FALSE KILLER WHALE (*Pseudorca crassidens*): Hawaiian Islands Stock Complex – Main Hawaiian Islands Insular, Northwestern Hawaiian Islands, and Hawaii Pelagic Stocks

STOCK DEFINITION AND GEOGRAPHIC RANGE

False killer whales are found worldwide in tropical and warm-temperate waters (Stacey et al. 1994). In the North Pacific, this species is well known from southern Japan, Hawaii, and the eastern tropical Pacific. False killer whales were encountered during two shipboard line-transect surveys of the U.S. Exclusive Economic Zone (EEZ) around the Hawaiian Islands in 2002 and 2010 (Figure 1; Barlow 2006, Bradford et al. 2014) and focused studies near the main and Northwestern Hawaiian Islands indicate that false killer whales occur in near shore waters throughout the Hawaiian archipelago (Baird et al 2008, 2013). This species also occurs in U.S. EEZ waters around Palmyra and Johnston Atolls (e.g., Barlow et al. 2008, Bradford & Forney 2013) and American Samoa (Johnston et al. 2008, Oleson 2009).

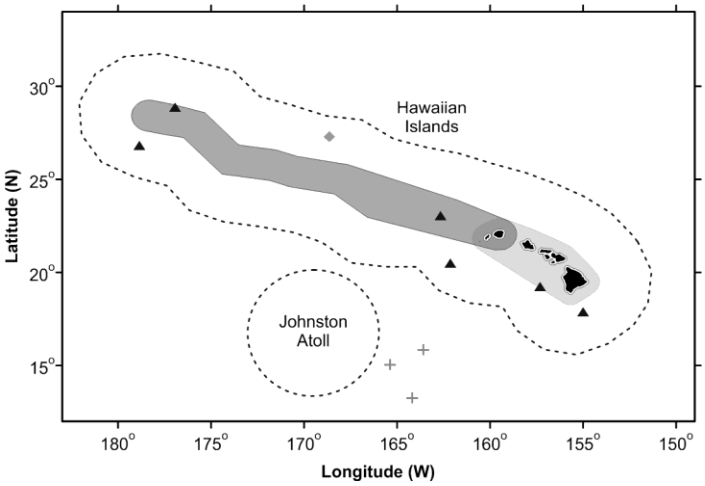

Figure 1. False killer whale on-effort sighting locations during standardized shipboard surveys of the Hawaiian Islands U.S. EEZ (2002, gray diamond, Barlow 2006; 2010, black triangles, Bradford et al. 2014, pelagic waters of the central Pacific south of the Hawaiian Islands (2005, gray crosses, Barlow and Rankin 2007) and the Johnston Atoll EEZ. Outer dashed lines represent approximate boundary of U.S. EEZs; light shaded gray area is the main Hawaiian Islands insular false killer whale stock area, including overlap zone between MHI insular and pelagic false killer whale stocks; dark shaded gray area is the Northwestern Hawaiian Islands stock area, which overlaps the pelagic false killer whale stock area and part of the MHI insular false killer whale stock area. Detail of stock boundaries shown in Figure 2.

Genetic, photo-identification, and telemetry studies indicate there are three demographically-independent populations of false killer whales in Hawaiian waters. Genetic analyses indicate restricted gene flow between false killer whales sampled near the main Hawaiian Islands (MHI), the Northwestern Hawaiian Islands (NWHI), and in pelagic waters of the Eastern (ENP) and Central North Pacific (CNP) (Chivers et al. 2010; Martien et al. 2011, 2014). Martien et al. (2014) analyzed mitochondrial DNA (mtDNA) control region sequences and genotypes from 16 nuclear DNA (nuDNA) microsatellite loci from 206 individuals from the MHI, NWHI, and offshore waters of the CNP and ENP and showed highly significant differentiation between populations confirming limited gene flow in both sexes. Their analysis using mtDNA reveals strong phylogeographic patterns consistent with local evolution of haplotypes unique to false killer whales occurring nearshore within the Hawaiian Archipelago and their assessment of nuDNA suggests that NWHI false killer whales are at least as differentiated from MHI animals as they are from offshore animals. Photographic–identification and social network analyses of individuals seen near the MHI indicate a tight social network with no connections to false killer whales seen near the NWHI or in offshore waters, and assessment of satellite telemetry collected from 27 tagged MHI false killer whales shows movements restricted to the MHI (Baird et al. 2010, 2012). Further evaluation of photographic and genetic data from individuals seen near the MHI suggests the occurrence of three separate social clusters (Baird et al. 2012, Martien et al. 2011), where mating occurs primarily, though not exclusively within clusters (Martien et al. 2011). Additional details on data and analyses supporting the separation of false killer whales in Hawaiian waters into three separate stocks are summarized within Oleson et al. (2010, 2012).

