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FALSE KILLER WHALE (*Pseudorca crassidens*): ~~Pacific Islands Region~~ Hawaiian Islands Stock Complex - Hawaiian Insular, Northwestern Hawaiian Islands, and Hawaii Pelagic ~~and Palmyra Atoll~~ Stocks

STOCK DEFINITIONS AND GEOGRAPHIC RANGES

False killer whales are found worldwide mainly 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. There are six stranding records from Hawaiian waters (Nitta 1991; Maldini et al. 2005). One on-effort sighting of false killer whales was made during a 2002 shipboard survey, and six during a 2010 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Figure 1; Barlow 2006~~; NMFS unpublished data~~ Bradford et al. 2012~~). Group size ranged from 1 to 52 false killer whales during the 2010 survey.~~ Smaller-scale surveys conducted around the main Hawaiian Islands (Figure 2) show that false killer whales are also encountered in nearshore waters there (Baird et al. 2005, Mobley et al. 2000, Mobley 2001, 2002, 2003, 2004), and a single on-effort and three off-effort sightings during a 2010 shipboard survey reveal that the species also occurs near shore in the Northwestern Hawaiian Islands (Baird et al 2012). This species also occurs in U.S. EEZ waters around Palmyra Atoll ~~(Figure 1)~~, Johnston Atoll (NMFS/PIR/PSD unpublished data), and American Samoa (Johnston et al. 2008, Oleson 2009).

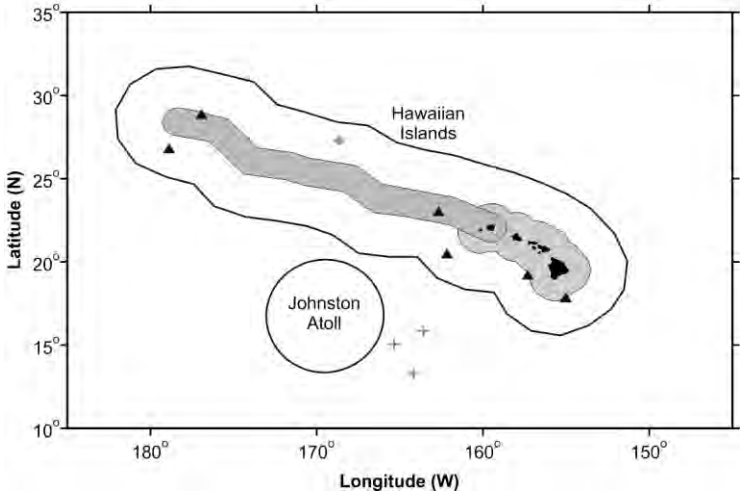

Figure 1. False killer whale on-effort sighting locations during standardized shipboard surveys of the Hawaiian U.S. EEZ (2002, gray diamond, Barlow 2006; 2010, black triangles, Bradford et al. 2012~~NMFS unpublished data~~), ~~the Palmyra U.S. EEZ~~ the Johnston Atoll EEZ and pelagic waters of the central Pacific south of the Hawaiian Islands (2005, gray crosses, Barlow and Rankin 2007). Outer lines represent approximate boundary of U.S. EEZs; light shaded gray area is the insular false killer whale stock area, including overlap zone between 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 insular false killer whale stock area.

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. 2007, 2010, Martien et al. 2011). Chivers et al. (2010) expanded previous analyses with additional samples and analysis of 8 nuclear DNA (nDNA) microsatellites, revealing strong phylogeographic patterns consistent with local evolution of haplotypes nearly unique to false killer whales occurring nearshore within the Hawaiian Archipelago. Analysis of 21 additional samples collected during a 2010 shipboard survey in Hawaiian waters reveals significant differentiation in both mitochondrial DNA (mtDNA) and nDNA between false killer whales found near the MHI and the NWHI (Martien et al. 2011). Photographic–identification of individuals seen near the NWHI confirms that they do not associate with individuals near the MHI. Two false killer whales previously photographed near Kauai were seen in groups observed near Nihoa in the NWHI and are not known to associate with animals from the MHI, suggesting geographic overlap of MHI and NWHI false killer whale populations near Kauai. Further evaluation of photographic and genetic data from individuals seen near the MHI suggest the occurrence of three separate social clusters (Baird et al. 2012, Martien et al. 2011), where mating primarily occurs within clusters, though some mating is known to occur between males and females of different social clusters (Martien et al. 2011).

