# Proposed Designation of Critical Habitat for the Endangered Main Hawaiian Islands Insular False Killer Whale Distinct Population Segment

# Draft Biological Report


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## LIST OF ACRONYMS

| | |
|---|---|
| CHRT | Critical Habitat Review Team |
| DOD | Department of Defense |
| DPS | Distinct Population Segment |
| EPA | Environnemental Protection Agency |
| ESA | Endangered Species Act |
| IFKW | Insular False Killer Whale |
| INRMP | Integrated Natural Resource Management Plan |
| MHI | Main Hawaiian Islands |
| NMFS | National Marine Fisheries Service |
| NPDES | National Pollutant Discharge Elimination System |
| NWHI | Northwestern Hawaiian Islands |
| OTEC | Ocean Thermal Energy Conversion |
| PIRO | Pacific Islands Regional Office |
| POPs | Persistent Organic Pollutants |

# EXECUTIVE SUMMARY

The Endangered Species Act (ESA) requires that, to the maximum extent prudent and determinable, critical habitat be designated endangered and threatened species based on the best scientific data available. This report contains a biological assessment in support of a proposed critical habitat designation for the endangered Distinct Population Segment (DPS) of main Hawaiian Islands (MHI) insular false killer whale (IFKW), *Pseudorca crassidens*. The National Marine Fisheries Service (NMFS) convened a critical habitat review team (CHRT) consisting of five NMFS biologists to evaluate critical habitat for the MHI IFKW DPS. Members of the team were tasked with using the best scientific data and knowledge available to 1) determine the geographical area occupied by the species, 2) identify habitat features essential to the conservation of the species, and 3) delineate specific areas within the geographical area occupied that contain at least one essential habitat feature that may require special management considerations or protection.

The CHRT defined the geographical area occupied by the species as island-associated marine areas in a minimum convex polygon of a 72 km radius (~39 nautical miles) extending around the MHI, with the offshore extent of the radii connected on the leeward sides of Hawaii Island and Niihau as described in Bradford *et al.* 2015 and the NMFS Stock Assessment Report (Carretta *et al.* 2016) (see Figure 3).

The CHRT identified physical and biological features essential to conservation of MHI IFKWs (essential features):

1) Island-associated marine habitat;
2) Prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth;
3) Waters free of pollutants of a type and amount harmful to MHI IFKWs; and
4) Habitat free of anthropogenic noise that would significantly impair the value of the habitat for false killer whales use or occupancy.

Within the geographical area occupied, the CHRT identified areas under consideration for critical habitat which contain at least one essential feature to include waters surrounding the MHI between the 45-m depth contour and the 3200-m depth contour (see Figure 5). The following sections discuss this in further detail: GEOGRAPHICAL AREA OCCUPIED BY THE SPECIES AND SPECIFIC AREAS WITHIN THE GEOGRAPHICAL AREA OCCUPIED and CRITICAL HABITAT REVIEW TEAM).

Critical habitat designations increase the protections for listed species by bringing awareness to the species' habitat needs and by insuring that federal agency activities are not likely to result in destruction or adverse modification of designated areas. The restriction on destruction and adverse modification of designated critical habitat are specific to federal agencies. The consultation process identified in section 7 of the ESA and outlined in joint NMFS and U.S. Fish and Wildlife regulations (50 CFR 402) establishes a method for avoiding and minimizing impacts to critical habitat. In addition to these identified protections, critical habitat designations may allow for informed natural resource planning for all stakeholders utilizing these areas.

This report summarizes the available data on MHI IFKW presence, distribution, ecological needs, and use of the identified areas as well as the CHRT's process for determining these areas as meeting the definition of critical habitat for this endangered DPS. The assessment and findings provided in this report, in conjunction with other agency analyses (e.g., economic analyses), support NMFS' proposal to designate critical habitat for the MHI IFKW DPS.

## ACKNOWLEDGEMENTS

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# BACKGROUND

On November 28, 2012, the National Marine Fisheries Service (NMFS) published a final rule listing the MHI IFKW (*Pseudorca crassidens*) Distinct Population Segment (DPS) as endangered under the Endangered Species Act (ESA) (77 FR 70915). Section 4(a)(3)(A) of the ESA (16 U.S.C. 1533(a)(3)(A)) requires that, to the maximum extent prudent and determinable, critical habitat be designated concurrent with the listing of species as endangered or threatened. Section 4(b)(2) of the ESA requires that critical habitat determinations are based on the best scientific data available.

NMFS identified five steps to move forward with the designation, including the following:

(1) Determine the geographical area occupied by the DPS at the time of listing;
(2) Identify the physical or biological features essential to the DPS' conservation;
(3) Delineate areas within the geographical area occupied by the species that contain these features, and that may require special management considerations or protections;
(4) Delineate any areas outside of the geographical area occupied by the species that are essential for the conservation of the species; and
(5) Conduct economic, national security, and other required analyses to determine if any areas identified in steps 3 and 4 could be excluded from critical habitat consideration under section 4(b)(2) of the ESA.

A critical habitat review team (CHRT) was convened, consisting of five NMFS staff members with experience working on issues related to MHI IFKWs and Hawaii's pelagic ecosystem. To prepare for this critical habitat designation, NMFS reviewed and summarized available information on false killer whales, including but not limited to: recent biological survey information, recent satellite tracking information, peer-reviewed literature, NMFS' status review for false killer whales (Oleson *et al.* 2010), information considered in the proposed and final listing rules for the MHI IFKW DPS (75 FR 70169, November 17, 2011; and 77 FR 70915, November 28, 2012), and information received from a Recovery Planning Workshop Summary for MHI IFKWs held on October 25-28, 2016. This report summarizes the available data on MHI IFKW presence, distribution, ecological needs, and use of the identified areas and the CHRT's process for determining these areas as meeting the definition of critical habitat for this endangered DPS. The assessment and findings provided in this report, in conjunction with other agency analyses (e.g., economic analyses), support NMFS' proposal to designate critical habitat for the MHI IFKW DPS.

# CRITICAL HABITAT UNDER THE ESA

The ESA defines critical habitat under section 3(5)(A) as:

> "(i) the specific areas within the geographical area occupied by the species at the time it is listed…, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and
>
> (ii) specific areas outside the geographical area occupied by the species at the time it is listed… upon a determination by the Secretary that such areas are essential for the conservation of the species."

Section 3 of the ESA (16 U.S.C. 1532(3)) defines the terms "conserve," "conserving," and "conservation" to mean: "to use, and the use of, all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this chapter are no longer necessary."

Section 4(a)(3)(B)(i) of the ESA precludes from designation any lands owned by, controlled by, or designated for the use of the Department of Defense that are covered by an integrated natural resources management plan (INRMP) that the Secretary [of Commerce] has found in writing will benefit the listed species.

Section 4(b)(2) of the ESA requires NMFS to designate critical habitat for threatened and endangered species "on the basis of the best scientific data available and after taking into consideration the economic impact, impact on national security, and any other relevant impact, of specifying any particular area as critical habitat." This section grants the Secretary discretion to exclude any area from critical habitat if he/she determines "the benefits of such exclusion outweigh the benefits of specifying such area as part of the critical habitat." The Secretary may not exclude an area if it "will result in the extinction of the species." The 4(b)(2) considerations and weighing process are outlined in the Draft ESA Section 4(b)(2) Report and summarized in the proposed rule (NMFS 2017).

Once critical habitat is designated, section 7 of the ESA requires federal agencies to "insure" that they do not fund, authorize, or carry out any actions that is not likely to destroy or adversely modify that habitat. Joint NMFS-USFWS regulations at 50 CFR 402.02 (81 FR 7214; February 11, 2016) define destruction or adverse modification as "a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of the species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features." This protection is in addition to the requirement under section 7 of the ESA that federal agencies insure that their actions are not likely to jeopardize the continued existence of listed species.

## MAIN HAWAIIAN ISLANDS INSULAR FALSE KILLER WHALE LIFE HISTORY AND STATUS

The MHI IFKW is one of three populations, or stocks, of false killer whales found in waters surrounding the Hawaiian Archipelago; the other two include the Northwestern Hawaiian Islands (NWHI) and pelagic populations (Carretta *et al.* 2016). Although there is overlap in the ranges (see Figure 1), these three populations are identified as demographically independent based on genetic, photo-identification, and telemetry studies and, consequently, are recognized and managed separately under the Marine Mammal Protection Act (MMPA) (Chivers *et al.* 2007, 2010, Martien *et al.* 2011, as referenced in Carretta *et al.* 2008, 2013, 2016).

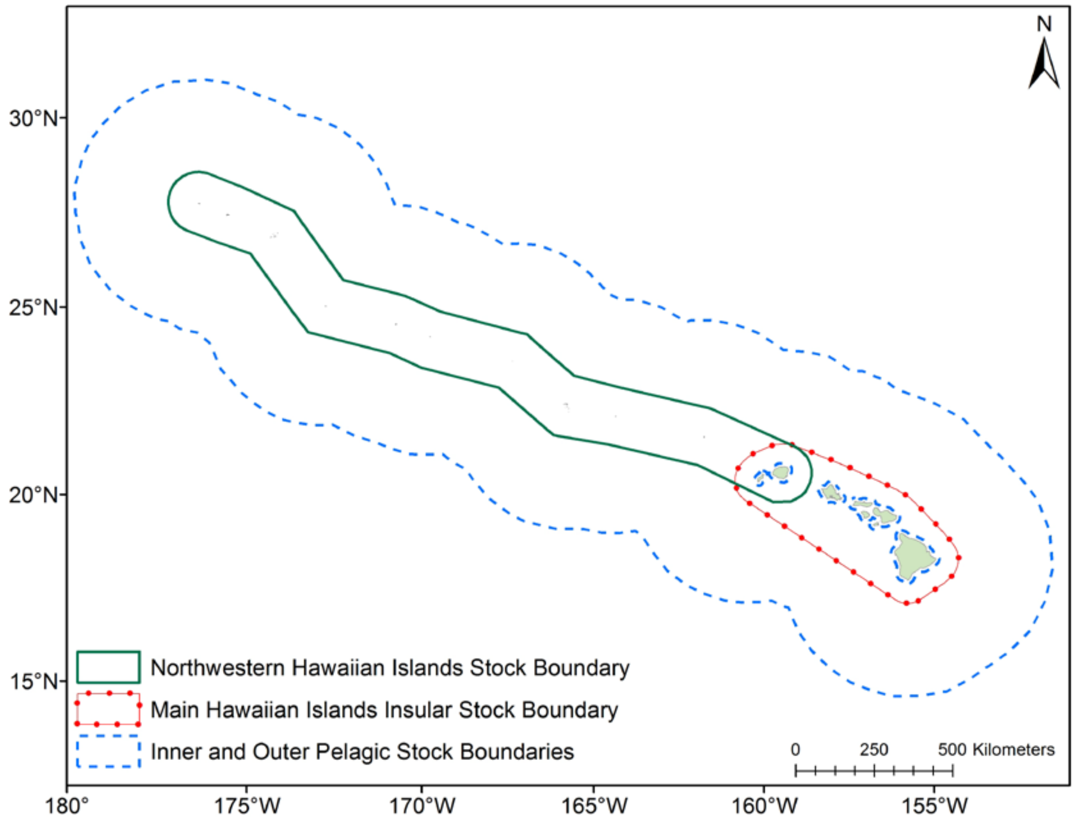


**Figure 1. Map depicting the population boundaries for false killer whales found in Hawaiian waters.**

In 2009, NMFS was petitioned to list the MHI IFKW under the ESA in light of characteristics that distinguish this population from other false killer whales in Hawaiian waters and due to declining population numbers. As noted above, NMFS reviewed the best available information and found the MHI IFKW population to be a DPS, in accordance with the ESA. This population was determined to be discrete from other populations based on behavioral factors associated with their restricted range, and genetic distinctions from other surrounding false killer whale populations. This population was also found to be significant to the taxon based on marked genetic differences between MHI IFKWs and their conspecifics in other areas. Ecological and cultural factors also supported the significance finding (Oleson *et al.* 2010 and Oleson *et al.* 2012, 77 FR 70915; November 28, 2012). This DPS was listed as endangered based on the population's high extinction risk and the insufficient conservation efforts in place to reduce that risk (77 FR 70915; November 28, 2012). Hereafter, we use "this DPS" synonymous with MHI IFKWs to refer to this endangered population. Although unique in some aspects of the population's genetics and ecology including social ecology, much of what is known of this DPS's general biology is shared with or believed to be largely similar to other false killer whales. The general description of the species below and the Life History and Reproduction and Vocalization, Hearing, and Underwater Sound sections provide general information on false killer whales. Sections of the report that follow provide information that is unique to this DPS' life history and status, relevant for understanding the habitat use and needs that support the conservation of MHI IFKWs, and informs this critical habitat designation. Additional information about this DPS and recovery planning may be found on MHI IFKW page of our website.

There are no recognized morphological features that distinguish this DPS from other false killer whales; the excerpts below from the 2010 Status Review (Oleson *et al.* 2010), which reviewed the biology of this population to consider whether this population may require protections under the ESA, provides a general description of the species and Figure 2 provides a depiction of this species.

> *The false killer whale is a slender, large delphinid, with maximum reported sizes of 610 cm for males (Leatherwood and Reeves, 1983) and 506 cm for females (Perrin and Reilly, 1984)…Large individuals may weigh up to 1400 kg.… Coloration of the entire body is black or dark gray, although lighter areas may occur ventrally between the flippers or on the sides of the head. A prominent, falcate dorsal fin is located at about the midpoint of the back, and the tip can be pointed or rounded. The head lacks a distinct beak, and the melon tapers gradually from the area of the blowhole to a rounded tip. In males, the melon extends slightly further forward than in females. The pectoral fins have a unique shape among the cetaceans, with a distinct central hump creating an S-shaped leading edge.*
>
> Oleson *et al.* 2010

**Figure 2. Biological illustration of false killer whale.**

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### *Life History and Reproduction*

Generally, false killer whales are long-lived, mature slowly, and reproduce infrequently – similar to killer whales (Baird 2009). This section provides general information about false killer whales life history and reproduction as derived from multiple sources.

Length at birth ranges from 160 cm to 190 cm and these animals grow between 40 and 50 percent in body length during their first year. In subsequent years, males grow at a faster rate (Odell and McClune 1999). Females are reported to reach sexual maturity between 8 and 11 years of age at lengths ranging from 320 to 427 cm; reports of males reaching sexual maturity range more widely in age from 5 to 19 years of age at lengths ranging from 396 to 457 cm (Kasuya 1986, Stacey *et al.* 1994, Odell and McClune 1999, Ferreira *et al.* 2014). Based on examining false killer whales from Japan and South Africa and reviewing scientific literature, Ferreira *et al.* (2014) noted that adult false killer whales from different geographic areas (and even from the same area) can differ significantly in mean body size. It is not clear where along the size range this DPS may fall. Only a few stranded animals have been measured from this DPS and they have been relatively small (Baird *et al.* 2016). West *et al.* 2016 reports two female false killer whales age 20 and 22 measuring 405 and 421 cm, respectively, and one male false killer whale age 24 measuring 445 cm. Growth is reported to cease between 20 and 30 years of age and maximum estimated age is reported at 63 years for females and 58 years for males (Kasuya 1986, Odell and McClune 1999).

Females ovulate one or more times per year (Stacey *et al.* 1994), and gestation estimates range from 11 to 16 months (Perrin and Reilly 1984, Kasuya 1986, Odell and McClune 1999, Ferreira 2008). Females with calves lactate for 18 to 24 months (Perrin and Reilly 1984). Kasuya (1986) reported the only birth interval for this species as 6.9 years between calves (Oleson *et al.* 2010). Using the annual pregnancy rates reported in Ferriera (2008), Oleson *et al.* (2010) calculated an inter-birth interval of 8.8 years for animals examined from Japan, which is low compared to other odontocetes with similar life history (e.g., killer whales, short-finned pilot whales, and sperm whales). However, a shorter average inter-birth interval would be calculated from an annual pregnancy rate were it to exclude post-reproductive females. The inter-birth interval for the MHI IFKW is unknown; however, the relatively low productivity in the central tropical Pacific may mean this DPS has a longer inter-birth interval than false killer whales found in areas with higher productivity.

Carcasses of female false killer whales over 40 years of age (from Japan and South Africa) demonstrated declines in evidence of recent ovulation or births and Ferreira (2008) estimated 45 years old as the age at which females cease to reproduce, despite still having a life expectancy of at least another 10 to 15 years. Photopoulou *et al.* (2017) further analyzed these samples and found both morphological and statistical evidence for a post-reproductive lifespan in false killer whales, similar to that demonstrated in short-finned pilot whales and killer whales. Although the evolutionary origin of post-reproductive lifespan is debated, adaptive theories suggest that these elderly females may support the survival of kin by enhancing the care of multiple generations (i.e., grandmother hypothesis) and by transferring knowledge important to survival (McAuliffe and Whitehead 2005, Oleson *et al.* 2010, Nichols *et al.* 2016). In the 2010 Status Review, the biological review team noted that learning is a common trait in social odontocetes (toothed whales), such as false killer whales and killer whales, and that the knowledge passed through learning from one generation to the next may play an important role in the evolutionary potential of false killer whales. Long-term studies of resident killer whales demonstrate the key role post-reproductive females play in providing ecological knowledge, as these individuals often lead group movement in and around salmon foraging grounds and are especially likely to do so in years with low salmon abundance (Brent *et al.* 2015).Similar to resident killer whales, post-reproductive MHI IFKW females may be important to this DPS' persistence in their restricted range, as these animals may transfer knowledge about where prey resources are found in and around the MHI, especially as temporal shifts in resources are experienced (Oleson *et al.* 2010 and Oleson *et al.* 2012). In other words, these females act as repositories of ecological knowledge and thereby buffer kin against environmental hardships (McAuliffe and Whitehead 2005).