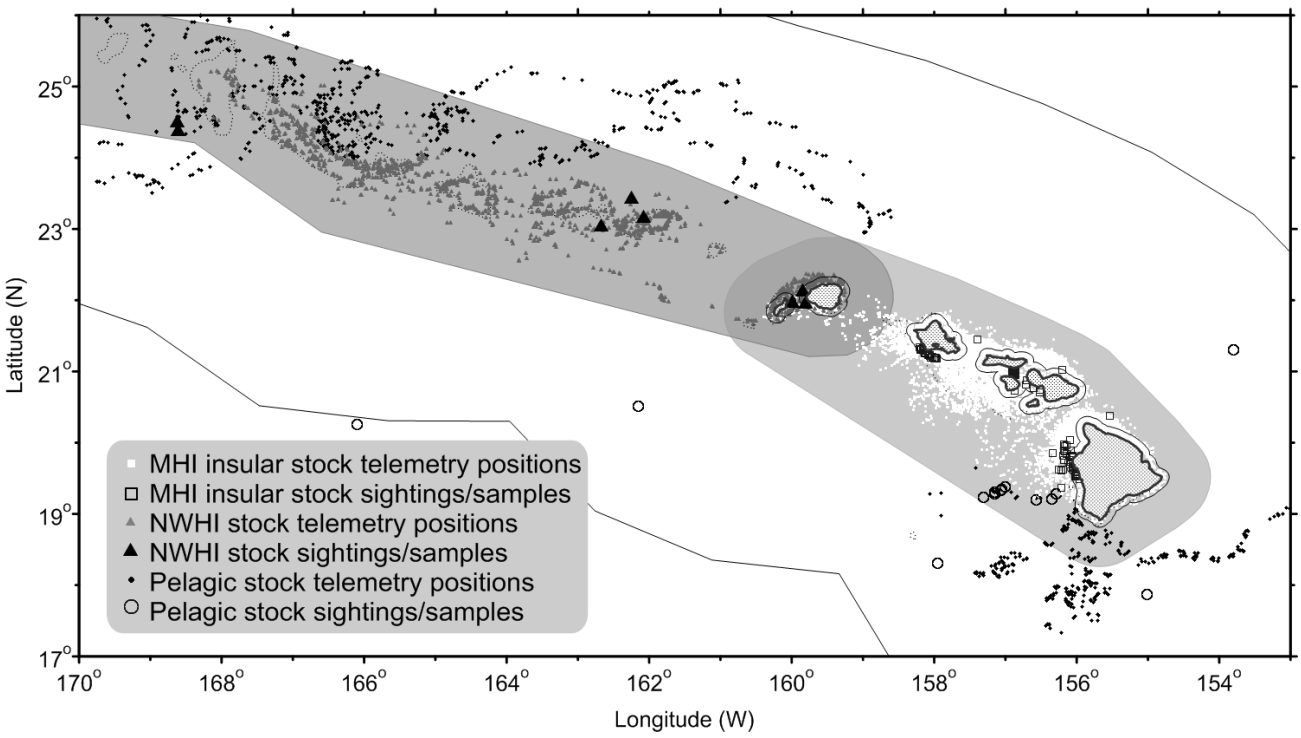

Figure 2. Sighting, biopsy sample, and telemetry record locations of false killer whale identified as being part of the MHI insular (square symbols), NWHI (triangle symbols), or pelagic (circle symbols) stocks. The MHI stock area is shown in light gray; the NWHI stock area is shown in dark gray; the pelagic stock area includes the entire EEZ excluding the region delineated by the black line around each of the MHI (reproduced from Bradford et al 2015). The MHI insular, pelagic, and NWHI stocks overlap around Kauai and Niihau.

Fishery observers have collected tissue samples for genetic analysis from cetaceans incidentally caught in the Hawaii-based longline fishery since 2003. Between 2003 and 2010, eight false killer whale samples, four collected outside the Hawaiian EEZ and four collected within the EEZ but more than 100 nautical miles (185km) from the main Hawaiian Islands were determined to have Pacific pelagic haplotypes (Chivers et al. 2010). At the broadest scale, significant differences in both mtDNA and nuDNA are evident between pelagic false killer whales in the ENP and CNP strata (Chivers et al. 2010), although the sample distribution to the east and west of Hawaii is insufficient to determine whether the sampled strata represent one or more stocks, and where pelagic stock boundaries would be drawn.

The stock range and boundaries of the three Hawaiian stocks of false killer whales were recently reevaluated given significant new information on the occurrence and movements of each stock and are reviewed in detail in Bradford et al. (2015) and shown in Figure 2. The stocks have partially overlapping ranges. MHI insular false killer whales have been satellite tracked as far as 115 km from the main Hawaiian Islands, while pelagic stock animals have been tracked to within 11 km of the main Hawaiian Islands and throughout the NWHI. NWHI false killer whales have been seen as far as 93 km from the NWHI and near-shore around Kauai and Oahu (Baird et al. 2012, Bradford et al. 2015). Stock boundary descriptions are complex, but can be summarized as follows. The MHI insular stock boundary is derived from a Minimum Convex Polygon (MCP) of a 72-km radius 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 of MHI individuals within that region. The NWHI stock boundary is defined by a 93-km radius around the NWHI, or the boundary of the Papahānaumokuākea Marine National Monument, with this radial boundary extended to the southeast to encompass Kauai and Niihau. The NWHI boundary is latitudinally expanded at the eastern end of the NWHI to encompass animal movements observed outside of the 93-km radius (see Figure 2). The pelagic stock has no outer boundary. Throughout the MHI the pelagic stock inner boundary is placed at 11 km from shore. There is no inner boundary within the NWHI. The construction of these stock boundaries results in a number of stock overlap zones. The waters outside of 11km from shore from Oahu to Hawaii Island out to the MHI insular stock boundary are an overlap zone between the MHI insular and pelagic stocks. The entirety of the NWHI stock range, with the exception of the area within 11km around

Kauai and Niihau is an overlap zone between NWHI and pelagic false killer whales. All three stocks overlap between 11 km from shore around Kauai and Niihau out to the MHI insular stock boundary between Kauai and Nihoa and to the NWHI stock boundary between Kauai and Oahu (see Figure 2).

