

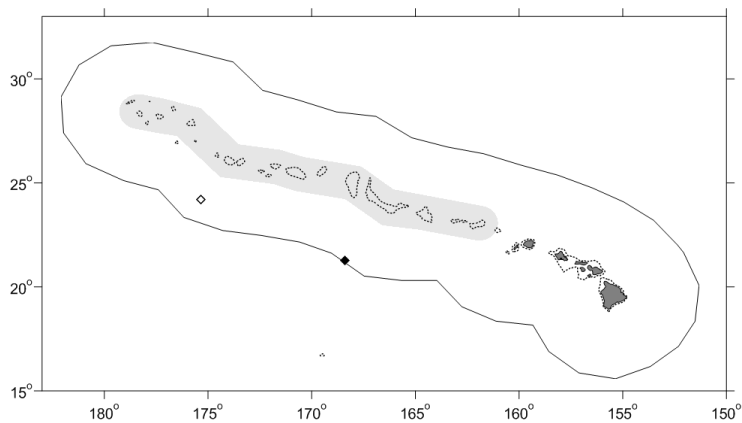
## **MELON-HEADED WHALE (*Peponocephala electra*): Hawaiian Islands Stock Complex: Hawaiian Islands & Kohala Resident Stocks**

### **STOCK DEFINITION AND GEOGRAPHIC RANGE**

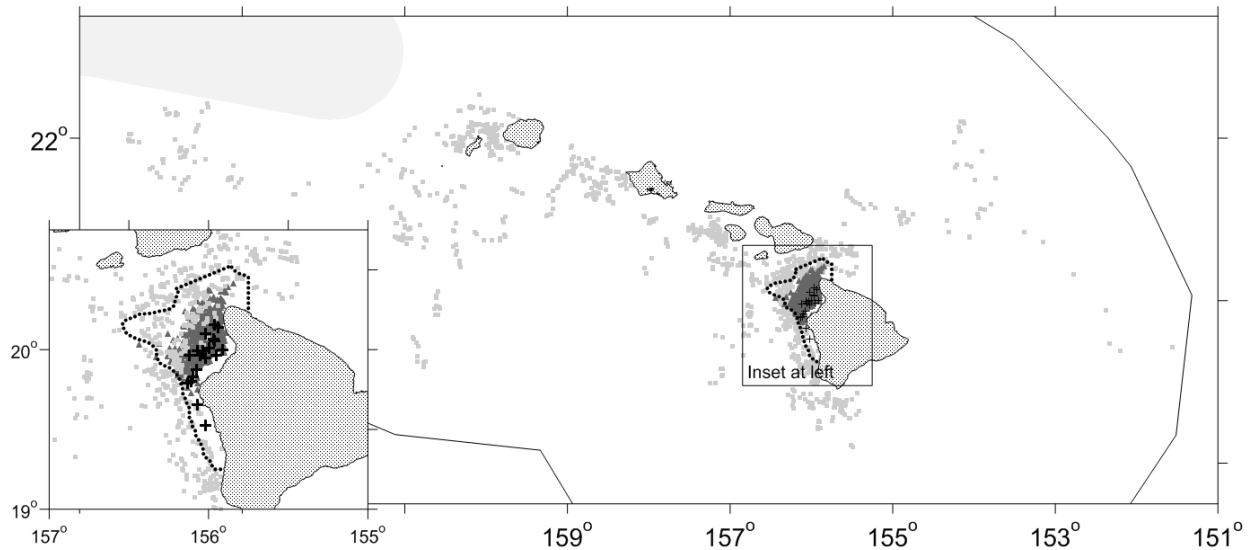
Melon-headed whales are found in tropical and warm-temperate waters throughout the world. The distribution of reported sightings suggests that the oceanic habitat of this species is primarily equatorial waters (Perryman et al. 1994). Small numbers have been taken in the tuna purse-seine fishery in the eastern tropical Pacific, and they are occasionally killed in direct fisheries in Japan and elsewhere in the western Pacific. Summer/fall shipboard surveys of the waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands during 2002 and 2010 resulted in only one sighting each year (Figure 1; Barlow 2006, Bradford et al. 2013). Little is known about this species elsewhere in its range, and most knowledge about its biology comes from mass strandings (Perryman et al. 1994).

