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RATIONALE FOR THE 2010 REVISION OF STOCK BOUNDARIES FOR THE HAWAI'I INSULAR AND PELAGIC STOCKS OF FALSE KILLER WHALES, *Pseudorca crassidens*

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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National Marine Fisheries Service
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Rationale for the 2010 revision of stock boundaries for the Hawai‘i insular and pelagic stocks of false killer whales, *Pseudorca crassidens*

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INTRODUCTION

Two stocks of false killer whales, *Pseudorca crassidens*, are currently recognized within the U.S. EEZ around Hawai‘i: the Hawai‘i insular stock and the Hawai‘i pelagic stock (Carretta et al. 2010). Chivers et al. (2008) recommended a stock boundary at about 75 nmi from the main Hawaiian Islands, and the final 2008 Stock Assessment Report (SAR) provisionally implemented a stock boundary as the "25-75 nmi"[1] (46-139 km) longline exclusion zone boundary around the main Hawaiian Islands. However, it was noted that this boundary may be revised as additional information becomes available (Carretta et al. 2009). The final 2009 Stock Assessment Report for false killer whales (Carretta et al. 2010) clarified that the stock boundary corresponded "to the February-September longline exclusion area" (Figure 1), but recognized that more recent satellite telemetry and survey data indicate there may be some overlap between the two stocks.

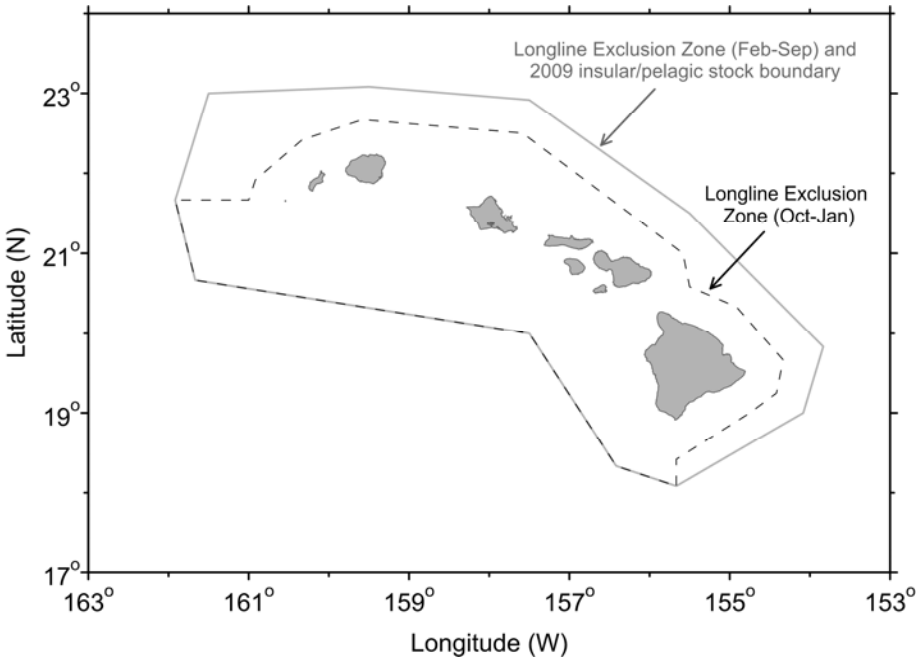

Figure 1. Seasonal longline exclusion zones and 2009 stock boundary between Hawai‘i insular and Hawai‘i pelagic false killer whale stocks (Carretta et al. 2010).

[1]Although characterized as a "25-75 nmi" longline exclusion boundary, the boundary was not set at a precise distance from shore and in fact varies from 42.4 nmi (78.6 km) to 104.4 nmi (193.4 km) from shore from February through September (median distance 61.1 nmi, 113.1 km). For the remaining four months of the year (October through January) approximately two-thirds (66.3%) of the boundary contracts towards the islands, such that the boundary ranges from 24.3 nmi (45.1 km) to 104 nmi from shore (median distance 48.7 nmi, 90.2 km). Given the complexity in describing the boundary in terms of distance to shore it will hereafter be referred to simply as the February-September longline boundary or the October-January longline exclusion boundary.