The pelagic stock includes animals found within the Hawaiian Islands EEZ and in adjacent international waters; however, because data on false killer whale abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005). The Palmyra Atoll stock of false killer whales is still considered to be a separate stock because comparisons amongst false killer whales sampled at Palmyra Atoll and those sampled from the MHI insular stock and the pelagic ENP reveal restricted gene flow, although the sample size remains too low for robust comparisons (Chivers et al. 2010). NMFS will obtain and analyze additional samples for genetic studies of Hawaii pelagic and Palmyra stock structure, and will evaluate new information on stock ranges as it becomes available.

For the Marine Mammal Protection Act (MMPA) stock assessment reports, there are currently five Pacific Islands Region management stocks : 1) the Main Hawaiian Islands insular stock, which includes animals inhabiting waters within a modified 72km radius around the main Hawaiian Islands, 2) the Northwestern Hawaiian Islands stock, which includes animals inhabiting waters within the Papahānaumokuākea Marine National Monument and to the east around Kauai, 3) the Hawaii pelagic stock, which includes false killer whales inhabiting waters greater than 11 km from the main Hawaiian Islands, including adjacent high seas waters, 4) the Palmyra Atoll stock, which includes animals found within the U.S. EEZ of Palmyra Atoll, and 5) the American Samoa stock, which includes animals found within the U.S. EEZ of American Samoa. Estimates of abundance, potential biological removal, and status determinations for the first three stocks are presented below; the Palmyra Atoll and American Samoa stocks are covered in separate reports.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New Serious Injury Guidelines

NMFS uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to distinguish 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*".

Fishery Information

Interactions with false killer whales, including depredation of catch of a variety of pelagic fishes, have been identified in logbooks and NMFS observer records from Hawaii pelagic longline fishing trips (Nitta and Henderson 1993, Oleson et al. 2010, PIRO 2015). False killer whales have been observed feeding on mahi mahi, *Coryphaena hippurus*, and yellowfin tuna, *Thunnus albacares* (Baird 2009), and they have been reported to take large fish from the trolling lines of commercial and recreational fishermen (Shallenberger 1981). There are anecdotal reports of marine mammal interactions in the commercial Hawaii shortline fishery which sets gear at Cross Seamount and possibly around the main Hawaiian Islands. The commercial shortline fishery is licensed to sell their catch through the State of Hawaii Commercial Marine License program, and until recently, no reporting systems existed to document marine mammal interactions. Baird and Gorgone (2005) documented high rates of dorsal fin disfigurements consistent with injuries from unidentified fishing line for false killer whales belonging to the MHI insular stock. A recent report included evaluation of additional individuals with dorsal fin injuries and suggested that the rate of interaction between false killer whales and various forms of hook and line gear may vary by population and social cluster, with the MHI insular stock showing the highest rate of dorsal fin disfigurements (Baird et al. 2014). The commercial or recreational fishery or fisheries responsible for these injuries is unknown. Examination of a stranded MHI insular false killer whale in October 2013 revealed that this individual had five fishing hooks and fishing line in its stomach (NMFS PIR Marine Mammal Response Network). Although the fishing gear is not believed to have caused the death of the whale, the finding confirms that MHI insular false killer whales are consuming previously hooked fish or are interacting with hook and line fisheries in the MHI. Many of the hooks within the whale's stomach were not consistent with those currently allowed for use within the commercial longline fisheries and could have come from a variety of near-shore fisheries. No estimates of human-caused mortality or serious injury are currently available for near-shore hook and line or other fisheries because these fisheries are not observed or monitored for protected species bycatch.

Because of high rates of false killer whale mortality and serious injury in Hawaii-based longline fisheries, a Take Reduction Team was established in January 2010 (75 FR 2853, 19 January, 2010). The Team was charged with developing recommendations to reduce incidental mortality and serious injury of the Hawaii pelagic, MHI insular and Palmyra stocks of false killer whales in Hawaii-based longline fisheries. The Team submitted a draft Take Reduction Plan (TRP) to NMFS (http://www.nmfs.noaa.gov/pr/pdfs/interactions/fkwtrp_draft.pdf), and NMFS published a final TRP based on the Team's recommendations (77 FR 71260, 29 November, 2012). Take reduction

measures include gear requirements, time-area closures, and measures to improve captain and crew response to hooked and entangled false killer whales. The seasonal contraction of the Longline Exclusion Zone (LLEZ) around the MHI was also eliminated. The TRP became effective December 31, 2012, with gear requirements effective February 27, 2013. These measures were not in effect during 2008-2012, the majority of the period for which bycatch was estimated in this report. Adjustments to bycatch estimation methods are implemented for 2013 to account for changes in fishing gear and captain training intended to reduce the false killer whale serious injury rate (see below, McCracken 2015).

