOAA programs that utilize small boats (less than 300 gross tons) such as those used in monk seal research.

3.3.2 *Sea Turtles*

There are five species of sea turtles that occur in the Hawaiian islands (see Table 3.3-3), all of which are listed under the ESA including green, hawksbill, loggerhead, olive ridley, and leatherback turtles. Critical habitat has not yet been designated for any of these species in the U.S. Pacific. Most of the sea turtle species do not often occur where Hawaiian monk seals are found and would not be affected by the proposed action. None of these species (except green sea turtles) would be affected by the proposed activities because appropriate mitigation would be implemented to avoid activities co-occurring in locations with these turtles and/or to avoid disturbance. Researchers do not work at night so no nesting animals would be disturbed. If turtles are sighted during the day, research activities would not occur in that area. Boat drivers would watch for turtles to avoid disturbance or collision. Green sea turtles are likely to be found in similar habitat as Hawaiian monk seals throughout the NWHI and may be present on beaches where monk seal researchers conduct their work; therefore, additional detail on green sea turtles is provided below.

Table 3.3-3 Sea Turtle Species of Hawai'i

Common Name	Scientific Name
Green Sea Turtle	*Chelonia mydas*
Hawksbill Turtle	*Eretmochelys imbricate*
Leatherback Turtle	*Dermochelys coriacea*
Loggerhead Turtle	*Caretta caretta*
Olive Ridley Turtle	*Lepidochelys olivacea*

Source:
Hawaii Department of Land and Natural Resources (HDLNR) 2011

Green Turtle (Chelonia mydas)

Green turtles are listed as threatened under the ESA, except for breeding populations found in Florida and the Pacific coast of Mexico, which are both listed as endangered. Green turtle populations are in serious decline throughout most of the rest of the Pacific Ocean, except for the Hawaiian population. The Hawaiian green sea turtle population is generally comprised of one genetic stock (Balazs and Chaloupka 2006).

Green turtles occur in the coastal waters surrounding the MHI throughout the year and also migrate seasonally to the NWHI to reproduce (Thompson 2003). The largest nesting colony in the central Pacific Ocean occurs at French Frigate Shoals in the NWHI, where about 200 to 700 females nest each year (Balazs 1976, as cited in Balazs and Chaloupka 2006). On occasion, green turtles also nest in the MHI. Nesting in the MHI has occurred along the north shore of Molokai`i, the northwest shore of Lāna`i, and the south, northeast, and southwest shores of Kaua`i.

The Hawaiian green turtles' nearshore benthic foraging pastures and associated underwater habitats are among the best known in the Pacific. Important resident areas have been identified and are under study along the coastlines of O`ahu, Molokai`i, Maui, Lāna`i, Hawai`i, as well as at Lisianski Island and Pearl and Hermes Reef (Balazs *et al*. 1987; Balazs 1979, 1980, and 1982b). The available evidence indicates that the range of adult green turtles using French Frigate Shoals is confined to the 2,400 km expanse of the Hawaiian Archipelago (Balazs 1976, as cited in Balazs and Chaloupka 2006) and to Johnston Atoll immediately to the south, where algal foraging pastures occur (Balazs 1985).

In the NWHI, and especially at French Frigate Shoals, adult male and female green turtles regularly haul out during the daytime to bask along the shoreline, a behavior not common in other Pacific green sea turtle populations (Balazs 1980; Whittow and Balazs 1982).

Following harvest restrictions in 1978 (50 Code of Federal Register [CFR] 17.11), the population of green sea turtles endemic to the Hawaiian Archipelago has increased in abundance (Balazs and Chaloupka 2006). The population has also shown a distinct 3-4 year periodicity in nesting abundance, which may indicate synchronized breeding behavior throughout the Archipelago.

In terms of health, green sea turtles residing in certain benthic habitats of the Hawaiian Islands are afflicted by tumors (*fibropapillomas*) on their skin, scales, scutes, eyes, oral cavities, and viscera (Balazs and Pooley 1991). The tumors begin as small, localized lesions that rapidly grow to exceed 30 cm in diameter, greatly interfering with or even prohibiting swimming, feeding, breathing, or seeing. The lesions have been classified as fibropapillomas, based on established histologic criteria for tumor classification. The cause of this disease is unknown, but a herpes virus is thought to be responsible (Herbst 1994). The disease has increased to epidemic proportions in Hawai`i since the mid-1980s. The Recovery Plan for U.S. Pacific Populations of the Green Turtle (*Chelonia mydas*) (NMFS and USFWS (1998) identifies the fibropappilloma disease as one of the highest priorities for ongoing research and conservation of the species.

The 1998 Recovery Plan (NMFS and USFWS) also outlines key recovery strategy priorities for green turtles, including measures to protect turtles in their nesting environment on beaches and in the marine environment.

3.3.3 Cetaceans

There are 23 species of cetaceans that occur in the vicinity of the Hawaiian Archipelago (Table 3.3-4). Many of these species do not occur close enough to the shoreline to be affected by the proposed action. Additionally, because the proposed alternatives include measures to avoid marine mammals during aerial and boat surveys, most cetaceans would not be affected by the project.

Table 3.3-4 Cetaceans Occurring in Hawaiian Archipelago

Cetaceans		
Common Name	**Scientific Name**	**Status[a]**
North Pacific right whale	*Eubalaena japonica*	E
Humpback whale	*Megaptera novaeangliae*	
Minke whale	*Balaenoptera acutorostrata*	
Sei whale	*Balaenoptera borealis*	E
Fin whale	*Balaenoptera physalus*	E
Blue whale	*Balaenoptera musculus*	E
Bryde's whale	*Balaenoptera edeni/brydei*	
Sperm whale	*Physeter macrocephalus*	E
Pygmy sperm whale	*Kogia breviceps*	
Dwarf sperm whale	*Kogia sima*	
Cuvier's beaked whale	*Ziphius cavirostris*	
Blainville's beaked whale	*Mesoplodon densirostris*	
Longman's beaked whale	*Indopacetus pacificus*	
Rough-toothed dolphin	*Steno bredanensis*	
Pantropical spotted dolphin	*Stenella attenuata*	
Spinner dolphin	*Stenella longirostris*	
Striped dolphin	*Stenella coeruleoalba*	
Risso's dolphin	*Grampus griseus*	
Melon-headed whale	*Peponocephala electra*	

Cetaceans		
Common Name	**Scientific Name**	**Status[a]**
Fraser's dolphin	*Lagenodelphis hosei*	
Pygmy killer whale	*Feresa attenuata*	
False killer whale	*Pseudorca crassidens*	
Killer whale	*Orcinus orca*	

[a] E = Endangered under the ESA

In 1992, the Hawaiian Islands Humpback Whale National Marine Sanctuary (HIHWNMS) was established to protect humpback whales (*Megaptera novaeangliae*) and their habitat (see Section 3.4.11.1). Given that monk seals also inhabit this area and some research and enhancement activities may also occur within the HIHWNMS, humpback whales are discussed in more detail in this section. In addition, spinner dolphins (*Stenella longirostris*) in the NWHI may occur in close enough proximity to monk seals to be affected by certain proposed actions; thus, additional detail on this species is provided below.

<u>Humpback Whale (Megaptera novaeangliae)</u>

The humpback whale is listed as endangered under the ESA. There is no designated critical habitat for this species in the North Pacific. Humpback whales and other marine mammals are of interest from a cultural perspective to some Native Hawaiians and other people (NOAA 2003).

Abundance of humpback whales for the entire North Pacific Ocean is estimated to be 18,302 individuals, with over 50% of the population (approximately 10,000) estimated to winter in Hawaiian waters (Calambokidis et al. 2008).Humpback whales use Hawaiian waters as a major breeding ground during winter and spring (November through April). Peak abundance around the Hawaiian Islands is from late February through early April (Mobley *et al.* 2001; Carretta *et al.* 2005). During the fall–winter period, primary occurrence is expected from the coast to 50 nm offshore, which takes into consideration both the available sighting data and the preferred breeding habitat (shallow waters) (Mobley *et al.* 1999, 2000, 2001). The greatest densities of humpback whales (including calves) are in the four-island region consisting of Maui, Molokai`i, Kaho`olawe, and Lāna`i, as well as Penguin Bank (Baker and Herman 1981; Mobley *et al.* 1999; Maldini 2003) and around Kaua`i (Mobley 2005).

Humpback whales return to the feeding grounds of near northern California to the Aleutian Islands as determined by comparing songs (McSweeney *et al.* 1989) and recording the migration path of animals with satellite tags (Mate *et al.* 1998). Many of the Central North Pacific stock of humpback whales migrate south to Hawai`i in winter for breeding and calving from December through April

(Clapham and Mead 1999; Mobley *et al.* 2001). Recent studies (Lambert *et al.* 2011) have found wintering activity in the Northwestern Hawaiian Islands. Monitoring of song activity indicates that humpback whales are common in the NWHI from late December until mid-May. A comparison of song activity with the main Hawaiian Islands found that song length and volume was comparable between O`ahu locations (known to provide wintering habitat) and the NWHI locations at Maro Reef, Lisianski Island, and French Frigate Shoals.

Spinner Dolphin (Stenella longirostris)

The spinner dolphin is found in tropical and subtropical waters worldwide. In the Hawaiian Islands, spinner dolphins occur along the leeward coasts of the MHI and at several NWHI. Long-term site fidelity has been noted for spinner dolphins along the Kona coast of Hawai`i, along O`ahu, and off the island of Moorea in the Society Islands (Norris et al, 1994; Östman 1994; Poole 1995; Marten and Psarakos 1999). Spinners spend their daylight hours in coastal waters, generally in calm bays. They use these areas to rest, care for their young and to avoid predators, before traveling to deeper water at night to hunt for food. Spinner dolphins form large schools of hundreds of animals when feeding at night and split off into much smaller groups, sometimes of only a dozen individuals, when socializing and resting during the day (NMFS 2011).

Spinner dolphins that may be affected by the proposed action are part of the Hawaiian stock, and are referable to the subspecies S. longirostris longirostris (Carretta et al 2008). The most current population estimate for the Hawaii stock is 2,805 based on a 2002 ship survey; however, this may be low since limited effort was given to near shore areas where spinners are common (Barlow 2006). In the NWHI, atoll-associated communities at Kure Atoll range from 120-180 individuals; at Midway Atoll from 260-320 individuals; and at Pearl and Hermes reef approximately 350-450 individuals (L. Karczmarski, pers. comm., January 14, 2009).

In recent years, the increase in human-spinner dolphin interactions in the MHI including from "swim with wild dolphin" tours, and individuals that swim or kayak from shore to seek out dolphins, has resulted in disturbance of this species during times of rest. Under a separate project, NMFS is drafting an EIS on the potential rulemaking under the MMPA to provide more protection to Hawaiian spinner dolphins. Additional information can be found at: http://www.fpir.noaa.gov/PRD/prd_spinner_EIS.html

3.3.4 Sharks

Approximately 40 species of sharks occur in Hawaiian waters (HDLNR 2011) (see Table 3.3-5). Inshore species of sharks include the Galapagos shark, blacktip reef shark, gray reef shark, bignose shark, blacktip shark, sandbar shark, tiger shark, scalloped hammerhead shark, smooth hammerhead shark, and whitetip reef shark.

The four most common shark species in the coastal waters surrounding the Hawaiian Islands are sandbar sharks, tiger sharks, Galapagos sharks, and gray reef sharks (Wetherbee *et al.* 1994).Tiger sharks and Galapagos sharks have been found to be more abundant in the northern Hawaiian islands (Papastamatiou *et al.* 2006), consistent with diver-based surveys that have found increasing abundance of large, predatory sharks from south to north in the Hawaiian islands (Friedlander and DeMartini 2002).

Table 3.3-5 Inshore Shark Species of Hawai'i

Common Name	Scientific Name
Galapagos shark	*Carcharhinus galapagensis*
Blacktip reef shark	*Carcharhinus melanopterus*
Gray reef shark	*Carcharhinus amblyrhynchos*
Bignose shark	*Carcharhinus altimus*
Blacktip shark	*Carcharhinus limbatus*
Sandbar shark	*Carcharhinus plumbeus*
Tiger shark	*Galeorcerdo cuvier*
Scalloped hammerhead shark	*Sphyrna lewini*
Smooth hammerhead shark	*Sphyrna zygaena*
Whitetip reef shark	*Triaenodon obesus*

Source:
HDLNR 2011

Acoustic monitoring conducted at French Frigate Shoals in the NWHI was used to assess movement patterns of tagged tiger and Galapagos sharks within the atoll, particularly at locations where monk seal pups had been preyed upon (Lowe *et al*. 2006). Tiger sharks were detected at French Frigate Shoals throughout the year, but there was a strong seasonal trend in area use through the atoll, with tiger sharks spending more time around East Island in the summer months, but more time around the northern islands (Tern, Trig, and Shark Islands) in winter months (Lowe *et al*. 2006). A smaller number of Galapagos sharks was tagged at French Frigate Shoals (four adults), but available data indicate that the presence of the sharks at Trig Island varied within the diel cycle, within annual cycles, and among individual sharks. The Galapagos sharks were most common at islands close to the outer reef of French Frigate Shoals (Tern, Trig, and Shark), and were not frequently found within the interior of the atoll (Lowe *et al*. 2006).

3.3.5 *Other Fish Species*

The Hawaiian Archipelago distinguishes itself as a subprovince of the spacious tropical and subtropical Indo-Pacific region, which extends from the Red Sea and coast of East Africa to the easternmost islands of Oceania (Hawai`i and Easter Island). The composition of the Hawaiian marine life varies enough from the rest of the Indo-Pacific to be treated as a distinct faunal subregion. Hawai`i's unique fish fauna can be explained by its geographical and hydrographical isolation (Randall 1998). Pelagic fishes such as the larger tunas, the billfishes, and some sharks are able to traverse the great distance that separates the Hawaiian Islands from other islands or continents in the Pacific Ocean; however, shore fishes are dependent on passive transport as larvae in ocean currents for distribution. As would be expected, the fish families that have a high percentage of species in the Hawaiian Islands compared to elsewhere tend to be those with a long larval life stage, such as the moray eels and surgeonfishes (*Acanthurus spp*.). Families that contain mainly species with short larval life stages, such as the gobies, blennies, and cardinal fishes, are not as well represented in Hawai`i as in the rest of the Indo-Pacific region (Randall 1995).

3.3.5.1 *Essential Fish Habitat*

The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) defines Essential Fish Habitat (EFH) as those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity (16 United States Code [U.S.C.]§ 1802). These waters include aquatic areas and their associated physical, chemical, and biological properties used by fish, and may include areas historically used by fish. Substrate types include sediment, hard bottom, structures underlying the waters, and associated biological communities. EFH can consist of both the water column and the underlying surface (for example, seafloor) of a particular area. Certain properties of the water column such as temperature, nutrients, or salinity are essential to various species. Some species may require certain bottom types such as sandy or rocky bottoms, vegetation such as sea grasses or kelp, or structurally complex coral or oyster reefs. EFH also includes those habitats that support the different life stages of each managed species, as a single species may use many different habitats throughout its life to support breeding, spawning, nursery, feeding, and protection functions.

Fisheries managed by the Western Pacific Regional Fishery Management Council (WPRFMC) and the state of Hawai`i units include 22 bottom fish species, 32 pelagic species, 5 crustacean species, and 13 precious corals and coral reef ecosystem species. Currently, no data are available to determine potential overfishing of pelagic species except for the bigeye tuna (*Thunnus obesus*) (NMFS 2004), which is declining throughout its range.

In 2009, the WPRFMC published a Fishery Ecosystem Plan (FEP) for the Hawaiian Archipelago, which establishes the framework under which the Council will manage fishery resources, and begin the integration and implementation of ecosystem approaches to management in the Hawaiian Archipelago. The Hawaiian Archipelago FEP is intended to consolidate, rather than replace existing fishery regulations for demersal species. Pelagic fisheries will continue to be managed by NMFS based on recommendations from the WPRFMC under a separate FEP (WPRFMC 2009).

3.3.5.2 Commercially Harvested Species

Among the various categories of fisheries, the pelagic fishing industry is the largest and most valuable one, accounting for almost 96% of commercial landings with 25.7 million pounds of pelagic fish caught commercially in 2009 (WPacFin 2010). Key fishery categories include the pelagic, coral reef fishery, bottomfish, precious corals, and crustacean fisheries. Tunas (especially bigeye tuna) and billfish (especially blue marlin, striped marlin, swordfish) are the main target species for pelagic fishing, but other species, such as mahimahi, ono (wahoo), and moonfish, are also important (NMFS 2005). Popular commercial coral reef fish species include akule (which dominates nearshore commercial landings), soldierfishes, surgeonfishes, goatfishes, squirrelfishes, unicornfishes, and parrotfishes (WPRFMC 2010b).

The most commonly harvested species of coral reef-associated organisms include the following: surgeonfishes (*Acanthuridae*), triggerfishes (*Balistidae*), jacks (*Carangidae*), parrotfishes (*Scaridae*), soldierfishes/squirrelfishes (*Holocentridae*), wrasses (*Labridae*), octopus (*Octopus cyanea, O. ornatus*), and goatfishes (*Mullidae*). A small-scale harvest of crustaceans occurs throughout the inhabited islands of the Western Pacific Region. The most common harvests include lobster species of the taxonomic groups Palinuridae (spiny lobsters) and Scyllaridae (slipper lobsters) (WPRFMC 2009).

The families of bottomfish and seamount fish that are often targeted by fishermen include snappers (*Lutjanidae*), groupers (*Serranidae*), and jacks (*Carangidae*). Distinct depth associations are reported for certain species of snappers and groupers (WPRFMC 2009).

Currently, there are minimal harvests of precious corals in the Western Pacific Region. However, in the 1970s to early 1990s, both deep- and shallow-water precious corals were targeted in waters around Hawai`i. The commonly harvested precious corals include pink coral (*Corallium secundum, Corallium regale, Corallium laauense*), gold coral (*Narella spp., Gerardia spp., Calyptrophora* *spp*.), bamboo coral (*Lepidisis olapa, Acanella spp*.), and black coral (*Antipathes dichotoma, Antipathes grandis, Antipathes ulex*) (WPRFMC 2009).

Additional information about commercial fisheries is provided in Section 3.4.3 Commercial Fishing.

3.3.5.3 Nearshore Species

The diversity of fish species in shallow marine habitat in Hawai`i is considered relatively low compared to other tropical areas of the Pacific, due to the isolation and northerly geographic setting. There are about 450 species of inshore fishes (Gosline and Brock 1960; Randall 1980). Common species of fish include moray eels (*Muraenidae*), squirrelfishes (*Holocentridae*), aholehole (*Kuhlia sandvicensis*), aweoweo (*Priacanthus cruentus*), upapalus (*Agoponidae*), nenue (*Kyphosus bigibius*), omilu (*Caranx melampygus*), papios (*Carangidae*), lai (*Scombroides lysan*), amaama (*Mugil cephalus*), nehu (*Stolephorus purpureus*), and needlefishes and halfbeaks (*Belonidae* and *Hemiramphidae*)(Gosline and Brock 1960).

3.3.6 Birds

The Project area includes the waters and shorezone (beaches and rocky shores) of the NWHI, MHI, and Johnston Atoll (see Section 1.3). Seabirds and shorebirds dominate the coastal bird life within the Project area. Millions of resident and migratory seabirds and overwintering shorebirds depend on the roosting, breeding, migratory, and overwintering habitats found here (USFWS 2005). In addition to the terrestrial environment, the waters surrounding the Hawaiian Archipelago and Johnston Atoll are essential habitat for pelagic seabirds since most rely on fish to feed their young (National Audubon Society 2008).

As described in Chapter 1, under the Migratory Bird Treaty Act (MBTA) (16 USC 703–712; 40 Stat. 755 as amended) and Executive Order (EO) 13186, Responsibilities of Federal Agencies to Protect Migratory Birds, NMFS is required to analyze the potential impacts its actions may have on migratory birds. The MBTA prohibits the take of any migratory bird without authorization from USFWS.

The NWHI Important Bird Area (IBA) coincides with the Monument and provides critical foraging grounds for seabirds (National Audubon Society 2008). Because most seabirds breeding there are pelagic feeders that also rely on the waters surrounding the islands for fish to feed their young, both the terrestrial and the aquatic habitats in the NWHI are integral components of the IBA.

3.3.6.1 *Seabirds*

Surveys around the Hawaiian Islands in 2002 documented 40 resident and migrant seabird species (USFWS 2005). Most migratory seabirds arrive to breed in February and March, and leave by the late summer or fall. The exceptions are the albatross, which breed in winter and spring (USFWS 2005). All seabird species that regularly breed within the Hawaiian Archipelago have been identified as Hawai`i's Species of Greatest Conservation Need (SGCN) and are listed in Table 3.3-6 (Mitchell *et al.* 2005).

Table 3.3-6 Hawaiian Coastal Bird Species of Conservation Need

Common Name	Scientific Name	MHI	NWHI	State of Hawai`i	USFWS	IUCN
SEABIRDS						
Laysan albatross	*Phoebastria immutabilis*	X	X	SGCN	BCC	NT
Black-footed albatross	*Phoebastria nigripes*	X	X	SGCN	BCC	E
Short-tailed albatross	*Phoebastria albatrus*		X	E	E	VU
Hawaiian petrel	*Pterodroma sandwichensis*	X		E	E	VU
Bonin petrel	*Pterodroma hypoleuca*		X	SGCN		LC
Bulwer's petrel	*Bulweria bulwerii*	X	X	SGCN		LC
Wedge-tailed shearwater	*Puffinus pacificus*	X	X	SGCN		LC
Christmas shearwater	*Puffinus nativitatis*	X	X	SGCN	BCC	LC
Newell's shearwater	*Puffinus auricularis newelli*	X		T	T	E
Band-rumped storm petrel	*Oceanodroma castro*	X		SGCN	C/BCC	LC
Tristram's storm petrel	*Oceanodroma tristrami*		X	SGCN	BCC	NT
White-tailed tropicbird	*Phaethon lepturus*	X	X	SGCN		LC
Red-tailed tropicbird	*Phaethon rubricauda*	X	X	SGCN		LC
Masked (blue-faced) booby	*Sula dactylatra*	X	X	SGCN		LC

Common Name	Scientific Name	MHI	NWHI	State of Hawai`i	USFWS	IUCN
Brown booby	*Sula leucogaster*	X	X	SGCN		LC
Red-footed booby	*Sula sula*	X	X	SGCN		LC
Great frigatebird	*Fregata minor*	X	X	SGCN		LC
Gray-backed tern	*Sterna lunata*	X	X	SGCN		LC
Sooty tern	*Sterna fuscata*	X	X	SGCN		LC
Brown noddy	*Anous stolidus*	X	X	SGCN		LC
Black noddy	*Anous minutus*	X	X			LC
Blue-gray noddy	*Procelsterna cerulea*		X	SGCN		LC
White (Fairy) tern	*Gygis alba*	X	X			LC
SHOREBIRDS						
Hawaiian Stilt	*Himantopus mexicanus knudseni*	X		E	E	LC
Pacific golden plover	*Pluvialis fulva*	X	X	SGCN		LC
Wandering tattler	*Heteroscelus incanus*	X	X	SGCN		LC
Bristle-thighed curlew	*Numenius tahitiensis*	X	X	SGCN	BCC	VU
Ruddy turnstone	*Arenaria interpres*	X	X	SGCN		LC
Sanderling	*Calidris alba*	X	X	SGCN		LC
ADDITIONAL NWHI ESA LISTED SPECIES						
Laysan Duck	*Anas laysanensis*		X	E	E	CR
Nihoa millerbird	*Acrocephalus familiaris kingi*		X	E	E	CR
Laysan finch	*Telespiza cantans*		X	E	E	VU
Nihoa finch	*Telespiza ultima*		X	E	E	CR

Sources:
Mitchell *et al*. 2005, USFWS 2010a, USFWS 2008, International Union for the Conservation of Nature and Natural Resources (IUCN) 2010
Legend:
E = endangered, T = threatened, C = Candidate, BCC = Bird of Conservation Concern, NT = Near Threatened, VU = Vulnerable, CR = Critically Endangered, LC = Least Concern

Seabird species typically nest in colonies either directly on the ground or underground in burrows and crevices or on vegetation (USFWS 2005). Nesting and/or brood-rearing seabirds that occur on or adjacent to beaches will primarily be the seabird species found within the Project area. These species include: Laysan albatross (*Phoebastria immutabilis*), black-footed albatross (*Phoebastria nigripes*), wedge-tailed shearwater (*Puffinus pacificus*), masked (blue-faced) booby (*Sula dactylatra*), brown booby (*Sula leucogaster*), gray-backed tern (*Sterna lunata*), sooty tern (*Sterna fuscata*), black noddy (*Anous minutes*), brown noddy (*Anous stolidus*), and white (Fairy) tern (*Gygis alba*) (USFWS 2005). The distribution of seabird species that depend on beach habitats where monk seal research and enhancement activities may occur are identified in Table 3.3-7.

Seabird colonies in the NWHI constitute one of the largest and most important assemblages of tropical seabirds in the world, with over 14 million birds and 5.5 million birds of 24 species breeding annually (USFWS 2005). Many species of seabirds that breed on or near beaches depend on the NWHI. Sooty terns are the most numerous breeding species in the NWHI with annual breeding populations estimated at more than 2.5 million birds. The largest populations of Laysan albatross and black-footed albatross in the world nest at Midway Atoll and Laysan Islands. Populations of gray-backed tern in the NWHI are of global significance; and the endangered short-tailed albatross (*Phoebastria albatrus*) are currently nesting on Midway Atoll and attempting to nest at Kure Atoll (NWHI USFWS 2005; USFWS, pers. comm. 2011). Although nesting seabird species are often found throughout the NWHI, the most important islands for breeding seabirds are Laysan, Lisianski, Nihoa, and Necker Islands (Mitchell *et al.* 2005).

The larger islands within the MHI that have higher elevations historically supported large and diverse populations of nesting seabirds. However, human habitation has greatly altered these islands. Today, many of the seabirds nest on the smaller rocks and islets off the MHI where they are free from predators and human disturbance (USFWS 2005). The MHI are still the primary nesting habitat for cliff-nesting species such as petrels and shearwaters that do not nest on islands of low elevation. Many of these species, (*i.e.,* Hawaiian Petrel [*Pterodroma sandwichensis*] and Newell's shearwater [*Puffinus auricularis newelli*]), are threatened by predators and habitat degradation and are listed under the ESA. Some of the most important seabird habitats in the MHI occur on Lehua and Kaula islets off of Ni`iahu, as well as on Mokumanu and Manana islets off of O`ahu (OIRC 2011). The seabird species that depend on beach habitats within the MHI are listed in Table 3.3-7.