### *Vocalization, Hearing, and Underwater Sound*

Odontocetes, such as false killer whales, have evolved highly complex acoustic sensory systems through which they produce, receive, and interpret sounds to support navigation, communication, and foraging (Au 2000, Olsen *et al.* 2010). Commonly referred to as echolocation or biosonar, these animals – similar to bats - use their ability to produce sounds to locate objects within their environment by receiving and interpreting the returning echoes from their own vocalizations. These animals also vocalize to communicate with one another and passively listen to natural and biological acoustic cues from the ocean and to understand their environment (Au *et al.* 2000).

There are three categories of vocalizations that most odontocetes make, which support their ability to interpret the surrounding environment and to communicate with each other – echolocation clicks, burst-pulsed vocalizations, and whistles (Au 2000) (See Table 1 below for generalized vocalization ranges for odontocetes). Echolocation clicks (or click trains) and burst-pulsed sounds are sometimes described as a single category termed pulsed sounds/pulse trains (Murray *et al.* 1998). Functionally, echolocation clicks support orientation and navigation within the whale's environment, while burst-pulsed sounds and frequency modulated whistles are social signals (Au 2000). False killer whales produce sounds that meet all three categories and sometimes produce sounds that are intermediate or between categories (Murray *et al.* 1998).

Vocalization ranges are reported for this species between 4 and 130 kHz (Croll *et al.* 1999). Source levels from free-ranging whales were reported by Madsen *et al.* (2004) from 201-225 dB (re: 1µPa-m), while a study of a captive animal reported a maximum peak-to-peak level (re: 1 µPa @ 1 m) of false killer whale sounds of 228 dB (Thomas and Turl 1990). Studies from captive animals indicate that this dynamic ability to produce different sounds aids false killer whales in a variety of tasks, including detecting objects at a distance, discriminating between different objects, and intercepting prey (Thomas and Turl 1990, Brill *et al.* 1992, Madsen *et al.* 2004, Wisniewska *et al.* 2014).

**Table 1. Odontocete vocalizations (for species that whistle).**

| Description | Frequency | Source Level | Reference |
|---|---|---|---|
| Generalized description for odontocetes frequency modulated tonal calls (whistles). | 1-40 kHz (harmonics may extend to higher frequencies) | 100-180 dB re 1μPa-m | NOAA NOS 2016 (see references for full information) |
| Generalized description for odontocetes broadband clicks (echolocation clicks and pulsed calls). | <1kHz to 150 KHz (pulsed calls); 5-130 kHz (echolocation clicks) | 220 to 230 dB re 1μPa-m peak to peak | NOAA NOS 2016 (see references for full information) |

NMFS classifies cetaceans into different hearing groups to assess sound impacts to these animals, and false killer whales are classified within the mid-frequency hearing group. This grouping's hearing is conservatively estimated between approximately 150 Hz and 160 kHz (Southall *et al.* 2007, NOAA 2016). In a captive environment, Thomas *et al.* (1988) conducted an underwater audiogram on a young (4-year old) false killer whale and reported the most sensitive range of hearing from 16 to 64 kHz, but noted that the whale has good sensitivity (i.e., within -40 dB) from 8 to 105 kHz (Thomas *et al.* 1988 as cited in Thomas and Turl 1990). Yuen *et al.* (2005) conducted behavioral and Auditory Evoked Potential (AEP) audiograms on a 30-year old female and reported best sensitivity between 16 and 24 kHz and peak sensitivity at 20 kHz for behavioral data. AEP audiograms showed best sensitivity from 16 to 22.5 kHz and peak sensitivity at 22.5 kHz. Notably the researchers hypothesized that this whale may have experienced hearing loss associated with age or presbycusis, because earlier studies indicated exceptional hearing capabilities for this animal. Kloepper *et al.* (2010) reported a decrease in echolocation performance for this individual following the high-frequency hearing loss and suggested that hearing at ultrasonic frequencies may have evolved in response to pressures for fine-scale echolocation discrimination. Au *et al.* (1997) tested hearing sensitivity of this species to a low-frequency 75 Hz phase modulated, 195 dB re 1μPa source level acoustic signal and reported thresholds of 140.7±1.7 dB for a 75-Hz pure tone signal and 139.0±1.1 dB for the phase modulated signal.

Captive studies demonstrate that hearing is a dynamic process for these animals and that false killer whales can actively change their hearing sensitivity to optimize their ability to hear returning echoes while echolocating (Nachtigall and Supin 2008). Nachtigall and Supin (2008) described this ability as an active 'automatic gain control' and note that hearing sensitivity becomes most acute while searching for targets (Supin *et al.* 2008, Nachtigall and Supin 2013). Further studies indicate that this ability to adjust and dampen sound may provide some protection to false killer whales against intense sounds within their environment, if the intense noise is anticipated (Nachtigall and Supin 2013). Captive studies also demonstrate false killer whales are able to perceive and distinguish harmonic combinations of sounds (Yuen *et al.* 2007). Ecologically, the capacity to distinguish and produce different combinations of sounds may play an important role in facilitating coordinated movements of groups and maintaining associations over wide areas (Yuen *et al.* 2007).

While captive studies provide some insights into this species' production and utilization of sound, studies in the wild suggest that free-ranging animals may not always employ biosonar signals in the same manner demonstrated in captive environments (Madsen *et al.* 2004). Differences in source level and spectral dominance, as well as instances where free-ranging false killer whales used short click trains (similar to captive belugas) indicate that there is still more to learn about how these false killer whales' employ acoustic signals within their natural environment to navigate, forage, and communicate. Both captive and free-range studies demonstrate that these animals rely on sound as a fundamental component of their habitat to navigate, communicate, avoid predators, and locate prey.

The soundscape – referring to "all of the sound present in a particular location and time, considered as a whole" – varies spatially and temporally across habitats as the physical and biological attributes of habitats shift and the physical, biological, and anthropogenic factors that contribute to noise within that habitat change (Pijanowski *et al.* 2011a, Pijanowski *et al.* 2011b, Hatch *et al.* 2016). For example, water depth, salinity, and seabed type affects how well sound propagates in a habitat, thus the soundscape will vary as those attributes change. Additionally, the soundscape differs by the sources that contribute to noise within the environment; noise may be from physical, biological, or anthropogenic sources. Physical sources of noise (such as rain, wind, or waves) and biological sources of noise (made by the biological community within that habitat) may vary over time as weather patterns change or behavioral activity varies. For example, summer storm activity, or breeding activity may alter the soundscape at different points of the year. Human activities that contribute to noise within habitats can vary widely in frequency content, duration, and intensity; consequently, anthropogenic sound sources may have varied effects on a habitat depending on how that sound is propagated in the environment and what animals use that habitat (Hatch *et al.* 2016). Considering how human activities may change the soundscape and determining the biological significance of that change can be complex as it includes the consideration of many variables. These variable include the characteristics of human noise sources (frequency content, duration, and intensity); the animal of concern's ability to produce, receive sound, and adapt to other sounds within their environment; the physical characteristics of the habitat; the baseline soundscape; and how the animal uses that habitat (Shannon *et al.* 2015, Hatch *et al.* 2016, Erbe *et al.* 2016). Noise with certain characteristics may cause animals to avoid or abandon important habitat, or can mask -- or interfere with the detection, recognition, or discrimination of -- important acoustic cues within that habitat (Gedamke *et al.* 2016). In these cases, the duration of the offending or masking noise will determine whether the effects or degradation to the habitat may be temporary or chronic, and whether such alterations to the soundscape may alter the conservation value of that habitat.

Ultimately, noise with certain characteristics (i.e., characteristics that can mask, or deter MHI IFKWs) can negatively affect MHI IFKWs' ability to detect, interpret, and utilize acoustic cues within that habitat. If these anthropogenic noises are chronic or cause cumulative interference such that the animals' ability to receive benefits (e.g., opportunities to forage or reproduce) from these habitats is sufficiently inhibited, the habitat will no longer be able to support the conservation of these animals.

### *False Killer Whales around Hawaii*

The evolution of three different false killer whale populations, two of which are island-associated (MHI and NWHI) in an otherwise offshore species, raises questions about how these populations became and remain separated. However, this differentiation in population structure is not uncommon in cetacean species and in some cases is explained by differences in foraging specializations (Hoelzel 1998). Other odontocete populations in Hawaii reflect differences between pelagic and nearshore animals (e.g., common bottlenose dolphins, pantropical spotted dolphins) as well as, between animals using the NWHI and the MHI (e.g., spinner dolphins) (Andrews *et al.* 2010, Carretta *et al.* 2016). Martien *et al.* (2014) suggested the genetic differences seen in the population structure of Hawaii's false killer whales, similar to other species, may be driven by the unique habitats offered by the Hawaiian Archipelago.

The Hawaiian Islands are part of the Hawaiian-Emperor Seamount Chain. These submerged and partially submerged mountains disrupt and influence basin-wide oceanographic and atmospheric processes, which in turn influence the productivity in the surrounding waters (Oleson *et al.* 2010, Martien *et al.* 2014, Gove *et al.* 2016). Referred to as the "Island Mass Effect," islands (land surrounded by water) and atolls (a ring-shaped reef, or grouping of small islands that surround a lagoon) can create a self-fueling cycle where the geomorphic type (atoll vs. island), bathymetric slope, reef area, and local human impacts (e.g., human-derived nutrient input) influence the phytoplankton biomass and the trophic-structure of the entire surrounding marine ecosystem (Doty and Oguri 1956, Gove *et al.* 2016). Thus, in the center of the North Pacific Ocean the Hawaiian Islands create biological hotspots that support a different marine ecosystem from that of waters in the surrounding Pacific basin (Gove *et al.* 2016).

Differences in geographical location and landmass contribute to ecological differences between the NWHI and the MHI (Oleson *et al.* 2010, 2012). The Hawaiian archipelago extends for nearly 2,400 km from Kure Atoll in the northwest to Hawaii Island in the southeast. The NWHI include a series of low-lying atolls and islands, which are one-tenth of one percent of the land area in the entire Archipelago (Rauzon 2001). Productivity and temperatures fluctuate widely over the year and across years in the NWHI, where ecosystems are influenced by the northern location and proximity to other shifting oceanographic features (e.g., transition zone chlorophyll front) (Baker *et al.* 2011). These older islands and atolls are vulnerable to the elements and to rising sea levels (Baker *et al.* 2006).

In contrast, the MHI islands include large landmasses, with high elevations (e.g., Mauna Kea, Mauna Loa, Kilauea, and Haleakala) that have far-reaching effects on the surrounding ocean-atmospheric systems (Xie *et al.* 2001). These large islands essentially block and redirect prevailing currents and trade wind flow patterns around the MHI contributing to different spatial patterns of habitat in the leeward areas, channel areas, and windward area of each island ecosystem (Xie *et al.* 2001, Oleson *et al.* 2012). Windward and leeward habitats of the islands offer contrasting conditions between rainfall, temperature, wind, and sea conditions that continue to influence how these islands feed into the self-fueling cycle noted above (Doty and Oguri 1956, Oleson *et al.* 2012, Gove *et al.* 2016). In addition, habitats of the MHI offer eddies, enhanced amounts of freshwater runoff, underlying tidal patterns, and extensive amount of shelf habitat that influence the complexity of the surrounding ocean environment (Oleson *et al.* 2012).

These differences between the habitats in the NWHI and the MHI may ultimately influence behavioral patterns and social structure in some species, including false killer whales. For example, spinner dolphin populations of the NWHI demonstrate long-term group fidelity and social stability, which contrasts with the social groupings that change in size and composition in the MHI spinner dolphin populations (Karczmarski *et al.* 2005, Andrews *et al.* 2010). Karczmarski *et al.* (2005) suggested that this difference in social structure might be in response to the remoteness, isolation, and limited resting habitats of the northwestern atolls. Similarly, Martien *et al.* (2014) suggests that the genetic separation between the NWHI and MHI false killer whales may be a reflection of how these populations have adapted to the differences between the unique habitats found in these two areas of the chain. Ultimately, the MHI IFKW DPS distinction from other populations may reflect foraging specialization specific to the MHI habitats (Martien *et al.* 2014).

### *Population Status and Trends*

The 2015 and draft 2016 Stock Assessment Reports (SAR) report the best estimate of population size for the MHI IFKW as 151 animals (CV=0.20) (Carretta *et al.* 2016a and 2016b). This estimate relies on an open population model from 2006-2009 identified in the Status Review for the MHI insular population and was reported as being a possible overestimate because it does not account for known missed matches of individuals within the photographic catalog (Oleson *et al.* 2010). The minimum population estimate for the MHI IFKW is reported as 92 false killer whales, which is the number of distinctive individuals identified in photo identification studies from 2011-2014 by Baird *et al.* (2015) (Carretta *et al.* 2016 and 2016b). While new systematic surveys are unavailable to update these abundance estimates, NMFS is exploring a new method of estimating abundance using sightings of IFKWs from dedicated and opportunistic surveys in the MHI. This methodology would provide new annual abundance estimates dating back to 2000, but annual estimates would be limited to the spatial and temporal constraints of areas surveyed in a given year. Preliminary analyses indicate abundance estimates not largely different from those reported by the 2015 SAR (Carretta *et al.* 2016a); however, the difference in methodology suggests these preliminary numbers may be an underestimate of true population abundance in a given year (Oleson February 14, 2017 presentation to the Pacific Scientific Review Group). Importantly, these annual estimates may not be comparable to assess trends for this population.

A complete history of MHI IFKW status and trends is unknown; however, the 2015 SAR (Caretta *et al*. 2016a) provides an overview of information that suggests this DPS has experienced a historical decline (see box below). In addition, Silva *et al.* (2013) reports that the rate of encounter of false killer whales in leeward Maui County waters in 1995 was over five times greater than in 2011.

*Reeves et al. (2009) suggested that the MHI IFKWs may have declined during the last two decades, based on sightings data collected near Hawaii using various methods between 1989 and 2007. Baird (2009) reviewed trends in sighting rates of false killer whales from aerial surveys conducted using consistent methodology around the main Hawaiian Islands between 1994 and 2003 (Mobley et al. 2000). Sighting rates during these surveys showed a statistically significant decline that could not be attributed to any weather or methodological changes. Oleson et al. (2010) presented a quantitative analysis of extinction risk using a Population Viability Analysis (PVA). The modeling exercise was conducted to evaluate the probability of actual or near extinction, defined as a population reduced to fewer than 20 animals, given measured, estimated, or inferred information on population size and trends, and varying impacts of catastrophes, environmental stochasticity and Allee effects. All plausible models indicated the probability of decline to fewer than 20 animals within 75 years was greater than 20%. Though causation was not evaluated, all plausible models indicated the population has declined since 1989, at an average rate of -9% per year (95% probability intervals -5% to -12.5%), though some two-stage models suggested a lower rate of decline over the past decade (Oleson et al. 2010).*

*Carretta et al. 2016a*

### *Range*

MHI IFKWs are found in the waters surrounding each of the MHI (Niihau to Hawaii). At the time of the ESA listing (2012) the range of the MHI IFKW DPS was described consistent with the MMPA description for this population as nearshore of the main Hawaiian Islands out to 140 km (approximately 75 nautical miles) (77 FR 70915; November 28, 2012; Carretta *et al.* 2013). New satellite-tracking data has since proved this description of the range to be more restricted, especially on the windward sides of the islands (Bradford *et al.* 2015). NMFS revised the MHI IFKW's range in the 2015 Stock Assessment Report (SAR), under the MMPA (Carretta *et al.* 2016), in accordance with a review and reevaluation of satellite tracking data by Bradford *et al.* (2015).

Social network analyses divide the population into broad social clusters (Baird *et al.* 2012, Mahaffy *et al.* 2017, see also ***Group Dynamics and Social Network*** below). Overall, tracking information from 31 MHI IFKWs (23 from Cluster 1 and 8 from Cluster 3,) suggest that the DPS has a much smaller range than previously thought, and that the use of habitat is not uniform around the islands (Bradford *et al.* 2015). Specifically, MHI IFKWs show less offshore movement on the windward sides of the islands (maximum distance from shore 51.4 km) than on the leeward sides of the islands (maximum distance from shore 115 km). Acknowledging that the available tracking information has a seasonal bias (88.6% collected from August through January) and that data is lacking from Clusters 2 and 3, Bradford *et al.* (2015) set goals to refine the range in a manner that would reflect known differences in habitat use and allow for uncertainty in spatial and seasonal habitat use. The MHI IFKW's range was derived from a minimum convex polygon of a 72 km radius (~39 nautical miles) extending around the Main Hawaiian Islands, with the offshore extent of the radii connected on the leeward sides of Hawaii Island and Niihau to encompass the offshore movements within that region (see Figure 3). Since this analysis, three individuals from a single group within Cluster 2 were tagged, as was one individual from Cluster 3 and two from Cluster 1; tracking information received from these animals are contained within the revised boundary established by the 2015 SAR (Carretta *et al.* 2016; Baird, pers. communication, November 7, 2016).