The 2009 SAR provisionally assigned all bycatch in Hawai‘i-based longline fisheries to the pelagic stock, because the observed longline sets with false killer whale takes occurred beyond the insular/pelagic stock boundary or straddling this boundary, and the two available samples from false killer whales taken within the Hawaiian Islands EEZ were from the pelagic stock (Carretta et al. 2010). The SAR noted, however, that there is potential for overlap between insular false killer whales and the longline fishery, and that further study is needed. From October to January, some longline fishing effort takes place within the current stock range of the Hawaiian Insular Stock, and Baird and Gorgone (2005) documented a high rate of dorsal fin disfigurements, which were consistent with injuries from unidentified fishing line.

Following a review of available evidence on movements, distribution, and fishery interactions with animals known to belong to insular or pelagic false killer whales stocks, the Pacific Scientific Review Group made a recommendation to revise the false killer whale stock boundaries at their November 2009 meeting (meeting summary and recommendations are available at http://swfsc.noaa.gov//prd-sars.aspx). Following these recommendations, this document presents a revised insular/pelagic false killer whale stock boundary that more closely matches the current knowledge regarding movements of individuals from insular and pelagic false killer whale stocks, taking into account uncertainty associated with small sample sizes of both satellite telemetry data and survey data. This revised boundary has been incorporated in the Draft 2010 SAR (see Federal Register, 75 FR 46912, August 4, 2010) and has been used to allocate false killer whale bycatch in the Hawai‘i-based longline fisheries by stock (McCracken and Forney 2010).

STOCK DISTRIBUTION DATA

Chivers et al. (2008) reviewed the data available through 2008 on the distribution of insular and pelagic false killer whales, including photographic identification of individual false killer whales and genetic samples obtained from false killer whales caught in longline fisheries and encountered during research cruises. Both lines of evidence indicated that there is a discrete population of false killer whales that is found within about 75 nmi (139 km) of the main Hawaiian Islands and that this population does not associate with pelagic animals found farther offshore. Chivers et al. (2008) therefore recommended that animals within 75nmi of the main Hawaiian Islands be considered part of the insular stock and animals beyond this distance be considered part of the pelagic stock. However, however, they noted that photographic evidence suggested some pelagic false killer whales may move across this boundary and that the boundary should be re-evaluated as additional information becomes available.

Since that time, additional surveys, genetic samples, and satellite telemetry studies have yielded additional information on the distribution of insular and pelagic false killer whales. Survey and satellite telemetry data have confirmed that there is no fixed boundary between insular and pelagic false killer whale stocks (Baird et al. 2008, 2010), but rather that these two genetically distinct stocks overlap in portions of their range, similar to eastern North Pacific Offshore and eastern North Pacific Southern Resident stocks of killer whales (Ford 2006). The likelihood of individuals belonging to one or the other stock of false killer whales varies with distance from shore, with insular false killer whales found closer to the Hawaiian Islands than pelagic false killer whales. For example, of the 30 sightings of false killer whales made during small-boat surveys from 2000 through 2009, all sightings less than 40 km from shore (n= 24) were known to be from the insular population (Baird, unpublished). Of the six sightings > 40 km from shore,

one was known to be from the insular population (69.8 km offshore), and four of the remaining five sightings (at distances from 42 to 123 km offshore) were known or thought to be from the pelagic stock based on genetics or photo-identification results (Baird unpublished). The fifth sighting was only a single individual that was not photo-identified or genetically sampled, so it was not possible to determine the stock identity. However, individuals from three different insular stock groups tagged off the island of Hawai‘i moved 83, 87 and 96 km offshore (Baird et al. 2009) and false killer whales from three additional groups tagged off O‘ahu in October 2009 moved to the west side of Kaua‘i and Ni‘ihau, eastward among the main Hawaiian Islands, and as far as 112.8 km from shore.

Recent tagging opportunities have increased the documented range and/or maximum offshore movement of insular false killer whales, and sample sizes of satellite-tagged individuals (20 individuals from 10 “groups”, median duration of 37 days) are still sufficiently small that future deployments can be expected to result in further increases in observed maximum distances and known areas utilized. Sample sizes are also still insufficient to establish whether there might be differences in the offshore range of false killer whales on the leeward vs. windward sides of the islands. Eddies, which increase productivity, are known to be more prevalent on the leeward side of the islands (Seki et al. 2002). However, two lines of evidence suggest that false killer whale prey distribution may be similar on the windward and leeward sides of the islands. Prior to the enactment of the longline exclusion zone[2], longline, troll, and handline fisheries that targeted false killer whale prey (e.g. tunas, mahimahi, billfish) out to roughly 75 nmi from shore occurred at similar levels of effort (number of trips) on the windward and leeward sides. Fishery catch data also indicate that tunas, billfish, and mahimahi are abundant on both leeward and windward sides, although catch composition among these species varies (He et al. 1997). Further, satellite-tagged false killer whales have been documented using similar water depths and types of habitat on the windward and leeward sides of all islands (Baird et al. 2010). A greater sample size of satellite-tagged individuals will be required to resolve the question of potential differences in windward vs. leeward range of false killer whales.