Table 3.3-7 Distribution of Breeding or Brood-Rearing Seabird Species That Occur on or Near Beaches in the Hawaiian Archipelago

Common Name	**Scientific Name**	**Nesting Habitat**	**Kaua'i**	**O'ahu**	**Moloka'i**	**Lāna'i**	**Maui**	**Kaho'olawe**	**Hawai'i**	**NWHI (throughout)**
Laysan albatross	*Phoebastria immutabilis*	Surface, with vegetation	X	X						X
Black-footed albatross	*Phoebastria nigripes*	Surface, with and without vegetation		X						X
Wedge-tailed shearwater	*Puffinus pacificus*	Below surface, burrows	X	X	X	X	X	X	X	X
Masked (blue-faced) booby	*Sula dactylatra*	On surface, no vegetation		X			X			X
Brown booby	*Sula leucogaster*	On surface, with vegetation	X	X						X
Gray-backed tern	*Sterna lunata*	On surface, no vegetation		X						X
Sooty tern	*Sterna fuscata*	On surface, with vegetation		X						X
Black noddy	*Anous minutus*	Above ground, on vegetation; on surface, no vegetation	X	X	X	X	X	X	X	X
Brown noddy	*Anous stolidus*	Above ground, on vegetation; on surface, with and without vegetation		X			X			X
White (Fairy) tern	*Gygis alba*	Above ground, on vegetation; on surface, no vegetation		X						X

Source:
USFWS 2010a, USFWS 2005, Mitchell *et al*. 2005

3.3.6.2 *Shorebirds*

Forty-seven species of shorebirds have been recorded in the Hawaiian Islands (National Audubon Society 2008). Most shorebirds are migratory birds that winter throughout the Hawaiian Archipelago, arriving in July and August then returning to the Arctic to breed in May. Younger birds may skip breeding their first summer and remain in the Pacific Islands (National Audubon Society 2008). The only breeding shorebird species in the MHI is the endangered endemic Hawaiian Stilt; no breeding shorebirds occur in the NWHI.

Most shorebird species overwintering in Hawai`i are infrequent visitors or vagrants, but the Hawaiian Islands are of primary importance for four species: Hawaiian stilt (*Himantopus mexicanus knudseni*), Pacific golden-plover (*Pluvialis fulva*), bristle-thighed curlew (*Numenius tahitiensis*), and wandering tattler (*Heteroscelus incanus*) (Engilis and Naughton 2004). Other common winter visitors include ruddy turnstone (*Arenaria interpres*) and sanderling (*Calidris alba*) (Engilis and Naughton 2004). All of these shorebird species have been identified as Hawaii's SGCN and are listed in Table 3.3-6 (Mitchell *et al.* 2005).

Shorebirds utilize a variety of habitats throughout the Hawaiian Islands, many of which differ from those habitats used by continental wintering populations. Tidal flats, estuaries, exposed reefs, freshwater and salt marshes, ephemeral wetlands, ephemeral playas, and aquaculture wetlands (taro, shrimp, and rice) support the highest diversity of shorebirds (Engilis and Naughton 2004). Beaches, including coral and volcanic sands, and associated dune systems, provide important habitat for curlews, turnstones, sanderlings, and to a lesser degree, Pacific golden-plovers (Engilis and Naughton 2004).

Protected Bird Species

The Hawaiian Islands display a rich biodiversity arising from a variety of factors, including the remoteness of the islands, millions of years of isolation, varying climates, diverse topography, and the pattern of volcanic activity. This biodiversity includes a high percentage of endemic plants and animals.

Unfortunately, roughly ten percent of the endemic bird species to Hawai`i are identified as birds of conservation concern (BCC) (Mitchell *et al.* 2005). The Hawaiian Islands also have a disproportionately large number of bird species listed as either endangered or threatened under the ESA; combining BCC with endangered or threatened species, about 25 percent of the native Hawaiian avifauna is at risk (USFWS 2008a).

There are varying levels of protection for bird species found within the project area, including at the state, federal and international level. Therefore, several lists exist that provide information on the conservation status of these bird species, many of which include the same species. The conservation status of seabird and shorebird species that occur within the Project area are summarized below relative to their applicable state, federal and international protection.

__State Listed Species__

Hawai`i's Comprehensive Wildlife Conservation Strategy (CWCS) identifies Hawai`i's Bird SGCN (Mitchell *et al.* 2005). The Hawaiian Islands are biologically diverse, with fauna characterized by high levels of endemism. In addition, many migratory species spend key parts of their life cycles (for example, breeding or wintering) in Hawai`i. To recognize the global rarity of these species or the importance of Hawai`i to these species, 77 species of birds were identified as SGCN. Migratory species with irregular or insignificant presence in Hawai`i were not included on the list.

Hawai`i's CWCS identified 77 species of birds as SGCN, including 23 species of breeding seabirds and 6 species of shorebirds (Mitchell *et al.* 2005). All seabird and shorebird species listed as SGCN that occur in either the NWHI or MHI, as well as any ESA listed bird species in the NWHI, are listed in Table 3.3-5.

__Birds of Conservation Concern__

The primary statutory authority for BCC is the Fish and Wildlife Conservation Act of 1980 (FWCA), as amended; the 1988 amendment to FWCA mandates the USFWS to "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the ESA of 1973." The objective of the BCC is to prevent or remove the need for additional ESA bird listings by implementing proactive management and conservation actions. These lists should be consulted in accordance with EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds.

Seabird and shorebird species in the Project area listed as BCC include Laysan albatross and black-footed albatross (USFWS 2008a). Laysan albatross breed throughout the NWHI and on the MHI of Kauai and O`ahu and Lehua Islet off of Ni`ihau. Outside of Hawai`i, Laysan albatross breed on islands off of Japan and Mexico. In the Hawaiian Archipelago, the population is estimated at greater than 590,000 pairs, with the largest colonies occurring on Midway Atoll (441,000 pairs) and Laysan (145,000 pairs) (Mitchell 2005). Total population of all MHI colonies is less than 100 pairs. Worldwide population is estimated at 630,000 breeding pairs. Threats include introduced predators, invasive species, contaminants, marine pollution, collisions, and fisheries (Mitchell et al 2005).

The breeding distribution of black-footed albatross is almost entirely restricted to the Hawaiian Islands except of small breeding populations off Japan (USFWS 2005). In Hawai`i, breeding colonies occur on the NWHI and Kaula and Lehau islets off Ni`iahu. The largest colonies occur at Laysan and Midway Atoll. Black-footed albatross nest close to the shoreline on open sandy beaches or dunes. Longline fisheries, ingestion of plastics, and sea level rise are major threats to this species.

ESA Listed Species

Section 7 of the ESA provides protection for threatened and endangered bird species. Under these regulations, NMFS is required to analyze the potential impacts its actions may have on threatened, endangered, or candidate birds. This section addresses birds that are listed as endangered or threatened, or are considered as candidates for listing by USFWS within the Project area.

ESA-listed species identified within the Project area include: Laysan duck, Nihoa millerbird, Laysan finch, Nihoa finch, short-tailed albatross, Hawaiian petrel, Newell's shearwater, band-rumped storm petrel (candidate species) and Hawaiian stilt (USFWS 2010a). No critical habitat has been designated for any of these species (USFWS 2010a). USFWS previously found NMFS monk seal activities were not likely to affect the Nihoa millerbird, Nihoa finch and Laysan duck because they primarily occur in the vegetated or interior areas of the NWHIs (USFWS 2010a). Hawaiian stilt are shorebirds that depend on large coastal wetlands and ephemeral playas in the MHI. Hawaiian petrel, Newell's shearwater, and band-rumped storm petrels are seabirds that nest in upper elevation sea cliffs.

Previously, short-tailed albatross have been observed rarely in the NWHI at Midway Atoll (Sand and Eastern Islets), Laysan Island, French Frigate Shoals (Tern Islet), Pearl and Hermes Reef (Southeast Islet) and Kure Atoll (Green Islet) (USFWS 2008b). Recently, however, a pair began nesting on Eastern Island, Midway Atoll (USFWS 2010b). If successful, this will be the first confirmed hatching of short-tailed albatross outside of Japan in modern history (USFWS 2010b). Another pair is possibly incubating an egg at Kure Atoll, although this may be a female-female pair so the egg may not be fertilized (USFWS pers. comm.). Short-tailed albatross typically nest higher on sloping hillsides (USFWS 2008b).

Laysan finches are endemic to Laysan Island and were introduced to Southeast Island and Grass Island (respectively) at Pearl and Hermes Reef in 1967. This species is restricted to the vegetated area of Laysan Island (NMFS 2003). Laysan finches are a single species and population numbers fluctuate widely, with current estimates to be 17,780 + 2819 individuals at Laysan Island and approximately 329 at Pearl and Hermes Reef (USFWS 2008c). The Laysan finch is threatened by degradation of habitat from invasive species and both Laysan and Pearl and Hermes Reef are highly susceptible to rising sea levels (Baker et al. 2006).

IUCN Listed Species

The IUCN Red List is the world's most comprehensive inventory of the global conservation status of plant and animal species (IUCN 2010). It uses a set of criteria to evaluate the extinction risk of thousands of species and subspecies. These criteria are relevant to all species and all regions of the world. The IUCN

Red List is recognized as the most authoritative guide to the status of biological diversity (IUCN 2010).

According to the IUCN Red list, the Laysan duck, Nihoa millerbird and Nihoa finch are listed as critically endangered; the black-footed albatross are listed as endangered; Laysan finches are listed as vulnerable; and Laysan albatross are listed as near-threatened.

The Laysan duck, Nihoa millerbird, Nihoa finch, and Laysan finch are listed under the ESA and discussed under the ESA section above. Laysan albatross and black-footed albatross are considered BCC and are discussed under the BCC section above.

3.3.7 Coral

The Hawaiian Islands contain 6,764.5 square miles of coral reefs, representing 84% of the coral reefs in the United States (NOAA 2008a). Hawai`i, because of its isolated location in the central pacific, contains relatively few coral species (about 50 species in 17 genera) (WPRFMC 2005). These reefs consist of both shallow water, waters less than 98 feet (30 m) and deep water, waters greater than 98 feet (30 m). In the NWHI, 57 species of coral have been identified, with 30 percent of them being endemic (NOAA 2008a).

Precious corals of the genus *Corallium* (pink), *Gerardia* (gold), *Narella* (gold), *Lepidisis* (bamboo), and *Antipathes* (black) are regulated by the State of Hawai`i and the U.S. Federal government (NOAA 2008a). Precious corals that are commonly harvested include pink coral, gold coral, bamboo coral, and black coral (WPRFMC 2009).The State of Hawai`i regulates all coral out to 3 nm and also claims jurisdictional authority over the Makapuu Coral Beds, 6 miles off Makapuu (NOAA 2008a). The U.S. Federal government, represented by WPRFMC, regulates all precious coral within the U.S. Exclusive Economic Zone (EEZ) which extends from 3 to 200 nm off the coast of Hawai`i (NOAA 2008a).

3.3.7.1 Shallow Water Corals

Shallow water ecosystems are the best understood of the reef ecosystems as most assessment and monitoring of reefs are done at waters shallower than 98 feet (30 m) (NOAA 2008b). Corals are defined by the Coral Reef Conservation Act of 2000 (16 USC 6401 *et. seq.*) as any of the 6000 "species of the phylum Cnidaria including:

A. All species of the orders black corals (*Antipatharia*), stony corals (*Scleractinia*), horny corals (*Gorgonacea)*, organpipe corals and others (*Stolonifera)*, soft corals (*Alcyanacea)*, and blue coral (*Coenothecalia)*, of the class *Anthozoa*; and

B. All species of the order fire corals and hydrocorals (*Hydrocorallina)* of the class Hydrozoa.

Coral reef ecosystems are rock like structures that consist of both reef-building and non-reef-building corals, sand and unconsolidated sediments, colonized hardbottom, and microalgae (NOAA 2008b; WPRFMC 2005; NOAA 2005). With the exception of a few outliers and deep water reefs, most coral are confined to warm tropical and subtropical waters located between 30o North and 30o South (WPRFMC 2005; NOAA 2005).

In the NWHI shallow water reef ecosystem, cover ranges from 4.4% to 64.1% and less than 1% to nearly 100% within various island habitats (NOAA 2008b).

3.3.7.2 Deep Water Corals

Deep water corals are found at depths of greater than 98 ft (30 m) (NOAA 2008b) in temperatures as low as 39 °F (NOAA 2008a). Few data are available on the deepwater banks, seamounts and the abyssal plain in the NWHI. In some areas where depths approach 1,000 fathoms (6,000 ft), dense communities of corals (*ahermatypic* [non reef building]) and sponges obscured the underlying substratum (NOAA 2008a). At this depth, light penetration is not sufficient enough for photosynthesis to occur. Deep water ecosystems provide essential habitat, feeding grounds, recruitment and nursery grounds for a variety of deep water epibenthic invertebrates, fishes, and marine mammals (for example monk seals) (NOAA 2008a). Deep water ecosystems are prevalent throughout the Hawaiian Archipelago (NOAA 2008a) extending from the big island of Hawai`i in the south (NOAA, 2008a) to the NWHI (NOAA 2008b).

3.3.8 ESA-Listed Plant Species

There are approximately 343 endangered and 11 threatened plant species in the Hawaiian Islands (USFWS 2010). While consultation with USFWS for NMFS permit 10137 concluded that any proposed activities would not affect any ESA-listed plant species (NOAA 2009c), those species found in or near the coastal zone in the Hawaiian Archipelago will be evaluated in Chapter 4 for potential impacts associated with the proposed alternatives.

3.3.9 Invasive Species

The introduction of alien species to the Hawaiian Islands is considered to be the main culprit for the decline of the native Hawaiian species (USFWS 2010). Invasive or alien species are defined as an organism (plant, animal, or microbe) that is introduced into a non-native ecosystem and which cause, or are likely to cause, harm to the economy, environment, or human health (USFWS 2009; HISC 2008a).

The Hawai`i Invasive Species Council (HISC) was formed in 2002 for the "purpose of providing policy level direction, coordination, and planning among state departments, federal agencies, and local and international initiatives for the control and eradication of harmful invasive species infestations through the State of Hawai`i (HISC 2008a). The body of the HISC is collaboration between the Department of Land and Natural Resources (DLNR), Department of Agriculture, University of Hawai`i, Hawai`i Department of Business, Economics, Development, and Tourism, Hawai`i DOH, and the Hawai`i Department of Transportation (HISC 2008b).

The HISC recognizes 46 high-profile invasive species/categories of concern within the Hawaiian Islands (http://www.hawaiiinvasivespecies.org/pests/index.html). Additionally, in the NWHI, there is special concern over the introduction and proliferation of non-native seeds, insects or other alien species such as snakes, amphibians, rodents, dogs, cats and others.

The islands and atolls of the NWHI provide habitat for a number of rare endemic plants and animals. While some islands are considered to be "relatively pristine" (NOAA 2009e), several others have already been impacted to lesser or greater extent by several introduced alien species. Historically, three notable examples of alien species introduction to Laysan Island included rabbits, rats, and the common sandbur (*Cenchrus echinatus*) a mat-forming weed that inhibits regeneration of the primary nest substrate (*Eragrostis variabilis*) for Laysan finches (Morin and Conant 1998).

Throughout the Archipelago there are concerns that a variety of insect and arachnids species (*e.g.*, beetles, weevils, grasshoppers, bees, wasps, spiders and ants), reptiles (*e.g.*, snakes, lizards) and mammals (*e.g.*, mice, rats, dogs, cats), could be translocated from the MHI to the NWHI and between islands and atolls within the NWHI. Any of these animals may be accidently introduced to a new location.

Invasive plant species include golden crown beard (*Verbesina encelioides*) on Pearl and Hermes Reef, Laysan Island, Kure Atoll, and Midway Atoll and sandbur (*Cenchrus echinatus*) on Laysan Island.

The Monument permit General Terms and Conditions sets out protocols and procedures to reduce the risk of the spread of non-native (invasive) species including the assurance that "…all vessels are inspected for potential introduced species prior to departing the last port before entering the Monument". In addition, NOAA Administrative Order (NAO) 216-6, Section 7.03 addresses the integration of EO 13112, Invasive Species, in the NOAA Decision making process, requiring the agency to "…use authorities to prevent introduction of invasive species, respond to and control invasions in a cost effective and environmentally sound manner".

3.3.10 *Other Scientific Research on Protected Species within the Project Area*

Information about other scientific research and other activities within the project area was gathered from two sources: 1) NOAA Fisheries Authorizations and Permits for Protected Species (APPS) for activities involving marine mammals and other marine and anadromous endangered and threatened species, and 2) the Papahānaumokuākea Marine National Monument Permitted Activities 2009 Report.

Permits authorized under the ESA and MMPA cover the following types of activities:

- Scientific research permits;
- enhancement permits;
- 4(d) research authorizations;
- incidental take permits;
- incidental take authorizations;
- photography permits;
- General Authorizations;
- permits to import/export parts for scientific research;
- authorization to import/export pre-Act parts;
- authorization to receive U.S. stranded marine mammal parts for scientific research or education; and
- permits related to public display.

Table 3.3-8 below presents a list of currently permitted research activities within the project area.

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Table 3.3-8 Current NMFS Permits and Authorizations for Federally Protected Species Under the ESA and MMPA

Permit/File Number	Project Title	Organization	Date issued	Date Expired	Location	Species	Take Actions	Capture Methods
10018	Level B Harassment of Humpback Whales in the Near Shore Waters Around Maui, Hawai`i	Keiki Kohola Project	6/18/2008	6/30/2013	Waters of the Au-Au Channel and in the near shore waters off the Four Island region of Maui, Hawai`i. All research activities would be conducted within the 200 fathom contour encompassing the islands of Maui, Molokai`i, Lāna`i, and Kaho`olawe.	Bottlenose Dolphin, Hawaiian Stock (All); Humpback Whale (Adult/ Juvenile; Calf); Spinner Dolphin, Hawaiian Stock (All); Killer False killer Whale, Hawaiian Stock (All); Short-finned Pilot Whale, Hawaiian stock (All); Spotted Pantropical spotted Dolphin, Hawaiian Stock (All)	Harass	Survey, vessel
10137	Pacific Islands Fisheries Science Center (PIFSC) Hawaiian monk seal field research and enhancement activities.	NMFS PIFSC, Marine Mammal Research Program	6/30/2009	6/30/2014	Activities may occur in the Hawaiian Archipelago, which includes the NWHI and MHI, and at Johnston Atoll.	Monk Hawaiian Monk Seal, Hawaiian Islands (Adult; All; pup; Pup/ Juvenile)	Capture/Handle/Release; Harass; Harass/Sampling; Unintentional mortality	Hand and/or Dip Net; Other
1127-1921	Permit to conduct level B harassment and biopsy sampling of cetaceans in Hawaiian waters	Hawai`i Marine Mammal Consortium	6/18/2008	6/30/2013	The core study area is the leeward coast of the island of Hawai`i (Figure 1b), but activities might be conducted in any of the near shore waters of the main and northwestern Hawaiian Islands, from 18^0 to 29^0 North latitude (Figure 1a), including waters of the (cut off in original)	Blue Whale, Western North Pacific Stock (All); Bottlenose Dolphin, Hawaiian Stock (All); Bryde's Whale, Hawaiian Stock (All); Fin Whale, Hawaiian Stock (All); Fraser's Dolphin, Hawai`i Stock (All); Humpback Whale, Western North Pacific Stock (Adult; Adult/ Juvenile; Calf); Killer Whale, Hawaiian Stock (All); Melon-headed Whale, Hawaiian Stock (All); Minke Whale, Hawaiian stock (All); Risso's Dolphin, Hawaiian Stock (All); Rough-toothed Dolphin, Hawaiian Stock (All); Sei Whale, Hawaiian stock (All); Sperm Whale, Hawaiian stock (All); Spinner Dolphin, Hawaiian Stock (All); Striped Dolphin, Hawaiian Stock (All); Beaked Blainville's beaked Whale, Hawaiian Stock (All); Beaked Cuvier's beaked Whale, Hawaiian Stock (All); Beaked Longman's beaked Whale, Hawaiian Stock (All); Killer False killer Whale, Hawaiian Stock (All); Killer Pygmy killer Whale, Hawaiian Stock (All); Short-finned Pilot Whale, Hawaiian stock (All); Sperm Dwarf sperm Whale, Hawaiian Stock (All); Sperm Pygmy sperm Whale, Hawaiian stock (All); Spotted Pantropical spotted Dolphin, Hawaiian Stock (All)	Harass/ Sampling	Survey, vessel
13846	Behavior, social organization and communication in humpback and gray whales in Hawai`i, Alaska and Washington	Whale Trust	7/14/2010	7/31/2015	Coastal waters of S.E. Alaska and Hawai`i / Coastal waters of the main Hawaiian Islands (N21 W157); coastal waters throughout S.E. Alaska (N58 W134). Primary study area in AK within the Frederick Sound, Chatham Strait, Stephens Passage, Lynn Canal and Icy Strait areas.	Humpback Whale, Central North Pacific Stock (Adult; Adult/ Juvenile; All); Killer Whale (All)	Harass; Harass/Sampling	Survey, vessel
14097	NMFS Southwest Fisheries Science Center (SWFSC) pinniped, cetacean and sea turtle studies	NMFS SWFSC	7/7/2010	6/30/2015	North Pacific Ocean / Turtles	Sea Green sea Turtle (Adult/ Subadult/ Juvenile); Sea Hawksbill sea Turtle (Adult/ Subadult/ Juvenile); Sea Leatherback sea Turtle (Adult/ Subadult/ Juvenile); Sea Loggerhead sea Turtle (Adult/ Subadult/ Juvenile); Sea Olive ridley sea Turtle (Adult/ Subadult/ Juvenile)	Capture/Handle/Release	Hand and/or Dip Net

Permit/File Number	Project Title	Organization	Date issued	Date Expired	Location	Species	Take Actions	Capture Methods
14353	Humpback whale research around Maui, Hawai`i	Cetos Research Organization	7/14/2010	7/31/2015	Humpback research: Au-au Channel; minke research: main HI islands / For humpbacks: the Au'au Channel, < 108' deep. The Channel is surrounded by four-islands: Moloka`i, Maui, Kaho'olawe, and Lāna`i to the west, resulting in calm, protected waters. For minkes: primarily around Kaua`i and the other main HI islands.	Bottlenose Dolphin, Hawaiian Stock (All); Humpback Whale, Western North Pacific Stock (Adult; All; Calf); Melon-headed Whale, Hawaiian Stock (All); Minke Whale, Hawaiian stock (All); Risso's Dolphin, Hawaiian Stock (All); Rough-toothed Dolphin, Hawaiian Stock (All); Spinner Dolphin, Hawaiian Stock (All); Beaked Cuvier's beaked Whale, Hawaiian Stock (All); Killer False killer Whale, Hawaiian Stock (All); Killer Pygmy killer Whale, Hawaiian Stock (All); Short-finned Pilot Whale, Hawaiian stock (All); Sperm Dwarf sperm Whale, Hawaiian Stock (All); Sperm Pygmy sperm Whale, Hawaiian stock (All); Spotted Pantropical spotted Dolphin, Hawaiian Stock (All)	Harass; Harass/Sampling	Survey, vessel
14381	Sampling sea turtle bycatch in Hawaiian Longline Fisheries	NMFS PIRO	2/12/2010	3/1/2015	Hawai`i Shallow-Set Longline Fishery	Sea Green sea Turtle (Subadult/ Adult); Sea Leatherback sea Turtle (Subadult/ Adult); Sea Loggerhead sea Turtle (Subadult/ Adult); Sea Olive ridley sea Turtle, Mexican Breeding Population (Subadult/ Adult)	Handle/Release	Capture under other authority
14451	Assessing distribution and abundance of marine mammals on Navy operational area, instrumented ranges and adjacent waters using surface vessel surveys, photo identification, videography, and acoustic recording	University of Hawai`i at Manoa	7/14/2010	7/31/2015	North Pacific Ocean Offshore Hawaiian Islands/ Federal and state waters around the main Hawaiian Islands and Northwest Hawaiian Islands, including the Hawaiian Islands Humpback Whale National Marine Sanctuary and Papahānaumokuākea Marine National Monument, and waters of and adjacent to US Navy PMRF	Blue Whale, Western North Pacific Stock (All); Bottlenose Dolphin, Hawaiian Stock (All); Bryde's Whale (All); Fin Whale (All); Fraser's Dolphin (All); Humpback Whale (All); Killer Whale (All); Melon-headed Whale (All); Minke Whale (All); Risso's Dolphin (All); Rough-toothed Dolphin (All); Sei Whale (All); Sperm Whale (All); Spinner Dolphin, Hawaiian Stock (All); Striped Dolphin (All); Unidentified baleen Whale (All); Unidentified Dolphin (All); Unidentified Mesoplodon Whale (All); Unidentified toothed Whale (All); Beaked Baird's beaked Whale (All); Beaked Blainville's beaked Whale (All); Beaked Cuvier's beaked Whale (All); Beaked Longman's beaked Whale, Hawaiian Stock (All); Beaked Unidentified beaked Whale (All); Killer False killer Whale (All); Killer Pygmy killer Whale (All); Short-beaked Common Dolphin (All); Short-finned Pilot Whale (All); Sperm Dwarf sperm Whale (All); Sperm Pygmy sperm Whale (All); Spotted Pantropical spotted Dolphin (All)	Harass	Survey, aerial; Survey, aerial/vessel
14585	Behavior and biology of humpback whales in the Pacific Ocean, primarily off Hawai`i and Alaska	University of Hawai`i at Hilo	7/14/2010	7/31/2015	Eastern, Central, and Western North Pacific Ocean / Includes waters off Hawai`i (main study area) and along the North Pacific rim from California northward to Southeast Alaska and then westward through the Gulf of Alaska, Aleutian Islands, and regions of the upper western Pacific. Research may also take pl (cut off in original)	Humpback Whale (Adult/ Juvenile; All; Non-neonate); Sperm Whale (All); North Pacific Right Whale, Eastern North Pacific Stock (All)	Harass; Harass/Sampling	Survey, vessel

Permit/File Number	Project Title	Organization	Date issued	Date Expired	Location	Species	Take Actions	Capture Methods
					Hawaiian Islands Exclusive Economic Zone / Waters of the Hawaiian EEZ only	Blue Whale, Western North Pacific Stock (All); Bottlenose Dolphin, Hawaiian Stock (All); Bryde's Whale, Hawaiian Stock (All); Fin Whale, Hawaiian Stock (All); Fraser's Dolphin, Hawai`i Stock (All); Killer Whale (All); Melon-headed Whale, Hawaiian Stock (All); Minke Whale, Hawaiian stock (All); Rough-toothed Dolphin, Hawaiian Stock (All); Sei Whale, Hawaiian stock (All); Spinner Dolphin, Hawaiian Stock (All); Striped Dolphin, Hawaiian Stock (All); Beaked Blainville's beaked Whale, Hawaiian Stock (All); Beaked Cuvier's beaked Whale, Hawaiian Stock (All); Killer False killer Whale, Hawaiian Stock (All); Killer Pygmy killer Whale, Hawaiian Stock (All); Kogia (dwarf/pygmy sperm) Unidentified Kogia (dwarf/pygmy sperm) Whale (All); Short-finned Pilot Whale, Hawaiian stock (All); Spotted Pantropical spotted Dolphin, Hawaiian Stock (All)	Harass	Survey, vessel
14682	Application for a Permit for Scientific Research or to enhance the survival or recovery of a stock under the Marine Mammal Protection Act and the ESA	University of Hawai`i	8/6/2010	11/15/2015	Off the western end of O`ahu, and in the Au Au Channel, in the Four-Island Region of the Hawaiian Main Islands	Bottlenose Dolphin, Hawaiian Stock (Adult; All); Humpback Whale (Adult; All); Killer Whale (Adult; Adult/ Juvenile; All); Melon-headed Whale, Hawaiian Stock (Adult; All); Risso's Dolphin, Hawaiian Stock (Adult; All); Rough-toothed Dolphin, Hawaiian Stock (Adult; All); Spinner Dolphin, Eastern Tropical Pacific Stock (Adult; All); Spinner Dolphin, Hawaiian Stock (Adult; All); Striped Dolphin, Hawaiian Stock (Adult; All); Beaked Blainville's beaked Whale, Hawaiian Stock (Adult; Adult/ Juvenile; All); Beaked Cuvier's beaked Whale, Hawaiian Stock (Adult; Adult/ Juvenile; All); Killer False killer Whale, Hawaiian Stock (Adult; Adult/ Juvenile; All); Killer Pygmy killer Whale, Hawaiian Stock (Adult; All); Short-beaked Common Dolphin (Adult; All); Short-finned Pilot Whale, Hawaiian stock (Adult; Adult/ Juvenile; All); Sperm Dwarf sperm Whale, Hawaiian Stock (Adult; All); Sperm Pygmy sperm Whale, Hawaiian stock (Adult; All); Spotted Pantropical spotted Dolphin, Hawaiian Stock (Adult; All); White-sided Pacific white-sided Dolphin (Adult; All)	Harass; Harass/Sampling	Survey, vessel
1581	PR1 Permit #1581 scientific research	NMFS PIFSC	12/13/2006	12/31/2011	Hawaiian Islands	Sea Green sea Turtle (Adult/ Subadult/ Juvenile); Sea Hawksbill sea Turtle (Adult/ Subadult/ Juvenile)	Capture/Handle/Release	Other
587-1767	PR1 Permit #587-1767 scientific research	Hawai`i Whale Research Foundation	10/3/2005	9/30/2011 (will be replaced by File No. 15274)	Hawai`i and Alaska	Bottlenose Dolphin, Hawaiian Stock (All); Humpback Whale (All); Killer Whale (All); Spinner Dolphin, Hawaiian Stock (All); Killer False killer Whale, Hawaiian Stock (All); Short-finned Pilot Whale, Hawaiian stock (All); Spotted Pantropical spotted Dolphin, Hawaiian Stock (All)	Harass	Survey, vessel