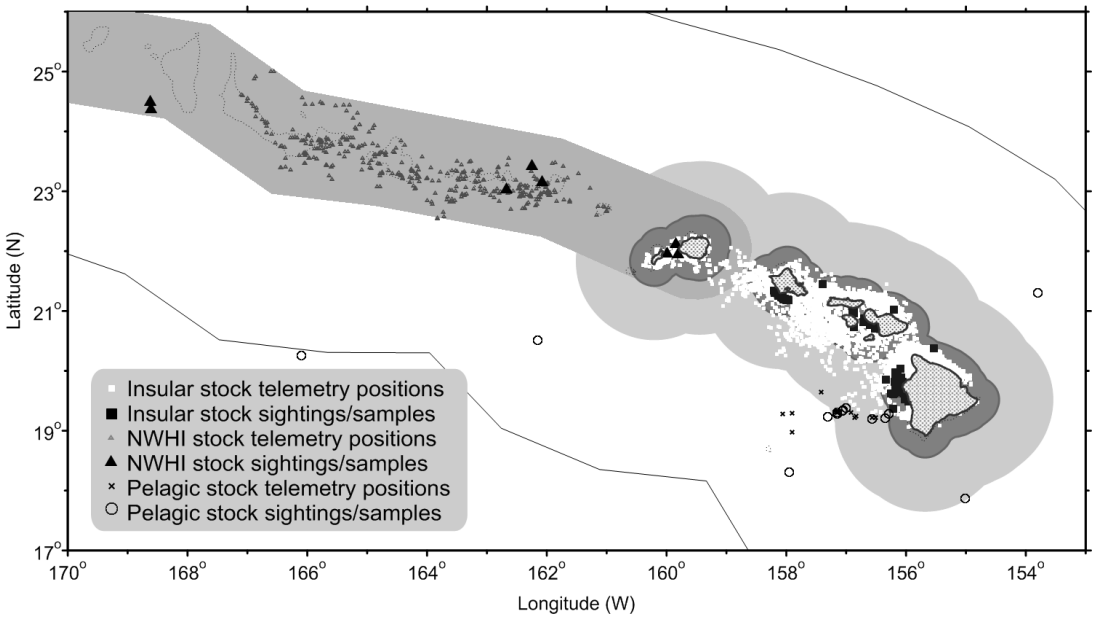

Figure 2. Sighting, biopsy, and telemetry records of false killer whale identified as being part of the insular (square ~~closed~~ symbols), NWHI (triangle symbols), or ~~versus~~ pelagic (open and cross symbols) stocks. The dark gray area is the 40-km insular core area; light gray area is the 40-km to 140-km insular-pelagic overlap zone (Baird et al. 2010, Baird unpublished data; reproduced from Forney et al. 2010); medium gray area is the 50-nmi (93-km) Monument boundary extended to the east to encompass Kauai, representing the NWHI stock boundary. The insular, pelagic, and NWHI stocks overlap in the vicinity of Kauai.

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 (see Figure 3), were determined to have Pacific pelagic haplotypes (Chivers et al. 2010). At the broadest scale, significant differences in both mtDNA and nDNA 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.