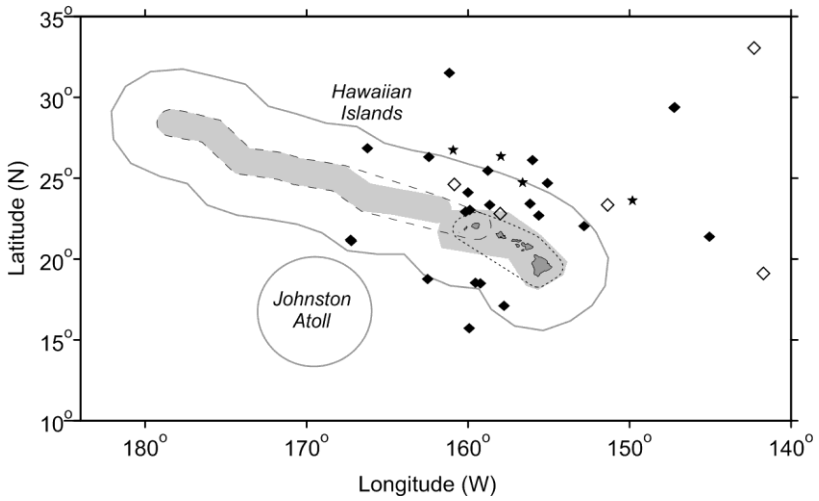

Figure 3. Locations of observed false killer whale takes (black symbols) and possible takes (blackfish) of this species (open symbols) in the Hawaii-based longline fisheries, 2009-2013. Takes occurring prior to the implementation of Take-Reduction Plan (2009-2012) regulations are shown as diamonds, and those since the TRP regulations (2013) are shown as stars. Some take locations overlap. Solid gray lines represent the U.S. EEZ; the dotted line is the MHI insular stock area; the dashed line is the NWHI stock area; both MHI and NWHI stocks overlap with the pelagic stock. The gray shaded area represents the longline exclusion zone, implemented year-round since December 31, 2012, and Papahānaumokuākea Marine National Monument. Both areas are currently closed to longline fishing.

There are two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas, but are prohibited from operating within the Papahānaumokuākea Marine National Monument and within the LLEZ around the main Hawaiian Islands. Stock Assessment Reports generally describe fishery interaction details for the most recent five years, and as such, only years 2009 through 2013 are described here. Year 2008 is also included in Table 1 to allow for computation of a 5-yr annual bycatch estimate for the period prior to the implementation of the TRP. Between 2009 and 2013, three false killer whales were observed hooked or entangled in the SSLL fishery (100% observer coverage) within the U.S. EEZ of the Hawaiian Islands, and 24 false killer whales were observed taken in the DSLL fishery (20-22% observer coverage) within Hawaiian waters or adjacent high-seas waters (excluding Palmyra Atoll EEZ waters) (Bradford & Forney 2015). The severity of injuries resulting from interactions with longline gear is determined based on an evaluation of the observer's description of each interaction and following the most recently developed criteria for assessing serious injury in marine mammals (NMFS 2012). Of the three animals taken in the SSLL fishery, one was considered seriously injured, one was considered not seriously injured and one could not be determined based on the information provided by the observer. In the DSLL fishery, 13 false killer whales were taken within the Hawaiian EEZ. Two of those takes occurred within the pelagic-NWHI overlap zone north of Kauai in 2012 before this area was closed to longline fishing and both animals were considered to be seriously injured. Of the remaining 11 interactions within the Hawaiian EEZ, all were within the range of the pelagic stock, and eight were considered seriously injured, one was not considered seriously injured, and two could not be determined based on the information provided by the observer. Outside of the Hawaii EEZ, one animal was dead, eight were considered seriously injured, and two were not considered seriously injured. Five additional unidentified "blackfish" (unidentified cetaceans known to be either false killer whales or short-finned pilot whales) were also taken, one within the SSLL fishery and four in the DSLL fishery. The single SSLL interaction occurred outside the Hawaiian EEZ and the animal was considered seriously injured. Of the four DSLL interactions, two occurred inside the Hawaii EEZ, with both considered seriously injured, and two occurred outside the Hawaii EEZ, with one considered seriously injured and one considered not seriously injured. In 2014, 2 false killer whales were taken inside the Hawaii EEZ and 9 outside of the EEZ (NMFS PIRO Observer Program). Serious injury determinations are not yet available for these takes.

Table 1. Summary of available information on incidental mortality and serious injury (MSI) of false killer whales and unidentified blackfish (false killer whale or short-finned pilot whale) in commercial longline fisheries, by stock and EEZ area, as applicable (McCracken 2015). 5-yr mean annual takes are presented for 2008-2012, prior to the implementation of the TRP, for 2013 due to changes in fishing gear under the TRP intended to reduce serious injury rate, and for 2009-2013 assuming no significant change in mortality rate. Information on all observed takes (T) and combined mortality & serious injury is included. Unidentified blackfish are pro-rated as either false killer whales or short-finned pilot whales according to their distance from shore (McCracken 2010). CVs are estimated based on the combined variances of annual false killer whale and blackfish take estimates and the relative density estimates for each stock within the overlap zones. Values of '0' presented with no further precision are based on observation at 100% coverage and are not estimates.