Permit/File Number	Project Title	Organization	Date issued	Date Expired	Location	Species	Take Actions	Capture Methods
731-1774	Baird - cetacean scientific research	Cascadia Research Collective	9/16/2005	8/31/2011 (will be replaced by File No. 15330)	Pacific Ocean (Hawaii, California, Oregon, Washington, Alaska, other U.S. territories and international waters of the Pacific Ocean)	Blue Whale (All); Bottlenose Dolphin (All); Bryde's Whale (All); California Sea lion, US Stock (All); Dall's Porpoise, California/Oregon/Washington Stock (All); Fin Whale (All); Fraser's Dolphin, Hawaii Stock (All); Gray Whale, Eastern North Pacific (All); Harbor Porpoise (All); Harbor Seal (All); Humpback Whale (All); Killer Whale (All); Killer Whale, Eastern North Pacific Southern Resident Stock (All); Melon-headed Whale, Hawaiian Stock (All); Minke Whale (All); Risso's Dolphin (All); Rough-toothed Dolphin, Hawaiian Stock (All); Sei Whale (All); Sperm Whale (All); Spinner Dolphin, Hawaiian Stock (All); Steller Sea lion (All);Beaked Baird's beaked Whale (All);Beaked Blainville's beaked Whale, Hawaiian Stock (All);Beaked Cuvier's beaked Whale (All);Beaked Ginkgo-toothed beaked Whale (All);Beaked Hubbs' beaked Whale (All);Beaked Longman's beaked Whale (All);Beaked Perrin's beaked Whale (All);Beaked Stejneger's beaked Whale, Alaska Stock (All);Elephant Northern elephant Seal (All);Killer False killer Whale, Hawaiian Stock (All);Killer Pygmy killer Whale, Hawaiian Stock (All);Long-beaked Common Dolphin, California Stock (All);Right whale Northern right whale Dolphin (All);Short-beaked Common Dolphin, California/Oregon/Washington Stock (All);Short-finned Pilot Whale (All);Sperm Dwarf sperm Whale (All);Sperm Pygmy sperm Whale (All);Spotted Pantropical spotted Dolphin, Hawaiian Stock (All);White-sided Pacific white-sided Dolphin (All)	Harass; Harass/ Sampling; Import/export/ receive only	Survey, vessel
727-1915	PR1 Permit #727-1915 scientific research	Scripps Institution Of Oceanography	2/6/2008	2/1/2013	Hawai`i / Palmyra Atoll	Bottlenose Dolphin, Hawaiian Stock (Adult/ Juvenile; All); Bryde's Whale, Hawaiian Stock (Adult/ Juvenile; All); Fin Whale, Hawaiian Stock (Adult/ Juvenile; All); Fraser's Dolphin, Hawai`i Stock (Adult/ Juvenile; All); Melon-headed Whale, Hawaiian Stock (Adult/ Juvenile; All); Minke Whale, Hawaiian stock (Adult/ Juvenile; All); Risso's Dolphin, Hawaiian Stock (Adult/ Juvenile; All); Rough-toothed Dolphin, Hawaiian Stock (Adult/ Juvenile; All); Sei Whale, Hawaiian stock (Adult/ Juvenile; All); Sperm Whale, Hawaiian stock (Adult/ Juvenile; All); Spinner Dolphin, Hawaiian Stock (Adult/ Juvenile; All); Striped Dolphin, Hawaiian Stock (Adult/ Juvenile; All); Beaked Blainville's beaked Whale, Hawaiian Stock (Adult/ Juvenile; All); Beaked Cuvier's beaked Whale, Hawaiian Stock (Adult/ Juvenile; All); Beaked Longman's beaked Whale, Hawaiian Stock (Adult/ Juvenile; All); Beaked Unidentified beaked Whale (Adult/ Juvenile; All); Killer False killer Whale, Hawaiian Stock (Adult/ Juvenile; All); Killer Pygmy killer Whale, Hawaiian Stock (Adult/ Juvenile; All); Short-finned Pilot Whale, Hawaiian stock (Adult/ Juvenile; All); Sperm Dwarf sperm Whale, Hawaiian Stock (Adult/ Juvenile; All); Sperm Pygmy sperm Whale, Hawaiian stock (Adult/ Juvenile; All); Spotted Pantropical spotted Dolphin, Hawaiian Stock (Adult/ Juvenile; All)	Harass; Harass/Sampling	Survey, vessel

Permit/File Number	Project Title	Organization	Date issued	Date Expired	Location	Species	Take Actions	Capture Methods
782-1719	PR1 Permit #782-1719 scientific research	NMFS National Marine Mammal Laboratory	6/30/2004	6/30/2011; will be replaced by File No. 14525	North Pacific and Arctic Oceans (including Hawai`i and Alaska), the Gulf of Alaska, Bering, Chukchi, and Beaufort Seas, Gulf of California, Southern Ocean (Antarctica), territorial waters of Canada, Russia, Japan and Philippines, territorial seas and international waters	Beluga Whale (All); Beluga Whale, Beaufort Sea Stock (Adult/ Juvenile; All); Beluga Whale, Bristol Bay Stock (Adult/ Juvenile; All); Beluga Whale, Cook Inlet Stock (Adult/ Juvenile; All); Beluga Whale, Eastern Bering Sea Stock (Adult/ Juvenile; All); Beluga Whale, Eastern Chukchi Sea Stock (Adult/ Juvenile; All); Blue Whale (Adult/ Juvenile; All); Blue Whale, Eastern North Pacific Stock (Adult/ Juvenile; All); Bottlenose Dolphin (Adult/ Juvenile; All); Bowhead Whale, Western Arctic Stock (Adult/ Juvenile; All); Dall's Porpoise (Adult/ Juvenile; All); Fin Whale, California/Oregon/Washington Stock (Adult/ Juvenile; All); Fin Whale, Northeast Pacific Stock (Adult/ Juvenile; All); Gray Whale, Eastern North Pacific (Adult/ Juvenile; All); Harbor Porpoise (Adult/ Juvenile; All); Humpback Whale, Central North Pacific Stock (Adult/ Juvenile; All; Calf); Humpback Whale, Eastern North Pacific Stock (Adult/ Juvenile; All); Humpback Whale, Western North Pacific Stock (Adult/ Juvenile; All); Killer Whale (Adult/ Juvenile; All); Killer Whale, Eastern North Pacific Southern Resident Stock (All); Melon-headed Whale (Adult/ Juvenile; All); Minke Whale (Adult/ Juvenile; All); Risso's Dolphin (Adult/ Juvenile; All); Rough-toothed Dolphin (Adult/ Juvenile; All); Sei Whale (Adult/ Juvenile; All); Sperm Whale, North Pacific (Adult/ Juvenile; All); Spinner Dolphin (Adult/ Juvenile; All); Striped Dolphin (Adult/ Juvenile; All); Beaked Baird's beaked Whale (Adult/ Juvenile; All); Beaked Cuvier's beaked Whale (Adult/ Juvenile; All); Beaked Stejneger's beaked Whale (Adult/ Juvenile; All); Beaked Unidentified beaked Whale (Adult/ Juvenile; All); Long-beaked Common Dolphin (Adult/ Juvenile; All); North Pacific Right Whale, Eastern North Pacific Stock (Adult/ Juvenile; All); Right whale Northern right whale Dolphin (Adult/ Juvenile; All); Short-beaked Common Dolphin (Adult/ Juvenile; All); Short-finned Pilot Whale (Adult/ Juvenile; All); Sperm Dwarf sperm Whale (Adult/ Juvenile; All); Sperm Pygmy sperm Whale (Adult/ Juvenile; All); Spotted Pan	Capture/Handle/Release; Harass; Harass/Sampling; Unintentional mortality	Net; Survey, aerial; Survey, aerial/vessel; Survey, vessel
932-1905	PR1 Permit #932-1905 research/enhancement	NMFS Office of Protected Resources, Marine Mammal Health and Stranding Response Program	6/30/2009	6/30/2014	Beaches, coastal waters of the US, waters within the US EEZ, and international waters; world-wide import/export; U.S. rehabilitation and captive facilities	ESA-listed Cetacea, all ESA-listed Pinnipedia under NMFS jurisdiction	Capture/Handle/Release; Harass; Harass/Sampling; Unintentional mortality	Net; Survey, aerial; Survey, aerial/vessel; Survey, vessel; captive
978-1791	Auditory research on stranded and rehabilitating cetaceans	Marine Mammal Research Program, Hawai'i Institute of Marine Biology	2/9/2006	2/28/12; will be replaced by File No. 16053	U.S. waters and rehabilitation facilities; primary location is Hawai`i	Any cetacean species that strands; excluding mysticetes	Captive animals (rehabilitating)	Captive
898-1764	PR1 Permit #898-1764 - enhancement permit for maintenance of captive Hawaiian monk seals	Sea Life Park Hawai`i captive facility	5/15/2006	5/31/2011	Sea Life Park Hawai`i captive facility	Monk Hawaiian monk Seal, Hawaiian Islands (Adult)	Captive animals (research, enhancement, public display)	Captive

Permit/File Number	Project Title	Organization	Date issued	Date Expired	Location	Species	Take Actions	Capture Methods
1071-1770	Long-term population studies of cetacean species in the Eastern, Western and Central North Pacific Ocean	The Dolphin Institute	6/9/2006	6/30/2011	Main study area is Hawaii; permit includes waters along the rim of the Pacific from CA northward to southeast AK, westward through the Gulf of AK, Aleutian Islands and regions of the upper Pacific.	Blue Whale, Eastern North Pacific Stock (All); Bottlenose Dolphin, Hawaiian Stock (All); Fin Whale, Hawaiian Stock (All); Humpback Whale, Eastern North Pacific Stock (Adult/ Juvenile;All); Killer Whale, Hawaiian Stock (All); Melon-headed Whale, Hawaiian Stock (All); Rough-toothed Dolphin, Hawaiian Stock (All); Sperm Whale, Hawaiian stock (All); Spinner Dolphin, Hawaiian Stock (All); Striped Dolphin, Hawaiian Stock (All);Beaked Blainville's beaked Whale, Hawaiian Stock (All);Beaked Cuvier's beaked Whale, Hawaiian Stock (All);Killer False killer Whale, Hawaiian Stock (All);Killer Pygmy killer Whale, Hawaiian Stock (All);Kogia (dwarf/pygmy sperm) Unidentified Kogia (dwarf/pygmy sperm) Whale (All);Short-finned Pilot Whale, Hawaiian stock (All);Spotted Pantropical spotted Dolphin, Hawaiian Stock (All)	Harass; Harass/ Sampling	Survey, vessel
15453	Scientific Research Relating to Enhancing the Survival of the Hawaiian monk seal (Monachus schauinslandi) under the Marine Mammal Protection Act and the Endangered Species Act.	Waikiki Aquarium, University of Hawai`i	Application in process; FR published 1/27/11	N/A; will replace Permit No. 455-1760 (exp. 5/31/11)	Waikiki Aquarium, University of Hawaii 2777 Kalakaua Avenue Honolulu, HI 96815	Hawaiian monk Seal, Hawaiian Islands (Adult)	Captive animals (research, enhancement, public display)	Captive
15685	Ocean capture research of green (Chelonia mydas) and hawksbill (Eretmochelys imbricata) sea turtles in the Hawaiian Islands to determine growth rates, health status, stock and population structure, foraging ecology, habitat use, and movements.	George Balazs, NMFS Pacific Islands Fisheries Science Center	Application in process; FR notice published 2/14/11	N/A; will replace Permit No. 1581 (exp. 12/31/11)	Coastal waters (bays, reefs, canals, etc.). Most of the study sites are accessed by land, the exception being Kaneohe Bay, which is accessed by boat. Public beach accesses, private residences, hotel and resort beaches, and State and National Parks are used.	Green sea Turtle (Adult/ Subadult/ Juvenile); Hawksbill sea Turtle (Adult/ Subadult/ Juvenile)	Capture/Handle/Release	Hand and/or Dip Net
978-1857	PR1 Permit #978-1857 scientific research	Marine Mammal Research Program, Hawai`i Institute of Marine Biology	5/17/2007	5/31/2012	Hawai`i; floating pens on the leeward side of Coconut Island in Kaneohe Bay at the Hawai`i Institute of Marine Biology, O`ahu Hawai`i.	Bottlenose Dolphin (Adult; Adult/Juvenile); Killer False killer Whale (Adult)	Captive animals (research, enhancement, public display)	Captive

Source:

NMFS Authorizations and Permits for Protected Species Website : https://apps.nmfs.noaa.gov. Date Accessed: January 11, 2011

3.3.10.1 *Papahānaumokuākea Marine National Monument Permitted Activities*

The Papahānaumokuākea Marine National Monument (Monument) is administered jointly by three Co-Trustees: Department of Commerce (DOC) through NOAA, the Department of the Interior through USFWS, and the State of Hawai`i through DLNR ("Co-Trustees"). In addition, the Co-Trustee agencies work in close collaboration and consultation with the Office of Hawaiian Affairs to ensure that both cultural and natural resources are protected.

More information about the Monument can be found in Section 3.4.11.2 of this document.

Permit applications are approved in one of six permit categories:

1) **Research** – projects that are designed to further understanding of Monument resources and qualities;

2) **Education** – projects that will further the educational value of the Monument;

3) **Conservation and Management** – projects that will assist in the conservation and management of the Monument;

4) **Native Hawaiian** – practices and activities that will allow Native Hawaiian cultural practices (non-commercial);

5) **Special ocean use** – projects that will allow a special ocean use (ecotourism, documentary filmmaking); or

6) **Recreational** – projects that will allow recreational activities such as snorkeling, wildlife viewing and kayaking.

For details of the permitted activities, please refer to the Papahānaumokuākea Marine National Monument Permitted Activities Annual Report 2009 (NOAA 2009d). BMPs for activities permitted within the Monument are presented in Appendix G. Table 3.3-9 lists the number of 2009 active permits by category. Table 3.3-10 provides basic information about each activity - permit type, permittee affiliation and project title/description.

Table 3.3-9 Number of Active Permits by Permit Type 2009

Permit Type	2009 Permits
Research	26
Conservation and Management	6
Education	2
Native Hawaiian Practices	3
Recreation	1
Special Ocean Use	9
TOTAL	47

Adapted from: Monument Permitted Activities Report 2009 (NOAA 2009d)

Table 3.3-10 Papahānaumokuākea Marine National Monument Permitted Activities 2009

Permit Category	Permittee Affiliation	Number of Permits Issued	Permitted Project Titles
Research	NOAA National Marine Fisheries Service PIFSC	3	Hapu'upu'u (*Epinephelus quernus*) Growth Studies on Kure Atoll and Midway Atoll; Lobster and Bottomfish Monitoring Activities in Federal Waters at Mokumanamana and Maro Reef; Juvenile Hawaiian Monk Seal Enhancement Activities
	NOAA National Ocean Service, Office of National Marine Sanctuaries (ONMS)	2	Northwestern Hawaiian Islands Reef Assessment and Monitoring Program; Use of Conventional and Technical SCUBA Diving Technology to Document the Biodiversity and the Presence or Absence of Alien/Invasive Species in Deep Reef Areas
	University of California, Santa Cruz	3	Study on the Foraging Ecology of Red-footed and Masked Boobies at Tern Island, French Frigate Shoals and Midway Atoll; Research and Monitoring of Hawaiian Albatrosses from Tern Island, French Frigate Shoals and Midway Atoll National Wildlife Refuge; Investigations of Black-lipped Oyster (*Pinctada margaritifera*) Recruitment and Abundance at Midway Atoll

Permit Category	Permittee Affiliation	Number of Permits Issued	Permitted Project Titles
	University of Hawai`i Departments of Oceanography, Plant and Environmental Protection Sciences, Botany, and Anthropology	4	Algal Baseline Characterization Activities; Collection of Adult and Larval *Hyposmocoma* Moths to Conduct Species Descriptions and DNA Analysis of Their Evolutionary Relationships; Characterization of Large Deep-sea Scavenging Fauna, General Habitat Associations and Their Relationship to Water Depth Within the Monument; Documentation and Assessment of Cultural Sites on Mokumanamana and Nihoa Islands
	University of Hawai`i Hawai`i Institute of Marine Biology	8	Quantifying the Movements of Sharks at French Frigate Shoals; Coral Genetics Research of Temperature in Coral Health and the Physical Environments of Coral Reefs at French Frigate Shoals and Pearl and Hermes Reef; Coral Endosymbiont Research; Quantifying the Movements of Top Predators Within Papahänaumokuäkea; Support for Activities to Quantify Shark Movements at French Frigate Shoals; Comparison of the Biological Community Structure and Diversity of Maritime Heritage Resource Sites with Surrounding Areas; Reef Fish Genetic Survey Research; Reef Invertebrate Genetic Survey Research

Permit Category	Permittee Affiliation	Number of Permits Issued	Permitted Project Titles
	University of Hawai`i Hawai`i Undersea Research Laboratory	2	Support for Permitted Activities Using the Pisces IV and Pisces V Submersibles and RCV-150 Remotely Operated Vehicle; Multi-beam Mapping, Deep Water Surveys, and Voucher Specimen Collection in Papahänaumokuäkea Marine National Monument
	Hawai`i Pacific University	2	Quantification of the Amount and Types of Marine Debris Ingested by Albatross Species at French Frigate Shoals, Midway Atoll, and Kure Atoll; Analysis of Carbonate Chemical Make-up of Waters Surrounding Atoll Systems within Papahānaumokuākea Marine National Monument
	University of Lisbon, Portugal	1	Genetics Comparison of Pacific and Atlantic Bulwer's Petrels
Conservation and Management	Monument Co-Trustees	1	Co-Trustee conservation and management activities (See below for details)
	NOAA Office of Marine and Aviation Operations	2	Support for permitted activities aboard NOAA Ship *Hi'ialakai*; Support for permitted activities aboard NOAA Ship *Oscar Elton Sette*
	NOAA National Ocean Service ONMS	1	Maritime Heritage Conservation and Management Activities
	NOAA National Marine Fisheries Service , PIFSC	1	Galapagos Shark Predatory Monitoring and Mitigation Efforts on Hawaiian Monk Seal Pups
	University of Hawai`i, Marine Center	1	Support for Permitted Research Activities Using the University of Hawai`i Research Vessel *Ka'imikai-o-Kanaloa* as a Support Platform

Permit Category	Permittee Affiliation	Number of Permits Issued	Permitted Project Titles
Education	NOAA National Ocean Service, ONMS	1	Papahänaumokuäkea ʻAhahui Alakaʻi (PAA) Educator Program at Midway Atoll
	Waikiki Aquarium, University of Hawai`i	1	Selected Reef Fish and Coral Collection Activities to Produce Educational Exhibit
Recreation	USFWS, National Wildlife Refuge System	1	Administering the Visitor Services Program at Midway Atoll
Special Ocean Use	Conservation International	1	Participation in Wildlife Observation, Photography, Historical Tours, and Limited Recreational Activities on Midway Atoll
	Photo Safaris	1	Photo Documentary Activities on Wildlife, Cultural, and Historic Features of Midway Atoll
	Current TV	1	Production of a Short Film on Midway Atoll About the Effects of Marine Debris on Marine Life and Ecosystems
	Oceanic Society	1	Educational and Volunteer Activities on Midway Atoll
	Freelance Photographer	1	Marine and Terrestrial Photography Activities Within the Monument
	Chukyo T.V. Broadcasting Co.	1	Filming and Photography Activities of the PLASTIKI Sailing Vessel on Midway Atoll
	Telluride Institute / Reel Thing Productions	1	Filming Activities on Midway Atoll to Support a Documentary on the Impacts of Plastic Debris on the Environment
	Chris Jordan Photography	1	Establishing a Collection of Multimedia Art About Marine Plastic Pollution on Midway Atoll
	Amateur Radio Operator	1	Filming Ham Radio Activities on Midway Atoll

Permit Category	Permittee Affiliation	Number of Permits Issued	Permitted Project Titles
Native Hawaiian Practices	University of Hawai`i, Hawai`i Community College; Edith Kanaka'ole Foundation	1	Winter Solstice Cultural Research and Native Hawaiian Practices on Mokumanamana
	NOAA ONMS; Na Mamo O Mu'olea; The Nature Conservancy	1	Examination of the Basic Ecology of 'Opihi' Populations from a Cultural Perspective within Papahänaumokuäkea
	OAA ONMS; University of Hawai`i, Hawai`i Institute of Marine Biology	1	Continuation of the Cultural Health Index (CHI) Project within Papahänaumokuäkea

Notes:
Permitted projects with activity in 2009.
Source:
Adapted from: Monument Permitted Activities Report 2009 (NOAA 2009d)

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A single conservation and management permit is issued annually, pending a stringent review process, to the Monument Co-Trustee agencies for conservation and management activities conducted within the Monument. These activities are:

- Management and Operation of Midway Atoll Field Station;
- Benthic Habitat Mapping;
- Management and Operation of French Frigate Shoals, Tern Island Field Station;
- Marine Maritime Surveys at Midway Atoll;
- Maintenance and Operation of Hawaiian Monk Seal Monitoring Field Stations;
- Marine Debris Removal; and
- Management and Operation of Kure Atoll Field Station.

3.4 SOCIAL AND ECONOMIC ENVIRONMENT

This section describes the existing social and economic conditions in the area that may be affected by the proposed action and alternatives. The Project Area, as described in Section 1.3, is the State of Hawai`i, including both the NWHI and the MHI. Where available from reliable sources, information is also presented at the county- or island-level. The key social and economic resources addressed in this section include population trends; area economy (employment, income, and unemployment); commercial fishing; subsistence fishing; recreational fishing; cultural resources and historic properties; recreation and tourism; environmental justice; sanctuaries, monuments and refuges; and military activities within the project area.

3.4.1 Population Trends

The human population in the State of Hawai`i has grown by over 22% between 1990 and 2010, with an estimated population of close to 1.4 million (U.S. Census Bureau 1990, 2000, and 2010) (see Table 3.4-1). The City and County of Honolulu has the highest population and population density in the state, with almost 0.95 million people and 1,589 people per square mile.

Table 3.4-1 Population and Population Change

Area	Population			Population Change (%)			Population Density in 2010 (People per Square Mile)
	1990	2000	2010	1990-2000	2000-2010	1990-2010	
City and County of Honolulu	836,231	876,156	953,207	4.8%	8.8%	14.0%	1,589
Hawai'i County	120,317	148,677	185,079	23.6%	24.5%	53.8%	46
Kaua'i County	51,177	58,463	67,091	14.2%	14.8%	31.1%	108
Maui County *	100,504	128,241	154,924	27.6%	20.8%	54.1%	132
State of Hawai'i	1,108,229	1,211,537	1,360,301	9.3%	12.3%	22.7%	212
U.S.A.	248,709,873	281,421,906	308,745,538	13.2%	9.7%	24.1%	87

Notes:
* Information for Maui County includes Kalawao County, which has a population of 90 people according to the 2010 Census.
Sources:
U.S. Census Bureau (2010). *2010 Census National Summary File of Redistricting Data, Tables P1 and H1*. Website (http://factfinder2.census.gov/), accessed April 19, 2011.
U.S. Census Bureau (2000). *Census 2000 Summary File 1*. Website (http://factfinder.census.gov/), accessed April 19, 2011.
U.S. Census Bureau (1990). *DP-1, General Population and Housing Characteristics: 1990, 1990 Summary Tape File 1 (STF 1) - 100-Percent Data, United States*. Website (http://factfinder.census.gov/), accessed April 19, 2011.

3.4.2 *Area Economy*

The economy of Hawai'i and its counties is contingent upon employment, income, the unemployment rate, and industry employment characteristics. To understand the economic and social and economic makeup of the Project Area, key economic indicators such as employment and unemployment and income are further explored here.

Data in this section are presented at the county level, the level for which consistent data for economic indicators are available from reliable and published sources. However, it is acknowledged that the economies of some islands within the same county can be quite different from one another. To the extent that such differences are important for evaluating the effects of the proposed alternatives and that sufficient island-level information/data are available, the effects on these islands may be discussed individually in Chapter 4 of this PEIS.

3.4.2.1 *Employment*

Industry-specific employment information provides important insight into the characteristics of a regional economy. Total non-farm employment in Hawai`i consisted of 861,789 jobs in November 2008 (BEA 2010) (see Table 3.4-2). About 78% of non-farm employment in the state is private, while the rest is government. The counties more or less reflect this trend, with major employment in the private sector. The industry with the highest level of employment in Hawai`i is accommodation and food services (11%), followed by state and local government (military) and retail trade, respectively. The high employment in the accommodation and food services industry reflects Hawai`i's dependence on tourism. Table 3.4-2 presents employment by industry in 2008 the state and its counties.