Photo-identification and telemetry studies suggest there are two demographically-independent populations of melon-headed whales in Hawaiian waters, the Hawaiian Islands stock and the Kohala resident stock. Resighting data and social network analyses of photographed individuals indicate very low rates of interchange between these populations (0.0009/yr) (Aschettino et al. 2012). This finding is supported by preliminary genetic analyses that suggest restricted gene flow between the Kohala residents and other melon-headed whales sampled in Hawaiian waters (Oleson et al. 2013). Some individuals in each population have been seen repeatedly for more than a decade, implying high site-fidelity for both populations. Individuals in the larger Hawaiian Islands stock have been resighted throughout the main Hawaiian Islands. Satellite telemetry data revealed distant offshore movements, nearly to the edge of the U.S. EEZ around the Hawaiian Islands (Figure 2), with apparent foraging near cold and warm-core eddies (Woodworth et al. 2012). Individuals in the smaller Kohala resident stock have a range restricted to shallower waters of the Kohala shelf and west side of Hawaii Island (Aschettino et al. 2012, Schorr et al. unpublished data). Satellite telemetry data indicate they occur in waters less than 2500m depth around the northwest and west shores of Hawaii Island, west of  $156^{\circ} 45'$  W and north of  $19^{\circ} 15'$  N (Oleson et al. 2013). The northern boundary between the two stocks provisionally runs through the Alenuihaha Channel between Hawaii Island and Maui, bisecting the distance between the 1000m depth contours (Oleson et al. 2013).

For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are two Pacific management stocks within the Hawaiian Islands EEZ (Oleson et al. 2013): 1) the Kohala resident stock, which includes melon-headed whales off the Kohala Peninsula and west coast of Hawaii Island and in less than 2500m of water, and 2) the Hawaiian Islands stock, which includes melon-headed whales inhabiting waters throughout the U.S. EEZ of the Hawaiian Islands, including the area of the Kohala resident stock, and adjacent high seas waters. At this time, assignment of individual melon-headed whales within the overlap area to either stock requires photographic-identification of the animal. Because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of the Hawaiian Islands stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).



**Figure 1.** Melon-headed whale sighting locations during the 2002 (open diamond) and 2010 (black diamond) shipboard surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006, Bradford et al 2013; see Appendix 2 for details on timing and location of survey effort). Outer line represents approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahānaumokuākea Marine National Monument. Dotted line represents the 1000m isobath.



**Figure 2.** Sighting locations of melon-headed whales identified as being part of the Kohala resident stock (crosses) and telemetry records of Kohala resident (dark gray triangles) and Hawaiian Islands (light gray squares) melon-headed whale stocks (Schorr et al., unpublished data). The dotted line around waters adjacent to the northwest and west shores of Hawaii Island represents the provisional stock boundary for the Kohala resident stock (Oleson et al. 2013). The Kohala resident stock and the Hawaiian Islands stocks overlap throughout the range of the Kohala resident stock. Outer line represents U.S. EEZ. Gray shading indicates area of Papahānaumokuākea Marine National Monument.

## HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

### New Serious Injury Guidelines

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998, Andersen et al. 2008, NOAA 2012). NMFS defines serious injury as an “*injury that is more likely than not to result in mortality*”. Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

### Fishery Information

Information on fishery-related mortality and serious injury of cetaceans in U.S. EEZ of the Hawaiian Islands waters is limited, but the gear types used in Hawaii fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Entanglement in gillnets and hooking or entanglement in various hook and line fisheries have been reported for small cetaceans in Hawaii (Nitta & Henderson, 1993). No interactions between nearshore fisheries and melon-headed whales have been reported in Hawaiian waters. No estimates of human-caused mortality or serious injury are currently available for nearshore hook and line or gillnet fisheries because these fisheries are not observed or monitored for protected species bycatch. Long-term photo-identification studies have noted individuals from both the Kohala Resident and Hawaiian Islands stocks with bullet holes in their dorsal fin or with linear scars on their fins or bodies (Aschettino 2010) which may be consistent fisheries interactions.