Genetic, photographic, and telemetry data collected from Hawaiian false killer whales demonstrates the existence of a previously unknown stock of island-associated false killer whales in the NHWI, and supports the current recognized boundaries of the insular and pelagic stocks. The three stocks have overlapping ranges. Insular false killer whales have been seen as far as 112 km from the main Hawaiian Islands, while pelagic stock animals have been seen within 42 km of the main Hawaiian Islands (Baird et al. 2008, Baird 2009, Baird et al. 2010, Forney et al. 2010). NWHI false killer whales have been seen as far as 93 km from the NWHI and near Kauai (Baird et al. 2012, Bradford et al. 2012, Martien et al. 2011). Animals seen within 40 km of the main Hawaiian Islands between Hawaii Island and Oahu are considered to belong to the insular stock. Waters within 40 km of Kauai and Niihau are an overlap zone between the Hawaii insular and NWHI stock, as individuals from both populations have been seen here. Animals seen within 93 km of the NWHI, inside the Papahānaumokuākea Marine National Monument may belong to either the NWHI or pelagic stock, as animals from both stocks have been seen inside the Monument. Animals beyond 140 km of the MHI and beyond 93 km of the NWHI are considered to belong to the pelagic stock. The insular and pelagic stocks overlap between 40 km and 140 km from shore between Oahu and Hawaii Island. All three stocks overlap within 40 km and 93 km around Kauai and Niihau, and the insular and pelagic stocks overlap from 93 km to 140 km around these islands (Figure 2).

~~Genetic analyses of tissue samples collected within the Indo-Pacific indicate restricted gene flow between false killer whales sampled near the main Hawaiian Islands, and false killer whales sampled in all other regions (Chivers et al. 2007, 2010). The recent update from Chivers et al. (2010) included additional samples and analysis of 8 nuclear DNA (nDNA) microsatellites, revealing strong phylogeographic patterns that are consistent with local evolution of haplotypes that are nearly unique to false killer whales occurring the separate insular population around the main the Hawaiian Islands. Further, the recent analysis revealed significant differentiation, in both mitochondrial and nDNA, between pelagic false killer whales in the Eastern (ENP) and Central North Pacific (CNP) strata defined in 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 stock boundaries would be drawn.. An additional 24 samples collected during the 2010 shipboard survey in pelagic Hawaiian waters are currently being analyzed and will be used to further evaluate stock identity and boundaries.~~

~~Since 2003, observers of the Hawaii based longline fishery have also been collecting tissue samples of caught cetaceans for genetic analysis whenever possible. 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 (see Figure 3), were determined to have Pacific pelagic haplotypes (Chivers et al. 2010). Recent satellite telemetry studies, boat based surveys, and photo identification analyses of false killer whales around Hawaii have demonstrated that the insular and pelagic false killer whale stocks have overlapping ranges, rather than a clear separation in distribution. Insular false killer whales have been documented as far as 112 km from the main Hawaiian Islands, and pelagic stock animals have been documented as close as 42 km to the islands (Baird et al. 2008, Baird 2009, Baird et al. 2010, Forney et al 2010). Based on a review of new information (Forney et al. 2010), the 2010 stock assessment report recognized a new, overlapping stock structure for insular and pelagic stocks of false killer whales around Hawaii: animals within 40 km of the main Hawaiian Islands are considered to belong to the insular stock; animals beyond 140 km of the main Hawaiian Islands are considered to belong to the pelagic stock, and the two stocks overlap between 40 km and 140 km from shore (Figure 2).~~