Table 3.4-2 Employment by Industry in 2008

	Hawai`i County		City and County of Honolulu		Kaua`i County		Maui & Kalawao Counties		State of Hawai`i	
	Employees	% of Total Employment	Employees	% of Total Employment	Employees	% of Total Employment	Employees	% of Total Employment	Employees	% of Total Employment
Total employment	100,921	100%	626,137	100%	43,987	100%	102,704	100%	873,749	100%
Farm employment	6,067	6%	2,108	0%	1,061	2%	2,724	3%	11,960	1%
Nonfarm employment	94,854	94%	624,029	100%	42,926	98%	99,980	97%	861,789	99%
Private employment	80,857	80%	473,274	76%	37,869	86%	89,277	87%	681,277	78%
Forestry, fishing, and related activities	(D)		1,116	0%	(D)		(D)		3,471	0%
Mining	(D)		573	0%	(D)		(D)		892	0%
Utilities	517	1%	2,074	0%	249	1%	501	0%	3,341	0%
Construction	(D)		32,672	5%	(D)		6,841	7%	50,787	6%
Manufacturing	2,270	2%	14,298	2%	692	2%	1,848	2%	19,108	2%
Wholesale trade	(D)		17,787	3%	(D)		2,026	2%	22,831	3%
Retail trade	11,747	12%	60,126	10%	5,192	12%	11,891	12%	88,956	10%
Transportation and warehousing	(D)		23,468	4%	(D)		3,357	3%	30,971	4%
Information	932	1%	9,795	2%	386	1%	1,156	1%	12,269	1%

	Hawai`i County		City and County of Honolulu		Kaua`i County		Maui & Kalawao Counties		State of Hawai`i	
	Employees	% of Total Employment	Employees	% of Total Employment	Employees	% of Total Employment	Employees	% of Total Employment	Employees	% of Total Employment
Finance and insurance	(D)		23,980	4%	(D)		2,024	2%	29,286	3%
Real estate and rental and leasing	(D)		26,755	4%	(D)		6,628	6%	42,091	5%
Professional, scientific, and technical services	(D)		36,316	6%	(D)		4,289	4%	46,679	5%
Management of companies and enterprises	(D)		6,694	1%	(D)		482	0%	7,594	1%
Administrative and waste services	5,552	6%	40,891	7%	3,638	8%	7,530	7%	57,611	7%
Educational services	(D)		14,781	2%	(D)		1,488	1%	18,408	2%
Health care and social assistance	8,035	8%	54,523	9%	2,864	7%	6,434	6%	71,856	8%
Arts, entertainment, and recreation	(D)		12,900	2%	(D)		4,711	5%	23,003	3%
Accommodation and food services	(D)		58,824	9%	(D)		20,588	20%	99,939	11%
Other services, except public administration	(D)		35,701	6%	(D)		6,877	7%	52,184	6%
Government and government enterprises	13,997	14%	150,755	24%	5,057	11%	10,703	10%	180,512	21%
Federal, civilian	1,334	1%	29,483	5%	549	1%	878	1%	32,244	4%
Military	1,390	1%	52,918	8%	582	1%	1,155	1%	56,045	6%
State and local	11,273	11%	68,354	11%	3,926	9%	8,670	8%	92,223	11%
State government	8,518	8%	56,046	9%	2,698	6%	6,090	6%	73,352	8%
Local government	2,755	3%	12,308	2%	1,228	3%	2,580	3%	18,871	2%

Note:
(D) - Not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals.
Source:
Regional Economic Information System, Bureau of Economic Analysis (BEA), US DOC. (April 2010). *CA25N Footnotes*. Retrieved from http://www.bea.gov/regional/docs/footnotes.cfm?tablename=CA25N

Between 2001 and 2008, employment in Hawai`i increased by 14% (see Table 3.4-3). The highest gain is in the mining industry at almost 62%, followed by construction. Jobs in the tourism-related sectors of accommodation and food services and arts, entertainment, and recreation increased by over 9% and over 16%, respectively. Three sectors that experienced job losses during this period include forestry, fishing, and related activities; information; and manufacturing.

Table 3.4-3 Industry Employment Growth, 2001 to 2008 (% Change)

	Hawai`i County	City and County of Honolulu	Kaua`i County	Maui & Kalawao Counties	State of Hawai`i
Total employment	23.7%	11.8%	16.8%	18.3%	14.0%
Farm employment	14.3%	-26.1%	-20.2%	-2.7%	-2.7%
Nonfarm employment	24.3%	12.0%	18.2%	19.0%	14.3%
Private employment	26.6%	13.6%	20.3%	19.6%	16.2%
Forestry, fishing, and related activities		-38.6%			-13.3%
Mining		70.0%			61.9%
Utilities		22.4%		26.8%	23.2%
Construction		50.4%		41.5%	50.5%
Manufacturing		-3.3%		-14.4%	-2.8%
Wholesale trade		8.9%		25.4%	11.4%
Retail trade	16.5%	1.8%	6.0%	11.1%	5.0%
Transportation and warehousing		3.6%		14.2%	6.9%
Information	13.9%	-13.4%	-16.3%	-1.4%	-10.8%
Finance and insurance		17.4%		40.6%	21.3%
Real estate and rental and leasing		33.0%		32.4%	34.0%
Professional, scientific, and technical services		19.5%		27.2%	21.0%
Management of companies and		22.5%		20.2%	22.0%

	Hawai`i County	City and County of Honolulu	Kaua`i County	Maui & Kalawao Counties	State of Hawai`i
enterprises					
Administrative and waste services	34.3%	17.2%	39.8%	45.5%	23.1%
Educational services		17.2%		60.2%	24.2%
Health care and social assistance	20.0%	19.5%	12.6%	23.0%	19.5%
Arts, entertainment, and recreation		6.1%		20.6%	16.3%
Accommodation and food services		10.0%		7.3%	9.1%
Other services, except public administration		12.8%		22.7%	17.5%
Government and government enterprises	12.4%	7.1%	4.5%	13.5%	7.8%
Federal, civilian	37.5%	7.5%	46.8%	65.7%	10.1%
Military	-3.9%	5.2%	-10.3%	-6.9%	4.5%
State and local	12.3%	8.5%	2.9%	13.2%	9.1%
State government	10.1%	9.7%	-0.7%	10.1%	9.4%
Local government	19.7%	3.4%	11.5%	21.3%	8.2%

Source:
Regional Economic Information System, Bureau of Economic Analysis (BEA), US DOC. (April 2010). *CA25N Footnotes*. Retrieved from http://www.bea.gov/regional/docs/footnotes.cfm?tablename=CA25N

3.4.2.2 *Income*

Hawai`i's per capita personal income ($39,242) is slightly higher than that of the nation as a whole , with the annualized growth rate of 6% between 2001 and 2007 (DBEDT 2009a) (see Table 3.4-4). Among the counties, the City and County of Honolulu has the highest per capita personal income in 2007 of $42,015, while Hawai`i County has the lowest at $29,702. A high per capita income in a community indicates the presence of high paying employment opportunities. See Table 3.4-4 for a summary of personal income the U.S., and the State of Hawai`i and its counties.

Table 3.4-4 Personal Income in 2007

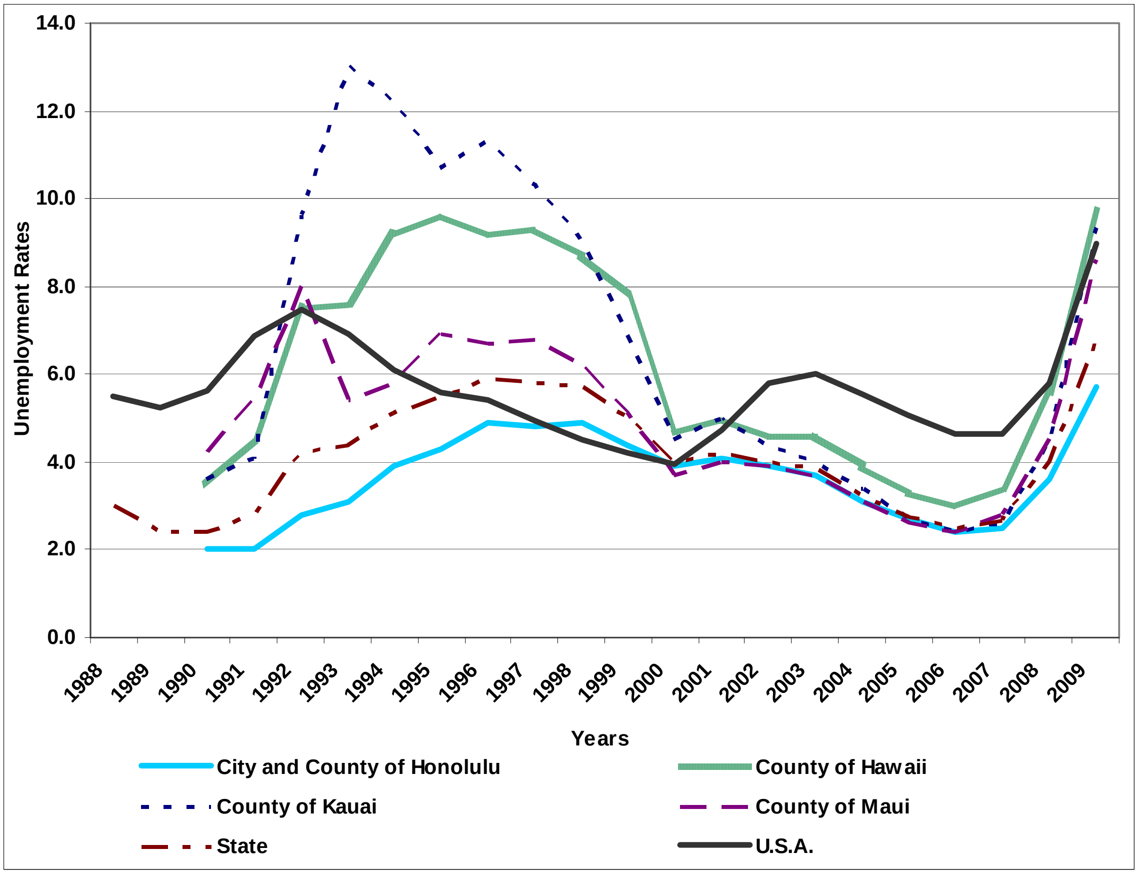
Area	Per Capita Personal Income ($)		
	2001	**2007**	**Annualized Rate of Change (%)**
City and County of Honolulu	30,759	42,015	6.1%
Hawai`i County	22,355	29,702	5.5%
Kaua`i County	24,421	33,356	6.1%
Maui County	25,456	35,835	6.8%
State of Hawai`i	28,840	39,242	6.0%
U.S.A.	30,582	38,615	4.4%

Source:
DBEDT (2009). *County Social, Business and Economic Trends in* Hawai`i*: 1990 – 2008.*

3.4.2.3 *Unemployment*

The unemployment rate is a key economic indicator providing important insight into the economic health of a region. High unemployment is a sign of an unhealthy economy, which can lead to reduced spending, a decreased tax base, and more unemployment. In the current recession, Hawai`i and its counties have faced high unemployment. As of 2009, the unemployment rate in Hawai`i is 6.8%, up from 4.0% in 2008. Among the counties, the highest unemployment rate is in the County of Hawai`i at 9.7%, followed by county of Kaua`i at 9.3% and County of Maui at 8.6% (see Figure 3.4-1). Despite these high rates, the national unemployment rate has grown faster than in the State of Hawai`i.

Figure 3.4-1 Historic Unemployment Rates in the Counties in Hawai`i, the State of Hawai`i, and the United States



3.4.3 Commercial Fishing

Commercial fisheries in Hawai`i are extensive, and include fish caught for sale, as well as charter fishing services. An annually renewable commercial marine license (CML) is required for commercial fishing in the state. Based on CML data, there were 4,263 licensed commercial fishers in 2008 (Hawai`i Division of Aquatic Resources (DAR) and WPacFin 2010).

In 2009, about 27 million pounds of fish were caught for commercial purposes in the state, worth over $71 million (WPacFIN 2009) (see Table 3.4-5). The average value of commercial landings between 1990 and 2009 exceeds $63 million (WPacFIN 2009). The overall price per pound (based on amount paid to commercial fishers by dealers) for all commercial fish in 2009 was approximately $2.65. Key fishery categories include pelagic, coral reef, bottomfish, precious corals, and crustaceans.

Table 3.4-5 Quantity, Value, and Price Per Pound of Commercial Landings in Hawai'i, 1990-to 2009

Year	Quantity (Millions of Pounds)	Value (Millions of Dollars)	Price per Pound (Dollars)
1990	17.95	$48.05	$2.68
1991	26.68	$64.38	$2.41
1992	26.83	$67.98	$2.53
1993	29.39	$73.45	$2.50
1994	23.23	$62.67	$2.70
1995	25.99	$59.22	$2.28
1996	24.10	$57.70	$2.39
1997	27.53	$61.60	$2.24
1998	28.52	$61.04	$2.14
1999	28.99	$62.91	$2.17
2000	28.62	$68.21	$2.38
2001	23.48	$48.08	$2.05
2002	23.97	$52.38	$2.19
2003	23.74	$52.75	$2.22
2004	24.46	$57.68	$2.36
2005	28.14	$71.04	$2.52
2006	25.66	$66.12	$2.58
2007	28.94	$75.70	$2.62
2008	30.68	$85.12	$2.77
2009	26.91	$71.17	$2.65

Source:

WPacFIN. (2010). 1982-2009 *Commercial Landings* (various data tables and charts). Retrieved from http://www.pifsc.noaa.gov/wpacfin/central/Pages/central_data.php

3.4.3.1 *Pelagic Fisheries*

Among the various categories of fisheries, the pelagic fishing industry is the largest and most valuable one, accounting for almost 96% of commercial landings with 25.7 million pounds of pelagic fish caught commercially in 2009 (see Table 3.4-6). Pelagic fisheries primarily use longline gear, but also include the MHI troll and handline, offshore handline, and the aku boat (pole and line) fisheries (NMFS 2005). Tunas (especially bigeye tuna) and billfish (particularly blue marlin, striped marlin, swordfish) are the main target species for pelagic fishing, but other species, such as mahimahi, ono (wahoo), and moonfish are also important (NMFS 2005).

3.4.3.2 *Coral Reef Fisheries*

Coral reef fish made up about 1% of commercial landings in 2009 (see Table 3.4-6). With presently no active commercial coral reef fisheries in the NWHI, the commercial catch primarily comes from nearshore reef areas around the MHI (NMFS 2005). However, there has been a notable decline in nearshore coral reef fishery resources in recent decades because of overfishing (NMFS 2005). Coral reef fish species popular for commercial purposes include akule (which dominates nearshore commercial landings), soldierfishes, surgeonfishes, goatfishes, squirrelfishes, unicornfishes, and parrotfishes (WPRFMC 2010b). Numerous fishing gears are used to target these species, including nets, traps, hook and line, spear, hand, and other methods.

3.4.3.3 *Bottomfish Fisheries*

Catches of bottomfish accounted for about 2%of commercial landings in 2009 (see Table 3.4-6). Target species include snappers, jacks, and a single species of grouper that is concentrated at depths of 30 to 150 fathoms (fm) (NMFS 2005). The most desirable species are seven deepwater species known as the Deep 7 (opkapaka, onaga, hapuupuu, ehu, kalekale, gindai, and lehi), which made up 54% of the commercial bottomfish catch in 2008 (WPRFMC 2010a).

After the establishment of the NWHI Marine National Monument in 2006 (later renamed Papahānaumokuākea Marine National Monument [Monument]), bottomfishing was scheduled to end in the Monument in 2011 (WPRFMC 2010b). However, this fishery was closed in 2009 when permit holders surrendered their permits in lieu of compensation from the federal government. Bottomfishing continues to take place in the MHI, where roughly about 50% of bottomfish habitat is located in state waters (WPRFMC 2010b). While bottomfishing around the MHI is conducted both commercially and by recreational fishermen, fishing in the NWHI was solely for commercial purposes (NMFS 2005). Methods and gear used in these fisheries are highly selective for desired species and sizes. In 2008, the Deep 7 fishery in the MHI was managed through the implementation of a federally-mandated total allowable catch (TAC) limit of 241,000 lbs, as a means to end overfishing of these species (DAR and WPacFin 2010).

3.4.3.4 *Precious Coral Fisheries*

The discovery of two species of commercially valuable black coral in 1958, including Au'au, led to the establishment of a small black coral cottage industry for manufacturing black coral jewelry. Recently, this industry is threatened by changes in harvesting pressure and the introduction of an alien pest species (WPRFMC 2010b). Over the past 30 years, almost all of the black coral has been harvested from state waters and from a bed located in the Au'au Channel (WPRFMC 2010b). The domestic fishery for pink, gold, and bamboo precious coral resumed in 1999 (NMFS 2005). Harvest of precious corals is only allowed by selective gear with submersibles or by hand (NMFS 2005).

3.4.3.5 *Crustaceans Fisheries*

The main target species under this category are a species of spiny lobster and the common slipper lobster and kona crab; other lobster to the family Scyllaridae are also desirable (WPRFMC 2010b). In the MHI, commercial catch of spiny lobsters dropped by 75 to 85% by the early 1950s (NMFS 2005). The NWHI had the largest crustacean fishery in Hawai`i, until it was closed by NMFS in 2000 due to uncertainties regarding accurate lobster stock assessments. This fishery remains closed due to the establishment of the Monument (NMFS 2005).

Table 3.4-6 Hawai`i Annual Reported Commercial Landings (Millions of Pounds) for Pelagic, Bottom, Reef, and Other Fisheries Categories, 2000 to 2009

Year	Pelagic Fishes	Bottomfishes	Reef Fishes	Other Fishes
2000	26.74	0.72	0.20	0.95
2001	22.00	0.65	0.24	0.59
2002	22.34	0.62	0.35	0.67
2003	22.06	0.62	0.33	0.73
2004	23.03	0.62	0.24	0.56
2005	26.91	0.53	0.22	0.48
2006	24.51	0.44	0.20	0.51
2007	27.73	0.44	0.23	0.54
2008	29.57	0.43	0.27	0.41
2009	25.70	0.45	0.27	0.49

Source:
NMFS, PIFSC. (2010). *Annual Reported Commercial Landings of Pelagic Fishes, Bottomfishes, Reef Fishes, Other Fishes*. Retrieved from http://www.pifsc.noaa.gov/wpacfin/hi/Data/Landings_Charts/hr3a.htm

3.4.4 *Subsistence Fishing*

Hawai`i Revised Statutes (HRS) Section 188-22.6 defines subsistence fishing as the customary and traditional Native-Hawaiian uses of renewable ocean resources for direct personal or family consumption or sharing. Native Hawaiian in the HRS is defined as any descendant of the races inhabiting the Hawaiian Islands prior to 1778.

Annual fish consumption in Hawai`i is about 90 lbs per capita, over twice the national average (U.S. Department of the Navy 2008a). There is no license required for subsistence and recreational fishing in Hawai`i. Without a requirement for subsistence licenses, it is difficult to assess the overall level of subsistence fishing activity due to a lack of detailed catch data. No formal attempt to assess the subsistence fishing contribution to island economies has been made in the past, but the value of fishing for subsistence by contemporary Native Hawaiians is known to be an important component of some communities, particularly rural communities (U.S. Department of the Navy 2008a).

3.4.5 Recreational Fishing

Fishing is a popular pastime for people in Hawai`i, with a quarter of the population participating in some form of fishing at least once a year (U.S. Department of the Navy 2008a). In addition, fishing is also popular with tourists visiting Hawai`i. However, as with subsistence fishing, data on recreational fishing in Hawai`i are very limited because no license was required for non-commercial saltwater fishing. While occasional surveys have been fielded over the years, there has been no systematic collection of such data.

The Marine Recreational Fisheries Statistical Survey collected data in Hawai`i for a period ending about 20 years ago. The program was recently restarted in Hawai`i as the Hawai`i Marine Recreational Fishing Survey (HMRFS). HMRFS is collecting data through a dual approach including random telephone surveys, as well as fisherman intercept surveys conducted at boat launch ramps, small boat harbors, and shoreline fishing sites. Given the HMRFS is a relatively recent undertaking, some scattered information is made available through the newsletters released by NMFS, but not enough intercepts of fishermen have occurred to date to allow catch and effort determinations for Hawai`i fisheries.

Based on the 2006 HMRFS data, it is estimated that 396,413 recreational fishermen brought in 17.6 million pounds of fish (HIPA 2009). The USFWS estimates the total number of recreational fishermen in Hawai`i at 158,000 in 2006, a significantly lower number compared to HMRFS. This discrepancy in the two sources of data may be due to different survey methodologies and accuracy of data, and also the lack of licensing and reporting requirements for recreational fishermen (HIPA 2009).

A new initiative by NMFS, the Marine Recreational Information Program, is anticipated to collect better data and produce improved estimates of marine recreational catch and effort. The Marine Recreational Information Program is anticipated to replace the HMRFS (Marine Recreational Information Program

2011). An important component of Marine Recreational Information Program is the National Saltwater Angler Registry. All Hawaii recreational fishermen (including indigenous fishermen) who fish more than 3 miles from shore (Federal waters) are required to register. The registration is valid for one year from the date of registration, and must be renewed.

Absent systematic data, it is believed that offshore recreational and subsistence catch is likely equal to or greater than the offshore commercial fisheries catch, with more species taken using a wider range of fishing gear (Friedlander *et al.* 2004).

The issue is further complicated by the overlapping behaviors of subsistence, commercial, and recreational fishermen. A recent study that surveyed the small boat pelagic fishermen reveals that within that specific fishery, while 42% of the survey respondents classified themselves as commercial fishermen, 60% actually sold fish in the 12 months preceding the study (PIFSC 2011). Also, over 30% of fishermen classifying themselves as recreational sold fish in the past one year. Most fishermen within this fishery participate in fish sharing networks, with 97% of those surveyed indicating that they give away a portion of the catch to friends or relatives (not immediate family). About 62% consider the fish they catch to be an important source of food for their family (PIFSC 2011).

3.4.6 Cultural Environment

Native Hawaiians have a rich, traditional history of cultural and customary practices. These practices are acknowledged in the Hawai`i State Constitution, under Articles IX and XII.

Traditional Hawaiian customary practices are based on the kinship between Native Hawaiians and the land or `āina. Native Hawaiians see them as both children and stewards of their native lands. Traditional Hawaiian stewardship is based on a resource management system known as the "ahupua'a" system. The traditional ahupua'a system was a geo-political system that allowed for equitable and sustainable use of natural resources. Most ahupua'a extended from the highest mountain ridge (*i.e.*, the top of the watershed system) through the forests and low-lying areas out to the submerged reef. While not part of local ahupua'a systems, open ocean areas were nonetheless essential to cultural and customary practices as deep sea fishing was regularly practiced by Native Hawaiians.

NMFS PIRO commissioned a research project in 2010 to study the historical and cultural significance of the Hawaiian Monk Seal (Appendix K). The study included a review of existing and known research on the monk seal, the collection of information from the Hawaiian language archives and conducting ethnographic interviews with individuals from across the state. Over one dozen kūpuna (elders), practitioners, and other experts were interviewed or consulted for the study.

The results of the study showed that while individuals may have varied perspectives on the cultural significance of the Hawaiian monk seal, archival documentation shows that the monk seals were known to Hawaiians in the 19th century. Numerous names were discovered for the monk seal, including `īlioholoikauaua, hulu, he-`īlio-o-ke-kai and others. It was also discovered that there are many places throughout Hawaii that may be named for the monk seal, including `Īlio-pi`i (Moloka`i), Kalaeoka`īlio and others. References to monk seals were also found in traditional mo'olelo (stories) and genealogies.

Despite the archival documentation discovered, ethnographic interviews revealed that some Native Hawaiians do not believe the monk seal to be a native species. Whereas other interviews identified the monk seal as being associated with the Hawaiian god Lono or being `aumākua (ancestral guardians). Interviews also revealed current cultural practices associated with the monk seal that occur within the project area.

3.4.7 Cultural Resources and Historic Properties

Cultural resources include material remains of past human activities, both from historic and Pre-European contact. In addition, cultural resources include traditional cultural properties, such as areas used for ceremonies or other cultural activities that may leave no material traces, and may have on-going use important to the maintenance of cultural practices. Cultural resources management seeks to identify and protect all of these types of cultural resources with the goals of enhancing understanding of human behavior and protecting cultural practices. For cultural resources qualifying as historic properties, protection is afforded under the National Historic Preservation Act (NHPA).

NHPA defines an historic property as follows:

> …any Pre-European contact or historic district, site, building, structure, or object included in, or eligible for listing on the National Register, including artifacts, records, and material remains related to such a property or resource (46 CFR 800, as amended 2006, Title III, Section 301, #5).

The term "historic property" is used in the sense defined here throughout this chapter.

The criteria for evaluating eligibility for listing on the National Register of Historic Places (NRHP) are as follows:

The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling and association, and:

- That are associated with events that have made a significant contribution to the broad patterns of our history; or
- That are associated with the lives of persons significant in our past; or
- That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
- That have yielded, or may be likely to yield, information important in prehistory or history (National Parks Service [NPS] 1997).

To qualify for protection under NHPA, a cultural resource must meet the rigorous criteria for National Register eligibility, thereby qualifying as an historic property.

If a cultural resource can be demonstrated to meet the criteria for listing on the NRHP, it qualifies as an historic property, and impacts to that historic property must be avoided or mitigated appropriately. Historic properties are protected from both indirect and direct effects. Indirect effects diminish some significant aspect of the historic property, but do not physically alter it. Direct effects physically alter the historic property in some way. The Area of Potential Effect (APE) is the area within which the proposed undertaking has the potential to either directly or indirectly impact historic properties that may be present. If an effect on an historic property is identified within the APE, consulting parties must agree on whether the effect is adverse. If an effect is adverse, either avoidance of the effect or mitigation for the effect is required under NHPA. Historic properties that are not in the APE are identified but excluded from further analysis because there is no potential effect on those properties from any of the alternatives.

This section describes cultural and historic resources located within the direct APE, both on and offshore, within and adjacent to areas where research and enhancement activities may occur. As determined by NMFS, the APE for this project encompasses the range where Hawaiian monk seals are found throughout the Hawaiian Archipelago, including the NWHI, MHI and Johnston Atoll. More specifically, the APE includes portions of the open ocean and near shore environment where monk seals may be found as well as the shore zone of the islands, islets, and atolls that make up the Hawaiian Archipelago and Johnston Atoll. For the purposes of this project, the direct APE includes areas within 25 m of the shoreline. In addition, secondary use areas, such as research field camps in the NWHI, are also included in the direct APE. Known shipwrecks or navigational hazards within 300 meters from shore will also be evaluated.

The Hawai`i State Historic Preservation Division's Statewide Historic Preservation Plan suggests several themes important in the history and development of Hawai`i. The following cultural resources could offer insight into traditional Hawaiian life and history:

- Traditional agricultural fields;
- Dwellings;
- Fish ponds;
- Trails;
- Petroglyphs;
- Heiau (religious structures); and
- Burials.

Important Euro-Historic themes include missionary and religious endeavors, sugar and pineapple plantations, whaling and other maritime pursuits, and military activities. Also important in the history of Hawai`i is the multi-ethnic society, reflected by varied religious institutions and cemeteries (SHPD 2001).

3.4.7.1 Cultural and Historic Resources in the Northwestern Hawaiian Islands

A variety of cultural resources may be found within the NWHI. Offshore, sunken vessels including World War II military ships, historic cargo ships, whaling and fishing vessels, and recreational boats could potentially be present, though data on the presence and the location of these are limited. Other offshore archaeological resources that could be found include submerged aquaculture ponds, junked land vehicles, and submerged harbor and shoreline features. In addition to archaeological sites and traditional cultural properties, the potential exists in the NWHI for historic structures, including harbor and other ocean related facilities, as well as military structures. Stone walls, terraces, platforms, wells, heiau, cultural artifacts, and mounds representing cultural activity could also be found in the NWHI. The NWHI also includes numerous sites significant to traditional Hawaiian navigation and seafaring traditions.

A recently discovered shipwreck is representative of whaling activity in the NWHI. The whaling ship Two Brothers, which sank off of French Frigate Shoals in 1823, was identified. The potential for shipwrecks within the NWHI is confirmed by this find. The Two Brothers shipwreck is the subject of on-going study by NOAA researchers (ScienceDaily 2011).

Several historic properties listed on the NRHP are located in the NWHI. The National Historic Landmark (NHL) World War II Facilities site is located on Midway Atoll, a nationally significant historic site. This historic property's significance is based on the role the atoll played in the pivotal battle of the Pacific War. Several ammunition magazines, a concrete pillbox, and gun and battery emplacements are the features related to this historic event that are included in the NHL listing (NPS 2011). However, this historic property is not located within the APE and will not be affected by the proposed project.