				Observed takes		**Estimated M&SI (CV)**			
				FKW T/MSI UB T/MSI		**Pelagic Stock**			
Fishery Name	**Year**	**Data Type**	**Percent Observer Coverage**	**Outside U.S EEZ**	**Within Hawaii EEZ**	**Outside U.S EEZ**	**Within Hawaii EEZ**	**MHI insular Stock**	**NWHI Stock**
Hawaii-based deep-set longline fishery	2008	Observer data	22%	0 0	3/3 3/3	0 (-)	16.20 (0.4)	0.30 (0.4)	0.51 (1.1)
	2009		21%	7/7 0	3/3 0	38.52 (0.2)	11.81 (0.9)	0.22 (0.8)	0.37 (1.3)
	2010		21%	1/1 0	3/2 1/1	5.56 (1.5)	13.16 (0.4)	0.36 (0.5)	0.17 (1.0)
	2011		20%	0 1/0	3/2 1/1	2.24 (3.6)	12.24 (0.4)	0.11 (0.6)	0.25 (1.2)
	2012		20%	0 1/1	3/2* 0	3.55 (2.3)	12.99 (0.4)	0.07 (3.9)	1.61 (1.3)
	2013		20%	3/1 0	1/1 0	6.60 (0.9)	4.06 (1.4)	0.04 (1.9)	0.00 (-)
Pre-TRP Mean Estimated Annual Take (CV) 2008-2012						**9.97 (0.4)**	**13.28 (0.2)**	**0.21 (0.4)**	**0.58 (0.8)**
Estimated Annual Take (CV) under TRP [2013 only]						**6.60 (0.9)**	**4.06 (1.4)**	**0.04 (1.9)**	**0 (-)**
Mean Estimated Annual Take (CV) 2009-2013						**11.29 (0.3)**	**10.85 (0.3)**	**0.15 (0.5)**	**0.49 (0.9)**
Hawaii-based shallow-set longline fishery	2008	Observer data	100%	0 1/1	1/0 0	0.59	0.00	0	0.00
	2009		100%	0 0	1/1 0	0	0.99	0	0.01
	2010		100%	0 0	0 0	0	0	0	0
	2011		100%	0 1/1	1/0 0	0.70	0.00	0	0
	2012		100%	0 0	1/0 0	0	0.32	0	0.01
	2013		100%	0 0	0 0	0	0	0	0
Mean Annual Takes (100% coverage) 2008-2012						**0.26**	**0.27**	**0**	**0.00**
Mean Annual Take (CV) under TRP [2013 only]						**0**	**0**	**0**	**0**
Mean Annual Takes (100% coverage) 2009-2013						**0.14**	**0.27**	**0**	**0.00**
Pre-TRP Minimum total annual takes within U.S. EEZ (2008-2012)							**13.55 (0.2)**	**0.21 (0.4)**	**0.58 (0.8)**
Minimum total take under TRP within U.S. EEZ [2013 only]							**4.06 (1.4)**	**0.04 (1.9)**	**0 (-)**
Minimum total annual takes within U.S EEZ (2009-2013)							**11.12 (0.3)**	**0.15 (0.5)**	**0.49 (0.9)**

* Two observed takes occurred within the NWHI-pelagic overlap zone and are therefore allocated for proration between NWHI and pelagic stocks. Remaining estimated takes are prorated among stocks as described for each overlap zone.

The injury status of estimated takes is prorated to serious versus non-serious using the historic rate of serious injury within the observed takes. For the period 2008 to 2012, the rate of serious injury for false killer whales was 93% (McCracken 2014). Following the implementation of the TRP these historic averages were not used. The allocation of estimated serious versus non-serious injuries in 2013 take was based on the proportion of serious versus non-serious injuries of observed takes in 2013 (McCracken 2015). The proration of serious injury status will be updated as additional data become available to better estimate serious versus non-serious injury proportion under TRP measures.