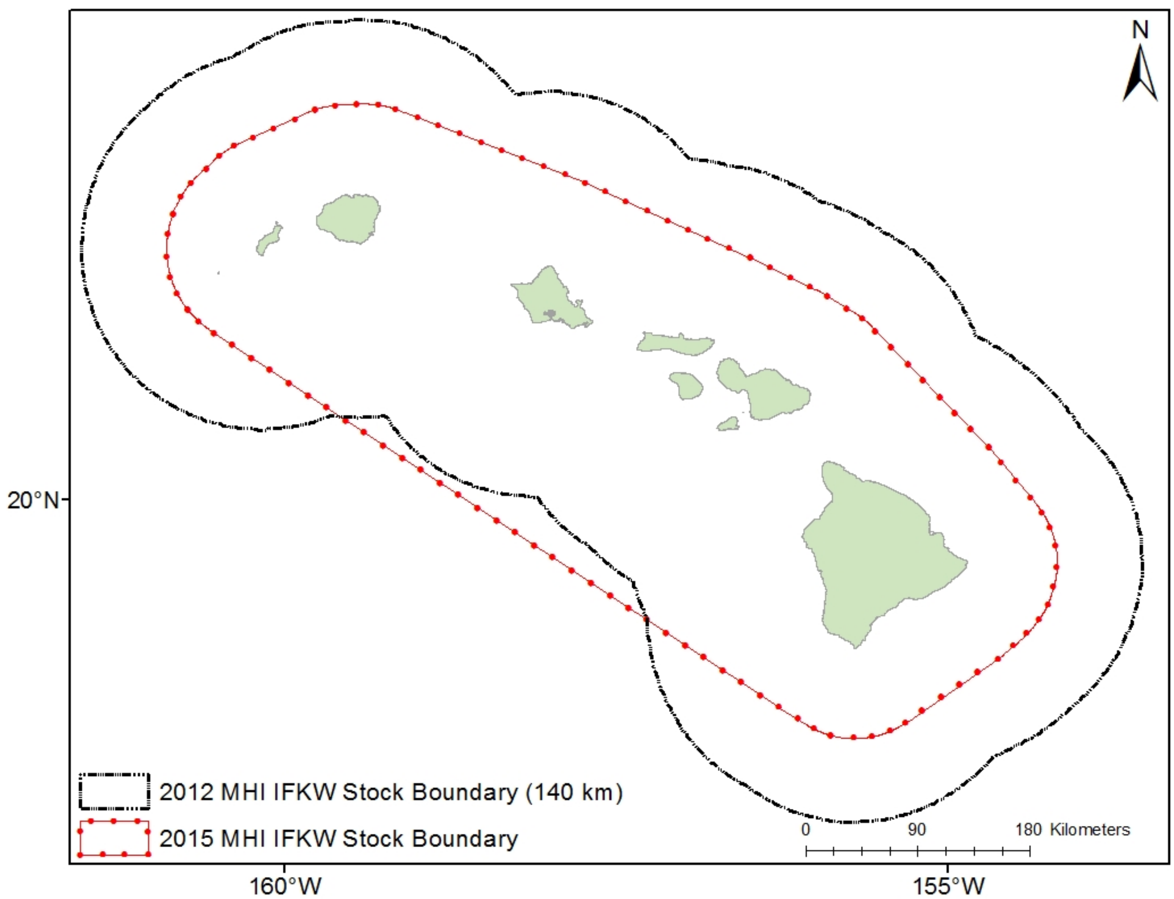


**Figure 3. Map depicting the 2012 and 2015 (or current) MHI IFKW population boundaries.**

### *Group Dynamics and Social Network*

False killer whales are social odontocetes. This species is most commonly observed in groups and are known to rely on group dynamics to support daily activities, including foraging. *et al.*Studies in Hawaii indicate that MHI IFKWs are most commonly observed in groups of about 10 to 20 animals; these groups may be part of a larger aggregation of subgroups that are dispersed over a wider area (Baird *et al.* 2008, Reeves *et al.* 2009, Baird *et al.* 2010, Oleson *et al.* 2010; Bradford *et al.* 2014 PLOS one). Subgroups may be separated by 2-10 km or more, but Baird *et al.* (2008) noted that over extended encounters (> 4hrs) subgroups would intermix. Baird *et al.* (2008) describes these large groups as temporary, larger, loose associations of subgroups generally moving in a consistent direction and at a similar speed. These aggregations of subgroups may allow these whales to effectively search a large area for prey and converge when one sub-group locates a prey source (Baird *et al.* 2009).

This DPS has a complex social structure; observations from field studies indicate that uniquely identified individuals associate and regularly interact with at least one or more common individuals (Baird 2009, Baird *et al.* 2010). Evidence from photo-id and tracking studies suggest that somewhat stable bonds exist among individuals, lasting over periods of years, (Baird *et al.* 2008, Baird *et al.* 2010). Social network analyses once divided the population into three broad social clusters based on these connections (Baird *et al.* 2012); however, increased information from field studies indicates more complexity in these social connections and a fourth social cluster has recently been identified (Mahaffy *et al.* 2017). As analyses revealing the fourth cluster have not yet been published in detail, we use Clusters 1, 2, and 3 at times in this report to note differences in movement and habitat use patterns described by past analyses; further delineations in groupings may slightly alter how these patterns are described in the future.

Genetic analyses of MHI IFKWs demonstrates distinctions between these whales and the other populations found in Hawaii's waters (Martien *et al.* 2014). Genetic analyses of this DPS also suggest that both males and females exhibit philopatry to natal social clusters (meaning these animals stay within their natal groups), and that mating occurs both within and between social clusters (Martien *et al.* 2011).

### *Movement and Habitat Use*

False killer whales are commonly recognized as a pelagic species that feeds on fish and squid in the open ocean; however, the MHI IFKW DPS is an island-associated population of false killer whales that restrict their movement and foraging to waters surrounding the main Hawaiian Islands (Baird *et al.* 2008, Baird *et al.* 2012). This habitat specialization indicates that this population has adapted to exploiting the unique resources offered by the submerged habitats of the MHI. Within these waters, generally, this DPS is found in deeper areas just offshore, rather than the shallow nearshore habitats used by island-associated spinner or bottlenose dolphins (Baird *et al.* 2010). MHI IFKWs circumnavigate the islands and quickly move throughout their range (Baird *et al.* 2008, Baird *et al.* 2012). For example, one individual moved from Hawaii to Maui to Lanai to Oahu to Molokai, covering a minimum distance of 449 km over a 96-hr period (Baird *et al.* 2010, Oleson *et al.* 2010). Overall tracking information demonstrates that individuals generally spent equal amounts of time on both leeward and windward sides of the islands; however, these animals exhibit greater offshore movements on the leeward sides of the islands, with reported distances as far as 122 km from shore (Baird *et al.* 2012). Baird *et al.* (2012) explored this disparity between time spent in areas and spatial habitat use to help understand the strategies employed by this DPS and to distinguish significant habitat areas.

Baird *et al.* (2012) applied several methods of density analyses to IFKW tracking location data to identify areas where these whales may concentrate their time and then examined high-density (or high-use) areas for ecologically significant characteristics. In review, all of the density analyses demonstrate that the population does not use habitat uniformly throughout the range and that high-use areas are evident. Selecting a best method for measuring density, Baird *et al.* (2012) compared physical and oceanographic characteristics associated with high-use and low-use areas of the range. Generally, they found that MHI IFKW high-use areas were on average shallower, closer to shore, and had gentler slopes in comparison to other areas in this DPS' range. Additionally, these areas had higher average surface chlorophyll-a concentrations (in comparison to low-use areas), which may be indicative of higher productivity. Across high-density cells, the median depth was reported as 623 m, median slope as 3, and chloropyll-a concentrations as 0.082 mg $m^{-3}$, whereas across low-density cells the median depth was reported as 1679 m, median slope as 6, and chloropyll-a concentrations as 0.074 mg $m^{-3}$ (Baird *et al.* 2012). Baird *et al.* (2012) suggested that high-use areas may indicate habitats where IFKWs have increased foraging success and may be particularly important to the conservation of this DPS. Still, they acknowledged that more high-use areas could be identified as information is gained from all social clusters and for all months of the year. For example, high-use areas for cluster 2 are not yet recognized and it is unclear whether this cluster demonstrates patterns in any particular areas.

From this study, Baird *et al.* (2012) described three areas of high-use by the insular population: the north side of the island of Hawaii (both east and west sides), a broad area extending from north of Maui to northwest of Molokai, and a small area to the southwest of Lanai. Habitat use appeared to vary based on social cluster. For example, areas off the north end of Hawaii were only a high-use area for individuals from Cluster 1, whereas the north side of Molokai was primarily high-use for Cluster 3 animals (Baird *et al.* 2012). However, new information that further delineates social clusters or provides more insight into seasonal movements may alter these perceived preferences for specific areas as it pertains to social cluster. Recent tagging data available through February 2017 increased the sample size and now include new information from three individuals from Cluster 2, one more individuals from Cluster 3, and one individual from the newly-identified Cluster 4 (previously this individual was assigned to Cluster 1) (Robin Baird, pers. comm., June 2017). Using the methods of Baird *et al.* (2012) new tagging information indicates that high-use areas may extend further towards Oahu and into the channel between Molokai and Oahu (Figure 4).

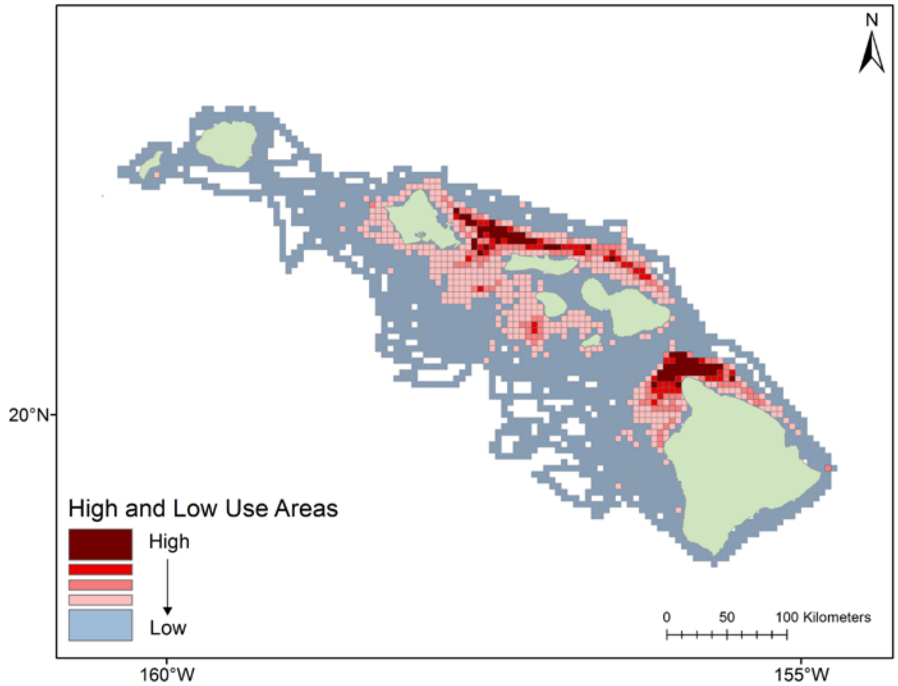


**Figure 4. MHI IFKW high use areas by all three clusters representing 27 satellite-tagged individuals through 2015; Cluster 1 (n=18), cluster 2 (n=1), cluster 3 (n=7), and cluster 4 (n=1). (Data provided by Cascadia Research Collective. Density analysis methodology described in Baird *et al.* 2012.)**

In 2010, NOAA committed to improving the tools used by the Agency to manage underwater noise impacts more comprehensively, including those to better address cumulative impacts to whales, dolphins, and porpoises. Subsequently, NOAA developed the CetSound program, which includes the CetMap mapping tool that aims to improve our ability to visualize cetacean density and distribution. Under this program, the term "biologically important areas" is defined and used to identify areas recognized in scientific data as significant (e.g., reproductive areas for migratory species). Due to the small and resident nature of MHI IKFWs, the high-use areas described by Baird et al. (2012) overlap with areas that meet the definition of "biologically important areas" as defined by NOAA's CetMap program. However, Baird et al. (2015) identifies biologically important areas as 1 standard deviation from the mean, while Baird et al. (2012) describes high-use areas using 2 standard deviations from the mean.

### *Diving behavior*

Limited information is available on the diving behavior of false killer whales. Cummings and Fish (1971) estimated the maximum dive depth at 500 m, and later reports suggest diving in excess of 600 to 700 m (Olsen *et al.* 2010, Minamikawa *et al.* 2013). Minamikawa *et al.* (2013) reported this deeper diving activity from a tagged false killer whale in the Kuroshio-Oyashio transition region and Kuroshio front region of the western North Pacific. In the Kuroshio front region, where prey was likely concentrated, information suggested that the whale used sprints during deep dives during the daytime to capture prey; dive duration of these sprint-dives were shorter than those without a sprint. Minamikawa *et al.* (2013)

calculated the aerobic dive limit of a 3-m false killer whale (assuming body weight as 250 kg and lean weight as 200kg) as 18.5 min using methods established by Tyack *et al.* (2006). The maximum dive duration of the tagged false killer whale was reported as 14.6 minutes, only 79 percent of the aerobic dive limit. Minamikawa *et al.* (2013) noted that this disparity may be explained by increased oxygen consumption that would be required for fast swimming (i.e., the sprints that were documented). During the night, the whale from this study rarely performed deep dives; however, it was not clear (from the measurements taken) if the whale could have been foraging at shallow depths throughout the night or if this was an indication of overall decreased diving activity.

Recent information from tagged MHI IFKWs indicates that these animals are capable diving deeper than earlier reported depths. Data received from depth-transmitting LIMPET satellite tags on four MHI IFKWs (3 from Cluster 3 and 1 from Cluster 1) demonstrates a maximum dive depth of 1,272 m with maximum dive durations reported as 18.65 minutes, (Baird, pers. communication, March 2017). Looking at information from all four animals, average maximum dive depths were similar during the day and night (912 m and 1,019 m respectively). The data demonstrate that these animals are diving greater than 50 m about twice as often during the day (0.71 dives/hour) than at night (0.32 dives/hour) (Baird pers. communication March 2017). In summary, limited data (from four individuals tagged in 2010 during the months of October and December) still indicate that a majority of foraging activity happens during the day, but that some nighttime activity also includes foraging.

### *Diet*

Literature on false killer whales indicates the species eats primarily fish and squid (Clarke 1996, Oleson *et al.* 2010, Ortega-Ortiz *et al.* 2014), but there are some global accounts of the species occasionally taking marine mammals and even sharks (Perryman and Foster 1980, Hoyt 1983, Palacios and Mate 1996, Rinaldi *et al.* 2007, unknown shark species; drone footage in Sydney, Australia, by Bruno Kataoka 2016).

This DPS' restricted range surrounding the Hawaiian Islands is unique for false killer whales. Accordingly, the foraging strategies and prey preferences of this DPS likely differ some from their pelagic counterparts (Oleson *et al.* 2010). In Hawaii, field observations of predation events (Baird *et al.* 2008, Oleson *et al.* 2010), stomach content analysis from stranded animals (West 2016), and depredation of prey from the Hawaiian nearshore troll and longline fisheries (Zimmerman 1983) provides information about prey species of this DPS. Most of these species include pelagic fish, but data gathered since the status review of this DPS indicate squid may be a part of the diet (West 2016). Although there is no information to distinguish which of the three populations of Hawaiian false killer whales are involved in recorded depredation events, longline observer data of fishery depredations of prey also provides some insight to potential prey items of this DPS (Oleson *et al.* 2010 – identified as NMFS unpublished data). Data from the longline fishery likely represents comingled depredation events from animals representing all three Hawaiian false killer whale populations. Table 2 below indicates the species reported as dietary items of MHI IFKWs.