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSL) fishery that targets primarily tunas, and a shallow-set longline (SSL) fishery that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2007 and 2011, no melon-headed whales were observed hooked or entangled in the SSL fishery (100% observer coverage) or the DSL fishery (20-22% observer coverage) (Bradford & Forney 2013, McCracken 2013). However, eight unidentified cetaceans were taken in the DSL fishery, and two unidentified cetaceans were taken in the SSL fishery, some of which may have been melon-headed whales.

### **Other Mortality**

In recent years, there has been increasing concern that loud underwater sounds, such as active sonar and seismic operations, may be harmful to beaked whales (Cox et al. 2006) and other cetaceans, including melon-headed whales (Southall et al. 2006) and pygmy killer whales (*Feresa attenuata*) (Wang and Yang 2006). The use of active sonar from military vessels has been implicated in mass strandings of beaked whales and recent mass-stranding reports suggest some delphinids may be impacted as well. A 2004 mass-stranding of 150-200 melon-headed whales in Hanalei Bay, Kauai occurred during a multi-national sonar training event around Hawaii (Southall et al. 2006). Although data limitations regarding the position of the whales prior to their arrival in the Bay, the magnitude of sonar exposure, behavioral responses of melon-headed whales to acoustic stimuli, and other possible relevant factors preclude a conclusive finding regarding the role of Navy sonar in triggering this event, sonar transmissions were considered a plausible cause of the mass stranding based on the spatiotemporal link between the sonar exercises and the stranding, the direction of movement of the transmitting vessels near Hanalei Bay, and propagation modeling suggesting the sonar transmissions would have been audible at the mouth of Hanalei Bay (Southall et al. 2006; Brownell et al. 2009). In 2008 approximately 100 melon-headed whales stranded within a lagoon off Madagascar during high-frequency multi-beam sonar use by oil and gas companies surveying offshore. Although the multi-beam sonar cannot be conclusively deemed the cause of the stranding event, the very close temporal and spatial association and directed movement of the sonar use with the stranding event, the unusual nature of the stranding event, and that all other potential causal factors were considered unlikely to have contributed, an Independent Scientific Review panel found that multi-beam sonar transmissions were a “plausible, if not likely” contributing factor (Southall et al. 2013) in this mass stranding event. This examination together with that of Brownell et al. (2009) suggests melon-headed whale may be particularly sensitive to impacts from anthropogenic sounds. No estimates of potential mortality or serious injury are available for U.S. waters.

### **KOHALA RESIDENT STOCK POPULATION SIZE**

Using the photo-ID catalog of individuals encountered between 2002 and 2009, Achettino (2010) used a POPAN open-population model to produce a mark-recapture abundance estimate of 447 (CV=0.12) individuals. A portion of the data used in that analysis is more than 8 years old; however, full sighting histories were required to produce a valid model for mark-recapture analyses, such that an estimate restricted to only the later years of the period is not available. Although this estimate includes individuals that have died since 2002, it should be considered an overestimate; however, it is currently the best available abundance estimate for the resident stock.

### **Minimum Population Estimate**

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al 1995) around the 2002-2009 mark-recapture abundance estimate (Achettino 2010), or 404 melon-headed whales in the Kohala resident stock.

### **Current Population Trend**

Photographic mark-recapture data will be evaluated in the future to assess whether sufficient data exists to assess trends.

### **CURRENT AND MAXIMUM NET PRODUCTIVITY RATES**

No data are available on current or maximum net productivity rate.

### **POTENTIAL BIOLOGICAL REMOVAL**

The potential biological removal (PBR) level for this stock is calculated as the minimum population estimate (404) times one half the default maximum net growth rate for cetaceans ( $\frac{1}{2}$  of 4%) times a recovery factor of 0.50 (for a species of unknown status with no known fishery mortality; Wade and Angliss 1997), resulting in a PBR of 4.0 Kohala resident melon-headed whales per year.