Takes of false killer whales of unknown stock within the stock overlap zones must be prorated to MHI insular, pelagic, or NWHI stocks. No genetic samples are available to establish stock identity for the two takes inside the NWHI-pelagic overlap zone north of Kauai, but both stocks are considered at risk of interacting with longline gear. The pelagic stock is known to interact with longline fisheries in waters offshore of the overlap zone, based on two genetic samples obtained by fishery observers (Chivers et al. 2010). MHI insular and NWHI false killer whales have been documented via telemetry to move far enough offshore to reach longline fishing areas (Bradford et al. 2015), and animals from the MHI insular stock have a high rate of dorsal fin disfigurements consistent with injuries from unidentified fishing line (Baird and Gorgone 2005, Baird et al. 2014). Annual bycatch estimates are prorated to stock using the following process. Takes of unidentified blackfish are prorated to false killer whale and short-finned pilot whale based on distance from shore (McCracken 2010). The distance-from-shore model was chosen following consultation with the Pacific Scientific Review Group, based on the model's logic and performance relative to a number of other models with similar output (McCracken 2010). Following proration of unidentified blackfish takes to species, Hawaii EEZ and high-seas estimates of false killer whale take are calculated by summing the annual false killer whale take and the annual blackfish take prorated as false killer whale within each region (McCracken 2015). For the deep-set fishery within the Hawaii EEZ, annual takes are apportioned to each stock overlap zone and the pelagic-only stock area based on relative annual fishing effort in each zone. The total annual EEZ bycatch estimate is multiplied by the proportion of total fishing effort (by set) within each zone to estimate the bycatch within that zone. Because the shallow-set longline fishery is fully observed, takes are assigned to the zone in which they were observed and there is no further apportionment based on fishing effort. For each longline fishery, the zonal bycatch estimates are then multiplied by the relative density of each stock in the respective zone to prorate bycatch to stock. For the deep-set fishery, if bycatch was observed within a specific overlap zone, the observed takes were assigned to that zone and the remaining estimated bycatch was assigned among zones and stocks according to the described process. Following proration by fishing effort and stock density within each zone, stock-specific bycatch estimates are summed across zones to yield the total stock-specific annual bycatch by fishery. Uncertainty in stock-specific bycatch estimates combines variances of total annual false killer whale bycatch and the fractional variance of false killer whale density according to which stock is being estimated. Enumeration of fishing effort within stock overlap zones is assumed to be known without error.

Based on this approach, estimates of annual mortality and serious injury of false killer whales, by stock and EEZ area, are shown in Table 1. A 5-yr average mortality and serious injury estimate is provided for years 2008-2012, a single year estimate is provided for 2013 given the change in fishing regulations that occurred with the implementation of the TRP, and a 5-yr average is provided for years 2009-2013 assuming no significant change in mortality rate within the fishery (Table 1). Proration of false killer whale takes within the overlap zones and of unidentified blackfish takes introduces unquantified uncertainty into the bycatch estimates, but until methods of determining stock identity for animals observed taken within the overlap zone are available, and all animals taken can be identified to species (e.g., photos, tissue samples), these proration approaches are needed ensure that potential impacts to all stocks are assessed in the overlap zones.

MAIN HAWAIIAN ISLANDS INSULAR STOCK

POPULATION SIZE

A Status Review for the MHI insular stock in 2010 (Oleson et al. 2010) used recent, unpublished estimates of abundance for two time periods, 2000-2004 and 2006-2009 in a Population Viability Analysis (PVA). These estimates were based on open population models, for the two time periods. The abundance estimate for the 2000-2004 period is 162 (CV=0.23) animals. Two separate estimates for 2006-2009 were presented in the Status Review; 151 (CV=0.20) and 170 (CV=0.21), depending on whether animals photographed near Kauai are included in the estimate. The animals seen near Kauai included in the higher estimate have now been associated with the NWHI stock (Baird et al. 2013), such that the best estimate of population size for the MHI insular stock is the smaller estimate of 151 animals. However, it should be noted that even this smaller estimate may be positively-biased, because missed photo-ID matches were discovered after the analyses were complete (discussed in Oleson et al. 2010).

Minimum Population Estimate

The minimum population estimate for the MHI insular stock of false killer whales is the number of distinctive individuals identified during 2011 to 2014 photo-identification studies, or 92 false killer whales (Baird et al. 2015). Recent mark-recapture estimates (Oleson et al. 2010) of abundance are known to have a positive bias of unknown magnitude due to missed matches, and therefore are not suitable for deriving a minimum abundance estimate.

Current Population Trend

Reeves et al. (2009) suggested that the MHI insular stock of false killer whales 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. The Status Review of MHI insular false killer whales (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).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for this species in Hawaiian waters.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the MHI insular false killer whale stock is calculated as the minimum population estimate (92) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.1 (for a stock listed as Endangered under the ESA and with minimum population size less than 1500 individuals; Taylor et al. 2000) resulting in a PBR of 0.18 false killer whales per year, or approximately one animal every 5.5 years.

STATUS OF STOCK

The status of MHI insular stock false killer whales relative to OSP is unknown, although this stock appears to have declined during the past two decades (Oleson et al. 2010, Reeves et al. 2009; Baird 2009). MHI insular false killer whales are listed as “endangered” under the Endangered Species Act (1973) (77 FR 70915, 28 November, 2012). The Status Review report produced by the Biological Review Team (BRT) (Oleson et al. 2010) found that Hawaiian insular false killer whales are a Distinct Population Segment (DPS) of the global false killer whale taxon. Of the 29 identified threats to the population, the BRT considered the effects of small population size, including inbreeding depression and Allee effects, exposure to environmental contaminants (Ylitalo et al. 2009), competition for food with commercial fisheries (Boggs & Ito, 1993, Reeves et al. 2009), and hooking, entanglement, or intentional harm by fishermen to be the most substantial threats to the population. The BRT concluded that Main Hawaiian Islands insular false killer whales were at high risk of extinction. Following additional information on the occurrence of another island-associated stock in the NWHI, the BRT reevaluated the DPS decision and concluded that the population still met the standard to be listed as a DPS (Oleson et al. 2012). Because MHI insular false killer whales are formally listed as "endangered" under the ESA, they are automatically considered as a "depleted" and "strategic" stock under the MMPA. For the 5-yr period prior to the implementation of the TRP, the average estimated mortality and serious injury to MHI insular stock false killer whales (0.21 animals per year) exceeded the PBR (0.18 animals per year). For year 2013, the estimate of mortality and serious injury (0) is below the PBR (0.18), and even if no change in mortality rates is assumed under the TRP, the mortality and serious injury to MHI insular false killer whales for 2009-2013 (0.15) is less than PBR (0.18). The total fishery mortality and serious injury for the MHI insular stock of false killer whales cannot be considered to be insignificant and approaching zero, as it is greater than 10% of PBR. Following implementation of the TRP a significant portion of the recognized stock range is inside of the expanded year-round LLEZ around the MHI, providing significant protection for this stock from longline fishing. Prior to that time, a seasonal contraction to the LLEZ potentially exposed a significant portion of