**Table 2. Species reported as dietary items of MHI IFKWs including the reported sources.**

| Scientific name | English name | Local name | Reported in |
|---|---|---|---|
| *Alectis ciliaris* | Threadfin jack | Kagami ulua | Baird 2009 |
| *Xiphias gladius* | Broadbill swordfish | A'uku | Baird 2009 |
| *Acanthocybium solandri** | Wahoo | Ono | Baird *et al.* 2008(a), Oleson *et al.* 2010 |
| *Aluterus scriptus* | Scrawled File fish | Loulu | Baird *et al.* 2008(a) |
| *Eumegistus illustrus* | Lustrous pomfret | Monchong | Baird *et al.* 2008(a), Oleson *et al.* 2010 |
| *Katsuwonus pelamis* | Skipjack tuna | Aku | Baird *et al.* 2008(a) |
| *Thunnus alalunga* | Albacore tuna | 'Ahi pālaha | Baird *et al.* 2008(a) |
| *Thunnus albacares* | Yellowfin tuna | Ahi | Baird *et al.* 2008(a) |
| *Coryphaena hippurus* | Dolphinfish | Mahi-mahi | Baird *et al.* 2008(a) & West 2016, Oleson *et al.* 2010 |
| *Serioli dumerili* | amber jack | Kāhala | Baird unpublished data |
| Genus species not determined | Marlin | Species unknown | West 2016 |
| *Albula spp* | Bonefish | 'O'īo | West 2016, Baird unpublished data |
| *Caranx spp* | Jack | NA | West 2016 |
| Genus species not determined | Ommastrephid squid | NA | West 2016 |
| *Thysanoteuthis rhombus* | Diamondback squid | NA | West 2016 |
| *Makaira nigricans* | Blue marlin | A'u | Zimmerman 1983 |
| *Genus species not determined* | Spearfish | NA | Zimmerman 1983 |
| *Thunnus obesus* | Bigeye tuna | Ahi | Zimmerman 1983 |
| Genus species not determined* | Billfish | NA | Oleson *et al.* 2010 |
| *Lampris regius** | Moonfish | Opah | Oleson *et al.* 2010 Baird unpublished |
| Genus species not determined* | Tuna | NA | Oleson *et al.* 2010 |
| *Alepisaurus ferox* | Lancetfish | NA | Oleson *et al.* 2010 |

**Indicates species identified from Oleson et al. 2010 as false killer whale prey targets based on the percent of caught species depredated in the longline fisheries; for this information, data is not exclusive to MHI IFKW, because MHI IFKW depredation events are likely comingled with depredation by whales in the other two Hawaiian false killer whale populations.*

Diet composition can vary between animals of different age, size, sex, or population. Stable isotope analyses of false killer whales from Chile demonstrated potential differences in diet between animals of different age and size classes, but not between the sexes. Researchers suggested that these distinctions may reflect differences in foraging and diving capabilities between younger and smaller animals, and older and larger animals (Riccialdelli and Goodall 2015). Stable isotope studies of two false killer whale groups off Mexico suggest that groups of false killer whales found within the same habitat may differ in their prey preferences, perhaps feeding on prey from slightly different trophic levels (Ortega-Ortiz *et al.* 2014).

Little is known about diet composition, prey preferences, or potential differences between the diets of MHI IFKWs of different age, size, sex, or even social cluster and different methodologies create different biases about common prey items. From field studies, Baird *et al.* (2008) reports dolphinfish (mahi-mahi) as the most commonly observed prey, among other pelagic species reported. However, observations are limited to those foraging events where MHI IFKW are found at or near the water's surface, and prey handling of mahi-mahi may be different than for other species, making captures of that species easier to detect (Baird, pers. comm.). In comparison, stomach content analysis from five MHI IFKWs that stranded, four off the Island of Hawaii and one from Molokai (from 2010-2016), indicates that squid may play an important role in the diet along with other pelagic fish species (West 2016). However, four of the five whales were identified as part of social Cluster 3 (the social cluster of the fifth whale was not determined), and it is unknown if this information may reflect differences in foraging preferences or strategy between social clusters, or if the relative health of these individuals may have influenced prey consumption just prior to death. Tracking information and observational data demonstrate that social clusters may preferentially use some areas of the range over others. For example, Cluster 2 individuals are seen more often than expected off the Island of Hawaii and differences were noted between clusters 1 and 3's preference for certain high-use areas (see also *Movement and Habitat Use* above) (Baird *et al.* 2012). However, without additional data, it is difficult to know if these differences in habitat use may also reflect subtle differences in prey preference.

Oleson *et al.* (2010) determined the energy requirements for the IFKW DPS based on a model developed by Noren (2011) for killer whales. Using the best population estimate of 151 animals from the recent SAR, this DPS consumes approximately 2.6 to 3.5 million pounds of fish annually, depending on the whale population age structure used (see Oleson *et al.* 2010 for calculation method) (Brad Hanson, NMFS Northwest Fisheries Science Center (NWFSC), pers. comm. 2017).

As noted above, the Hawaiian Islands create biological hotspots that aggregate species at all trophic levels, including pelagic fish and squid (Gove *et al.* 2016, Bower *et al.* 1999, Itano and Holland 2000). In the same way that false killer whales exploit the resources of these islands, some large pelagic fish and squid also demonstrate island-associated patterns utilizing island resources and phenomena to support foraging or breeding activities (Bower *et al.* 1999, Itano and Holland 2000, Seki *et al.* 2002). Examples include: several species of squid that show increased spawning near the MHI to take advantage of higher productivity regions (Bower *et al.* 1999); yellowfin tuna in Hawaii appear to exhibit an island-associated, inshore-spawning run, peaking in the June-August period (Itano and Holland 2000); and eddies created by the influence of the islands are known to concentrate prey resources of larger game fish (Seki *et al.* 2002). Understanding the geographic extent and temporal aspects of overlap with prey species that demonstrate these island-associated patterns may provide further insight into factors that influence the diet of this DPS. Most of the species identified in Table 2 include species that are pelagic in nature, but that are found year-round in Hawaii's waters. Distribution and abundance of these large pelagic fish vary with seasonal changes in ocean temperature (Oleson *et al.* 2010). Scrawled filefish and the threadfin jack are commonly associated with reef systems but are also found in the coastal open water areas surrounding Hawaii (Oleson *et al.* 2010). Without further information about prey preferences, it is difficult to determine where prey resources of higher value exist for this DPS. However, foraging activities likely occur throughout the range as this species takes advantage of patchily distributed prey resources.

## PHYSICAL OR BIOLOGICAL FEATURES ESSENTIAL FOR CONSERVATION

As noted earlier in this report, section 3(5)(A) of the ESA (16 U.S.C. 1532 (5)(A)) describes the defining factors for identifying both occupied and unoccupied critical habitat. Areas meeting the statutory definition within the occupied range of the listed species must contain physical or biological features essential to the conservation of the species and which may require special management consideration or protection. The ESA does not specifically define physical or biological features, however, court decisions and joint NMFS-USFWS regulations at 50 CFR 424.02 (81 FR 7413; February 11, 2016) provide guidance on how physical or biological features are expressed.

Physical and biological features support the life-history needs of the species, including but not limited to, water characteristics, soil type, geological features, sites, prey, vegetation, symbiotic species, or other features. A feature may be a single habitat characteristic, or a more complex combination of habitat characteristics that support ephemeral or dynamic habitat conditions. Features may also be expressed in terms relating to principles of conservation biology, such as patch size, distribution distances, and connectivity. The features may also be combinations of habitat characteristics and may encompass the relationship between characteristics or the necessary amount of a characteristic needed to support the life history of the species.

Based on the best available scientific information, the CHRT identified specific biological and physical features essential for the conservation of the Hawaiian IFKW DPS to include the following:

1. ***Island-associated marine habitat for MHI insular false killer whales.***
   MHI IFKWs are an island-associated population of false killer whales that relies entirely on the productive submerged habitats of the main Hawaiian Islands to support all of their life-history stages. Adapted to an island-associated foraging strategy and ecology, these whales are generally found in deeper waters just offshore, moving primarily throughout and among the shelf and slope habitat on both the windward and leeward sides of all the islands. These areas offer a wide range of depths for IFKWs to travel, forage, and move freely around and between the main Hawaiian Islands.

2. ***Prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth.***
   MHI IFKWs are top predators that feed on a variety of large pelagic fish as well as squid. Within waters surrounding the main Hawaiian Islands, habitat conditions that support the successful growth, recruitment, and nutritional quality of prey are necessary to support the individual growth, reproduction, and development of MHI IFKWs.

3. ***Waters free of pollutants of a type and amount harmful to MHI insular false killer whales.***
   Water quality plays an important role as a feature that supports the MHI IFKWs' ability to forage and reproduce free from disease and impairment. Biomagnification of some pollutants can adversely affect health in these top marine predators, causing immune suppression, decreased reproduction, or other impairments. Water pollution and changes in water temperatures may also increase pathogens, naturally occurring toxins, or parasites in surrounding waters. Environmental exposure to these pollutants may adversely affect their health or ability to reproduce.

4. ***Habitat free of anthropogenic noise that would significantly impair the value of the habitat for false killer whales' use or occupancy.***
   False killer whales rely on their ability to produce and receive sound within their environment to navigate, communicate, and detect predators and prey. Anthropogenic noise of a certain level, intensity, and duration can alter these whales' ability to detect, interpret, and utilize acoustic cues that support important life history functions, or can result in long-term habitat avoidance or abandonment. Long-term changes to habitat use or occupancy can reduce the benefits that the animals receive from that environment (e.g., opportunities to forage or reproduce), thereby reducing the value that habitat provides for conservation. Habitats that support conservation of MHI insular false killer whales allow these whales to employ sound within their environment to support important life history functions.

# GEOGRAPHICAL AREA OCCUPIED BY THE SPECIES AND SPECIFIC AREAS WITHIN THE GEOGRAPHICAL AREA OCCUPIED

One of the first steps in the critical habitat designation process is to define the geographical area occupied by the species at the time of listing. As noted in the *Range* section of this report, the best available information indicates that this DPS is using a smaller range than identified at the time of listing (see Figure 3) and that the DPS does not use habitat uniformly around the main Hawaiian Islands (77 FR 70915; November 28, 2012, Bradford *et al.* 2015). The CHRT relied on the tagging and tracking information described in Bradford *et al.* (2015), as well as new data from tagging and tracking studies by Cascadia Research Collective to provide information on the current range and distribution of MHI IFKW DPS. The CHRT agreed that the range proposed by Bradford *et al.* (2015) provides the best available information to describe the areas occupied at the time of listing, because this range includes all locations tagged animals have visited in Hawaii's surrounding waters and accommodates for uncertainty in the data (see *Range*). Therefore, the CHRT described areas occupied by the species using the range, as seen in Figure 3 and described in Bradford *et al.* (2015) and recognized in the 2015 SAR (Carretta *et al.* 2016).

To be eligible for designation as critical habitat under the ESA's definition of occupied areas, each specific area must contain at least one physical or biological feature essential to the conservation of the species, which may require special management considerations or protection. To meet this standard, the CHRT concluded that false killer whale tracking data would provide the best available information to identify habitat use patterns by these whales and to recognize where the physical and biological features essential to the conservation exist. Cascadia Research Collective provided access to MHI IFKW tracking data for the purposes of identifying critical habitat for this DPS. Due to the unique ecology of this island-associated population, habitat use is largely driven by depth. Thus, the features essential to the species' conservation are found in those depths that allow the whales to travel throughout a majority of their range seeking food, and opportunities to socialize and reproduce.

One area has been identified as including the essential features for the MHI IFKW DPS; this area ranges from the 45-m depth contour to the 3200-m depth contour in waters that surround the main Hawaiian Islands from Niihau east to the Island of Hawaii. As noted in *Movement and Habitat Use*, MHI IFKWs are generally found in deeper areas just offshore, rather than shallow nearshore areas (Baird *et al.* 2010). MHI IFKW location data were used to identify a nearshore depth at which habitat use by MHI IFKWs may be more consistent. Specifically, at depths less than 45 m MHI IFKW locations are infrequent (less than 2 percent of locations are captured at these depths) and there does not appear to be a spatial pattern associated with these shallower depth locations (i.e., locations were not clumped in specific areas). The frequency of MHI IFKW locations increase at depths greater than 45 m and appear to demonstrate more consistent use of marine habitat beyond this depth (see CRITICAL HABITAT REVIEW TEAM). The 45-m depth contour was selected to demonstrate the inshore extent of areas that would include the essential features for MHI IFKWs based on these patterns in the IFKW data.

An outer boundary of 3200-m depth contour was selected to incorporate those areas of island-associated habitat where MHI false killer whales are known to spend a larger proportion of their time (see high-use discussion in *Movement and Habitat Use*) and to include island-associated habitat that allows for movement between and around each Island. This full range of depths from 45 m to 3200 m incorporates a majority of the tracking locations of MHI IFKW and includes those island-associated habitats and features essential to the MHI IFKWS DPS (see Figure 5 and Appendix A. for multiple views throughout the islands).

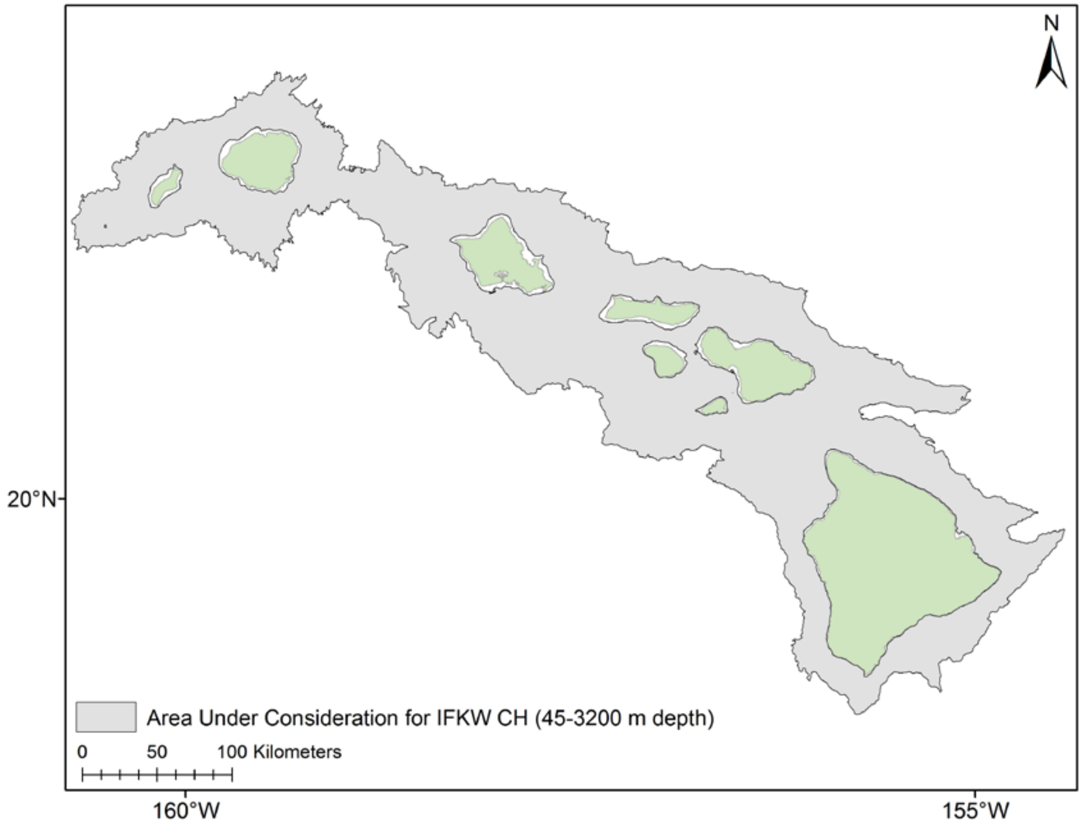


**Figure 5. Map depicting the areas under consideration for MHI IFKW critical habitat. The inner boundary is marked by the 45-m depth contour and the outer boundary is marked by the 3200-m depth contour. See Appendix B for a closer view of areas.**

## SPECIAL MANAGEMENT CONSIDERATIONS OR PROTECTION

Joint NMFS and USFWS regulations at 50 CFR 424.02 define "special management considerations or protection" to mean "methods or procedures useful in protecting physical and biological features essential to the conservation of listed species." Special management may entail management by any entity and, indeed, the existence of management measures to protect essential features of critical habitat is often considered indicative of the need for special management. However, the designation of critical habitat only affects activities with a federal nexus (i.e., a project that is authorized, funded, or carried out by a federal agency).

A designation of MHI IFKW critical habitat creates a consultation obligation for projects with a federal nexus (i.e., a project that is authorized, funded, or carried out by a federal agency) that have the potential to affect the essential features within designated areas of critical habitat. In some cases, measures may be required to prevent destruction or adverse modification of designated critical habitat. This is in addition to mitigation or management measures to ensure that their actions are not likely to jeopardize the MHI IFKW DPS throughout its range (i.e., throughout the waters that surround Hawaii). Such measures are determined during the section 7 consultation process and are project specific. Modifications of such projects would likely vary from project to project depending on such factors as location, the scope or extent of the project, number and type of essential features potentially affected, or project duration.

Activities with no federal nexus are not subject to the section 7 consultation, and therefore, are not subject to project modifications that might result from section 7 consultation. These include a variety of other activities that may occur in waters under consideration for MHI IFKW critical habitat (between the 45 and 3200-m depth contours) including common recreational activities such as boating, state-regulated fishing, or diving. NMFS places no additional prohibitions or restrictions on areas as a result of designating areas as critical habitat; however, nonfederal entities may use information from this critical habitat designation to protect and conserve the features that support MHI IFKW habitat.

Below we describe generalized threats to the physical and biological features essential to the conservation of listed species, as identified in this report, followed by a discussion of numerous activities which may require special management consideration to control these threats. This is not an exhaustive list of potential effects, rather a description of the primary concerns and potential effects that we are aware of at this time and that should be considered in accordance with section 7 of the ESA when federal agencies authorize, fund, or carry out these activities.

*Island-associated marine habitat* - MHI IFKWs restrict their movements to the submerged habitats of the Hawaiian Islands. Tracking information indicates that some areas are used more heavily than others, but that these whales circumnavigate and move quickly throughout the waters surrounding the MHI. These island-associated habitats provide conditions that support this DPS' ability to find food and to interact with other IFKWs (supporting socialization and reproduction). High-use areas of the range may indicate areas where foraging or social interactions are increased. Activities or conditions that may negatively impact island-associated marine habitat include those that occur over a large scale and over a long duration. Large-scale permanent activities (e.g., large in-water construction projects) are more likely to interrupt these whales' ability to move throughout island-associated habitat and may reduce the availability or access to high-use or other island-associated habitats.