As described in NOAA 2008b, all documented Native Hawaiian archaeological sites in the NWHI are on Nihoa Island and Necker Island (also known as Mokumanamana)), although the cultural significance of the entire NWHI chain has been documented in more recent publication (Kikiloi 2010). Both the Necker Island and Nihoa Island Archaeological Districts were listed on the NRHP in 1988. The period of significance for the Necker Island Archaeological District is 1500 to 1749 A.D.; this District includes agricultural fields, domestic remains, and ceremonial sites. The Nihoa Island Archaeological District period of significance is 1000 to 1749 A.D.; this District includes agricultural and domestic remains, as well as ceremonial sites (NPS 2011).

Nihoa and Necker Islands hold 45 heiau (shrines) between them (NOAA 2008b). Among the recorded sites on Nihoa and Necker Islands are religious and ceremonial features (cairns, terraces, stone platforms, upright stones, and burial sites; Emory 1928; TenBruggencate 2005; U.S. Department of Commerce, The Under Secretary of Commerce for Oceans and Atmosphere, 2007 as cited in U.S. Department of Navy 2008a). These historic properties are not located within the APE and although the entire Monument was named UNESCO's first mixed use (natural and cultural) World Heritage Site in the United States in 2010, sites would not be affected by the alternatives.

While relatively few historic properties are identified within the NWHI as compared to the MHI, the potential for significant archaeological and structural historic properties clearly exists. In addition to land-based historic properties, shipwrecks and other submerged cultural resources could be present off-shore in the NWHI. On land, cultural resources in the NWHI include burial sites, temples, campsites, house sites, sites related to the Plantation Period, Department of Defense facilities, sites including evidence of stone tool manufacture, and aquaculture ponds. No historic properties are recorded within the APE in the NWHI.

3.4.7.2 *Cultural and Historic Resources in the Main Hawaiian Islands*

Historic and cultural sites found within the APE in the MHI include shipwrecks, historic structures, burials, fishing shrines, heiau (religious structures), leina (cultural sites from which spirits leapt into the next world), cultural structures related to Hawai`i's traditional navigation and other seafaring traditions, and fishponds. This chapter will focus on cultural resources within approximately 300 m of the shoreline offshore and 25 m from shore inland, within the APE (see Figures 3.4-2-3.4-6 for Historic Sites within the project area). Many of the cultural and historic sites within the MHI are documented on the NRHP website (http://www.nps.gov/nr/). In addition, many cultural and historic resources have been summarized (including maps documenting known resources) in the recent Hawai`i Range Complex Final EIS/Overseas EIS (http://www.govsupport.us/navynepaHawaii/Hawaiirceis.aspx; U.S. Navy 2008a) and that information has been incorporated here by reference. The State of Hawai`i Office of Planning maintains a Geographic Information System (GIS) database that can be used to map shorezone features including fishponds (http://Hawai`i.gov/dbedt/gis/) (see Figures 3.4-7 through 3.4-9, Fishponds within the Project Area in the MHI). In addition, the University of Hawai`i at Manoa manages a database of identified Hawaiian saltwater fishponds (U.S. Navy 2008a).

Some aquaculture ponds date back to A.D. 1000, and some are still in use. Extant fishponds could be visible along the shoreline, or could be submerged. Several fishponds on O'ahu are listed on the NRHP, including Heeia (address restricted), Huilua (Kahana Bay), Kahaluu, and Molii. In addition, on March 14, 1973, Loko Okiokiolepe, also on O'ahu, was officially listed in the NRHP (Hawai`i State Historic Preservation Office, 2006; U.S. Department of the Navy, Commander Navy Region Hawai`i, 2002, as cited in U.S. Navy 2008a). Most of the interior of Loko Okiokiolepe has been filled, but the seaward coral wall still remains intact (Naval Facilities Engineering Command, 2006, as cited in U.S. Navy 2008a). Menehune fishpond in Kauai County is another NRHP-listed fishpond. The island of Moloka`i has numerous NRHP-listed fishponds, including Moloka`i Fishponds Multiple Property. The islands of Hawai`i, Maui, and Lāna`i also include fishponds located adjacent to the shoreline (Figures 3.4-10 through 3.4-13).

Offshore, shipwrecks are known within the MHI waters. Shipwrecks in shallow water close to shore that could present hazards to navigation are reported off almost all of the NHI, including Kaua`i, Lāna`i, O`ahu, Moloka`i, and Maui (OIRC 2011). Maps of known shipwrecks or navigational hazards within 300 m off shore are provided as Figures 3.4-7 through 3.4-9. While these shipwrecks do not necessarily have cultural significance, the potential exists. There are several shipwrecks off the coast of O`ahu that are listed on the NRHP, many of which are located in Pearl Harbor, including the U.S.S. Arizona, visible from the memorial constructed over the wreck, U.S.S. Bowfin, and U.S.S. Utah.

In Maui County, several NRHP listed properties are close to the shoreline. The NRHP-listed Wo Hing Society Building, in Lahaina, attests to the multi-cultural history of Hawai`i. Two NRHP-listed churches, Maui Jinsha Mission in Wailuku, and Wananalua Congregational Church in Hana, are located near the shoreline. Keanae School in Keanae, and the Moloka`i Lighthouse in Kalaupapa, are also listed on the NRHP and are located near the shoreline. Numerous archaeological sites in Maui County are listed on the NRHP, but the locations of these sites are protected; therefore their proximity to the shoreline cannot be determined (NPS 2011). The historic properties for which locations could be determined within Maui County are not located within the APE and are therefore excluded from further analysis.

The Na Pali Coast Archeological District located on Kaua`i, was listed on the NRHP in 1984 and includes 65,000 acres on the coast near Hanalei. Also in Waimea is the Yamase Building. Hanalei Pier and Hanalei Elementary School are NRHP-listed properties in and near Hanalei that are near the shoreline (NPS 2011). Only Hanalei Pier falls within the APE.

In Hawai`i County, a variety of historic property types are included on the NRHP. Some of the residential structures listed on the NRHP, such as the James M. Hind House and the J.A. Williamson House, are near the shoreline. Some government buildings are also located at or near the shoreline, such as the District Courthouse and Police Station and the U.S. Post Office and Office Building (NPS 2011). Moku'aikaua Church, Kailua-Kona, represents the first missionaries to work in Hawai`i. The extant stone structure, with an interior featuring native woods, was completed in 1837 on the site of the original thatched roofed structures, constructed in 1820 and 1825 (Fischer 2011). Moku'aikaua Church is located adjacent to the shoreline. Also in Hawai`i County is the residence of King Kamehameha I, and the Birthplace of Kamahameha III (NPS 2011). None of the historic properties in Hawai`i County are located within the APE.

Honolulu County (the island of O`ahu, and excluding the NWHI) includes numerous historic properties listed on the NRHP in the vicinity of the shoreline. Several residential structures in Honolulu, including Bartlett Cooper House, six houses on Kalakaua Drive, and C.W. Dickey House, are NRHP listed, and located within the APE. Two NRHP-listed U.S. Coast Guard lighthouses, Makapuu Point and Diamond Head, are located very close to the shoreline; only the lighthouse on Makapuu Point is located within the APE. Other military facilities on the NRHP in Honolulu County include War Memorial Natatorium, Battery Hawkins and Battery Hawkins Annex, and CINCPAC Headquarters and sunken vessels in Pearl Harbor, discussed above. Other buildings within the APE listed on the NRHP include the U.S. Immigration Office, C. Brewer Building, Dillingham Transportation Building, Aloha Tower, and Kakaao Pumping Station. Two fishponds, Kahaluu and Okiokilepe, and a heiau, Puu o Mahuka Heiau, are also NRHP listed. In addition, Honolulu includes several NRHP-listed historic districts that include areas near the shoreline (NPS 2011).

Traditional cultural properties that may be present in the MHI include archaeological sites such as ceremonial and burial sites, as well as natural resource areas employed for traditional cultural practices, such as dunes, water sources, and plant-gathering areas. Burial sites could also represent non-Native Hawaiian cultures, such as Japanese, Korean, Portuguese, Chinese, and Filipino. Known cemeteries representing these cultures are located in the Kekaha, Hanapepe, and Waimea areas. Traditional cultural properties recognized to be potentially eligible for listing on the NRHP include Kawaiele Ditch, Nohili Dune, and Elekuna Heiau. Another example of a traditional Native Hawaiian cultural property is Mana, an area believed to launch spirits of the deceased into the spiritual realms (U.S. Department of Navy 2008a).

3.4.8 Recreation and Tourism

The economy of Hawai`i has been dependent on tourism and tourism-related activities since statehood in 1959. In 2008, over 14% of jobs in the state were in industries directly involved with tourism, with many other indirectly associated with the industry (see Table 3.4-2). Hawai`i is a popular destination for both national and international tourists, with Japanese and Canadian tourists being the top two international tourist groups. Due to the recent downturn in the national and international economies, tourism in the state has suffered over the past couple of years. However, the industry is showing signs of recovery since September of 2010, with total visitor spending increasing by double digits for all islands between September and November.

Total spending by visitors to Hawai`i between January and November of 2010 was $10.3 billion, an increase of 16% compared to the same period in 2009 (HTA 2010) (see Table 3.4-7). Among the islands, the highest percent increase was in Maui with 21.3%, while O`ahu topped the list in terms of total spending at $5.1 billion. Per person per day spending increased by 6.5% and reached $172.2. Approximately 6.5 million people visited Hawai`i in the first 11 months of 2010, an increase of 8.6%from the same period in 2009. About 4 million of these visited O`ahu, while almost 2 million visited Maui. Overall, the total visitor days increased 8.9% to 59.8 million in Hawai`i (HTA 2010) (see Table 3.4-7).

Figure 3.4-2 National Register of Historic Places Within the Project Area - Hawai'i

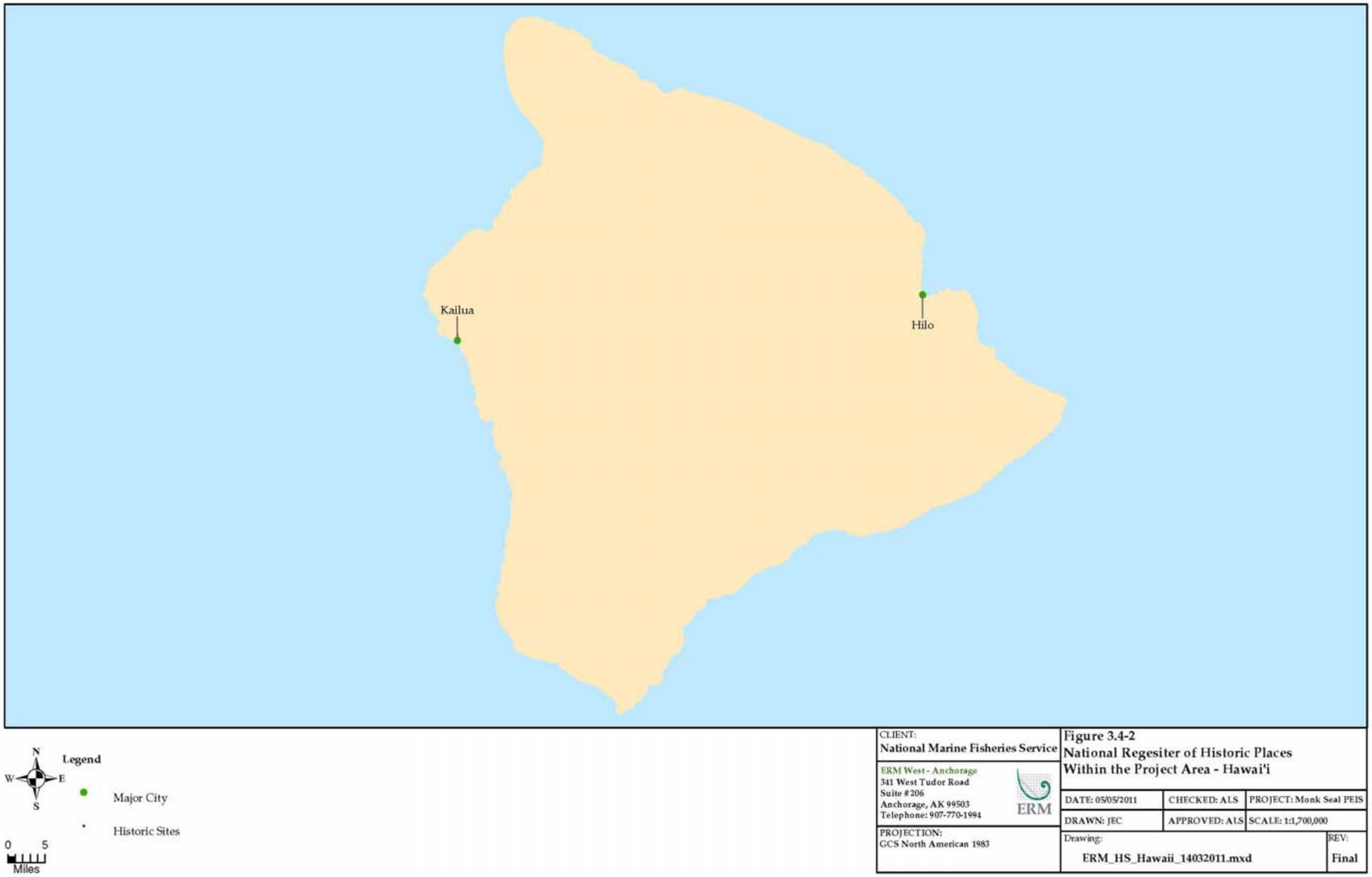


Figure 3.4-3   National Register of Historic Places Within the Project Area – Moloka'i, Lāna'i, Kaho'olawe, and Maui

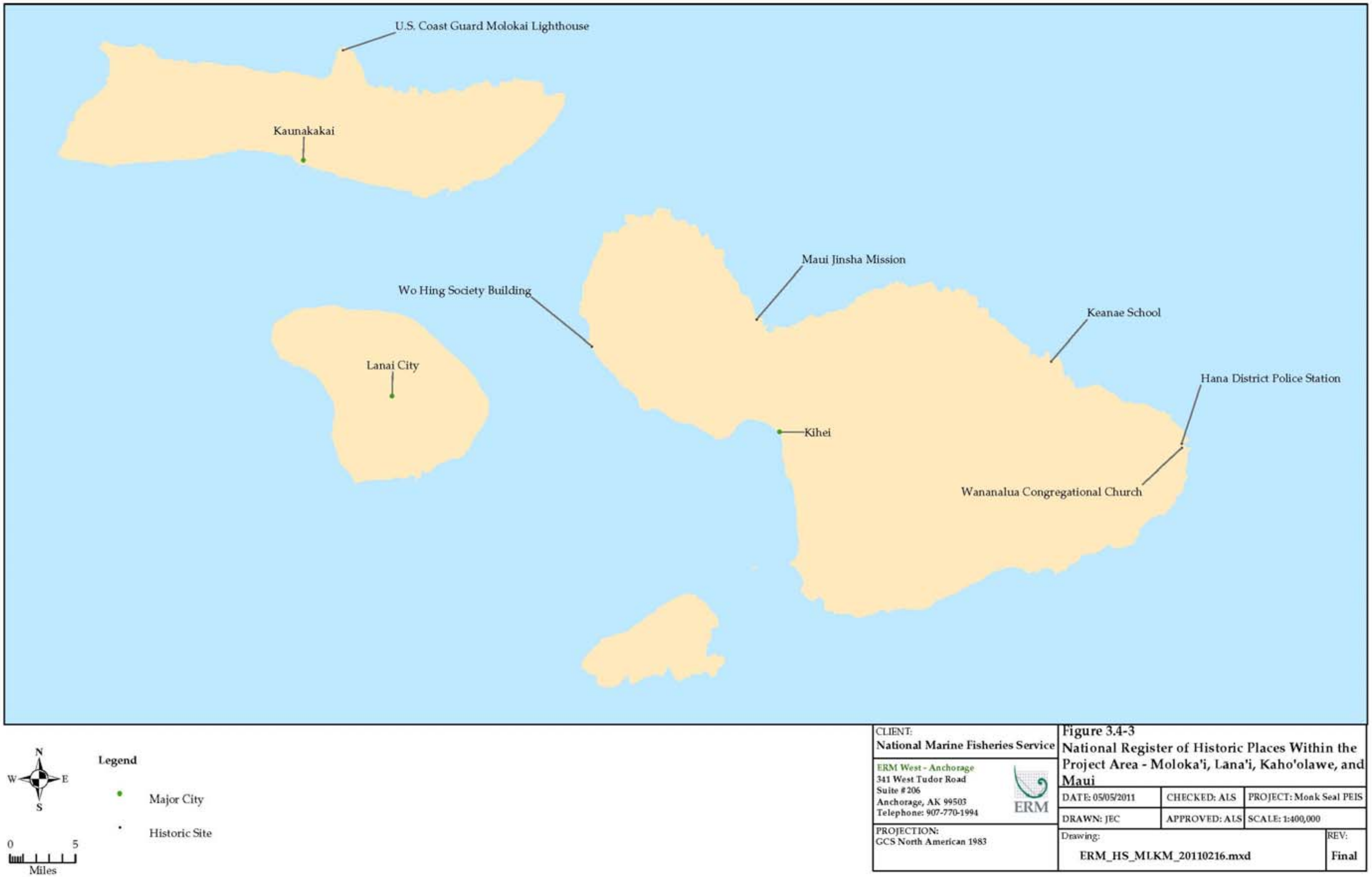


Figure 3.4-4 National Register of Historic Places Within the Project Area – O'ahu

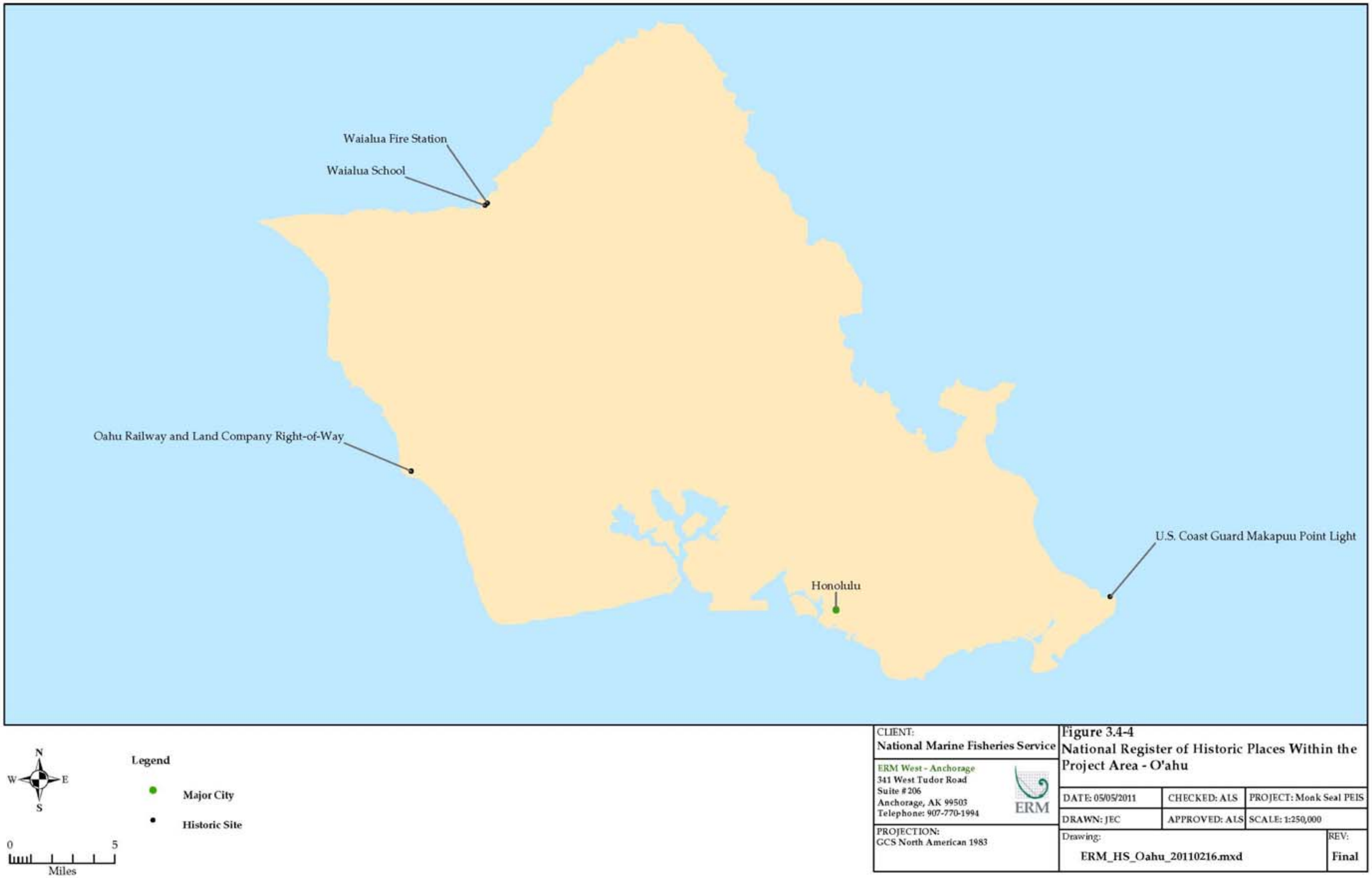


Figure 3.4-5 National Register of Historic Places Within the Project Area – O'ahu (Pearl Harbor and Waikiki)

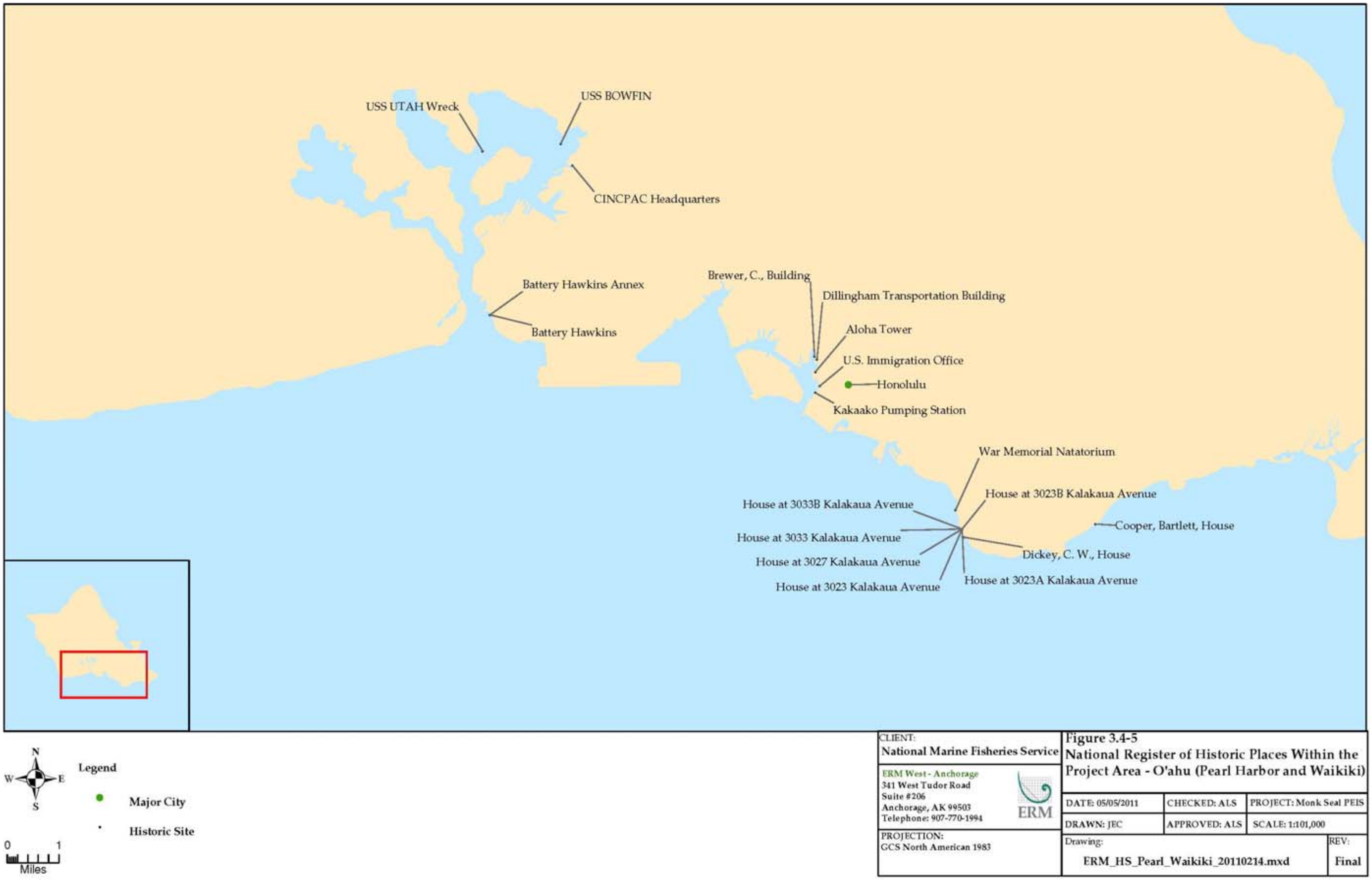


Figure 3.4-6 National Register of Historic Places Within the Project Area - Kaua'i and Ni'ihau