the offshore range of the stock to longline fishing. Additional monitoring of bycatch rates for this stock will be required before assessing whether the expansion of the LLEZ and other take-reduction measures have reduced fishery takes below PBR. Effects of other threats have yet to be assessed, e.g., nearshore hook and line fishing and environmental contamination. There is significant geographic overlap between various nearshore fisheries and evidence of interactions with hook-and-line gear (e.g. Baird et al. 2015), such that these fisheries may pose a threat to the stock. Recent research has indicated that concentrations of polychlorinated biphenyls (PCBs) exceeded proposed threshold levels for health effects in 84% of sampled MHI insular false killer whales (Foltz et al. 2014).

HAWAII PELAGIC STOCK

POPULATION SIZE

Analyses of a 2002 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in an abundance estimate of 484 (CV = 0.93) false killer whales within the Hawaiian Islands EEZ outside of about 75 nmi of the main Hawaiian Islands (Barlow & Rankin 2007). A new abundance survey was completed in 2010 within the Hawaiian Islands EEZ and resulted in five on-effort detections of false killer whales attributed to the Hawaii pelagic stock. Analysis of the 2010 HICEAS shipboard line-transect data resulted in an abundance estimate of 1,540 (CV=0.66) false killer whales outside of 11 km of the main Hawaiian Islands (Bradford et al. 2014, 2015). Bradford et al. (2014) reported that most (64%) false killer whale groups seen during the 2010 HICEAS survey were seen moving toward the vessel when detected by the visual observers. Together with an increase in sightings close to the trackline, these behavioral data suggest vessel attraction is likely occurring and may be significant. Although Bradford et al. (2014, 2015) employed a half-normal model to minimize the effect of vessel attraction, the abundance estimate may still be positively biased as a result of vessel attraction because groups originally outside of the survey strip, and therefore unavailable for observation by the visual survey team, may have moved within the survey strip and been sighted. There is some suggestion of such attractive movement within the acoustic data and visual data (Bradford et al. 2014), though the extent of any bias created by this movement is unknown. A 2005 survey (Barlow and Rankin 2007) resulted in a separate abundance estimate of 906 (CV=0.68) false killer whales in international waters south of the Hawaiian Islands EEZ and within the EEZ of Johnston Atoll, but it is unknown how many of these animals might belong to the Hawaii pelagic stock.

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 2010 abundance estimate for the Hawaiian Islands EEZ outside of 11 km from the main Hawaiian Islands (Bradford et al. 2014, 2015) or 928 false killer whales. The minimum abundance estimate has not been corrected for vessel attraction and may be an over-estimate of minimum population size.

Current Population Trend

No data are available on current population trend. It is incorrect to interpret the increase in the abundance estimate from 2002 to 2010 as an increase in population size, given changes to the survey design in 2010 and the analytical framework specifically intended to better enumerate and account for overall group size, the low precision of each estimate, and a lack of understanding of the oceanographic processes that may drive the distribution of this stock over time. Further, estimation of the detection function for the 2002 and 2010 estimates relied on shared data, such that the resulting abundance estimates are not statistically independent estimates and cannot be compared in standard statistical tests. Only a portion of the overall range of this population has been surveyed, precluding evaluation of abundance of the entire stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for this species in Hawaiian waters.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaii pelagic stock of false killer whales is calculated as the minimum population estimate for the U.S. EEZ of the Hawaiian Islands (928) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with a Hawaiian Islands EEZ mortality and serious injury rate CV <= 0.30; Wade and Angliss 1997), resulting in a PBR of 9.3 false killer whales per year.