*Prey* - Sustained decreases in prey quantity and availability in island-associated waters can influence foraging success of these whales and eventually lead to reduced individual growth, reproduction, and development. Additionally, factors that influence prey size and contaminant or toxin levels reduce the quality of prey for these whales. Decreased prey size reduces the energetic value gained, while contaminants and toxins introduced through prey consumption may put these whales' individual health or reproduction at risk (see *Water Quality* below).

*Water Quality* - Environmental contaminants, such as organochlorines, heavy metals, and other chemicals, persisting and accruing in surrounding waters accumulate through the food chain into prey species and subsequently into MHI IFKWs. Biomagnification of some of these pollutants can adversely affect health in these top marine predators, causing immune suppression, decreased reproduction, or other impairments. Water pollution and changes in water temperatures may also increase pathogens, naturally occurring toxins, or parasites in surrounding waters. MHI IFKWs may be exposed to these infectious or harmful agents (such as bacteria, viruses, toxins, or parasites) either through their prey or directly through ingestion of contaminated waters. Environmental exposure to these pollutants may adversely affect their health or ability to reproduce.

*Noise* - These whales rely on their ability to produce, receive, and interpret sound within their environment to navigate, communicate, and detect predators and prey. The introduction of chronic noise within their habitat can mask - or alter these animals' ability to detect or interpret - important acoustic cues that support life history functions such as foraging, reproduction, socialization, travel, and predator avoidance. This is particularly important given the dispersed nature of false killer whale groups (Baird *et al.* 2008; Bradford *et al.* 2013) and the importance of sound in coordinating activities. Ultimately, noise with certain characteristics (i.e., characteristics that can mask, or deter MHI IFKWs) can negatively affect MHI IFKWs' ability to detect, interpret, and utilize acoustic cues within that habitat. If these anthropogenic noises are chronic or cause cumulative interference such that the animals' ability to receive benefits (e.g., opportunities to forage or reproduce) from these habitats is sufficiently inhibited, the habitat will no longer be able to support the conservation of these animals.

Several activities are identified below which may threaten the physical and biological features essential to conservation, such that special management considerations or protection may be required. Identification of these activities are based on information from the MHI IFKW Recovery Outline, Status Review for this DPS, and discussions from the Main Hawaiian Islands Insular False Killer Whale Threats Workshop (Oleson *et al.* 2010, NMFS 2016). Major categories of activities include (1) in-water construction (including dredging); (2) energy development (including renewable energy projects); (3) activities that affect water quality; (4) aquaculture/mariculture; (5) fisheries; (6) environmental restoration and response activities (to oil spills, vessel groundings response, and marine debris clean-up activities); and (7) some military activities. All of these activities may have an effect on one or more of the essential features by altering the quantity, quality or availability of the features that support MHI IFKW critical habitat.

### *In-Water Construction*

This category consists of a broad range of activities associated with construction and development in marine habitats and may include any of these activities that would affect preferred island-associated marine habitat, prey species, water quality or the sound within that habitat. Many of the construction projects that include in-water work in Hawaii are coastal construction projects associated with the maintenance or replacement of existing structures along the coast that are unlikely to extend into the areas under consideration for MHI IFKW critical habitat (depths greater than 45 m). Projects unlikely to extend into the designation include the maintenance or construction of coastal structures such as docks, piers, revetments, harbors, marinas, or seawalls.

Still, some construction occurs in deeper waters. Common projects might include the installation of buoys, moorings, or fish aggregating devices, and the laying of cables or pipelines. Most of these projects are relatively small in scale or affect a limited amount of area during the initial construction phase. Temporary effects to prey, water quality, or even sound during initial construction or placement of these items are possible; however, existing best management practices for federal permits (such as those protecting water quality and reducing the impacts of sound on marine species) provide protections for these features. See Informal Consultation for the U.S. Army Corps of Engineers Standard Local Operating Procedures in the central and western Pacific Region (Pac-SLOPES; PIR-2017-10106, I-PI-16-1500-AG). While buoys, moorings, and fish aggregating devices have the potential to enhance prey species in certain areas, these changes are also expected to have little overall effect on prey resources across the wider expanse of habitat where MHI IFKW prey may be found. Overall, for most of these routine projects, additional modifications to the project are not anticipated to be necessary to protect MHI IFKW critical habitat.

In Hawaii, dredging activities primarily occur within the harbors and navigable waterways along the coastline. Most large harbor dredging projects do not overlap with areas under consideration for MHI IFKW critical habitat. However, ocean disposal sites for dredged materials do overlap and are located off South Oahu, Hilo, Nawiliwili, Port Allen, and Kahului. The effects of dredging activities are felt most heavily by the benthic community that is disturbed by the removal and/or depositing of sediment (Newell *et al.* 1998). However, this activity may also affect the pelagic community for a period by increasing turbidity, thereby affecting prey resources, or causing the re-suspension of contaminants into the water column (Todd *et al.* 2014). The effects of dredging and disposal activities on MHI IFKW critical habitat would depend on factors such as location, scale, frequency, method of dredging and disposal, local oceanographic and physical characteristics, and duration of these activities. Best management practices in place to reduce the scale of sedimentation impacts and avoid the re-suspension of contaminants into the water column help to protect the features essential to MHI IFKWs. At this time, NMFS currently has insufficient information to predict what, if any, project modifications may be necessary to address potential impacts to MHI IFKW essential features.

Although impacts from smaller in-water projects are expected to be minimal, large-scale in-water construction projects could have the potential to alter the quantity, quality, and availability of MHI IFKW critical habitat such that additional project modifications may be identified during section 7 consultation to reduce potential adverse effects to essential features. The placement of large structures in the marine environment can have contrasting effects on the features that support conservation for this DPS. For example, structures can act as fish aggregating devices enhancing the potential for finding prey resources and attracting predators (Leeney *et al.* 2014), such as MHI IFKWs, to these enhanced foraging areas. Alternatively, large-scale projects have the potential to negatively impact the availability of island-associated marine habitat, if these projects prevent these animals from accessing or utilizing large portions of high-use areas, or create a barrier to access island-associated habitat around and between Islands. Additionally, larger projects may affect water or sound quality within these areas depending on factors associated with size, maintenance, and operation of a given structure (see Energy Development for examples below). Project modifications associated with such a large-scale project are difficult to predict as modifications tend to be project specific - influenced by factors such as location, the scope or extent of the project, number and type of essential features potentially affected, or project duration. However, during planning for large-scale projects action agencies may choose to avoid MHI IFKW high-use areas to minimize the likelihood of negative impacts to areas where the conservation value may be higher. Additionally, as much is unknown about the long-term impacts of larger structures in the marine environment, modifications could involve monitoring how prey, water, sound, and habitat use is influenced by such a project.

### *Energy Development*

Energy development activities are akin to in-water construction activities; however, beyond the placement of a structure in the marine environment, operations of such projects may include the emission of electromagnetic fields and underwater sound into the marine environment (Thomsen *et al.* 2015). The national focus on energy independence has brought increased attention to renewable sources of energy. These activities include offshore wind energy, ocean thermal energy, and ocean wave or current energy. All of these projects may require the construction or placement of a structure in the marine environment, anchoring of the structure to the ocean floor, the installation of cables to conduct electricity ashore, possible anchors for those cables, and/or periodic maintenance of any associated structures. While some projects have been tested on a small scale, the impacts associated with the long-term operations of some of these projects on the marine environment have yet to be realized on a commercial scale.

Project locations for these activities will depend on the resource generating the energy (e.g., wind, waves, current, or ocean temperatures); however, strict federal and State regulations increasingly emphasize the importance of avoiding sensitive habitats when selecting project locations. The *Report to Congress on the Potential Environmental Effects of Marine and Hydrokinetic Energy Technologies* (Department of Energy 2009) identifies projects and studies where impacts, such as those described above, have been acknowledged, and identifies project location as playing the biggest role in minimizing potential environmental effects. Energy projects will need to be addressed on a project-specific basis to determine the nature of potential impacts to MHI IFKW critical habitat. Modifications to large-scale projects resulting from the critical habitat designation are likely to be the same as those discussed above for in-water construction. During the planning phase some projects may choose to select locations outside of high-use areas to minimize any impacts to potentially sensitive areas. Additionally, recommendations may include monitoring for potential long-term impacts, which may be relatively uncertain at this time.

Renewable energy development in marine areas will increase the number of undersea cables that transmit electricity to shore and there are concerns about how electromagnetic fields created by submarine cables may influence fish. Although studies indicate that some species of fish may be sensitive to magnetic fields and influenced by these fields, there is currently little information to understand if this will result in biologically significant impacts (Ohman *et al.* 2007, Gill *et al.* 2012). It is expected that bottom-associated species closest to these cables would be the most likely to be affected, but further information may guide the industry in the future to make modifications to protect sensitive species (Baring-Gould 2015). At this time, there is insufficient information to suggest that modifications may be necessary to protect MHI IFKW prey species, which are primarily pelagic in nature.

In addition to the construction impacts identified above, Ocean Thermal Energy Conversion (OTEC) projects may include impacts associated with the large transfer of water, which may disturb the thermal structure of the ocean near the intake area, change the salinity gradients, and change the amounts of dissolved gases, dissolved minerals, and turbidity (Department of Energy 2009). These types of changes may alter productivity in an area, and may be detrimental to certain sensitive habitats (Department of Energy 2009). As these effects are localized, project location may play the largest role in determining the potential for these types of activities to affect MHI IFKW critical habitat and modifications may include avoiding sensitive areas.

In 2011, the State of Hawaii requested that the Bureau of Ocean Energy Management (BOEM) form a BOEM-Hawaii intergovernmental renewable energy task force, which provides for coordination and consultation on renewable energy projects that may affect Hawaii (BOEM-Hawaii 2017). BOEM has since received three unsolicited lease requests for floating wind energy projects offshore of Oahu and has published a "Call for Information and Nominations for Commercial Leasing to Wind Power on the Outer Continental Shelf, Offshore of Oahu," (81 FR 41335; June 24, 2016). This announcement begins a long-term evaluation and planning process for any potential projects off Oahu. As discussed above, only large-scale in-water construction projects are expected to be capable of negatively affecting island-associated habitat for MHI IFKWs and the location, scale, and operations of these projects will determine whether project modifications are necessary to reduce any potential effects. Floating wind energy projects would include anchoring platforms with wind turbines offshore and transferring energy via undersea cables to shore (BOEM-Hawaii 2017). Effects to water quality are largely similar to those discussed above for buoys, moorings, and fish aggregating devices – and existing regulatory protections (e.g., section 10 of the Rivers and Harbors Appropriation Act or Clean Water Act) and best management practices are likely sufficient to address concerns associated with protecting water quality. Similar to these smaller projects, these structures may act as fish aggregating devices attracting prey species and potentially deterring some fishing due to the extended field of structures (Leeney *et al.* 2014). Given the large size of this as a potential attractant, it is difficult to determine how this may affect whale behavior in and around these areas and additional monitoring may be necessary to understand how prey and whale habitat use may be affected. Information is becoming available with regard to the noise generated from the offshore wind energy projects that involve a foundation (in most cases a monopile). For these projects, the largest noise concerns are associated with construction and pile driving or other efforts made to secure the foundation. However, these impacts are temporary and noise impacts to marine mammals during construction are often already reduced using several different procedures (Thomsen *et al.* 2015). Operational noise for these projects is described as low intensity and low frequency, but continuous during the lifetime of the wind farm (Tougaard *et al.* 2008, Tougaard end Henriksen 2009). These low frequency noises are not expected to result in masking effects to false killer whales. Little information is available with regard to floating wind energy projects and operational noise. However, impacts associated with construction and operational noise are expected to be lessened in comparison to projects with permanent foundations, because - without the foundation - extreme noises of pile driving during construction are avoided and operational noise is no longer transferred through the water column by the monopile (Bailey *et al.* 2014). Behavioral impacts on these whales from large-scale wind projects in offshore waters remain unclear and avoidance of these large-scale project areas may have the potential to negatively affect how these animals use or access island-associated habitat, especially high-use areas – similar to the large-scale in-water construction projects discussed above. The scale and location of these projects will determine whether MHI IFKW island-associated habitat use is negatively affected and whether additional modifications are recommended, such as shifts in site location or increased monitoring. However, measures to avoid such impacts may be taken early in the site selection process as the intergovernmental task force and scoping process are used to help identify sensitive and important habitats.

Offshore wave energy projects are in earlier stages of development and environmental impacts data are limited (Copping *et al.* 2014, Baring-Gould 2015). Noise impacts from these devices during operation may vary widely by device, location, and over time (Baring-Gould 2015). Additionally, these impacts may only be available for demonstration-scale devices. General construction impacts may be largely similar to other renewable energy projects; however, impacts to the physical/oceanographic systems - demonstrated as minimal by smaller devices - may be less clear with larger arrays (Baring-Gould 2015). The exploration of prototypes and experimental devices has begun in Hawaii's surrounding waters. For example, the U.S. Navy's Wave Energy Test Site near Kaneohe Bay, Oahu, is used to test a variety of different devices that may harness energy from ocean movement including an ocean energy buoy, and other wave energy conversion devices; projects are also being planned for a wave energy converter system off of Maui (Energy 2016). Ultimately, these projects may lead to large-scale wave energy development projects in other areas of Hawaii. With little information about how large-scale projects may impact sensitive habitats, caution may be taken in the early development stages to monitor impacts to MHI IFKW essential features. Alternatively, developers and environmental planners may choose to avoid selecting locations that overlap MHI IFKW high-use areas to avoid any potential impacts to areas that might be considered more sensitive.

### *Activities that Contribute to Water Pollution*

Pollutants that reach Hawaii's marine waters have the potential to degrade the water quality and may subsequently reduce the quantity or quality of available prey resources. Pollutants may enter Hawaii's marine waters via direct inputs (e.g., sewage outfalls, industrial, urban and agricultural runoff) as well as from indirect sources (e.g., ocean currents, atmospheric transport, and through migratory species in the food chain) (Friedlander *et al.*, 2008). Local sources of pollution may include but are not limited to wastewater discharge [from industrial and commercial facilities], sewage outfalls, storm water runoff, agricultural pesticide runoff, and development and agricultural activities that cause soil erosion and contribute sediment to coastal waters. Of biggest concerns to MHI false killer whale critical habitat are those activities that may reduce water or prey quality by increasing persistent organic pollutants

(POPs) or other chemicals of emerging concern, heavy metals, pathogens, or naturally occurring toxins in Hawaii's surrounding waters.

Persistent organic pollutants or their derivatives (from pesticides, industrial chemicals and their byproducts) may accumulate in local food chains, altering the quality of prey resources. Marine mammals can accumulate these toxins through their food sources (bioaccumulation) resulting in higher body burdens occurring in top predators, like false killer whales. Bioaccumulation of some persistent organic pollutants has been linked to impaired immunological response or reproductive impairment in some marine mammal species (de Swart *et al.*, 1996; Willcox *et al.*, 2004). With strict regulations some of these types of chemicals are no longer in production in the U.S.; however, many persist in the environment and continue to pose a risk to marine species. New chemicals – or chemicals of emerging concern - are being introduced to the market to meet industrial, agricultural, pharmaceutical, and commercial needs and may be introduced to the marine environment via direct and indirect modes of pollution (Oleson *et al.* 2010). However, little is known about the fate and influence of many of these newer chemicals on the marine environment or how these chemicals may affect MHI IFKW critical habitat.

Similar to POPs, heavy metals accumulate in marine mammals via bioaccumulation and pose a risk to marine mammal health (O'Hara and O'Shea 2005). Sources of heavy metals in the marine environment also include industrial waste water and runoff from urban areas. In addition to these commonly recognized sources, studies indicate that aqueous metals, chemicals, POPs, and other organic contaminants may adhere to microplastics found in increasing numbers in the marine environment and be transported to different areas or be ingested and transferred through the food chain; additionally, microplastics may leach chemicals into the environment as they decompose (Cole *et al.* 2011). Understanding the role that these plastics play in transferring toxic substances in the marine environment and food chain will help inform any future management measures.

The introduction of disease or toxins remains a concern for MHI IFKWs due to their small population size and restricted range, and water quality plays an important role in how these animals may be introduced to certain pathogens, naturally occurring toxins, and parasites. Alterations to the nutrient composition and temperature may alter the composition and diversity in marine communities, ultimately influencing which organisms survive and thrive. Accordingly, these factors can increase pathogen development and survival rates, disease transmission, and host susceptibility (Harvell *et al.* 2002). Similarly, these factors may increase the production of naturally occurring toxins (e.g., ciguatoxin, or biotoxins associated with harmful algal blooms) (Lapointe *et al.* 2015), enhancing the likelihood that this DPS is exposed to agents that may be detrimental its health.

Nonpoint source pollution remains a problem for the management of most coastal areas, including Hawaii, because multiple sources inadvertently contribute to this problem. For example, a recent study by the University of Hawaii scientists provide evidence of hydrologic connections between the municipal wastewater injection from the Lahaina Wastewater Reclamation Facility and the nearshore region of the Kaanapali coast on the Island of Maui, Hawaii (Glenn *et al*. 2010). To prevent pollution of waterways, most federal involvement with nonpoint source pollution includes funding programs or encouraging initiatives that will better control or minimize nonpoint source pollution to coastal waterways. As these programs are aimed at improving habitat, and are likely to incorporate best management practices to protect sensitive habitat and improve water quality, it is unlikely that this designation will result in modifications to activities associated with preventing or minimizing nonpoint source pollution.