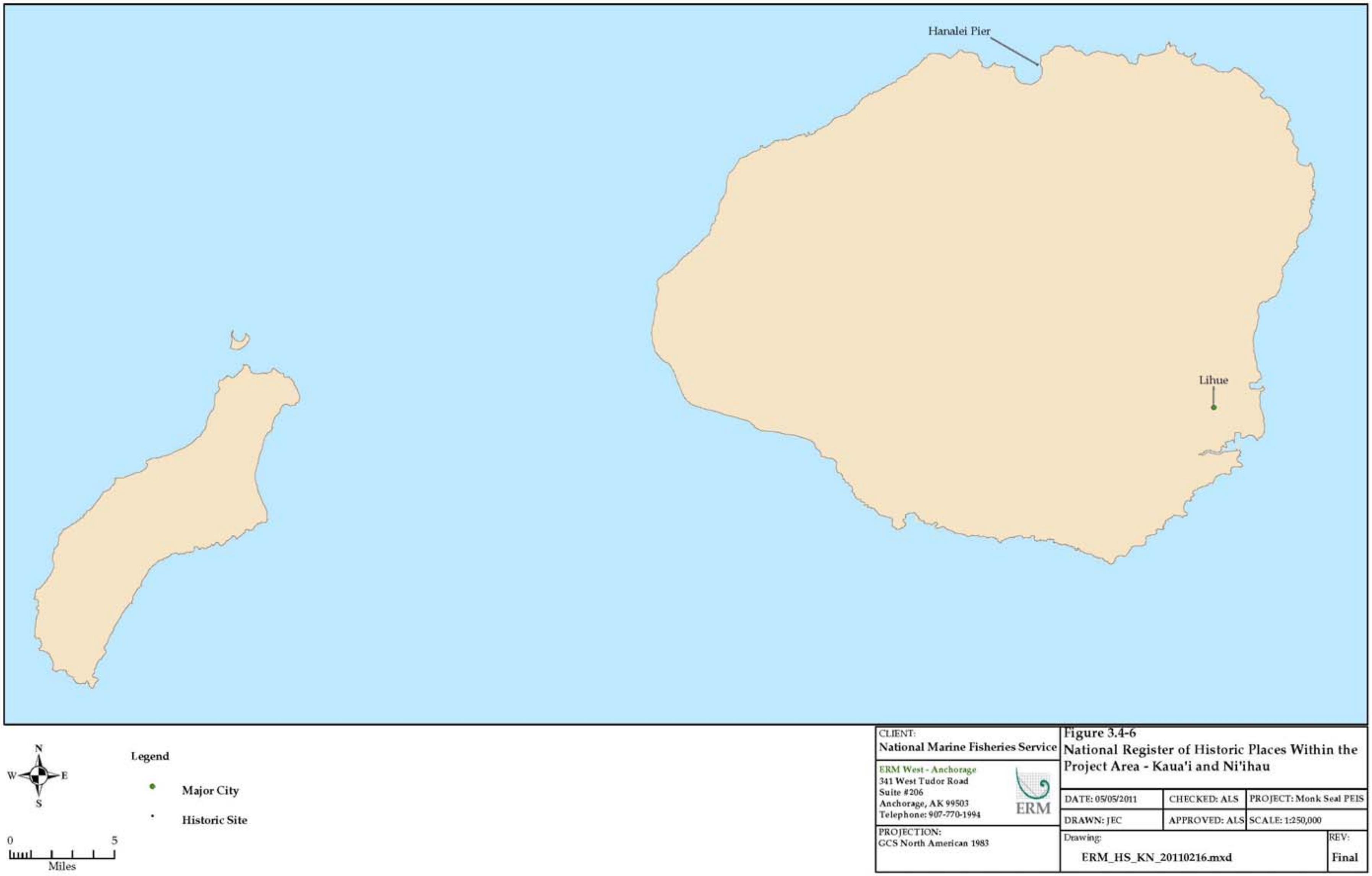


Figure 3.4-7 Shipwrecks Dangerous to Surface Navigation - Kaua'i

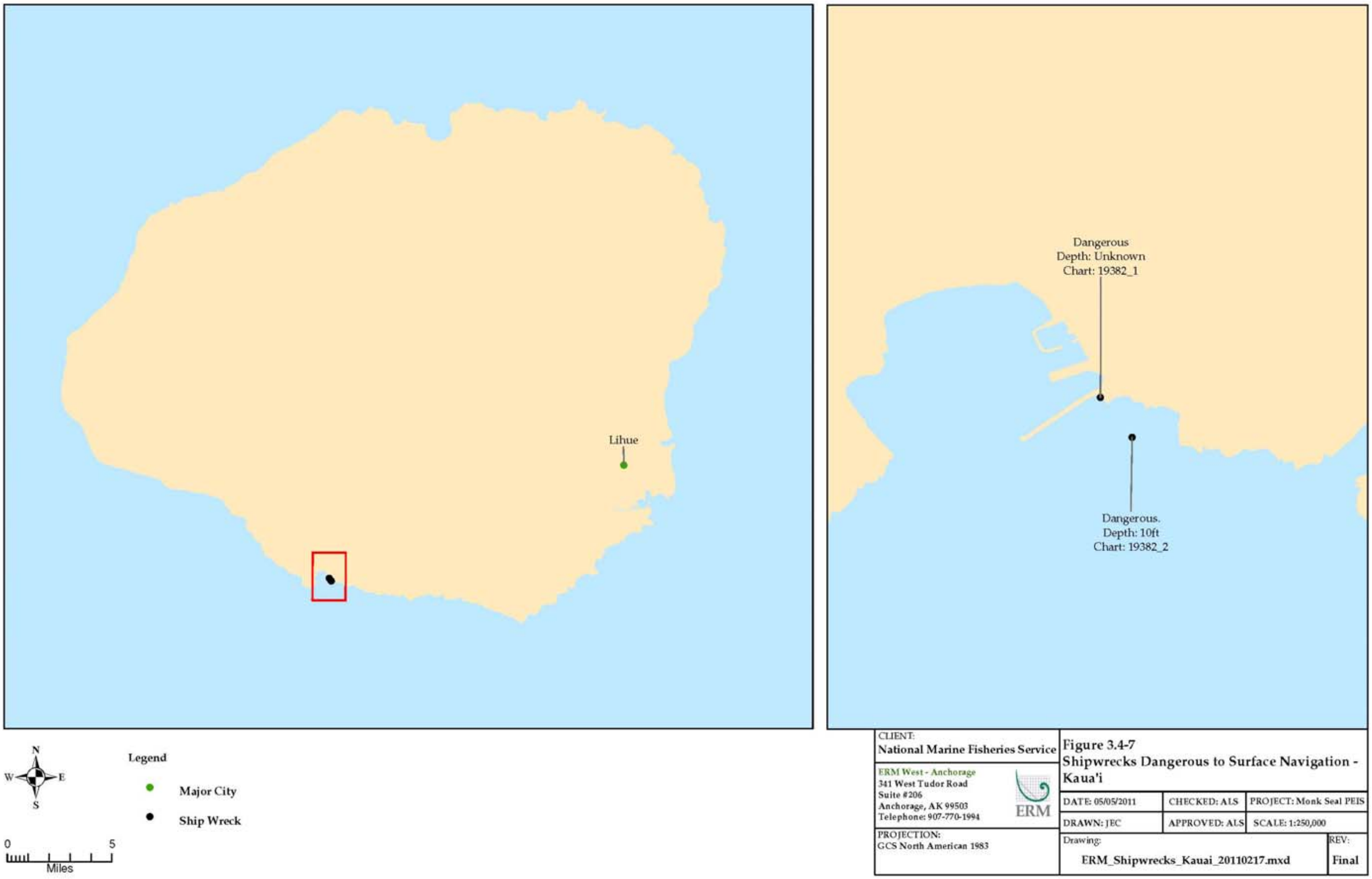


Figure 3.4-8 Shipwrecks Dangerous to Surface Navigation – O'ahu

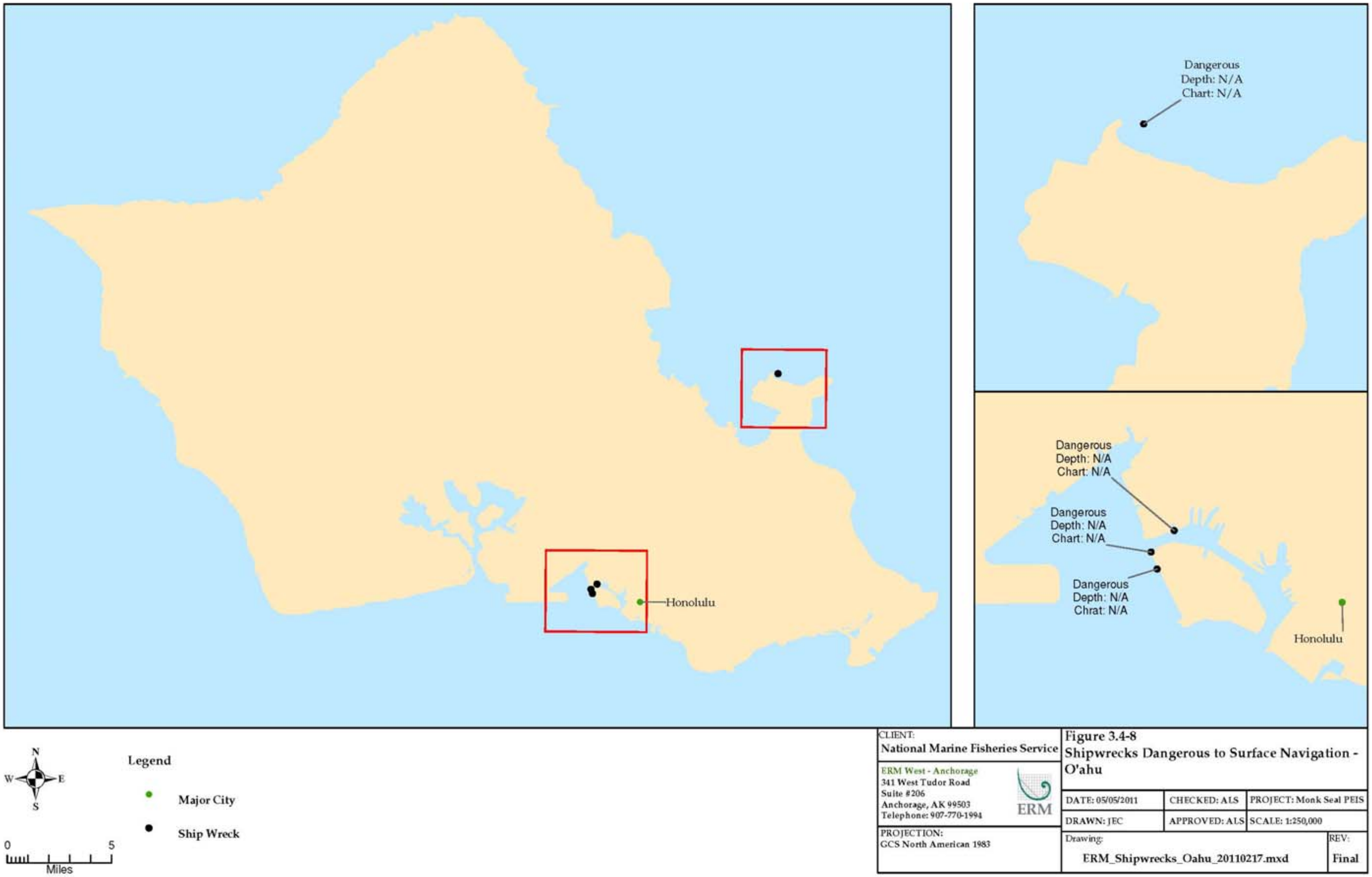


Figure 3.4-9 Shipwrecks Dangerous to Surface Navigation - Moloka'i, Lāna'i, Kaho'olawe, and Maui

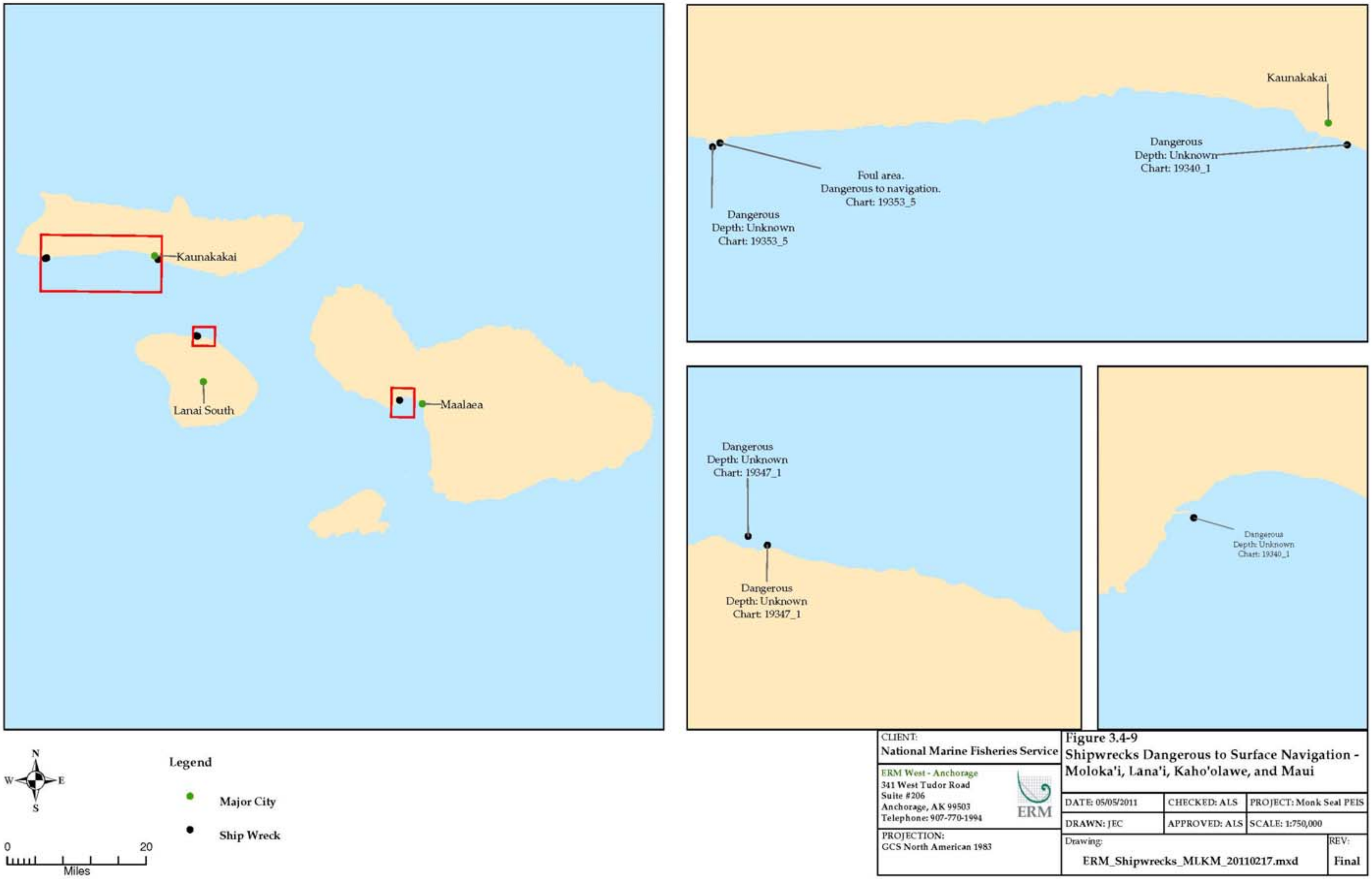


Figure 3.4-10 Fishponds Within the Project Area - Hawai'i

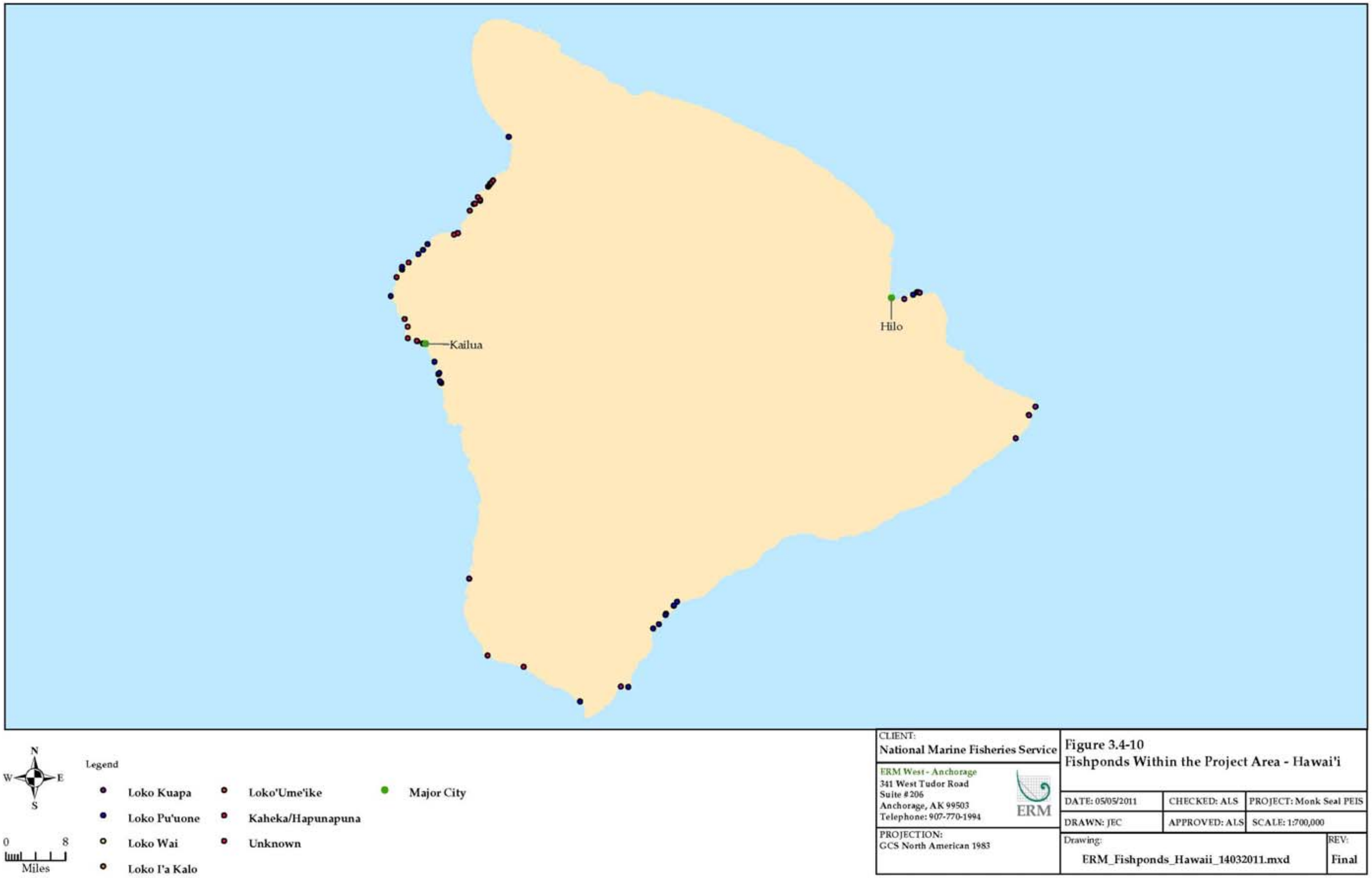


Figure 3.4-11 Fishponds Within the Project Area - Kaua'i and Ni'iahu

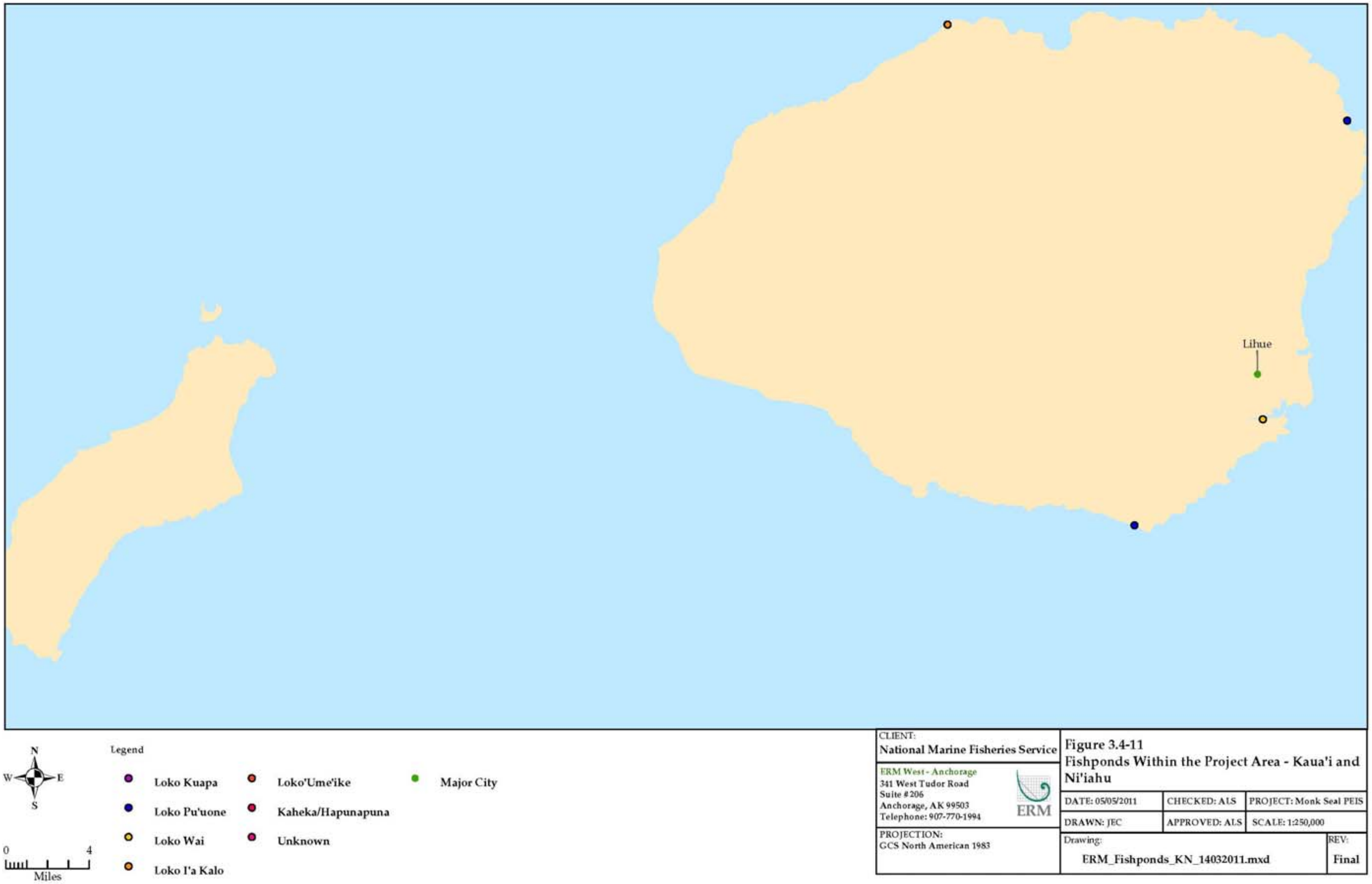


Figure 3.4-12 Fishponds Within the Project Area - Moloka'i, Lāna'i, Koho'oawe, and Maui

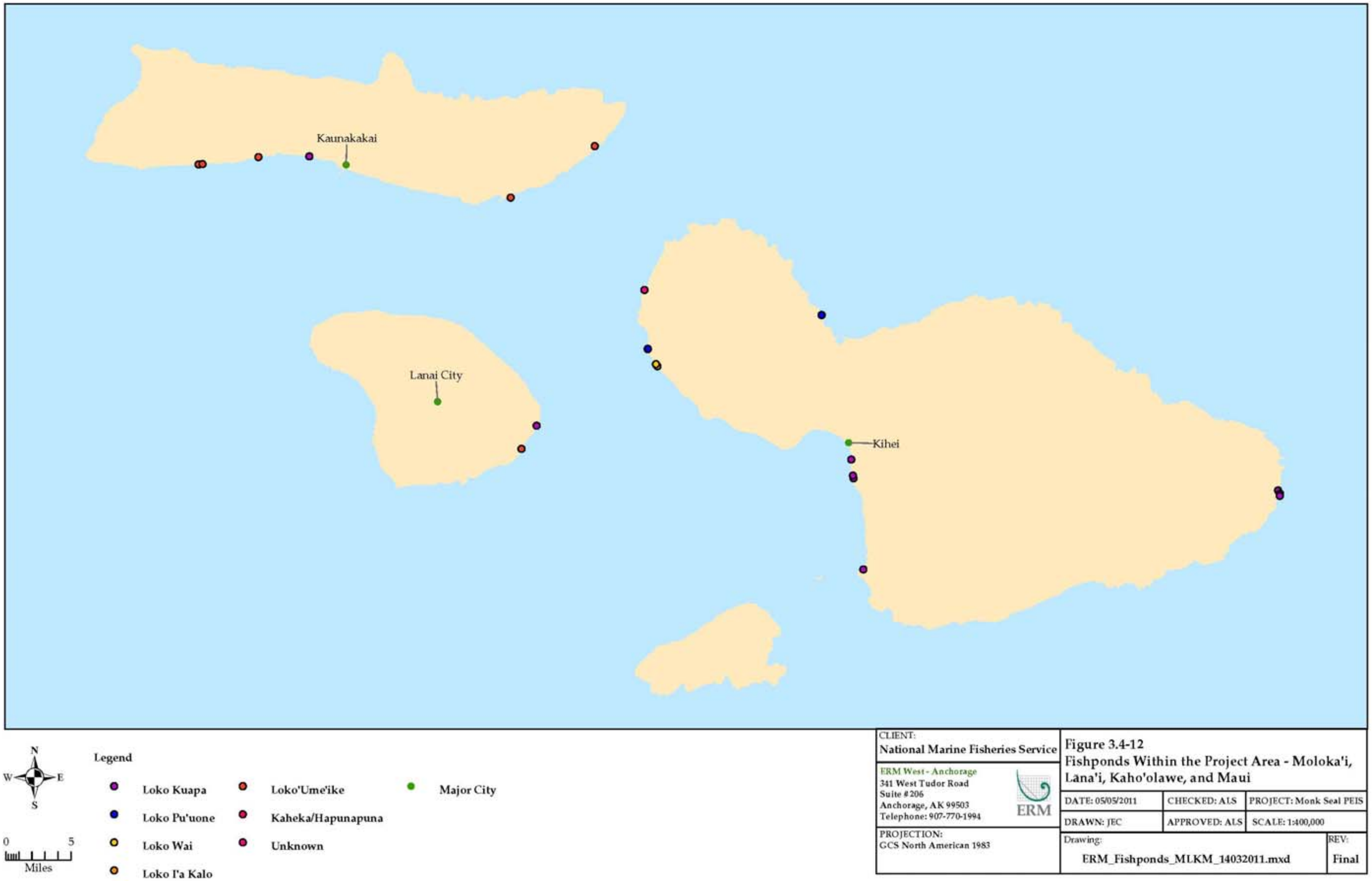


Figure 3.4-13   Fishponds Within the Project Area – O'ahu

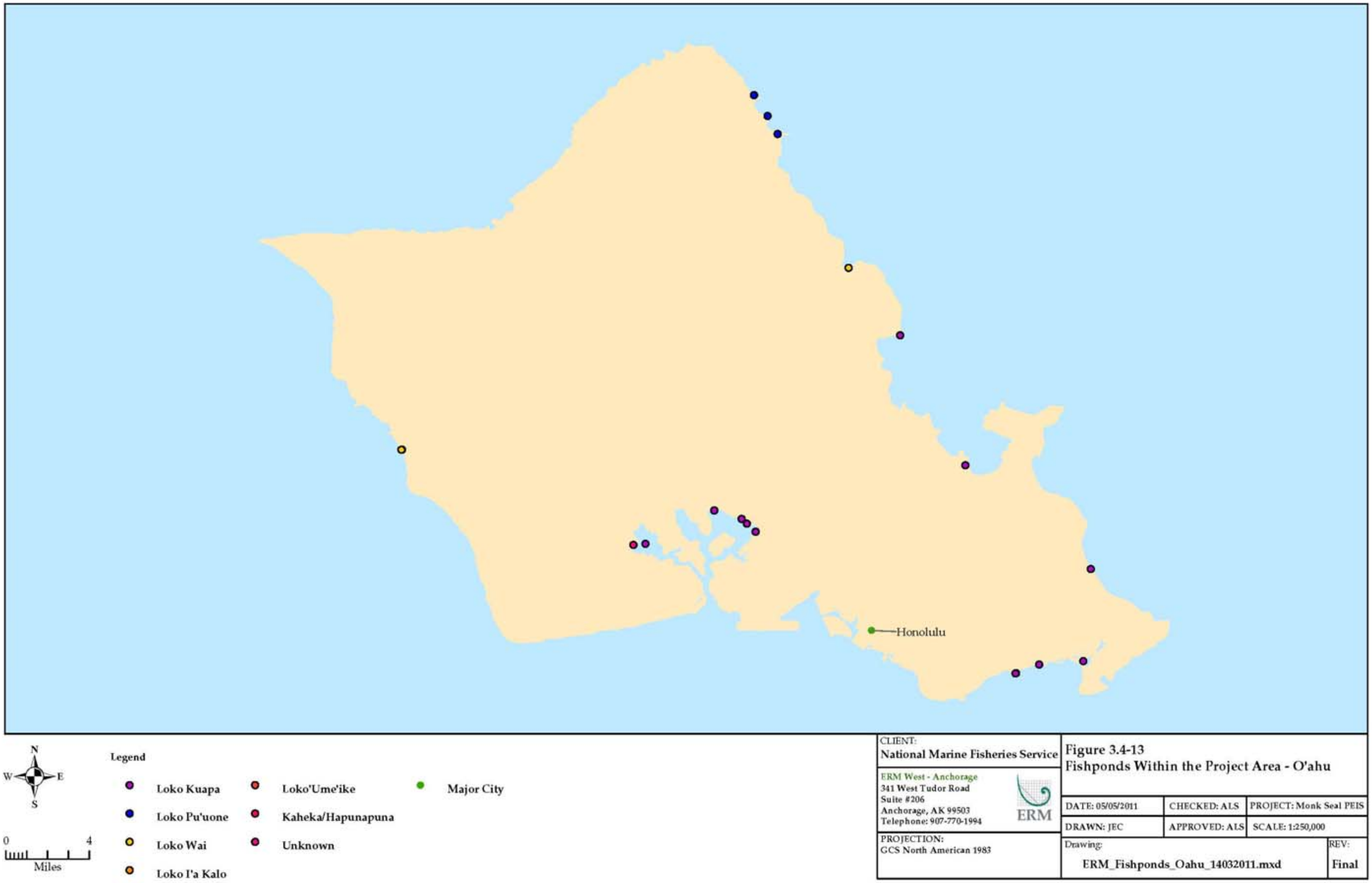


Table 3.4-7 Key Tourism Statistics for the State of Hawai`i and its Counties – January to November 2010 and Percent Change from January to November 2009

YTD thr Nov 2010	Hawai`i	% Change	Maui	% Change	Lāna`i 1/	% Change	Moloka`i 1/	% Change	O'ahu	% Change	Kaua`i	% Change	State Total	% Change
Total Arrivals	1,175,668	6.3%	1,904,904	10.3%	61,688	11.5%	45,710	4.3%	3,943,244	7.6%	883,841	4.0%	6,450,795	8.6%
Total Visitor Days	8,190,873	7.5%	15,182,809	10.7%	221,179	11.1%	218,005	4.3%	28,929,138	9.4%	6,559,176	5.3%	59,848,716	8.9%
Total Expenditures ($mil.)	1,299.1	18.1%	2,721.3	21.3%	62.2	11.1%	23.9	6.6%	5,146.9	13.7%	1,025.9	13.1%	10,304.8	16.0%
PPPD[2] Spending ($)	158.6	9.9%	179.2	9.5%	281.3	0.0%	109.4	2.1%	177.9	3.9%	156.4	7.4%	172.2	6.5%
Domestic Arrivals	898,806	3.7%	1,647,232	8.7%	52,409	9.6%	37,807	1.2%	2,359,802	5.4%	808,545	2.4%		
Int'l Arrivals	276,862	15.8%	257,672	21.6%	9,279	23.8%	7,903	22.6%	1,583,442	11.0%	75,296	24.0%		

Notes:

1/ Sample sizes for Moloka`i and Lāna`i are relatively small.