STATUS OF STOCK

The status of the Hawaii pelagic stock of false killer whales relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Concentrations of polychlorinated biphenyls (PCBs) exceeded

proposed threshold levels for health effects in 84% of sampled MHI insular false killer whales (Foltz et al. 2014), and elevated concentrations are also expected in pelagic false killer whales given the amplification of these contaminants through the food chain and likely similarity in false killer whale diet across the region. This stock is not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. Following the NMFS Guidelines for Assessing Marine Mammal Stocks (NMFS 2005), the status of this transboundary stock of false killer whales is assessed based on the estimated abundance and estimates of mortality and serious injury within the U.S. EEZ of the Hawaiian Islands because estimates of human-caused mortality and serious injury from all U.S. and non-U.S. sources in high seas waters are not available, and because the geographic range of this stock beyond the Hawaiian Islands EEZ is poorly known. For the 5-yr period prior to the implementation of the TRP, the average rate of mortality and serious injury to pelagic stock false killer whales within the Hawaiian Islands EEZ (13.6 animals per year) exceeded the PBR (9.3 animals per year). In most cases, the NMFS Guidelines for Assessing Marine Mammal Stocks (NMFS 2005) suggest pooling estimates of mortality and serious injury across 5 years to reduce the effects of sampling variation. If there have been significant changes in fishery operation that are expected to affect take rates, such as the 2013 implementation of the TRP, the guidelines recommend using only the years since regulations were implemented. However, recent studies (Carretta and Moore 2014) have demonstrated that estimates from a single year of data are biased when take events are rare, as with false killer whales in the Hawaii-based longline fisheries. Although the estimated mortality and serious injury of false killer whales within the HI EEZ during 2013 (4.1) is below the PBR (9.3), this estimate is within the range of past, pre-TRP estimates, so there is not yet sufficient information to determine whether take rates in the fishery have decreased as a result of the TRP. Indeed, the number of false killer whale takes during 2014 (for which no overall bycatch estimates are yet available), are the highest recorded since 2003. One of the goals of the TRP is to reduce the severity of injury (from serious to non-serious) by allowing hooked animals to free themselves. However, even if the serious injury rate were halved under TRP measures, a rough approximation of 2014 total mortality and serious injury (approximately 27 total false killer whales within and outside the EEZ), would be the second highest mortality and serious injury estimate available for this fishery. For these reasons, the strategic status for this stock has been evaluated relative to the most recent 5 years of estimated mortality and serious injury. The total 5-year mortality and serious injury for 2009-2013 (11.2) exceeds PBR (9.3), and this stock is considered a "strategic stock" under the MMPA. Additional monitoring of bycatch rates for this stock will be required before assessing whether TRP measures have reduced fishery takes below PBR. The total fishery mortality and serious injury for the Hawaii pelagic stock of false killer whales cannot be considered to be insignificant and approaching zero.

NORTHWESTERN HAWAIIAN ISLANDS STOCK

POPULATION SIZE

A 2010 line transect survey that included the waters surrounding the Northwestern Hawaiian Islands produced an estimate of 617 (CV = 1.11) false killer whales attributed to the Northwestern Hawaiian Islands stock (Bradford et al. 2014, 2015). This is the best available abundance estimate for false killer whales within the Northwestern Hawaiian Islands. Bradford et al. (2014) reported that most (64%) false killer whale groups seen during the 2010 HICEAS survey were seen moving toward the vessel when detected by the visual observers. Together with an increase in sightings close to the trackline, these behavioral data suggest vessel attraction is likely occurring and may be significant. Bradford et al. (2014, 2015) employed a half-normal model to minimize the effect of vessel attraction, because groups originally outside of the survey strip, and therefore unavailable for observation by the visual survey team, may have moved within the survey strip and been sighted. There is some suggestion of such attractive movement within the acoustic and visual data (Bradford et al. 2014) though the extent of any bias created by this movement is unknown.

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 2010 abundance estimate for the Northwestern Hawaiian Islands stock (Bradford et al. 2015) or 290 false killer whales. This estimate has not been corrected for vessel attraction and may be positively biased.

Current Population Trend

No data are available on current population trend because there is only one estimate of abundance from 2010.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for this species in the waters

surrounding the Northwestern Hawaiian Islands.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Northwestern Hawaiian Islands false killer whale stock is calculated as the minimum population estimate (290) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.40 (for a stock of unknown status, with a Hawaiian Islands EEZ mortality and serious injury rate CV > 0.8; Wade and Angliss 1997), resulting in a PBR of 2.3 false killer whales per year.

STATUS OF STOCK

The status of false killer whales in Northwestern Hawaiian Islands waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Concentrations of polychlorinated biphenyls (PCBs) exceeded proposed threshold levels for health effects in 84% of sampled MHI insular false killer whales (Foltz et al 2014), and elevated concentrations are also expected in NWHI false killer whales given the amplification of these contaminants through the food chain and likely similarity in false killer whale diet across the region. Biomass of some false killer whale prey species may have declined around the Northwestern Hawaiian Islands (Oleson et al. 2010, Boggs & Ito 1993, Reeves et al. 2009), though waters within the Papahānaumokuākea Marine National Monument have been closed to commercial longlining since 1991 and to other fishing since 2006. This stock is not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor as "depleted" under the MMPA. The rate of mortality and serious injury to NWHI false killer whales, (0.6 for 2008-2012, 0.1 for 2013, 0.5 for 2009-2013) is less than the PBR (2.3 animals per year), but is not approaching zero mortality and serious injury rate because it exceeds 10% of PBR (NMFS 2004). A significant portion of the recognized stock range is within the Marine National Monument and the expanded LLEZ, such that this stock is likely not exposed to high levels of fishing effort because commercial and recreational fishing is prohibited within Monument waters and longlines are excluded from the majority of the stock range. Additional monitoring of bycatch rates for this stock will be required before assessing whether TRP measures have reduced fishery takes below 10% of PBR.

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