Although information on the movements and range of individuals from the pelagic false killer whale stock is even more limited, the genetic analyses of tissue samples (Chivers et al. 2007, Chivers et al. 2010) and the continuous distribution of sightings and fishery interactions reported by longline observers across the EEZ boundary (see Carretta et al. 2010) indicate that false killer whales found in international waters adjacent to the U.S. EEZ around Hawai‘i are almost certainly part of the same population as the Hawai‘i pelagic stock. The full offshore range of pelagic animals is presently unknown, although genetic differentiation has been identified between central Pacific false killer whales, including the Hawai‘i pelagic stock, and animals found farther east in the tropical Pacific, off the coasts of Mexico and Central America (Chivers et al. 2010). One individual from the pelagic stock that was satellite-tagged approximately 124 km offshore of the island of Hawai‘i moved to within 62 km of shore and as far as 210 km from shore over a period of 15 days (Baird et al. 2010). Individuals likely to be from the pelagic stock have been documented as close as 42 km from shore (Baird et al. 2008).

Based on the above evidence, it is clear that the region from about 40 km to at least 112 km from the main Hawaiian Islands is an overlap zone, in which both insular and pelagic false killer whales can be found. A small sample size of satellite-tracked individuals creates some

[2] Unpublished data, Hawaii Division of Aquatic Resources

uncertainty in these two boundaries. In particular, the offshore boundary of the insular stock is likely to be farther than 112 km, because their documented offshore extent has increased as sample sizes of satellite-tracked individuals have increased. It is likely that additional deployments in the future will continue to result in greater maximum documented distances for insular false killer whales. Any revised stock boundary should take this sample-size limitation into account by providing an additional geographic 'buffer' beyond the present maximum distance of 112 km. Insufficient information is presently available to establish whether movements of insular false killer whales might differ between leeward and windward sides, and therefore a uniform distance from shore is considered most consistent with the available data. The approximate boundary of 75 nmi (~139 km) proposed by Chivers et al. (2008) thus still represents an appropriate offshore range limit.

NEW STOCK BOUNDARIES

The new stock boundaries (Figure 2) are designed to take into account that the probability of individuals being from the insular stock is very high within some distance from shore, while the probability of individuals being from the pelagic stock is very low (based on encounters during many years of survey effort and telemetry results). Conversely, at some large distance from shore, the probability of individuals belonging to the pelagic stock is very high and the probability of individuals being from the insular stock is very low. At intermediate distances from shore, the probability of individuals belonging to either stock may be similar. These