The pelagic stock includes animals found ~~both~~ 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 remains a separate stock, because comparisons amongst false killer whales sampled at Palmyra Atoll and those sampled from the insular stock of Hawaii and the pelagic ENP reveal~~ed~~ restricted gene flow, although the sample size remains low for robust comparisons (Chivers et al. 2007, 2010). NMFS will ~~continue to~~ obtain and analyze additional ~~tissue~~ samples for genetic studies of 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 ~~four~~ Pacific Islands Region management stocks (Chivers et al. 2008, Martien et al. 2011): 1) the Hawaii insular stock, which includes animals inhabiting waters within 140 km (approx. 75 nmi) of the main Hawaiian Islands, ~~and~~ 2) the Northwestern Hawaiian Islands stock, which includes animals inhabiting waters within 93 km (50 nmi) of the NWHI and Kauai, ~~and~~ 3) the Hawaii pelagic stock, which includes false killer whales inhabiting waters greater than 40 km (22 nmi) from the main Hawaiian Islands, ~~3~~ 4) the Palmyra Atoll stock, which includes animals ~~false killer whales~~ found within the U.S. EEZ of Palmyra Atoll, and ~~4~~ 5) the American Samoa stock, which includes animals ~~false killer whales~~ 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 ~~is~~ covered in ~~a~~ separate reports.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Interactions with ~~cetaceans have been reported for Hawaii based pelagic fisheries and~~ false killer whales, including depredation of catch, have been identified in ~~fishermen's logs~~ logbooks and NMFS observer records ~~as taking catches~~ from Hawaii pelagic longlines (Nitta and Henderson 1993, NMFS/PIR unpublished data). False killer whales have ~~also~~ been observed feeding on mahi mahi, *Coryphaena hippurus*, and yellowfin tuna, *Thunnus albacares* (Baird 2009), and they have been reported to take large fish ~~(up to 70 pounds)~~ from the trolling lines of ~~both~~ commercial and recreational fishermen (Shallenberger 1981). There are anecdotal reports of marine mammal interactions in the commercial Hawaii shortline fishery which sets gear ~~, which was developed to target bigeye tuna , *Thunnus obesus*, and lustrous pomfret , *Eumegistus illustris,*~~ at Cross Seamount and ~~may also set gear~~ possibly around the main Hawaiian Islands. ~~Fishing~~ The shortline fishery is permitted through the State of Hawaii Commercial Marine License program, and until recently, ~~there were~~ no reporting systems ~~in place~~ existed to document marine mammal interactions. This fishery was added to the 2010 List of Fisheries as a Category II fishery (Federal Register Vol. 74, No. 219, p. 58859-58901, November 16, 2009), and efforts are underway to obtain ~~further information~~ data on ~~the extent of~~ interactions between shortlines and marine mammals ~~and to document the species involved~~. Baird and Gorgone (2005) documented ~~a~~ high rate~~s~~ of dorsal fin disfigurements ~~that were~~ consistent with injuries from unidentified fishing line for false killer whales belonging to the insular stock. ~~At the present time, however, it~~ It is unknown whether these injuries might have been caused by longline gear, shortline gear, or other hook-and-line gear used around the main Hawaiian Islands.

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, within the ranges of both insular and pelagic stocks. Between ~~2005~~ 2006 and ~~2009~~ 2010, two 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% observer coverage) within Hawaiian waters or adjacent high-seas waters (excluding Palmyra Atoll) (Forney 2011) ~~(Forney 2010a, b)~~. ~~Two~~ One false killer whale take~~s~~ in the DSLL fishery resulted in the death of the animal ~~, one within the Hawaiian EEZ and the other~~ in international waters. 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 (Andersen et al. 2008), one animal taken in the SSLL fishery was considered not seriously injured and one was considered seriously injured, both within the Hawaii EEZ. In the DSLL fishery, one false killer whale taken within the overlap zone of the insular and pelagic stocks, two ~~one~~ taken in Hawaiian waters within the range of the pelagic stock, and one taken in international waters were considered not seriously injured. ~~For two~~ The level of injury could not be determined based on the observer descriptions for one false killer whale~~s~~ taken in the DSLL, ~~one within the overlap zone of the insular and pelagic stocks and one taken in Hawaiian waters~~ within the range of the pelagic stock. ~~, the level of injury could not be etermined based on the observer descriptions~~. The remaining ~~17~~ 18 false killer whales taken in the DSLL fishery (nine in international waters, ~~seven~~ nine in the Hawaiian Islands EEZ pelagic stock range ~~, and one in the EEZ of Palmyra Atoll~~) were considered seriously injured (Forney 2011 ~~2010a,b~~). ~~Nine~~ Seven additional unidentified "blackfish" (unidentified cetaceans known to be either false killer whales or short-finned pilot whales) ~~cetaceans~~ that may have been false killer whales were also seriously injured during 2006-2010 (Forney 2011). ~~2005-2009 (Forney 2010a,b)~~. ~~Eight~~ Six of these were taken in the DSLL fishery within U.S. EEZ waters, including ~~two~~ one animal~~s~~ within the insular stock range, and one was taken in the SSLL fishery in international waters (Figure 3).