Point source pollution is regulated through National Pollutant Discharge Elimination System permits (sometimes referred to as NPDES permits), and permitting authority has been granted to the State of Hawaii's Department of Health Clean Water Branch (CWB) by the United States Environmental Protection Agency (EPA). General water quality standards within the State of Hawaii require that permitted effluent does not cause degradation to local waterways and resources. These standards are monitored and enforced to meet the requirements of the Clean Water Act. Although these are State issued permits, the EPA maintains oversight over CWB actions that fall under the Clean Water Act. As our understanding of the fate and influence of POPs, chemicals of emerging concern, heavy metals, or other chemicals increases, new management or mitigation methods may be identified to support water quality in marine ecosystems adjacent to developed areas, including MHI IFKW critical habitat. At this time, without project specific information such as discharge location, chemical or biological composition, frequency, duration, and concentration, NMFS has insufficient information to predict, what if any, project modifications may be necessary to address potential impacts to MHI IFKW essential features.

### *Aquaculture/Mariculture*

Aquaculture and mariculture (cultivation of marine organisms) activities include impacts similar to both in-water construction and to activities that affect water quality. Those activities that occur adjacent to coastal areas, such as fishponds or coastal aquaculture facilities, will not overlap with the designation; however, some aquaculture activities do occur in deeper waters. Aquaculture activities that include the placement of cages or structures that are anchored in the marine environment have the potential to alter water quality, prey, sound or the availability of island-associated habitat. Water quality or prey resources may be affected by waste disposal, the introduction of exotic species or pathogens, or release of pesticides or antibiotics. Facilities may also impact local prey resources, because farms may use wild stock seeding, or feed made from wild fish (Naylor *et al.*, 2000). Alternatively, these aquaculture activities may positively affect wild stocks by decreasing commercial fishing pressure by lowering the demand on commercial fish species. Similar to routine in-water construction projects, best management practices already attempt to reduce risks associated with water quality and impacts to local fish species.

NMFS is proposing to develop an aquaculture management program to regulate where, how, and how much aquaculture may occur between 3 nm and 200 nm, and provide clear guidance to the industry. NMFS Pacific Islands Regional Office (PIRO) is preparing a programmatic environmental impact statement to analyze potential environmental, social, and economic impacts associated with the proposed aquaculture management program (NMFS 2015; also see our website. This program would support offshore aquaculture development by identifying appropriate management unit species for aquaculture, reasonably foreseeable types of offshore aquaculture operations, and permitting and reporting requirements for conducting aquaculture activities in federal waters (generally 3-200 nm). These efforts support a growing aquaculture industry in State waters and opens the potential for increased aquaculture activity in federal waters.

Currently, the aquaculture industry in Hawaii produces a wide variety of crustaceans, finfish, mollusks, and algae for food (United States Department of Agriculture 2015). As of February 2017, in Hawaii, there are permitted net pen facilities in both state and federal waters to culture finfish. Blue Ocean Mariculture is a commercial open ocean mariculture farm in state waters off Keahole Point (Hawaii Island). This company cultures the finfish *Seriola rivoliana*, known as Almaco Jack or locally known as Kampachi, and in 2014 it applied to the State for permission to increase production capacity from 500 metric ton (mt) to 1,100 mt of fish annually (Blue Ocean Mariculture 2014). Additionally, in July 2016, NMFS issued a Special Coral Reef Ecosystem Fishing Permit to Kampachi Farms, LLC for the culture and harvest of *S. rivoliana* using a net pen system. This net pen would be tethered to an existing mooring located in federal waters approximately 5.5 nmi offshore west of Keauhou Bay on the Island of Hawaii. This two-year permit authorizes the culture and harvest of a maximum amount of 30,000 kampachi fish or approximately 120,000 lb over the two-year course of the permit; this permit was recently transferred to Forever Ocean Inc.

An additional Army Corps of Engineers permit was issued to Hawaii Ocean Technology, Inc. to culture bigeye tuna (*Thunnus obesus*) and yellowfin tuna (*T. albacares*) in large sphere-shaped untethered fish cages off Kawaihae on the west side of Hawaii Island. Twelve "oceansphere" cages were expected to produce 6,000 tons of tuna per year. Oceanspheres, with a diameter of 177 feet (ft), were designed to dangle anchorless about 65 ft below the surface and about 1,250 ft above the ocean floor using a combination of ballast, thruster control, and surface buoys. In December 2016, Hawaii Ocean Technology, Inc. dissolved itself and these mariculture efforts were abandoned. There is still potential for additional aquaculture facilities to be developed within MHI IFKW critical habitat. NMFS has a marine aquaculture strategic plan for 2016-2020 that establishes a target of expanding sustainable U.S. marine aquaculture production by at least 50 percent by the year 2020 (NMFS 2015). It remains to be seen how this national goal will be implemented in the Pacific Islands Region, specifically in Hawaii. Modifications to aquaculture projects as a result of this designation are difficult to determine without project specific information that includes location, operation details, and size. It is expected that smaller projects that are similar to existing operations in low-use areas for MHI IFKWs using existing best management practices to protect water quality and marine resources will not require additional modifications. However, newer technologies or aquaculture methods may require monitoring efforts if the potential exists for different or new effects to water quality, prey, or sound. Similar to large-scale in-water construction projects, during the planning stages planners may choose to avoid high-use areas to avoid any potential impacts to areas that might be considered more sensitive.

### *Fisheries*

Fishing activities that may affect MHI IFKW critical habitat include those that reduce the quantity, quality, or availability of MHI IFKW prey species. The 2010 Status Review for this DPS indicated that fisheries may affect MHI IFKW prey resources in two ways: 1) by removing potential prey in the immediate vicinity of false killer whales, and 2) by contributing to the long-term reduction of prey biomass over the range of the fish stocks that these whales encounter (Oleson *et al.* 2010). False killer whales appear to forage primarily on large pelagic fish, including yellowfin tuna, albacore tuna, skipjack tuna, broadbill swordfish, mahi-mahi, wahoo, and lustrous pomfret. However, they are also known to prey on reef associated species, including bonefish, scrawled file fish, and threadfin jack (Baird 2009, Oleson *et al.* 2010, Table 2).

There are thousands of fishing vessels from dozens of fishing nations that harvest large pelagic fish in the Pacific Ocean. However, fisheries that target pelagic species of fish and overlap with the areas under consideration for MHI IFKW critical habitat are likely to have the most direct impact on the availability of prey resources found within MHI IFKW critical habitat.

Hawaii's pelagic fisheries include the longline, MHI troll and handline, offshore handline, and the aku (pole and line) fisheries. The target species include tunas and billfishes, but important other species include mahi-mahi, ono (wahoo), opah (moonfish), and monchong (pomfret) (Council 2009). Federally managed pelagic fisheries that are subject to section 7 consultations include the deep-set and shallow-set longline fisheries, which target tuna and swordfish, respectively, in waters surrounding the Hawaiian Islands. The 2010 Status Review notes the historical influence that these fisheries may have had on available prey resources prior to 1990 when these fisheries operated within the DPS' range (Oleson *et al.* 2010). However, in the early 1990s a longline exclusion zone was established around the MHI to reduce conflicts between longline and other nearshore fisheries (56 FR 28116, June 1991; 56 FR 47701, September 1991). This resulted in an effective closure of these fisheries in most of the MHI IFKWs' range, though some exceptions applied for small vessels (50 CFR Part 665, Subpart F, §665.807) and certain areas were opened seasonally from October through January in 1992 (57 FR 7661, March 1992). Additionally, this closure did not apply to State managed short liners. As part of the 2012 false killer whale Take Reduction Plan, the longline exclusion zone became effective year-round, leaving only a 5.4 percent overlap between this DPS' range and the areas where these fisheries operate (based on Bradford *et al.* 2015) (see Figure 3). However, areas under consideration for MHI IFKW critical habitat do not extend past the 3200-m depth contour and do not overlap with these federally managed fisheries (see Figure 6). Consequently, the deep-set and shallow-set longline fisheries do not harvest prey from areas under consideration for critical habitat.

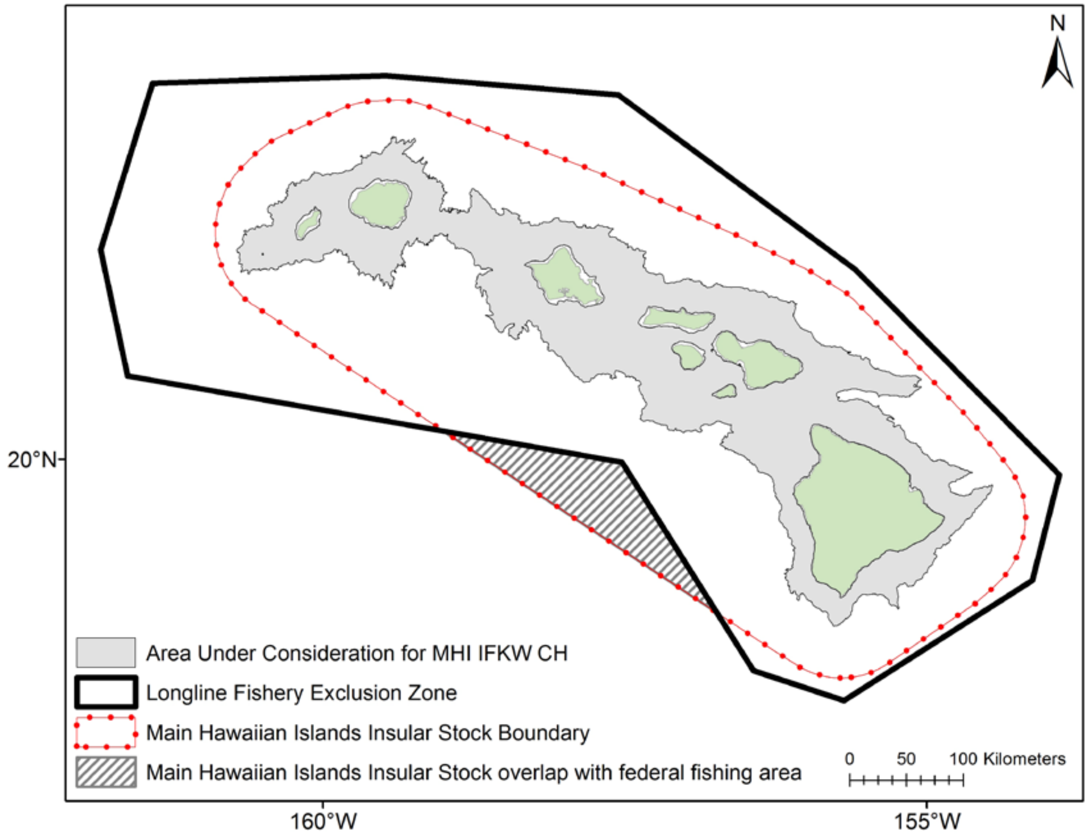


**Figure 6. Map depicting the Federal Longline Fishery overlap with the MHI IFKW range.**

As previously mentioned, many fisheries from many fishing nations harvest pelagic fish species and therefore, may indirectly contribute to the long-term reduction of prey species. However, for the purpose of ESA section 7, NMFS consults on federally-managed U.S. domestic fisheries. A full understanding of the degree to which these U.S. domestic fisheries may contribute to the long-term reduction of prey biomass over the range of the fish stocks that these whales encounter is confounded by several factors, including that diet composition, as well as prey preference and relative importance, is still somewhat uncertain for this DPS.. We consider information that is available about the sustainability of these fisheries and relative influence that these fisheries may have on certain fish stocks identified as prey items of this DPS (see Table 2). Some of these prey species are separated into separate management units for the purpose of assessing their abundance and status. For example, yellowfin are divided into two separate stocks for management purposes. The boundaries of the western and central Pacific Ocean (WCPO) stocks extend from Asia to 150 deg. W. long., while the boundaries of the Eastern Pacific Ocean (EPO) stocks extend from 150 deg. W. long. to the coast of the Americas. While the geographic range of the MHI IFKW is within the boundary of the WCPO yellowfin, we do not know the extent to which fish from the EPO may move through the range of these whales. Without surety of which species may be more important in the diet or to what degree the geographic range of important prey species overlaps with these fisheries, we consider information that is available about the sustainability of these fisheries and relative influence that these fisheries may have on certain fish stocks identified as prey items of this DPS (from Table 2).

Table 3 (below) identifies stock assessment information for nine fish species taken by the fishery, which are also listed in Table 2 as MHI IFKW prey items, as well as for the Western and Central North Pacific Ocean stock of striped marlin (Eastern Pacific Ocean stock of striped marlin is not included). Among these 10 species of fish, only the Western and Central North Pacific Ocean stock of striped marlin is considered overfished; however, this species is not yet identified as part of the MHI IFKW diet. For the nine other species, the U.S. landings compared to the stock's total estimated biomass are relatively low (less than 1 percent in most cases) and international and domestic management measures strive to ensure the sustainability of these stocks. In some species, information suggests stability or improvements in available biomass. For example, WCPO yellowfin tuna projections, based on the most recent fisheries statistics from 2013-2015 (Pilings *et al.* 2016), indicate increasing biomass for yellowfin tuna. In addition to these nine species, Table 2 identifies 16 other species that may be important prey items to MHI IFKW. The 2010 Status Review notes that past declines in large apex predators may have allowed for increases in the relative abundance of mid-trophic level fishes, such as mahi-mahi, ono, and flying squid (a potential prey item) (Polovina *et al.* 2009). Mahi-mahi is noted as a commonly observed prey items for these whales. This diversity in diet, which includes mid-trophic level fishes, likely allows these whales to shift to available prey items to meet their energetic needs.

Current data, although incomplete, suggests that competition between commercial federally managed fisheries is low, and that additional management is not necessary. However, future management needs may be identified as more information is gained about MHI IFKW foraging ecology, or a better understanding of the relative importance of certain prey species to the health and recovery of a larger MHI IFKW population is gained. At this time, there currently is insufficient information to suggest that any prey species may require additional conservation and management to ensure the conservation of MHI IFKWs. However, if future management were necessary, based on current fisheries management systems, NMFS retains broad authority to make modifications to federally managed fisheries to address impacts to ESA-listed DPSs like MHI IFKW, including restrictions to fishery catch or effort.

**Table 3. Stock information for species taken in the federal Longline Fishery.**

| **English name** ***Scientific name*** | **Total Stock Biomass (mt)** | **Spawning Stock Biomass (mt)** | **Maximum Sustainable Yield (mt)** | **Most Recent Estimated Landings by all Fishing Nations Combined (mt)** | **Estimated 2016 Landings in Hawaii-based longline fisheries[1]** | **U.S. landings percent of total biomass** | **Source** |
|---|---|---|---|---|---|---|---|
| Broadbill swordfish *Xiphias gladius (W&CNP)* | 72,500 | Not estimated | 14,920 | 9,863 (2012) | 638 | 0.88 | 2014 ISC |
| Broadbill swordfish *Xiphias gladius (EPO)* | 58,590 | Not estimated | 5,490 | 9,910 (2012) | 0 (2012) | <0.1 | 2014 ISC |
| Skipjack tuna *Katsuwonus pelamis (WCPO)* | Not estimated | Not estimated | 1,891,600 | 1,679,528 (2015) | 259 | Not available | 2016 SPC |
| Albacore tuna *Thunnus alalunga (NPO)* | 669,405 | 110,101 | 105,571 | 76,445 (Ave.2010-2012) | 244 | 0.04 | 2014 ISC |
| Yellowfin tuna *Thunnus albacares (WCPO)* | 1,994,655 | 998,622 | 586,400 | 598,128 (Ave.2008-2012) | 1,469 | 0.07 | 2014 SPC |
| Yellowfin tuna *Thunnus albacares (EPO)* | 494,645 | Not estimated | 274,960 | 255,713 | 249 | 0.05 | 2017 IATTC |

Continued on next page.

| **English name** ***Scientific name*** | **Total Stock Biomass (mt)** | **Spawning Stock Biomass (mt)** | **Maximum Sustainable Yield (mt)** | **Most Recent Estimated Landings by all Fishing Nations Combined (mt)** | **Estimated 2016 Landings in Hawaii-based longline fisheries[1]** | **U.S. landings percent of total biomass** | **Source** |
|---|---|---|---|---|---|---|---|
| Blue marlin *Makaira nigricans* | 78,082 | 24,809 | 19,901 | 20,356 (2014) | 517 | 0.66 | 2016 ISC |
| Bigeye tuna *Thunnus obesus (WCPO)* | 742,976 | 325,063 | 108,520 | 157,354 (Ave.2008-2011 | 6,270 | 0.84 | 2014 SPC |
| Bigeye tuna *Thunnus obesus (EPO)* | 462,732 | Not estimated | 160,201 | 94,519 | 2,087 | 0.45 | 2017 IATTC |
| Striped Marlin** *Kajikia audax (W&CNP)* | 6,819 | 1,094 | 5,657 | 2,984 (2013) | 329 | 4.82 | 2015 ISC |

**Striped marlin is not a prey species identified from Table 2.

A few reef-associated species occur far enough offshore (> 40 km) to be caught in the Longline fishery, such as rainbow runner (*Elegatis bipinnulatus*), amberjack (*Seriola dumerili*), and barracuda (*Sphyraena barracuda*). Rainbow runner and barracuda are among the incidental species depredated by false killer whales. The few coral reef species that have been observed in the diet of insular false killer whales (Baird, 2009) include scrawled filefish (*Aluterus scriptus*), bonefish (*Albula* spp.), and threadfin jack (*Alectis ciliaris*), and unknown species of jack (West 2016). However, there are no federally managed fisheries that target these species, although the Hawaii bottomfish fishery incidentally harvests amberjack and several species of jacks while fishing for bottomfish.