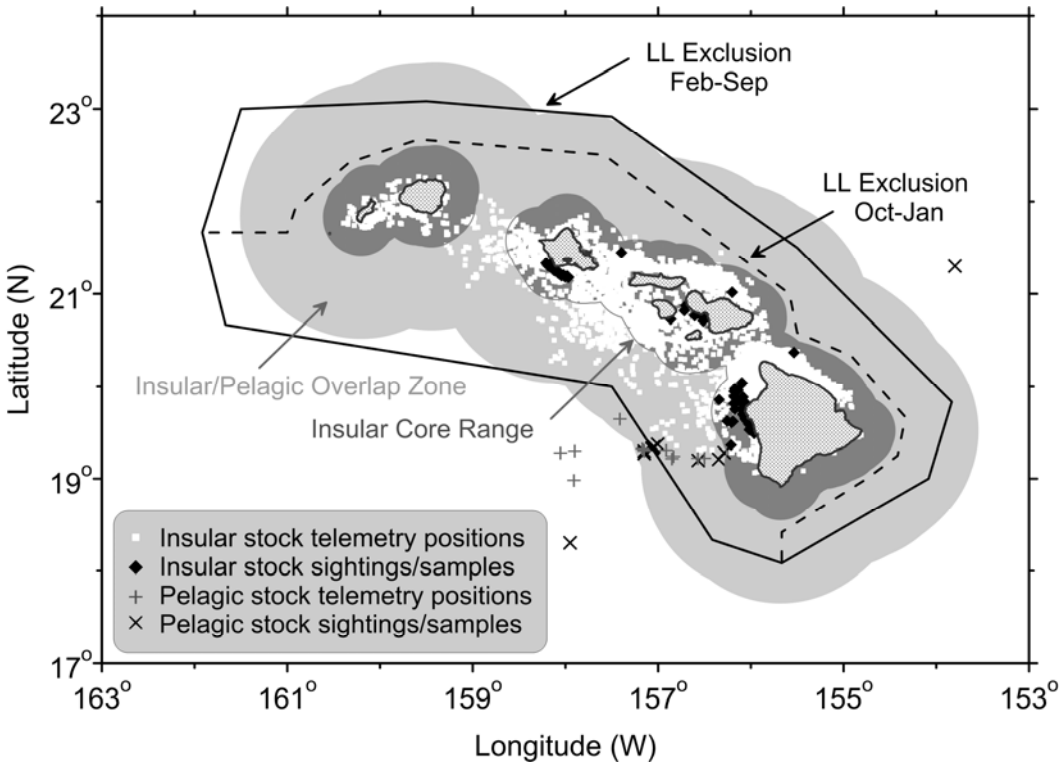

Figure 2. Revised stock boundary with information from satellite tagged false killer whales (from Baird et al. 2010, Baird et al., unpublished telemetry results), genetic samples collected by fishery observers and during research surveys (NMFS, PIRO Observer Program, Chivers et al. 2010), and sightings from directed research surveys. "LL Exclusion" lines are the longline exclusion boundaries for the indicated time periods. False killer whales farther from shore than the Insular/Pelagic overlap zone would be considered to be part of the pelagic stock, unless new data indicate otherwise.

probabilities cannot presently be determined from the existing data, but based on the documented area of overlap (in terms of distance from shore) and the recommendations of the Pacific Scientific Review Group, we outline a set of two new boundaries that define an insular stock area, a pelagic stock area, and an overlap zone for the two stocks.

A new offshore boundary has been chosen such that any false killer whales outside of this boundary are most likely to be from the pelagic stock. This boundary (outer edge of light gray area in Figure 2) is set at 140 km (approximately 75 nmi), from the main Hawaiian Islands, following the original recommendation of Chivers et al. (2008) and taking into account that ongoing telemetry studies have continued to increase the maximum distance recorded (currently at 112.8 km) as additional deployments are made. A second, inshore boundary has been chosen such that any false killer whales inshore of this boundary are most likely to be from the insular stock ("Insular Core Range" in Figure 2). This boundary is set at 40km from the islands, based on the approximate closest distance the pelagic stock has been documented from shore (42 km, Figure 2). Between the inner and outer boundaries, there is a pelagic/insular stock overlap zone, with unknown probabilities of occurrence for each stock. No information is currently available to assess whether one or the other stock is more likely to be encountered within this overlap zone, or whether and how probabilities of encounter for each stock might change with distance from shore.

IMPLICATIONS FOR BYCATCH ESTIMATION

Longline fishing effort is currently prohibited year-round within the above Insular Core Range, where false killer whales would automatically be considered part of the insular stock. However, any October-January longline fishing effort that takes place inshore of the February-September longline exclusion boundary would fall mostly within the overlap zone, except along the far western edge (Figure 2). Year-round longline effort is permitted within the overlap zone along the northern, eastern, and southern edges of the February - September longline exclusion zone. For stock-specific bycatch estimation, fishing effort and false killer whale bycatch would need to be estimated in a geographically stratified manner that separates insular, pelagic, and overlap zones. False killer whales caught beyond the 140-km boundary would be considered to be from the pelagic stock. False killer whales caught in the overlap region between 40 km and 140 km would need to be divided among the two stocks. Ideally, a method of pro-rating that takes into account the apparent inshore-offshore differences in probabilities of each stock would be developed. However, the available information is currently insufficient to do so quantitatively. Until additional evidence becomes available to estimate probabilities for each stock directly, the NMFS guidelines on assessing marine mammal stocks (NMFS 2005) recommend that bycatch estimates within areas of stock overlap be prorated based on the estimated densities of each stock within that region (NMFS 2005).

CONCLUSIONS

The existing stock boundary between insular and pelagic false killer whale stocks in Hawai‘i (Final 2009 SAR, Carretta et al. 2010) does not adequately take into account the geographic overlap between these two stocks in parts of their ranges. The above alternate stock boundary with an overlap zone that is based on available movement and sighting data allows a more accurate assessment of potential human-caused impacts, but uncertainty remains regarding the

precise location of these boundaries. Additional telemetry and genetic data will aid in refining and re-evaluating the boundaries for these two stocks in the future.

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