2/ PPPD - Per Person Per Day.

Source:

Hawai`i Tourism Authority, DBEDT-Research and Economic Analysis Division (2010). *November 2010 Visitor Spending Climbed 30.4 Percent.* December 28, 2010 (10-32).

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Recreation activities in Hawai`i are primarily centered around the ocean, while other non-ocean recreation is also popular. Ocean-based recreation includes surfing, pleasure boating (for various activities), fishing, swimming, snorkeling, SCUBA-diving, whale-watching, water-skiing, kite-boarding, kayaking, relaxing at beaches, and cruises, among others. The list of non-water recreation is also extensive, and includes, but is not limited to, hiking, golf, sightseeing, and hunting.

Various federal, state, and local agencies have specific roles and responsibilities for managing ocean-based recreation use in Hawai`i. Some of these include the USCG, NOAA, HLNR, Hawai`i State Department of Transportation, Hawai`i State Department of Health, and city and county governments (DOBOR 2009). Some of the regulatory tools for managing ocean-based recreation in the state include, among others, Designated Ocean Recreation Management Areas (ORMA), Non-Designated Ocean Recreation Management Areas, Fishery Management Areas, Local and Special Rules – Ocean Waters, Marine Life Conservation Districts, and Commercial Ocean Recreational Activity (CORA) permits (DOBOR 2009).

Select recreation resources in Hawai`i are presented in Table 3.4-8. The State of Hawai`i has many beaches and over 185 miles of sandy shoreline. Over 24 miles of this shoreline is safe, clean, accessible, and generally considered suitable for swimming. There are also 1,600 surfing sites throughout the state. There are a total of 55 wildlife sanctuaries and refuges. The 610 county parks extend over 8,553 acres, most of which are in O`ahu.

Ocean recreation in Hawai`i supports an $800 million industry (DOBOR 2011). As a result of population growth and demand for new products and destinations, ocean recreation in the state is increasing (DOBOR 2009). Economic and other data on most of these activities are older, sparse, and hard to obtain from public sources. A few older studies focusing on specific activities provide some information collected through surveys. Based on these, in 1999, the direct revenues from the ocean tour boat industry in the state were approximately $132 million (in 1999 dollars) (Utech 2000).

The tour boat industry includes whale watching, snorkeling, dinner cruises, and sunset cruises, and is a growing segment of Hawai`i's economy. The largest share of the revenue was from snorkeling tours (approximately $67 million) and dinner cruises (approximately $47 million). In geographical terms, tours in Maui brought in the highest revenue, followed by those in O`ahu. The total economic impact, including direct, indirect, and induced revenues was estimated to be $225 million (in 1999 dollars). The industry supported 3,232 jobs in 1999 (Utech 2000). Between 1990 and 1999, revenues from this industry in Big Island, Maui, and Kaua`i increased by 25% in real terms (Utech 2000).

Another large segment of ocean-based recreation industry in Hawai`i is the cruise industry. According to the U.S. Maritime Administration, Hawai`i was the seventh most popular cruise destination in North America in 2003 (DBEDT 2003). In 2003, over 83% of cruise visitors to Hawai`i were from within the United States, followed by Canada at 6.5% and Europe at 2.8%. The total direct economic impact of the cruise industry in Hawai`i in the same year (2003) was estimated at $268.7 million, with each cruise visitor brining about $157 into the state's economy per day. The largest impact was from out-of-state visitors, including cruise visitors and crew members, followed by that from cruise lines (DBEDT 2003). The direct, indirect, and induced effects from the cruise industry amounted to $390.5 million of Gross State Product in 2003, and the industry generated 4,582 jobs (DBEDT 2003).

Table 3.4-8 Select Recreation Resources in the Hawaiian Islands

Recreation Resources	Hawai`i	Maui	Lāna`i	Moloka`i	O`ahu	Kaua`i	Total
Swimming and Surfing Sites, by Island							
Miles of Sandy Shorelines[1]	19.4	32.6	18.2	23.2	50.3	41.2	184.9
Primary[2]	1.2	7.9	-	-	12.5	2.8	24.4
Other	18.2	24.7	18.2	23.2	37.8	38.4	160.5
Number of Surfing Sites[3]	185	212	99	180	594	330	1,600
State Parks and Historic Sites, 2009							
Number of State Parks and Historic Sites	19	8		2	30	10	69
Acreage of State Parks and Historic Sites	7,536.0	332.7		236.7	11,985.0	13,851.6	33,942
Developed Acreage of State Parks and Historic Sites	258.3	38.4		10.0	279.8	130.6	872.6
Recreation Visits per Year to State Parks and Historic Sites [4/]	1,237,000	1,069,000		8,000	2,745,000	2,271,000	7,330,000
Wildlife Sanctuaries and Refuges, by Island, 2009							
Number of Wildlife Sanctuaries and	8	11	4	6	19	7	55

Recreation Resources	Hawai`i	Maui	Lāna`i	Moloka`i	O`ahu	Kaua`i	Total
Refuges (excluding hunting areas)							
Acreage of Wildlife Sanctuaries and Refuges (1,000 acres) (excluding hunting areas)	83.3	0.3	Less than 50 acres	Less than 50 acres	0.6	10.5	94.8
County Parks, by Island, 2009							
Number of County Parks	126	112	4	13	288	67	610
Acreage of County Parks	1,734	1,070	14	100	5,148	487	8,553

Notes:
[1] Surveyed in 1962.
[2] Safe, clean, accessible, and generally suitable for swimming.
[3] Surveyed in 1971. A surfing site is defined as "a specific wave-breaking zone caused by a shoal and having sufficient consistency to be identified as a surfable riding area, either seasonally or in a combination of seasons, for example, Queen's Surf, Waikiki."
[4] Data represent the total number of visitors in 2008 per island with a year-to-date decrease by island for out-of-state visitors.
Source:
Department of Business, Economic Development & Tourism (DBEDT) (2009b). The State of Hawai`i Data Book 2009. Retrieved from http://hawaii.gov/dbedt/.

As presented in Table 3.4-9, there are seven major National Parks in Hawai`i, with a combined acreage of 369,111. In 2009, there were over 4.3 million visitors to these parks. The Hawai`i Volcanoes National Parks is the largest in terms of acreage and was visited by 1.2 million people. The most popular national park remains the U.S.S. Arizona Memorial, which got almost 1.3 million visitors in 2009.

Table 3.4-9 Acreage of and Visitation to National Parks in Hawai`i During 2009

National Park	Acreage			Visits
	Total	Federal	Non-Federal	
Hawai`i Volcanoes National Park 1/	323,431	323,431	-	1,233,105
Haleakala National Park	33,223	33,222	0.15	1,109,104
Pu'uhonua o Honaunau National Historical Park	420	420	-	397,665
Kaloko-Honokohau National Historical Park	1,161	616	545	166,380
Pu'ukohola Heiau National Historic Site	86	61	25	99,042
U.S.S. Arizona Memorial	11	11	-	1,276,868
Kalaupapa National Historical Park	10,779	23	10,756	30,654
Total	**369,111**	**357,784**	**11,326**	**4,312,818**

Notes:
1/ Federal land includes 9,654.67 acres under the custody and administration of the National Parks Service with their inclusion in the park pending.
Source:
DBEDT (2009b). The State of Hawai`i Data Book 2009. Retrieved from http://hawaii.gov/dbedt/.

Hawai`i also has many state parks, of which the seven major ones are listed in Table 3.4-10. The Wailua River State Park received the most recreation visits in 2009, followed by Waimea Canyon State Park. The largest state park in terms of acreage is the Na Pali Coast State Park, spread over 6,175 acres. The Kokee State Park has the most developed acres (55).

Table 3.4-10 Acreage of and Visitation to Major[3] State Parks in Hawai`i During 2009

State Park	Acreage		Recreation Visits (in 1,000) 1/
	Total	Developed	
Na Pali Coast State Park	6,175.0	4.0	304,456
Ahupua'a'O Kahana State Park	5,256.5	26.0	75,437
Kokee State Park	4,345.0	55.0	218,681
Waimea Canyon State Park	1,837.4	10.0	309,925
Kekaha Kai State Park	1,745.5	5.0	178,099
Sacred Falls (Kaluanui) State Park 2/	1,374.2	10.0	NA
Wailua River State Park	1,217.2	37.4	639,063

Notes:
1/ The total number of visitors by park was derived using the 2008 figure and decreasing it with an year-to-date percentage decrease by island in out-of-state visitors (2008 number calculated using 2007 HTA survey data).
2/ Park closed since May 1999.
3/ Parks having at least 500,000 recreation visits or 1,000 acres.
DBEDT (2009b). The State of Hawai`i Data Book 2009. Retrieved from http://hawaii.gov/dbedt/.

3.4.9 *Public Safety*

Since 1991, NMFS has documented 10 high profile cases of human-seal interactions involving habituated seals in the MHI (NMFS 2009). Of the 10 cases:

- Five involved seals that actually bit swimmers or divers (2003 – 2009);
- Two involved habituated seals conditioned by people through feeding and interactive play; and
- Three involved interactions with a mother protecting a dependent pup (NMFS 2011).

As the MHI seal population increases, human-seal interaction events are likely to continue and will require more attention and, in some cases, intervention from NMFS to protect both people and seals. Events in recent years where interactions have necessitated NMFS intervention, have often resulted from seals becoming socialized to humans. Prevention, mitigation and documented human-seal interactions are summarized in Table 3.4-11 below.

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Table 3.4-11 Prevention, Mitigation and Documented Human-Seal Interactions in the MHI (1991-2009)

Date	SEAL ID	Location	Type of Interaction Requiring Intervention	NMFS Response	Current Status
The following 2 seals remain in the MHI with no reported deleterious human-seal interactions post NMFS intervention to prevent socialization.					
August 2000	RH44	Poipu, Kaua`i	Human socialization concerns	Female weaned seal was translocated to Larson's beach after weaning to avoid socialization with people in high human density area.	Seal pupped on Moloka`i in 2007, 2008, 2010 and on Maui in 2009.
September 2000	RH58	Maha'ulepu, Kaua`i	Human socialization concerns	Female translocated to Larsen's Beach after weaning to avoid human socialization.	Seal pupped on Kaua`i in 2006, 2007, 2009 and 2010; observed on O`ahu 2011. No reports of interaction with humans since translocation.
The following seal remains in the NWHI with no reported deleterious human-seal interactions post NMFS intervention to prevent socialization.					
June 1991	RZ20	Waialee Beach Park, O`ahu	Female born near the mouth of a river with large outflow and potentially fatal conditions during a rainstorm.	Pup was initially translocated down the beach away from the river mouth. Due to proximity to a human-dense area and to prevent socialization with humans, the seal was translocated post weaning to Kure in June 1991.	Observed at Kure Atoll in 2008.
The following 6 seals have since died or disappeared, but had no reported deleterious human-seal interactions post NMFS intervention to prevent socialization.					
September 2000	RM68	Poipu, Kaua`i	Weaned in area with high human density.	Male translocated to Larsen's beach after weaning to avoid human socialization.	Last observed in 2001.

Date	SEAL ID	Location	Type of Interaction Requiring Intervention	NMFS Response	Current Status
September 2004	RI19	Maha'ulepu, Kaua`i	Human socialization concerns	Male translocated to Na Aina Kai after weaning to avoid human socialization.	Died from a gunshot wound April 2009.
September 2004	RI21	Poipu, Kaua`i	Human socialization concerns	Female translocated to Na Aina Kai after weaning to avoid human socialization.	Not resighted after 2004.
August 2005	R6AY	Hakalau, Big Island	Male born in close proximity to river mouth.	Due to disease concerns, the seal was captured and held in captivity for observation.	Died in captivity prior to release.
July 2006	RO32	Turtle Bay, O`ahu	Fishing line entanglement and human socialization concerns	Female translocated to Rabbit Island after weaning.	Died from entanglement drowning in October 2006.
July 2008	RW18	Mokuleia, O`ahu	Human socialization concerns	Male translocated to Rabbit Island after weaning to avoid human socialization.	Found dead at Waimanalo in October 2008.
The following 4 seals remain in the MHI with no further reported human-seal interactions post NMFS intervention.					
3/1/2003	R2AU	Poipu, Kaua`i	Three juvenile seals (2 male, 1 female) socializing among swimmers at Poipu Beach, Kauai.	Seals were tagged, instrumented with VHF transmitters and epidemiologically sampled. Seals were translocated to the north shore Kaua`i.	Seen on Kaua`i2008. No reports of interaction with humans since translocation.
3/1/2003	RH40	Poipu, Kaua`i	Three juvenile seals (2 male, 1 female) socializing among swimmers at Poipu	Seals were tagged, instrumented with VHF transmitters and epidemiologically sampled. Seals	Seen on Kaua`i2009.

Date	SEAL ID	Location	Type of Interaction Requiring Intervention	NMFS Response	Current Status
			Beach, Kauai.	were translocated to the north shore Kāuaʻi.	No reports of interaction with humans since translocation.
3/1/2003	R1AQ	Poipu, Kauaʽi	Three juvenile seals (2 male, 1 female) socializing among swimmers at Poipu Beach, Kauai.	Seals were tagged, instrumented with VHF transmitters and epidemiologically sampled. Seals were translocated to the north shore Kāuaʻi.	Seen on Oʽahu and Kauaʽi2009. No reports of interaction with humans since translocation.
September 1991	RZ22	Haena Pt., Kauaʽi	Female seal began socializing with swimmers post weaning.	Seal was translocated to Niʽihau in and re-sighted in 1994.	RZ22 was reported killed by a boat propeller prior to 1999.
The following 2 seals remain in the MHI but with continued human-seal interaction post NMFS intervention.					
10/1/2005	RV18	Kiahuna, Kauaʽi	Hooking	Male translocated to Kulikoa Pt. after weaning in October 2005 to avoid human socialization. Three separate dehooking events initiated by PIRO/PIFSC 2006–2008.	Observed on Kauaʽi in 2011.
11/1/2007	RB24	Maha'ulepu, Kauaʽi	Dog attack	Female seal was attempted to be translocated after weaning in November 2007 to avoid human socialization however the potential release site was deemed unacceptable and the seal was released at birth site. Seal was attacked by a dog in 2007 Maha'ulepu.	Observed on Kauaʽi in 2011.
The following 2 seals exhibited deleterious human-seal interactions but do not remain in the MHI due to death or disappearance. NMFS did not intervene in these					

Date	SEAL ID	Location	Type of Interaction Requiring Intervention	NMFS Response	Current Status
cases.					
April 1996 (seal birth date)	RP18	Kaneohe Bay Marine Corp Air Station, O`ahu	Male seal was reported socializing with humans. The seal began to move around the island post weaning.	Disappeared prior to NMFS planned translocation efforts.	Disappeared several moths post weaning in 1996.
9/1-17/1997	TEMP 700 ("Humpy")	Molokini	Seal, unknown sex, was reported interacting with snorkelers including biting, grabbing and mounting. Additional sightings of "Humpy" were reported although it was not clear if it is the same seal.	None	Permanent identification of the seal was not made therefore current status is unavailable.
8/1/1999	RD34	Pacific Missile Range Facility, Kaua`i	Female born in close proximity to a drainage canal.	Pup was tagged but not translocated August 1999.	Pup reported dead September 1999.
The following 4 seals do not remain in the MHI post NMFS intervention due to translocation out of the MHI, death, or placement into captivity.					
10/15/2003 – 12/1/2003	RM34	South Point, Hawai`i	Male born on the Big Island and became habituated to humans within first two years. Two separate fishing gear entanglements and dehooking events initiated by PIRO/PIFSC. First reported interaction on 15 October 2003 at Kealakekua Bay, Hawai`i.	Translocated back to birth location at South Point on 19 October 2003. Returned to Kealakekua Bay within seven days and re-initiated human interactions. Translocated to Kahoolawe Island on 28 October 2003. Observed at Big Beach, Maui on 18 November 2003, again interacting with humans. Recaptured on 21 November 2003 and moved to Kewalo Basin NMFS facility for holding. Translocated to Johnston Atoll on 1 December 2003.	Not relocated or detected via satellite tag following release in December 2003.
10/15/03 – 01/15/04	RK07	Nawiliwili Harbor, Kaua`i	Adult male approaching people at Nawiliwili Harbor to be fed. The first record of feeding was on 15 October 2003.	Observations of the seal were conducted and educational outreach for the community was provided in an effort to stop people from feeding	Last reported human interaction on

Date	SEAL ID	Location	Type of Interaction Requiring Intervention	NMFS Response	Current Status
			Anecdotal stories reported seal was fed beginning in 2001 although no reports were received at that time. Socialization with people also occurred at Waikaea canal in Kapaa at the boat ramp where feeding interactions most likely took place.	the seal.	15 January 2004. Found dead January 22, 2004. Cause of death systemic Toxoplasma gondii infection.
09/7/06 – 02.27 09	RO42	Black Point, Hawai`i	Female born on the Big Island near a stream mouth and translocated after weaning due to disease and habituation concerns.	The seal moved to Kapanai Beach where there was risk of human socialization as well as disease concerns due to proximity of freshwater stream. Animal then translocated a second time on 19 September 2006 three miles south of Lapakahi State Park but began interaction with the public. Captured on 24 August 2007 and translocated Keahaou however began interaction with people again. Translocated a fourth time on 26 August 2008 to Molokaʻi. Observed interacting with people on Lāna`i. Translocated a fifth time to captivity on Oahu 23 February 2009, translocated and released at Nihoa Island (NWHI) in February 2009.	Not re-sighted on Nihoa Islands following release.
February 2009 – Present	RW46 (KP2)	Kaunakakai Warf, Moloka`i	Male born to a mother who had abandoned first pup therefore second pup (KP2) was immediately taken into captivity and raised to wean. While in captivity he developed an eye problem, cause was never definitive. Seal was released at 8 months old to Kalaupapa, Molokaʻi on 15 December 2008. Two months post release reports of socialization with people at Kaunakakai Wharf.	Volunteers monitored area and used a palm frond and a loud voice to displace the seal when hauled out at the Kaunakakai Pier or other locations where interactions with humans occur. Seal was initially tracked by NMFS via satellite tag data and VHF location. Seal translocated 12 June 2009 back to Kalaupapa, Molokaʻi. Volunteers attempted educational outreach for the community in an effort to stop people from interacting with the seal. Veterinary exam during translocation attempt in October 2009 resulted in seal being held for	Held in captivity.

Date	SEAL ID	Location	Type of Interaction Requiring Intervention	NMFS Response	Current Status
				permanent captivity due to animals near blindness.	
Seal interactions with humans that involved biting and other aggressive behavior 2003-2009					
December 2009	N/A	Mahalepu'u, Kaua`i	Female with dependent pup attacked woman in the water; injury to woman's face and arm/hand	OLE investigation and response program investigation, NMFS and DAR staff also followed with woman	N/A
January 2009	R042	Kaumalapau, Lāna`i	Spearfisher diver sustained bite to the left calf through his wetsuit from a female seal that had been fed and interacted with by humans	NMFS relocated seal to NWHI (Nihoa Islands)	N/A
May 2007	N/A	Rabbit Island, O`ahu	Female with dependent pup bit a male swimmer on the arm when he got in close proximity to the seal pair	OLE investigation and response program investigation. Female is being monitored and when pupping occurs outreach is provided to public	N/A
September 2005	N/A	Poi'pu Beach, Kaua`i	Man was bit in buttocks after snorkeling in close proximity to female with dependent pup	Female is being monitored and when pupping occurs outreach is provided to public	N/A
October 2003	Temp700	Kealakakua Bay, Hawai`i	Male seal had been fed and interacted with by humans and was conditioned to human interaction. The seal was known for mounting, grabbing and nipping; one diver sustained bite wounds to the neck.	Seal was relocated to Johnston Atoll.	N/A

Note:
N/A = Data Not Available

Mitigation for human-seal interactions must consider the unique circumstances of each event and accordingly, use various techniques to minimize harm to humans and seals. NMFS prepared a "Technical Review of Aversive Conditioning and Monk Seal-Human Interactions in the Main Hawaiian Islands" (NMFS 2009) resulting from a workshop on the subject. The purpose of aversive conditioning is to change an animal's behavior by pairing a negative 'experience' with the undesired behavior to condition against the behavior (Shivik and Martin 2000). Methods used on monk seals must involve a detailed understanding of animal behavior and training techniques as well as the availability of aversive stimuli. The 2009 technical review provides an overview of mitigation techniques NMFS has historically used with monk seals to address interactions including, but not limited to:

Roping off small sections of beach around resting monk seals and/or pups (this area is typically approximately 80 ft in diameter or 5,072 square ft). Barriers (ropes) are removed once the seal(s) has left the area. most closures are up during daylight hours and removed when seals enter the ocean at night to feed;

- Translocation to remote areas; and
- Use of aversive stimuli to encourage seals to move away (for example, loud noises, motioning with palm fronds, etc).

As part of this PEIS, NMFS is considering other methods that will be effective to reduce human-seal interactions as described in Sections 2.6-2.10. An evaluation of potential impacts of human-seal interactions is provided in Sections 4.8.1 and 4.9.5.

3.4.10 Environmental Justice

Under EO 12898, Environmental Justice (59 CFR 7629), NMFS is required to identify if minority, low-income, or Native American populations are present in the action area. Using demographic data, if such populations are in the project area, a determination must be made whether or not carrying out the proposed action may cause disproportionately high and adverse human health or environmental impacts on those populations. The analysis of impacts is found in Section 4.9.6.

The Council on Environmental Quality (CEQ) defines the term "minority" as persons from any of the following U.S. Census categories for race: Black/Africa American; Asian, Native Hawaiian or Other Pacific Islander; and American Indian or Alaska Native. Additionally, for the purposes of this analysis, "minority" also includes all other nonwhite racial categories that were added to census definitions in the most recent (2000) censure, such as "two or more races."

The CEQ also mandates that persons identified through the U.S. Census as ethnically Hispanic, regardless of race, should be included in minority counts. Hispanic origin is considered an ethnicity, not a race; therefore Hispanics may be of any race. For the purposes of environmental justice analysis all persons except for “white, non-Hispanic” are considered “minority.” The Interagency Federal Working Group on Environmental Justice guidance states that a “minority population” may be present in an area if the minority percentage in the area of interest is “meaningfully greater” than the minority population of the general population (CEQ 1997).

For the purposes of this demographic analysis 2009 population estimates for the racial categories mentioned above were used, rather than 2000 census data. The Census Bureau's Population Estimates Program publishes population numbers annually between censuses to keep population data by age, sex, race, and Hispanic origin current. These data were deemed more meaningful for the purposes of this analysis.

Demographic analysis for Hawai`i covers each county separately, but is also aggregated into statewide totals. There are five counties; Kaua`i County, Honolulu County (City and County of Honolulu), Maui County, Kalawao County, and Hawai`i County.

Kaua`i County includes the privately owned Island of Ni`ihau that contains a small population of Native Hawaiians. Census data for Ni`ihau are not available separately, but are included in Kaua`i County totals. Kalawao County is located on the Kalaupapa Peninsula which encompasses a portion of the Island of Moloka`i. Kalawao County is a separate county from the rest of Moloka`i and Maui County. Maui County includes the islands of Maui, Moloka`i, and Lāna`i. While 2009 population estimates are used for Maui County totals, these data are not available for each island within Maui County. Therefore, data from the Census-Designated Places (CDPs) of Kaunakakai (Moloka`i) and Lāna`i City (Lāna`i) were used to provide population estimates. CDPs are delineated for each decennial census as the statistical counterparts of incorporated places. CDPs are delineated to provide census data for concentrations of population, housing, and commercial structures that are identifiable by name but are not within an incorporated place. CDP boundaries usually are defined in cooperation with state, local, and tribal officials.

Table 3.4-12 illustrates the racial and ethnic composition of the potentially affected communities by county and Hawai`i as a whole. The proportion of minority on the islands of Moloka`i and Lāna`i are 91.4% and 86.6% respectively. These proportions are significantly higher than Hawai`i in total, which has a minority population of 69.8%.

Table 3.4-13 illustrates the proportion of people with income considered below poverty in the potentially affected counties, as well as Hawai`i as a whole. The proportion of people with income below poverty level on the Island of Moloka`i, in Maui County, is 16.7% which is notably higher than other islands or counties which range from 8.3 percent to 13.3%. The State of Hawai`i proportion of people below the poverty level is 9.3%.