The Hawaii bottomfish fishery is jointly managed by NMFS and the State of Hawaii. Its area of operation overlaps with the areas under consideration for MHI IFKW critical habitat. The fishery harvests a complex of 14 species that includes nine snappers, four jacks, and a grouper, although the target species are six deep water snappers and the grouper. Commonly referred to as the "Deep 7 bottomfish," they include onaga (*Etelis coruscans*), ehu (*E. carbunculus*), gindai (*Pristipomoides zonatus*), kalekale (*P. sieboldii*), opakapaka (*P. filamentosus*), lehi (*Aphareus rutilans*), and hapuupuu (*Hyporthodus quernus*). Generally, Deep 7 bottomfish are caught along high-relief, deep slopes, ranging from 80-400 meters (m) (NMFS 2015). Deep 7 bottomfish have not been observed in the diet of the MHI IFKW.

In addition to the Deep 7 bottomfish, the Hawaii bottomfish fishery also harvests four species of jacks and three snappers. Termed the "non-Deep 7 bottomfish", they include the giant trevally or white ulua (*Caranx ignobilis*), black jack or black ulua (*C. lugubris*), amberjack or kahala (*Seriola dumerili*), thick lipped trevally or butaguchi (*Pseudocaranx cheilio*), gray jobfish/snapper or uku (*Aprion virescens*), blue lined snapper or taape (*Lutjanus kasmira*), and yellowtail snapper or yellow kalekale (*Pristipomoides auricilla*). However, uku is the primary non-Deep 7 bottomfish species harvested, and accounts for approximately 80 percent of the total commercial catch of non-Deep 7 bottomfish annually, followed by white ulua, black ulua, and butaguchi. Fishermen typically catch non-Deep 7 bottomfish during Deep 7 bottomfish trips, although at shallower depths (NMFS 2015). Due to their association with ciguatera poisoning, there is little to no commercial market for kahala or ulua (NMFS and WPFMC 2007). For this reason, they are generally discarded when caught, and those that are kept comprise a very small percentage of the overall Hawaii bottomfish catch. Because these prey species represent an insignificant fraction of total bottomfish fishery harvests, adverse impacts to MHI IFKW critical habitat are not expected, and no additional modifications are expected to this fishery.

Other Hawaii fisheries overlap with the areas under consideration for MHI IFKWs, such as the Hawaii crustacean and precious corals fisheries. These fisheries are subject to varying levels of federal management, including permits and annual catch limits. These fisheries do not target MHI IFKW prey species and present no major threats to the MHI IFKW essential features. No additional modifications are expected to these fisheries as a result of MHI IFKW critical habitat.

MHI IFKW prey species identified in Table 2 including ʻOʻīo, the white ulua, and other jacks, are targeted by Hawaii coral reef ecosystem fisheries such as the ulua shore cast and bonefish fisheries. Although NMFS and the Council annually set catch limits for these fisheries, they are not otherwise subject to federal management, and no additional modifications are expected to these fisheries as a result of MHI IFKW critical habitat.

There currently is insufficient information to suggest that any prey species may require additional conservation and management to ensure the conservation of MHI IFKWs. Still, future management needs may be identified as more information is gained about MHI IFKW foraging ecology, or a better understanding of the relative importance of certain prey species to the health and recovery of a larger MHI IFKW population is gained. However, if future management were necessary, based on current fisheries management systems, NMFS retains broad authority to make modifications to federally managed fisheries to address impacts to ESA-listed DPSs like MHI IFKW, including changes to the annual catch limits.

### *Environmental Response Activities (oil spill, vessel grounding, and marine debris)*

Oil-spill response activities may affect water quality and prey of MHI IFKWs. The severity of oil spill impacts on the marine environment depends on the volume of the spill, duration, and the type of petroleum product, in combination with the physical factors at the location of the spill such as wind, wave and current conditions. Minimization of impacts from oil spills depends on the ability to respond to the spill and the effectiveness of methods used to remove, or disperse the oil. The emergency nature of these events requires that general response activities are planned in advance and that protocols are adjusted to ensure that methods selected to disperse or remove oil reduce, to the extent possible, additional destruction to the site of the spill or destruction to nearby habitats.

Throughout the nation the response and recovery efforts associated with oil spill events are planned in advance to provide protection to environmental and economic interests; the National Oil and Hazardous Substances Pollution Contingency Plan provides the organization structure and procedures for this type of planning (40 CFR 300). Plans to protect MHI IFKW critical habitat may include contacting appropriate NMFS staff during a spill event, identifying the essential features present in the area of the spill, and identifying the appropriate response to protect those features during the recovery efforts. However, Hawaii's Area Contingency Plan (ACP) already calls for the protection of listed species "as well as listed species' habitat not yet designated as critical," (Commander U.S. Coast Guard 2010) to ensure that habitat impacts will not affect the listed species themselves. Hawaii's ACP attempts to identify sensitive areas and define the sensitivity of the area to provide specific response strategies to protect the site (Commander U.S. Coast Guard 2010). The ACP is currently in the process of being updated and this plan will undergo section 7 consultation to ensure that response activities consider the effects to protected species and habitats, including MHI IFKWs. In the event of an emergency ("acts of God, disasters, casualties, national defense or security emergencies, etc."), Joint regulations allow consultation to be conducted informally through alternative procedures that are deemed consistent with section 7 requirements (50 CFR 402.05). Response efforts will likely be unique to each area and multiple variables will play into the most appropriate protocol for response.

Similar to oil spills, the severity of impacts due to vessel grounding events are determined by the surrounding substrate, the possible release of fluid, methods or plans for removal, and the physical factors at the location. Groundings (and subsequent removal of vessels) in marine areas have the potential to disrupt habitat important to prey species and to increase sediment deposition in nearby areas, impacting water quality, and, potentially, prey health. Vessel groundings also have the potential to release oil and hazardous substances (including petroleum products and other chemicals) into the marine environment which, in turn, may impact the quantity and quality of prey species and water quality in surrounding areas. Groundings causing damage to coral reefs have also been linked to incidence of ciguatera outbreaks that are caused by blooms of toxic algae (de Sylva 1994). Most activities associated with removing grounded vessels from the marine environment already attempt to minimize the amount of damage to the surrounding habitat, and it is unlikely that further modifications will be necessary for these activities.

In Hawaii, the PIFSC Coral Reef Ecosystem Division leads Marine Debris Response efforts, partnering with other divisions and agencies, to collect and remove marine debris throughout Hawaii. Most of these activities occur in shallower depths, and involve removing debris from nearshore reefs and coastal areas, which do not overlap with MHI IFKW critical habitat. For those marine debris activities that may overlap, best management practices already recommended and practiced by staff to prevent impacts to the listed species or to sensitive habitats provide sufficient protection to MHI IFKW essential features.

### *Military Activities*

For the purposes of this report, military activities include a wide variety of training, construction, and research activities that may have the potential to affect the essential features of MHI IFKW critical habitat. Military construction activities would be no different from the in-water construction activities discussed above (see *In-Water Construction*) and concerns would be mostly associated with large-sized projects, especially in sensitive areas. Research activities may include the testing of certain technologies (some of these are discussed above under *Energy Development*), but may also include some testing associated with military preparedness and training (e.g., testing new weapons, or training exercises using sonar).

In combination, research and training for military preparedness may include activities that have the potential to affect island-associated habitat, water quality, prey availability, or the quantity or quality of noise within these habitats depending on the type of activity taking place and the location of the activity. The Department of Defense (DOD) already consults with NMFS to ensure its activities are not likely to jeopardize listed species; in these consultations, the impacts to the species are assessed. For example, for sonar-related activities the consultation includes the potential for these activities to result in behavioral, acoustic, and physiological effects on listed species such as IFKWs. To ensure that their activities are not likely to jeopardize IFKWs and other listed species, the DOD engages in many best management practices to minimize the impacts to the marine environment, and conducts monitoring and research to provide better information about potential impacts to protected species and their habitat. Many of these types of military activities are consulted on for a five-year period and an annual review of monitoring reports and activities is conducted. In addition, these activities are also reviewed under the MMPA (16 U.S.C. 1361 et seq), which allows NMFS to authorize the incidental take of marine mammals during the Navy's specified activities, determine permissible methods of taking, determine other means of effecting the least practicable adverse impact on marine mammals species or stocks and their habitat, and determine requirements pertaining to the monitoring and reporting of the incidental take. These MMPA letters of authorization are also issued for a five-year period (see Military Readiness: Incidental Take Authorizations for more information).

Similar to other activities discussed above, the location, essential features present, and the specifics associated with the military activity will determine to what degree any of the IFKW features may be impacted. Activities that are chronic in nature, and which have the potential to effect one of the listed features over a large-size area may raise the most concerns about degrading the quality of one or more of the features or the value of critical habitat. In contrast, activities that are within discrete locations for brief periods are less likely to have lasting effects on the overall feature within that habitat, unless that activity occurs on a regular basis and in aggregate the temporary effects degrade the habitat and ultimately prevent IFKWs from benefitting from that habitat. Regardless, military projects will need to be addressed on an activity-specific basis to determine the nature of potential impacts to the essential features of MHI IFKW critical habitat.

### *Other Factors Influencing MHI IFKW Essential Features*

As noted in the Vocalization, Hearing, and Underwater Sound section of this report, some chronic anthropogenic noise sources may be capable of degrading MHI IFKW habitat by masking or interfering with the detection, recognition, or discrimination of important acoustic cues or by causing these animals to abandon or avoid certain habitats for long periods. Increased anthropogenic noise and the effects that increased urbanization may have on ocean soundscapes has gathered increasing attention and NOAA has prepared a ten-year strategy to address increasing ocean noise (Gedamke *et al.* 2016). In addition to the anthropogenic activities that produce sound and are subject to section 7 consultation, highlighted in earlier sections of the SPECIAL MANAGEMENT CONSIDERATIONS OR PROTECTION above, increased vessel traffic and technology used by these vessels may all contribute to changes in ocean soundscapes. However, at this time, there is insufficient information to reasonably predict with any confidence if, how, and where noise-related activities such as those described may require additional management to protect MHI IFKW habitat and to ensure the conservation of MHI IFKWs. However, as our understanding of anthropogenic noise continues to improve, impacts to critical habitat and appropriate protections may be applied through the section 7 consultation process, or through additional recovery efforts as appropriate.

Climate change and ocean acidification are threats recognized in the 2010 Status Review (Oleson *et al*. 2010), which are likely to affect the essential features of MHI IFKW habitat. In particular, this threat may alter water quality and/or prey quantity or quality. The excerpt below provides additional detail as to how this threat may influence the availability of MHI IFKW prey.

> *…ocean temperature plays a key role in determining pelagic habitat for many species, and changes in this parameter would likely have a strong impact on false killer whales. Many prey species and competitor species have ranges closely linked to ocean temperature, both isotherms and gradients. Changes in temperature regimes could have severe impacts on pelagic ecosystems, in general. For false killer whales, specifically, many of their forage species are migratory and/or mobile (i.e., few benthic species). The movement of other large predatory marine species ranges is likely to change, which could impact competition with false killer whales. However, a much better understanding is needed of prey preferences and predator-prey dynamics before speculating on the possible impacts of warming or cooling trends on insular false killer whales. Temperature may also have a direct linkage to productivity and growth rate but again it remains difficult to establish directionality of net effect. Increases in low-productivity areas (e.g., Polovina et al., 2008; Brewer and Peltzer) would probably have the strongest impacts on false killer whales. Lower productivity resulting in decreases in forage abundance would have a negative impact unless mobile forage species were concentrated into smaller regions that could then be exploited more easily. Again, presumed effects are large but net directionality is difficult to predict.*
>
> Oleson *et al.* 2010

In addition, ocean warming raises concerns with regard to increased environmental exposure to harmful agents (such as bacteria, viruses, toxins, or parasites). Growth rates of marine bacteria and fungi are positively correlated with temperature and increased ocean temperatures may also increase the range of pathogens (Harvell *et al.* 2002; Parmesan 2006). However, the complexity of ecological interactions in these marine systems makes it difficult to predict exactly how these large-scale global changes will impact local systems.

While all of the processes associated with global climate change are recognized as threats to the essential features of the MHI IFKWs, activities that influence these threats are considered to be of a complex global scale. Current limitations in predicting the specific changes that will occur within these ecosystems impede NMFS' ability to predict the resultant impacts to MHI IFKW habitat with any certainty. As impacts from these forces are demonstrated or better understood, activities that exacerbate impacts to the essential features (e.g., changes to water and prey quality) will be further scrutinized and associated management efforts may be pursued. At this time, no single activity has been identified as contributing specifically to these threats. Climate change impacts will be more fully addressed through the individual consultation process when individual project details are known. Management efforts that are within the scope of an ESA section 7 consultation dealing with a single action or activity would likely focus on actions to minimize impacts to water quality and prey. In this manner, NMFS will be able to incorporate special management considerations for specific activities as the extent of impacts from global climate change are demonstrated or better understood.

## UNOCCUPIED AREAS

Section 3(5)(A)(ii) of the ESA authorizes the designation of "specific areas outside the geographical area occupied" at the time the species is listed, if the Secretary determines "that such areas are essential for the conservation of the species." There is insufficient evidence at this time to indicate that areas outside the present range are essential for the conservation of this DPS; therefore, no unoccupied areas were identified for designation.

## CRITICAL HABITAT REVIEW TEAM

NMFS convened a critical habitat review team (CHRT) to assist in the assessment and evaluation of critical habitat areas for the MHI IFKW DPS. The CHRT consisted of 5 Federal biologists from NMFS with a diverse range of experience and expertise that includes knowledge of cetacean biology and ecology, as well as the ecology and ecosystems of Hawaii, which supports this DPS. The CHRT used the best available scientific and commercial data and their best professional judgment to: (1) determine the geographical area occupied by the DPS at the time of listing, (2) identify the physical and biological features essential to the conservation of the species, and (3) identify specific areas within the occupied area containing those essential physical and biological features.

### *CHRT Phase 1*

In Phase 1, the CHRT convened to introduce the members to the critical habitat designation process, identify and synthesize the best available scientific and commercial data relevant to critical habitat for the MHI IKFW DPS, identify the geographical area occupied, and delineate and verify the specific areas within the geographical area occupied. First, the CHRT was given a brief overview of the statutory and regulatory requirements under the ESA regarding critical habitat. The CHRT then defined the geographical area occupied by the MHI IFKW DPS, the list of biological or physical features for the MHI IFKW DPS, and specific areas within the occupied range.

The CHRT agreed that the range proposed by Bradford *et al.* (2015) provides the best available information to describe the areas occupied at the time of listing, because this range includes all areas where false killer whales are known to have traveled (i.e., all available tracking information falls within this area) and accommodates for uncertainty in the available tracking data (i.e., lack of information from certain months of the year and limited information from certain social clusters). Therefore, the CHRT described areas occupied by the species using the minimum convex polygon of a 72 km radius (~39 nautical miles) extending around the Main Hawaiian Islands, as seen in Figure 3 and described in Bradford *et al.* (2015) and recognized in the 2015 SAR (Carretta *et al.* 2016).

While determining the essential features for MHI IFKWs the CHRT discussed the unique aspects of the populations' ecology and considered what physical and biological features influence the life history needs of this DPS. The CHRT reviewed features that support other cetacean species, reviewed scientific literature, and considered tracking information from MHI IFKWs provided by Cascadia Research Collective. Tracking information included data from 27 animals; social cluster affiliations were identified as follows: 19 animals from Cluster 1, 1 animal from Cluster 2, and 7 animals from Cluster 3. Tracking data were provided in the 5x5 km grids used by Baird *et al.* (2012) to identify high-use and low-use areas for MHI IFKWs. This information was spatially overlaid with factors such as depth, slope, and current to consider the potential influence on MHI IFKW habitat use. Additionally, tracking locations were provided by Cascadia Research Collective to consider other environmental factors that might guide the identification of boundaries for the designation.

The team noted that critical habitat must support this population's ability to successfully forage, socialize, and reproduce. This DPS' island-associated nature means that habitat use is largely driven by depth and that these whales are less likely to be found in very shallow waters and very deep waters, such as abyssal habitats further off the Islands. Beyond depth, other factors may influence this population's use of areas within the range including the availability of prey or the significance of the area to the populations' culture (i.e., some areas could be important for socializing between or among social clusters). Baird *et al.* (2012) theorized that MHI IFKW's high-use areas may provide conditions with greater foraging potential for IFKWs as these areas demonstrate evidence suggesting higher productivity. Still, information is limited seasonally, across the different social clusters, and over extended periods. Thus, the CHRT noted - similar to Baird *et al.* (2012) - that additional high-use areas may exist within the range of this DPS and the factors that influence use of the different areas may not be fully realized. There is no information to suggest that particular areas support reproduction, and foraging is believed to happen throughout the range – based on observational and diving data (Baird 2009, Baird *et al.* 2012). The CHRT identified that island-associated habitat essential to the conservation of this DPS must contain more than the currently recognized high-use areas and that this habitat must allow for movement around and between the Islands to support this population's ability to successfully forage, socialize, and reproduce. After reviewing factors that may influence habitat use in surrounding waters, such as depth, slope, and current velocity, the team agreed that the greatest influence appears to be depth because this population restricts movements to the submerged habitats of the Hawaiian Islands. In addition to island-associated habitat that allows for movement around and between the Islands, the CHRT identified that critical habitat for MHI IFKWs must provide prey resources to support this population, noise levels that allow this population to detect, interpret, and utilize important acoustic cues, and water quality that supports the health of this population. All of these features are essential to the conservation of MHI IFKWs because the features support the populations' ability to successfully find food and other IFKWs, supporting the energetic needs and reproductive success of this population.