### **STATUS OF STOCK**

The Kohala resident stock of melon-headed whales is not considered strategic under the MMPA. The status of this stock relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Melon-headed whales are not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor designated as “depleted” under the MMPA. There have been no reports of recent mortality or serious injuries; however, there is no systematic monitoring of takes in near-shore fisheries that may take this species. Given noted

bullet holes and potential line injuries on individuals from this stock, insufficient information is available to determine whether the total fishery mortality and serious injury for Kohala Resident melon-headed whales is insignificant and approaching zero mortality and serious injury rate. The restricted range and small population size of Hawaii Island resident melon-headed whales suggests this population may be at risk due to its proximity to U.S. Navy training, including sonar transmissions, in the Alenuihaha Channel between Hawaii Island and Maui (Anonymous 2006). Although a 2004 mass-stranding in Hanalei Bay, Kauai could not be conclusively linked to Naval training events in the region (Southall et al. 2006), the spatiotemporal link between sonar exercises and the stranding does raise concern on the potential impact on the Kohala Resident population due to of sonar training nearby.

## **HAWAIIAN ISLANDS STOCK**

### **POPULATION SIZE**

An abundance estimate of melon-headed whales is available for the eastern tropical Pacific (Wade and Gerrodette 1993), but it is not known whether any of these animals are part of the same population that occurs around the Hawaiian Islands. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 2,950 (CV=1.17) melon-headed whales (Barlow 2006). The recent 2010 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in an abundance estimate of 2,860 (CV=1.04) melon-headed whales (Bradford et al. 2013). Using the photo-ID catalog of individuals encountered between 2002 and 2009 near the main Hawaiian Islands, Achettino (2010) used a POPAN open-population model to produce a mark-recapture abundance estimate of 5,794 (CV=0.20) individuals. A portion of the data used in that analysis is more than 8 years old; however, full sighting histories were required to produce a valid model for mark-recapture analyses, such that an estimate restricted to only the later years of the period is not available. Although this estimate includes individuals that have died since 2002, the mark-recapture estimate is the best available abundance estimate for the Hawaiian Islands stock given the significantly larger dataset used to produce the estimate versus a single line-transect encounter.

### **Minimum Population Estimate**

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow et al 1995) of the 2002-2009 mark-recapture abundance estimate (Achettino 2010) or 4,904 melon-headed whales in the Hawaii pelagic stock. This log-normal 20<sup>th</sup> percentile minimum population size is greater than the number of photo-identified individuals within the population (820) (Achettino et al 2012) and greater than the log-normal 20<sup>th</sup> percentile line-transect estimate (1,326) (Bradford et al. 2013).

### **Current Population Trend**

No trend analyses have been conducted on Hawaiian Islands melon-headed whales from line-transect surveys because only two estimates exist. Photographic mark-recapture data will be evaluated in the future to assess whether sufficient data exists to assess trends.

### **CURRENT AND MAXIMUM NET PRODUCTIVITY RATES**

No data are available on current or maximum net productivity rate.

### **POTENTIAL BIOLOGICAL REMOVAL**

The potential biological removal (PBR) level for this stock is calculated as the minimum population estimate for the U.S. EEZ of the Hawaiian Islands (4,904) times one half the default maximum net growth rate for cetaceans ( $\frac{1}{2}$  of 4%) times a recovery factor of 0.50 (for a species of unknown status with no known fishery mortality; Wade and Angliss 1997), resulting in a PBR of 49 melon-headed whales per year.

### **STATUS OF STOCK**

The Hawaiian Islands stock of melon-headed whales is not considered strategic under the 1994 amendments to the MMPA. The status of this stock relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Melon-headed whales are not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor designated as “depleted” under the MMPA. There have been no reports of recent mortality or serious injuries; however, there is no systematic monitoring of takes in near-shore fisheries that may take this species. Given noted bullet holes and potential line injuries on individuals from this stock, insufficient information is available to determine whether the total fishery mortality and serious injury for Hawaiian Islands melon-headed whales is insignificant and approaching zero mortality and serious injury rate. A 2004 mass-stranding

of melon-headed whales in Hanalei Bay, Kauai occurred during a multi-national sonar training event around Hawaii (Southall et al. 2006). Although the event could not be conclusively linked to Naval training events in the region (Southall et al. 2006), the spatiotemporal link between sonar exercises and the stranding does raise concern on the potential impact on the Hawaiian Islands population due to its frequent use of nearshore areas within the main Hawaiian Islands.

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