Table 3.4-12 Study Area Race and Ethnicity, 2009

	Kaua`i County**	City and County of Honolulu	Maui County			Kalawao County	Hawai`i County	State of Hawai`i
			Island of Maui*	**Moloka`i ***	**Lāna`i* Lāna`i City**			
Total Population	67,091	953,207	144,444	7,255	3,102	90	185,079	1,360,301
White	22,159	198,732	51,708	1168	435	24	62,348	336,599
	33.0%	20.8%	33.0%	16.1%	14.0%	26.7%	33.7%	24.7%
Black / African American	278	19,256	837	28	5	0	1,020	21,424
	0.4%	2.0%	0.4%	0.4%	0.2%	0.0%	0.6%	1.6%
American Indian / Alaska Native	254	2,438	581	20	2	0	869	4,164
	0.4%	0.3%	0.4%	0.3%	0.1%	0.0%	0.5%	0.3%
Asian	21,016	418,410	41,719	1,131	1,737	7	41,050	525,078
	31.3%	43.9%	31.3%	15.6%	56.0%	7.8%	22.2%	38.6%
Native Hawaiian / Other Pacific Islander	6,060	90,878	13,967	1,879	205	44	22,389	135,422
	9.0%	9.5%	9.0%	25.9%	6.6%	48.9%	12.1%	10.0%
Two or More Races	16,716	213,036	32,609	3,006	713	1	54,535	263,985
	24.9%	22.3%	24.9%	41.4%	23.0%	1.1%	29.5%	19.4%
Total Minority	**44,324**	**744,018**	**44,324**	**2,491**	**2,662**	**52**	**119,863**	**950,073**
	66.1%	**78.1%**	**66.1%**	**83.6%**	**85.8%**	**57.8%**	**64.8%**	**69.8%**
Hispanic / Latino*** (of any race)	6,315	77,433	14,960	496	254	1	21,383	120,842
	9.4%	8.1%	9.4%	6.8%	8.2%	1.1%	11.6%	8.9%

Notes:
*Maui County Total includes the islands of Maui, Moloka`i, and Lāna`i. Moloka`i and Lāna`i census data presented here includes West Moloka`i, East, Moloka`i, and Lāna`i City Census-Designated Places.
**Kaua`i County includes the Island of Ni`ihau
***Hispanic origin is considered an ethnicity, not a race. Hispanics may be of any race.
Source:
U.S. Census Bureau, American FactFinder, Census 2010.

Table 3.4-13 Study Area Income Below Poverty Level, 2008

	Kaua`i County**	Honolulu County	Maui County			Kalawao County	Hawai`i County	State of Hawai`i
			Maui County Total*	Moloka`i * Kaunakakai	Lāna`i* Lāna`i City			
Total Population	64,529	907,574	145,157	2,726	3,164	83	177,835	1,295,178
Persons Below Poverty Line	9.9%	8.50%	9.0%	16.7%	8.3%	0%	13.3%	9.3%

Notes:
*Maui County Total includes the islands of Maui, Moloka`i, and Lāna`i. Moloka`i and Lāna`i census data presented here includes Kaunakakai and Lāna`i City Census-Designated Places.
**Kaua`i County includes the Island of Ni`ihau
Source:
U.S. Bureau of Census: 2008 Estimate.

3.4.11 Sanctuaries, Monuments, and Refuges

The State of Hawai`i has a system of conservation areas that include wildlife and marine sanctuaries, monuments, parks, refuges, natural area reserves, and marine life conservation districts (see Figure 3.4-13). These public lands have a variety of management structures, jurisdictional authorities, and permit requirements. The following section highlights the public lands and their managing agencies that NMFS interacts with more frequently and where notable overlap of boundaries and/or jurisdictions exist regarding monk seals and their management.

3.4.11.1 Hawaiian Islands Humpback Whale National Marine Sanctuary

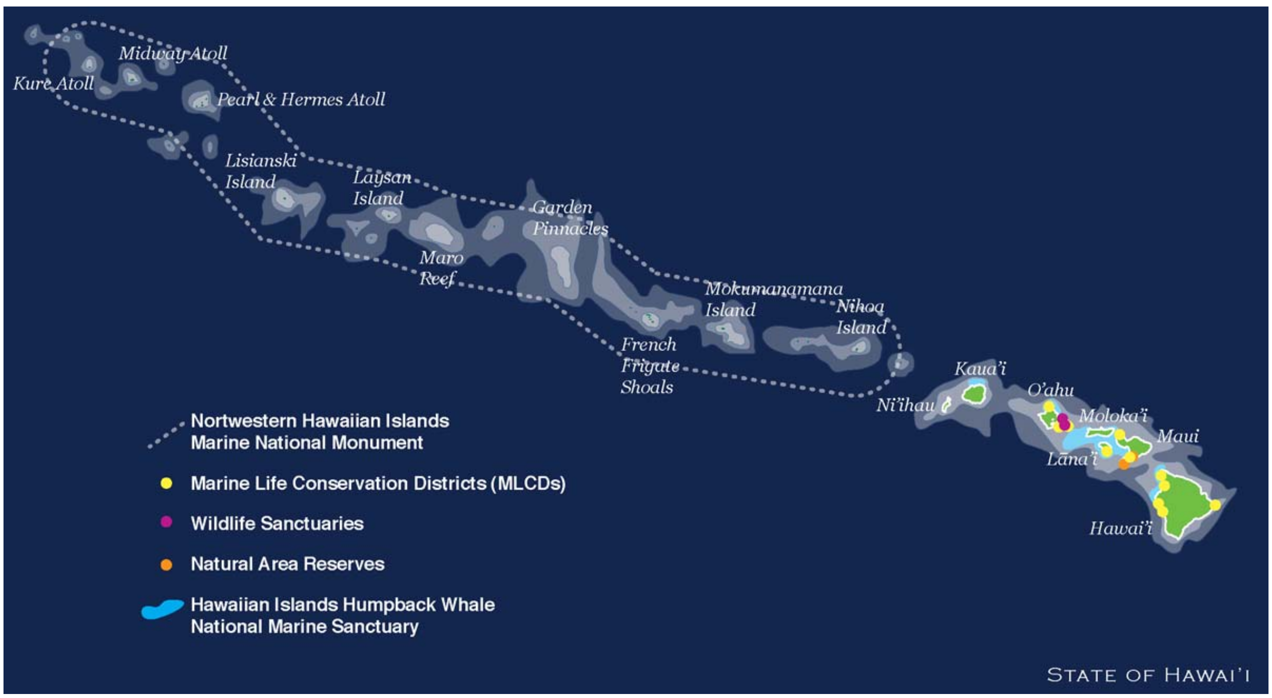
The HIHWNMS was established in 1992 by the Hawaiian Islands National Marine Sanctuary Act and is managed by the NOAA National Ocean Service (NOS), ONMS in co-management partnership with the State of Hawaii, Department of Land and Natural Resources. The primary purpose of the HIHWNMS is to protect humpback whales and their habitat.

The Revised Management Plan (2002) identified a strategy to "develop and implement a process that identifies and evaluates resources for possible inclusion in the sanctuary." This strategy is derived from the Hawaiian Islands National Marine Sanctuary Act Section 2304(b)(4), which required this be done. The Revised Management Plan (2002) committed to addressing this requirement, and the plan notes public support at Sanctuary Advisory Council meetings to include other marine species such as the monk seals.

With the current management plan revision, the addition of monk seals (and other species) is being evaluated and as such, NOAA NOS must coordinate efforts with NMFS to develop and/or adjust the focus of appropriate Sanctuary programs, "including expansion of the scope and type of research, monitoring, education, and outreach programs; enforcement efforts, and the use of management tools such as zoning" (NOAA NOS 2002).

NOAA NOS must also consult with NMFS to comply with Section 7 of the ESA with regard to monk seals any time the management plan is revised which is currently underway. The consultation must occur to review the possible effects to monk seals that could result from preparation and implementation of the revised management plan and any new rules. Resulting mitigation from the consultation would direct NOAA NOS' management activities with regard to monk seals.

Figure 3.4-14 Sanctuary and Conservation Areas Map



Source: Hawai`i DLNR 2010

3.4.11.2 *Papahānaumokuākea Marine National Monument*

Established on June 15, 2006 by Presidential Proclamation of President George W. Bush, the Monument is co-managed by U.S. DOC NOAA NOS, the USFWS, and the Hawai`i DLNR. The Monument boundaries surround the NWHI as one of the world's largest marine protected areas, and is home to several endangered and threatened species. The NWHI are considered a sacred place for many Native Hawaiian people and Nihoa and Mokumanamana Islands have many *wahi kūpuna* (ancestral sites) (PMNM 2008). Because of the Monument's outstanding and unique natural and cultural qualities significant to the international community, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) designated it a World Heritage Site in July 2010 (UNESCO 2011).

Research scientists wishing to conduct research and/or enhancement activities within the Monument are required to obtain a Research Monument Permit. The permit allows the permit holder to conduct their permitted activities within the Monument. The permit also covers activities that are proposed in the Hawaiian Islands National Wildlife Refuge, the Midway Atoll National Wildlife Refuge, Battle of Midway National Memorial, Northwestern Hawaiian Islands State Marine Refuge, Kure Atoll Hawai`i State Seabird Sanctuary, and the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve as these conservation units are within the Monument boundaries. The permit applications must go through a public process and any regulatory and agency reviews (PMNM 2008). Notably, the Office of Hawaiian Affairs review all permit applications from a cultural perspective (Johnson personal communication 2011).

3.4.11.3 Hawaiian Islands National Wildlife Refuge

USFWS manages the Hawaiian Islands National Wildlife Refuge, which was established in 1909 by an executive order from President Theodore Roosevelt. The Refuge includes the NWHI excluding Midway and Kure Atolls; thus its boundaries coincide with the Monument. The eight islands, reefs, and atolls within the Refuge provide habitat for monk seals and other threatened and endangered species like the Hawaiian green turtle and endemic songbirds and waterfowl. Much like the Monument, the Refuge includes unique cultural resources (USFWS 2011).

The Refuge is not open to public visitation nor are there any human inhabitants. As with the Monument, research scientists must obtain a Research Monument Permit to conduct their activities within the Refuge. The permit process is conducted through the Monument (USFWS 2011). A description of research camps in the Monument is provided in Section 3.3.1.9.

3.4.11.4 Kalaupapa National Historic Park

Hawaiian monk seals have established a year-round resident and breeding population on the Kalaupapa Peninsula, "has emerged as a premier birthing location for the seals in the MHIs" (NPS 2010). The Kalaupapa National Historic

Park (NHP) was established in 1980 on the north shore of Moloka`i on the remote Kalaupapa Peninsula below 2,000-foot sea cliffs. The Kalaupapa NHP is about 10,700 acres of non-federal land. NPS co-manages the NHP with the Hawai`i DOH. As part of the NPS management structure, several cooperative agreements exist with the land owners, which include the Hawai`i Departments of Health, Transportation, Land and Natural Resources, and Hawai`i Homelands. Specifically, NPS operates, preserves, and protects the park and the Hawai`i DOH provides health services to the residents. The Moloka`i Lightstation is owned and operated by the USCG (NPS 2011 and NPS 2010).

Although NPS does not have management authorities concerning monk seals, NPS must consult with NMFS to comply with Section 7 of the ESA within the context of implementing its various management duties (for example, with the recent proposal to repair the existing dock structures). NPS management activities are bound by mitigation required resulting from consultation. NPS also cooperates and assists NMFS with protecting hauled out seals.

3.4.11.5 Hawai`i State Marine Life Conservation Districts

The Hawai`i DLNR, DAR manages 11 Hawai`i State Marine Life Conservation Districts (MLCD) on O`ahu, Hawai`i, Lāna`i, Maui, and Molokini. The first MLCD was established in 1967 at Hana`uma Bay on O`ahu. These districts have restricted uses but allow some fishing and consumptive uses (DLNR DAR 2011). DAR consults and coordinates with NMFS when necessary and appropriate with regard to their management actions that could affect monk seals.

3.4.12 Military Activities within the Project Area

This section provides information on military installations within Hawai`i. Detail on individual installations is organized based on the five branches of the military including; U.S Air Force, U.S. Army, USCG, U.S. Marine Corp and the U.S. Navy. Only those installations located along the shoreline or have training exercises within the Pacific Ocean have been highlighted and discussed.

The military is the second most important sector to the Hawaiian economy, behind only tourism. The military contributes more than $4.6 billion annually to the Hawaiian economy and employs 27,000 civilians. There are an estimated 55,000 active duty military, 65,000 family members and 10,000 National Guardsmen in Hawai`i. Furthermore, in Hawai`i there are 13,000 retirees and 101,000 veterans receiving more than $55 billion in benefits from the U.S. government (U.S. Department of the Navy 2008).

3.4.12.1 *Air Force*

The Air Force has one base located in Hawai`i, the Hickam Air Force base, which is currently under reorganization with Naval Base Pearl Harbor. Details regarding Hickam Air Force Base are discussed below.

<u>Hickam Air Force Base (O'ahu)</u>

Hickam AFB is a 2,850 acre base located next to the Honolulu International Airport along the eastern shore of Pearl Harbor. The base is home to the 15th Airlift Wing and 67 partner units (U.S. Department of the Navy 2008a).

As part of a realignment strategy of the Base Closure and Realignment Commission, Hickam AFB and Naval Station Pearl Harbor are realigning to establish Joint Base Pearl Harbor-Hickam (U.S. Department of the Navy 2010). The individual mission areas of each branch will remain the same, while the installations management functions will be combined. In total, the combined land area of the establish Joint Base Pearl Harbor-Hickam will be approximately 27,700 acres. Hickam AFB has approximately one mile of shoreline.

3.4.12.2 *Army*

The U.S. Army Garrison-Hawai`i consists of Fort Shafter and Schofield Barracks communities, which include many other installations and sites (U.S Department of the Army 2010). Including active military, civilian, contractors and retirees, the Army population in Hawai`i is over 93,000 people with nearly 190,000 acres of land within Hawai`i (U.S Department of the Army 2010).

The two Army installations that directly border the shoreline include Makua Military Reservation and Dillingham Military Reservation. The Sikes Act requires that each military facility complete and implement an Integrated Natural Resource Management Plan ("Resource Plan") unless there is a significant lack of natural resources at those installations (US Army 2001). The Army has completed Resource Plans for both the Makua Military Reservation and Dillingham Military Reservation. Personal communication with a NMFS Marine Mammal Response representative reveals that the Army has not had any Hawaiian monk seal response events on their installations in Hawai`i (NMFS, personal communication 2011).

<u>Makua Military Reservation (O'ahu)</u>

Makua Military Reservation is an Army facility located on 4,190 acres in the Makua Valley on the northwestern side of O`ahu and has approximately two miles of shoreline (U.S Department of the Navy 2008a).

Since 2004, the use of Makua Military Reservation has been limited to non live-fire training including unmanned aerial vehicle training, blank ammunition training, and engineer training. The area has also been used as a staging base for ground or air movement, and to control elements for activities elsewhere in Hawai`i. A Record of Decision (ROD) for an increase in training activities at the Makua Military Reservation was approved in July of 2009. This ROD approves for up to 32 combined arms live-fire exercises (CALFEX) and 150 convoy live-fire exercises (LFX) per training year at the site (U.S. Army Environmental Command *et al.* 2009a).

The U.S. District court has recently found that the Army violated agreements required for its EIS to conduct a subsurface archaeological survey of areas within the Makua Military Reservation. Furthermore, the court ruled that the Army did not adequately study the effects of training activities on the *limu* along the shoreline of the area. Addition litigation surrounding increased military training on subsistence activities is scheduled for February 23, 2011 (Kobayashi 2010).

The Makua Military Reservation Resource Plan does not identify Hawaiian monk seals as being found on the Makua Military Reservation (US Army 2001). However, the recently completed EIS stipulates that the shore adjacent to the military reservation provides suitable habitat for Hawaiian monk seals (U.S. Army Environmental Command *et al.* 2009a). The EIS also claims that there has been at least one anecdotal sighting of and monk seal at the beach.

Mitigation measures for the Preferred Alternative identified in the Makua Military Reservation final EIS include:

- The Army will inspect Makua Beach immediately prior to training exercises and will not begin a training exercise if there are Hawaiian monk seals present; and
- Additional mitigation measures beyond those proposed for ground training may be incorporated after informal consultation with NOAA.

The Makua Military Reservation Resource Plan provides that the current management for endangered species includes surveying, monitoring, protection and the management of the natural communities from military training. The Army proposes to survey for new rare vertebrate species in unsurveyed areas and establish and update GIS information for rare invertebrates at the Makua Military Reservation. Furthermore, the Army proposes to monitor and determine military impacts on threatened, endangered and rare vertebrates at the Makua Military Reservation.

Dillingham Military Reservation (O'ahu)

The Dillingham Military Reservation is located on a 664 acres parcel of land with a beach and airfield near the northwestern corner of O'ahu and is approximately one mile north of the Makua Military Reservation. Mokuleia Beach borders the Dillingham Military Reservation for approximately one mile, but due to the heavy surf and coral beds amphibious training does not occur. (Global Security 2011h) There are no resident rare animal species documented at the Dillingham Military Reservation (U.S. Army 2001). Despite this, Hawaiian monk seals may potentially use the reservation or adjacent areas (U.S. Army 2001). Current management for threatened, endangered and rare vertebrates on the Dillingham Military Reservation includes surveying, but monitoring and management of rare species is not possible because no such populations have been identified.

3.4.12.3 Coast Guard

USCG District 14 is headquartered in Honolulu, Hawai`i. The USCG is the only military branch organized under the Department of Homeland Security. Under the USCG natural resource policy, the USCG must obtain all the necessary permits and conduct consultations with NMFS when preparing for work that may impact marine mammals, such as the construction or maintenance of structures along beaches. The USCG is also required to notify the chain of command when prohibited encounters with marine mammals occur (USGC 1997).

Under the Marine Mammal Health and Stranding Response Program (MMHSRP), NMFS and USCG have a Memorandum of Understanding (MOU), where the USCG assists NMFS with marine mammal response. The USCG provides transport via vessel or aircraft for NMFS to translocate monk seals; between three to five seals are transported by the USCG annually (NMFS Response Coordinator pers. comm. 2011). These translocation activities are conducted under the MMHSRP permit 932-1905 and are separate from the translocation activities considered in this PEIS.

Air Station Barbers Point (O'ahu)

The USCG is stationed at Air Station Barbers Point on Kalaeloa Airport in Honolulu on a former Navy base and is located along approximately three miles of shoreline. However, the Air Station is self-contained and separated from the shoreline by a highway. NMFS is responsible for HMS response along this section of shoreline. The USCG Air Station Barbers Point is the only Coast Guard Air Unit in Hawai`i and is responsible for search and rescue missions over a vast area of the Pacific including the Hawaiian Islands, Marianas, Caroline and the Marshalls. Air Station Barbers Point has four Aerospatiale HH-65A helicopters and four Lockheed HC-130H aircraft (U.S. Department of the Navy 2008a; Global Security 2005d).

3.4.12.4 *Marine Corp*

The Marine Corps has one base in Hawai`i along with an installation at Bellows Airfield. These facilities, which are located along the shoreline, are discussed below. The INRMP guides implementation of Marine Corps Base Hawaii (MCBH) integrated natural resource management program on their properties. Objectives of the MCBH INRMP outline the MCBH Environmental Departments management actions, which describe the incorporation of the marine mammal policy into base plans, projects and protocols as appropriate.

In total, MCBH properties have 12.5 miles of shoreline and coastal and MCBH resource responsibilities extend seaward from Mokapu Peninsula shoreline for 500 yards. Therefore, it is assumed that the MCBH manages approximately four square miles of nearshore area. Amphibious training maneuvers are conducted along the coastal areas of the MCBH in order to prepare USMC personnel for forced entry by sea (U.S. Marine Corps 2006). HMSs regularly come ashore on the MCBH-Kaneohe Bay beaches to rest. Furthermore, in 1996 there was a documented birth of a HMS pup at this location.

NMFS and the MCBH have a standing agreement where U.S. Marine Corps personnel notify NMFS in the event a HMS is located along MCBH shoreline. MCBH personnel cordon off the area where the HMS is located and notifies NMFS. A photo is then taken by either NMFS or MCBH personnel for documentation. (NMFS Response Coordinator personal communication 2011)

<u>Marine Corps Base Hawai'i (O'ahu)</u>

The MCBH is a 2,951 acre site on the Mokapu Peninsula, which is located along the southeastern shoreline of O`ahu. A large portion of the base is designated as urban and is located approximately 12 miles northeast of Honolulu (Global Security 2005e). As of 2005, there are approximately 10,000 marines and navy personnel stationed at the base (Global Security 2005f).

<u>Marine Corps Training Area/Bellows (O'ahu)</u>

The Marine Corps Training Area/Bellows is located on 1,078 acre site on the southeastern portion of O`ahu. The onsite airfield is inactive; however, it is occasionally used for Marine Corp helicopter training (U.S. Department of the Navy 2008a).

3.4.12.5 Navy

The Navy has the largest military presence in Hawai`i and contributes more than $2 billion to the local economy annually. The Navy accounts for more than 15,000 military personnel and over 10,000 civilian employees in Hawai`i (U.S. Department of the Navy 2011a). As of 2008, the United States Department of the Navy conducted more than 9,300 training and Research, Development, Test and Evaluation activities around Hawai`i each year (U.S. Department of the Navy 2008a).

The Navy's application to NMFS for authorization to incidentally harass marine mammals outlines the Navy's mitigation measures for acoustic effects and training exercises (U.S. Department of the Navy 2007). During anti-submarine warfare events, Navy ships have two or more personnel on watch. The bridge team has at least three officers whose responsibilities include observing the water. When marine mammals are close, operating procedures are implemented to avoid adverse effects, including the shutting down of active sonar operation. The Navy requires marine species awareness as part of its training for its bridge lookout personnel on ships and submarines as required training for Navy lookouts.

NMFS has a Protocol and Communication Plan with the Navy pertaining to training exercises and they are currently in the process of drafting an MOU (NMFS personal communication 2011). The Navy notifies NMFS 72 hours prior to major training exercises (NMFS personal communication 2011). NMFS and the Navy have a standing agreement where Navy personnel notify NMFS in the event a HMS is found along Navy installation shorelines. Navy personnel cordon off the area where the seal is located and notify NMFS. A photo is then taken by either NMFS or Navy personnel for documentation (NMFS personal communication 2011).

If major exercises must occur in an area where conditions may contribute to marine mammal stranding, the conditions must be fully analyzed in environmental planning documentation (U.S. Department of the Navy 2007). The Navy will also use aircraft to survey the area and detect marine mammals prior to the use of the area by exercise participants. Advance survey should occur within about two hours prior to mid-frequency active sonar use, and periodic surveillance should continue throughout the exercise. Unusual conditions, such as presence of sensitive species, should be reported to the Office in Tactical Command (OTC), who should give consideration to delaying, suspending or altering the exercise.

The Letter of Authorization for the taking of marine mammal's incidental to U.S. Navy training in Hawai`i Range Complex was issued on January 20, 2011 and expires on January 12, 2012. This permit allows for the take of 121 monk seals through level B harassment (NMFS 2001).

Kaula

Kaula is an uninhabited island located approximately 50 miles southwest of Kaua`i Island. The federally owned island is approximately 108 acres in size. The Navy uses approximately 10 acres along the south side of the island for aircraft gunnery and target practice (U.S. Department of the Navy 2008a).

Pacific Missile Range Facility (Kaua'i)

The Pacific Missile Range Facility is the world's largest instrumented range capable of supporting surface, subsurface, air and space operations simultaneously (U.S. Department of the Navy 2011c). There are over 1,100 square miles of instrumented underwater range and 42,000 square miles of controlled airspace.

The Pacific Missile Range Facility is located on the west side of Kaua`i, where the majority of Pacific Missile Range Facility's facilities and equipment are located upon the 1,925 acre main base (U.S. Department of the Navy 2008a). The facilities that support Pacific Missile Range Facility range operations include Kaua`i Test Facility, Makaha Ridge, Kokee, Hawai`i Air Nation Guard Kokee, Kamokala Magazines, Port Allen, Kiliaola Small Boat Harbor and Mt. Kahili.

A recently issued Record of Decision for the Hawai`i Range Complex EIS/Overseas EIS states that the number of Pacific Missile Range Facility training events and Research, Development, Test and Evaluation programs will be increasing effective June 26, 2008 (U.S. Department of the Navy 2008a).

Puuloa Underwater Range (O'ahu)

The Puuloa Underwater Range is a 2 square nm underwater demolition area. Puuloa Underwater Range is located near Ewa Beach, west of the entrance to Pearl Harbor. The range is located in water depths ranging from 9 feet to 228 feet, while the majority of the range is in water less than 39 feet deep (U.S. Department of the Navy 2008a).

Naval Defensive Sea Area (O'ahu)

The Naval Defense Sea Area is the restricted area extending outward from the mouth of Pearl Harbor and encompasses an area of approximately ten square miles. No vessels are allowed into Naval Station Pearl Harbor without permission of Commander Naval Region Hawai`i. The Naval Defense Sea Area is used for underwater training and Research, Development, Test and Evaluation activities (U.S. Department of the Navy 2008a).

Ewa Training Minefield (O'ahu)

The Ewa Training Minefield is a surface ship mine avoidance training area located offshore of Ewa Beach on O`ahu and is approximately ten square miles in size (U.S. Department of the Navy 2008a).

Barbers Point Underwater Range (O'ahu)

The Barbers Point Underwater Range is located offshore from the USCG Air Station and the Kalaeloa Airport on O`ahu and encompasses an area of approximately one square mile (U.S. Department of the Navy 2008a).

Naval Underwater Warfare Center (O'ahu)

The Naval Underwater Warfare Center, Shipboard Electronic Systems Evaluation Facility range is located off of Barbers Point on O`ahu and is approximately 35 square miles in size. The range is used to test combat systems which emit electromagnetic radiation. Furthermore, the NUWC conducts tests within the Fleet Operations Readiness Accuracy Check Site, which is an area approximately 30 square miles in size. The Naval Underwater Warfare Center Range control officer conducts visual lookout and radar searches of the Fleet Operations Readiness Accuracy Check Site range to determine if non-participating vessels are located within the area (U.S. Department of the Navy 2008a).

Naval Station Pearl Harbor (O'ahu)

Naval Station Pearl Harbor is a 25,170 acre site located on the southern shore of O`ahu (U.S. Department of the Navy 2008a). Furthermore, Naval Station Pearl Harbor hosts a population of approximately 35,000.

The Harbor is divided into three lochs; the West Lock, Middle Lock and East Loch. A major portion of the area adjacent to ship berthing and repair areas is used for maintenance, supply and storage (U.S. Department of the Navy 2008a). The base is currently undergoing realignment with the neighboring Hickam AFB as previously described. Pearl Harbor has nearly ten square miles of water and approximately 40 miles of shoreline.

Lima Landing Range (O'ahu)

Lima Landing Range is located within Joint Base Pearl Harbor-Hickam and is used a small underwater demolition training area. This range is less than one square mile in size. At this time, approximately five training events occur each year at the site (U.S. Department of the Navy 2008a).

Shallow-water Minefield Sonar Training Area (Maui)

The Shallow-water Minefield Sonar Training Area is used by Pearl Harbor based submarines to conduct mine sonar training and is approximately two square miles in size. Submarines utilize high-frequency active sonar and training can occur when marine mammals are present (U.S. Department of the Navy 2008a).

Kawaihae Pier (Hawai'i)

Kawaihae Pier is one of two deep water ports located on the island of Hawai`i. Expeditionary assault events are conducted by the Navy at the pier and primary activities include the loading and unloading of vehicles and equipment from vessels (U.S. Department of the Navy 2008a).

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