To be eligible for designation as critical habitat under the ESA's definition of occupied areas, each specific area must contain at least one physical or biological feature essential for the conservation of the species and which may require special management considerations or protection. To meet this standard, the CHRT identified that false killer whale tracking data would provide the best available information to identify habitat use patterns by these whales and to recognize where the physical and biological features essential to the conservation exist. As noted above, the team acknowledged that island-associated habitat use is largely driven by depth. Accordingly, this essential feature may be recognized by the depths that allow the whales to travel throughout a majority of their range seeking food, as well as opportunities to socialize and reproduce. As noted in *Movement and Habitat Use*, MHI IFKWs are generally found in deeper areas just offshore, rather than shallow nearshore areas (Baird *et al.* 2010). Tracking locations were used to identify a nearshore depth at which habitat use by MHI IFKWs may be more consistent. At depths less than 45 m, tracking locations were infrequent (less than 2 percent of locations are captured at these depths). Additionally, there was no spatial pattern associated with these shallower depth locations (i.e., locations were not clumped in any specific area). The frequency of MHI IFKW locations increased at depths greater than 45 m and appear to demonstrate more consistent use of marine habitat beyond this depth. The 45-m depth contour was selected to demonstrate the inshore extent of areas that would include the features essential to this DPS' conservation. The team explored several depth options to identify the outer extent of critical habitat for this DPS, guided mostly by the need to include island-associated habitat essential to conservation for this DPS. Factors that were discussed included ensuring that the depth selected included all of the recognized high-use areas (see high-use discussion in *Movement and Habitat Use*), island-associated habitat around each Island of the chain, and habitat that allows for movement between these areas. The outer boundary of 3200-m depth contour was selected to ensure that all these criteria were met. This full range of depths from 45 m to 3200 m incorporates a majority of the tracking locations of MHI IFKWs and based on this review incorporates features essential to the MHI IFKW DPS. In conclusion, the team identified one specific area as including the essential features for the MHI IFKW DPS; this area ranges in depth from the 45-m depth contour to the 3200-m depth contour in waters that surround the main Hawaiian Islands from Niihau east to Hawaii.

The CHRT was also asked to identify any unoccupied areas that may be essential for the conservation of the MHI IFKW DPS. As described in the section titled UNOCCUPIED AREAS above, unoccupied areas may be designated as critical habitat if the areas are determined to be essential for conservation of the species. The CHRT found no evidence that areas outside the geographical range of the species were essential for conservation of this DPS; accordingly, no unoccupied areas were identified for designation.

## Appendix A.

## Maps of the areas under consideration for MHI IFKW critical habitat.

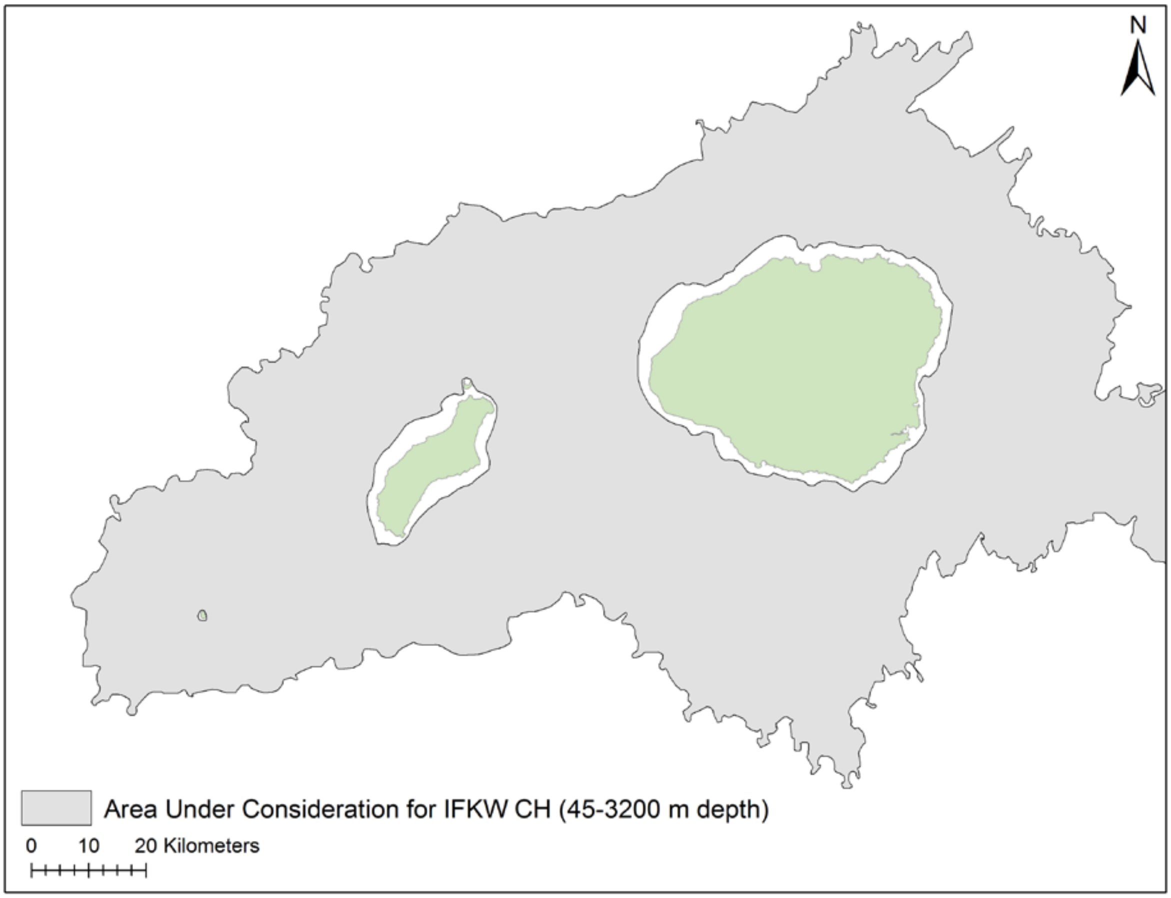


**Figure 7. Areas under consideration around Niihau and Kauai.**

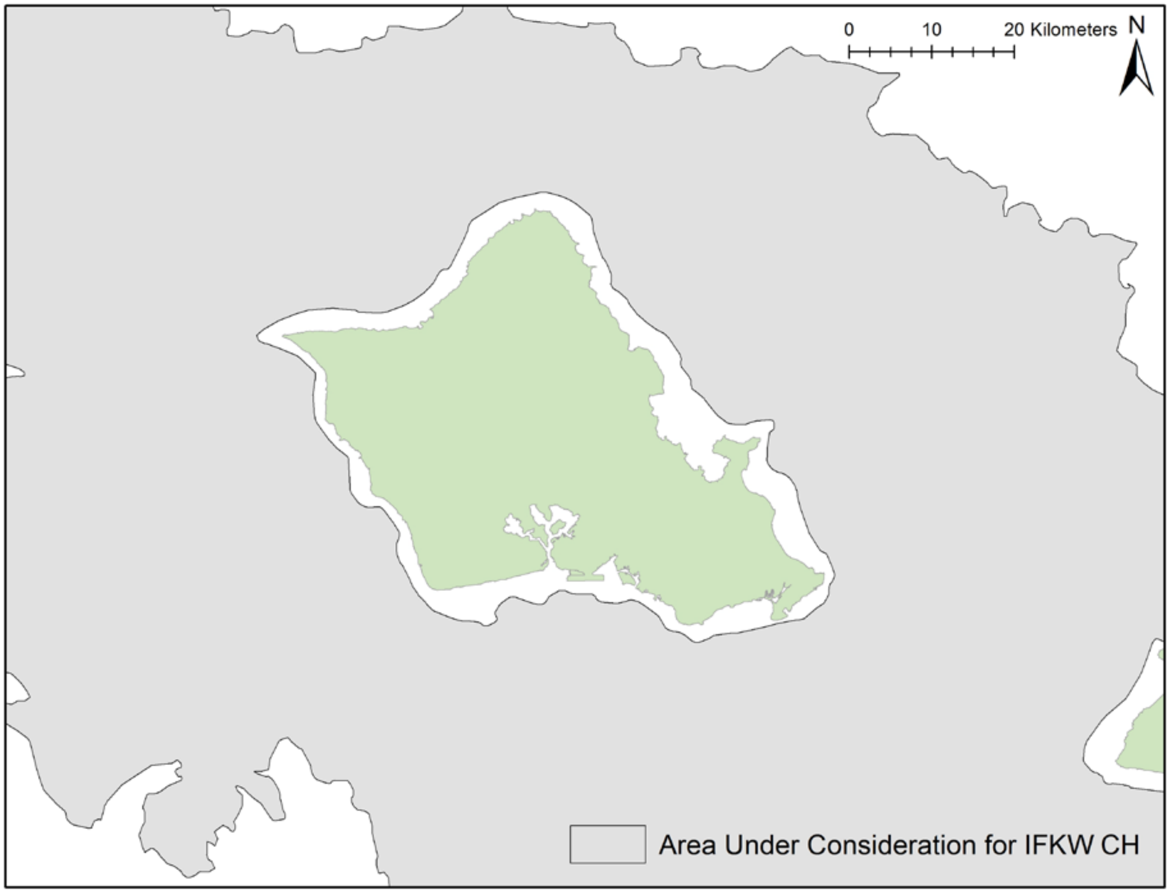


**Figure 8. Areas under consideration around Oahu.**

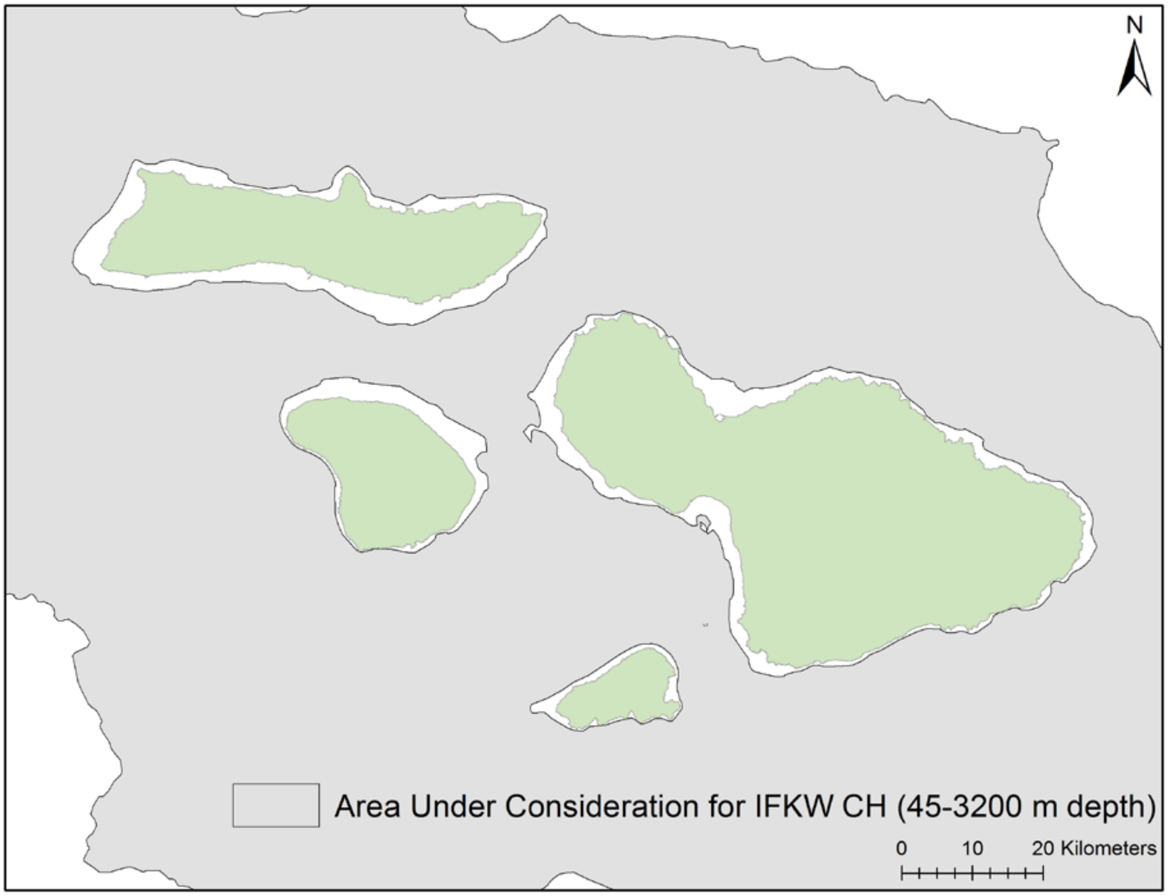


**Figure 9. Areas under consideration around Molokai, Lanai, Kahoolawe, and Maui.**

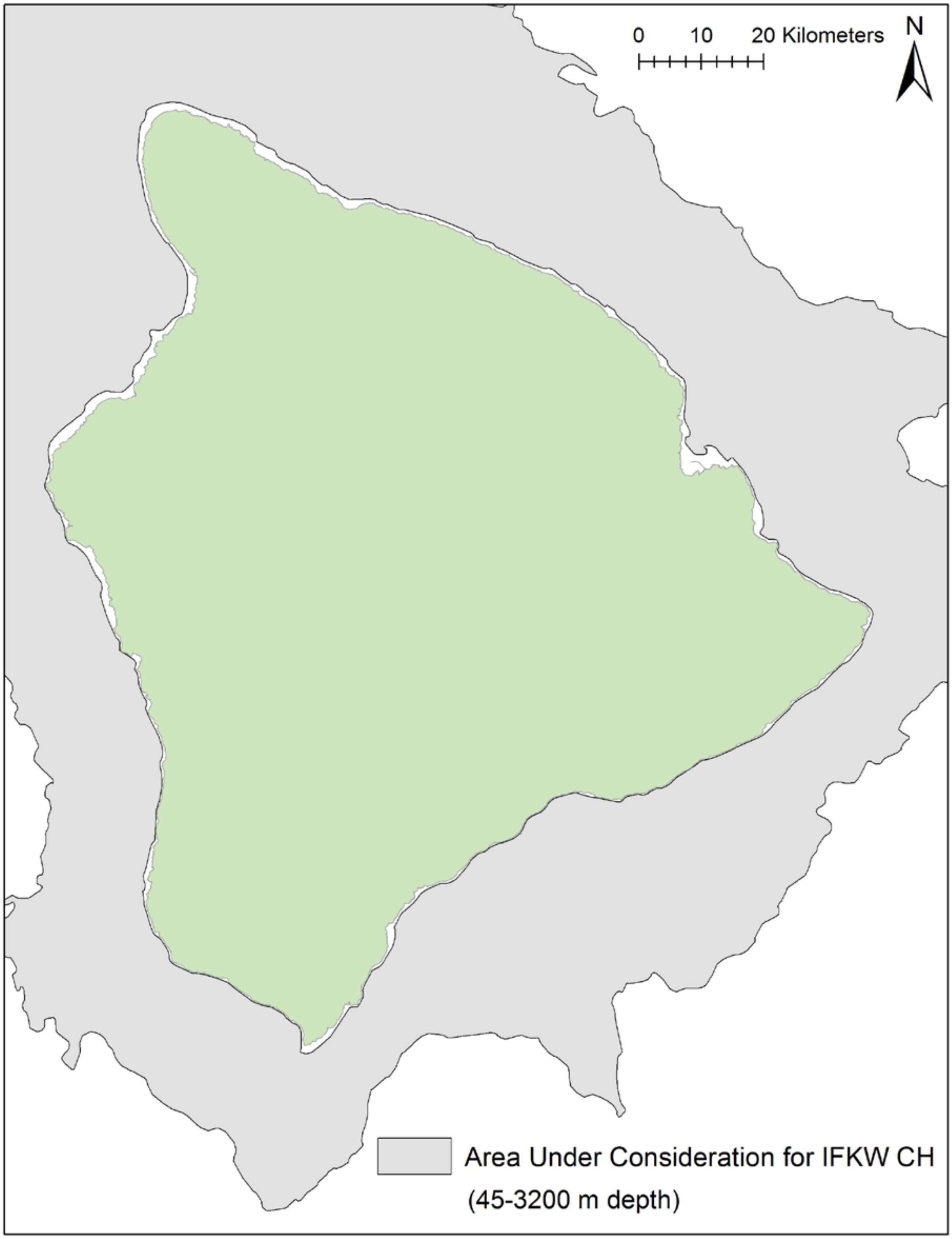


**Figure 10. Areas under consideration around Hawaii Island.**

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