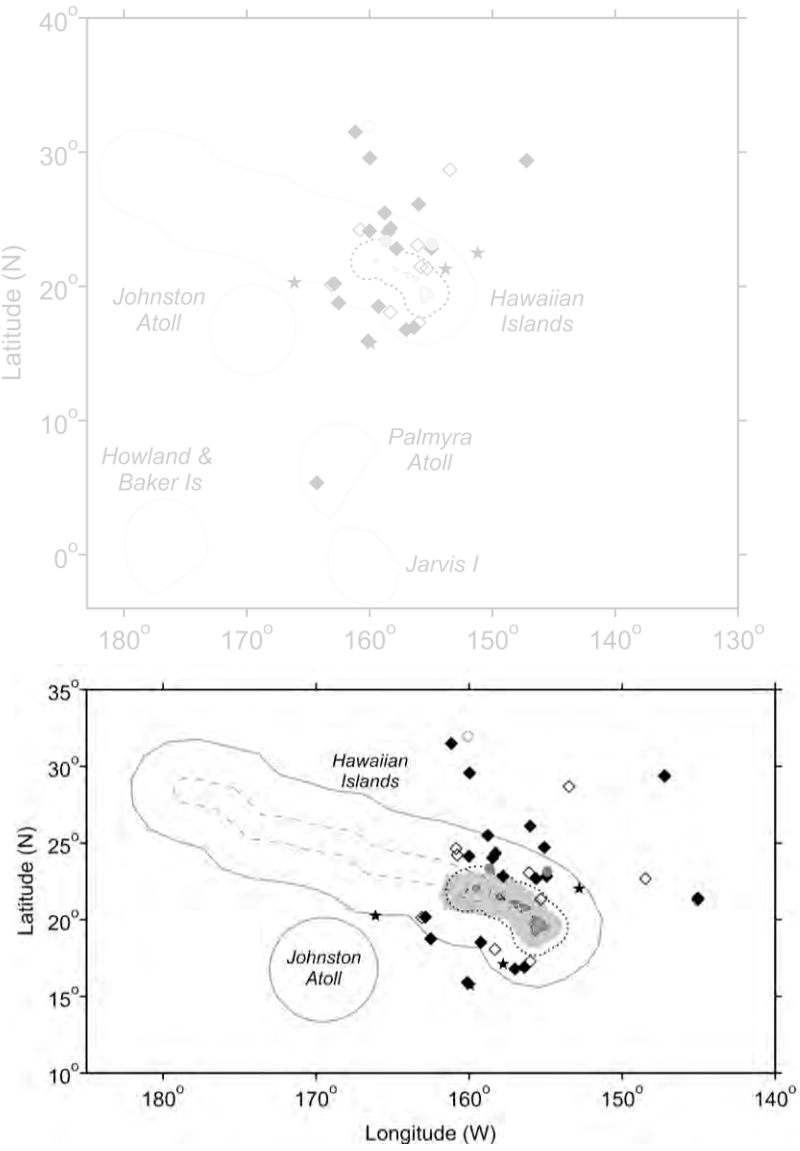

Figure 3. Locations of observed false killer whale takes (filled symbols) and possible takes of this species (open symbols) in the Hawaii-based longline fisheries, ~~2005-2009~~ 2006-2010. Deep-set fishery takes are shown in black; shallow-set fishery takes are shown in gray. Stars are locations of genetic samples from fishery-caught false killer whales. Solid gray lines represent the U.S. EEZ; the dotted line is the outer (140-km) boundary of the overlap zone between insular and pelagic false killer whale stocks; the dashed line is the 93-km boundary of the NWHI stock; the gray shaded area is the February-September longline exclusion zone. Fishery descriptions are provided in Appendix 1.

The total observed mortality and serious injury of cetaceans in the SSLL fishery (with 100% coverage), and the estimated annual and 5-yr average mortality and serious injury of cetaceans in the DSLL fishery (with approximately 20% coverage) are reported by McCracken (2011) ~~(2010a,b)~~. A number of recent changes are

reflected in the methodology. Estimated takes of false killer whales and observed takes for which ~~an~~ injury severity is undetermined ~~determination could not be made~~, are prorated based on the proportions of observed interactions that resulted in death or serious injury (~~92%~~ 93%) or non-serious injury (~~8%~~ 7%), between the years 2000 and ~~2009~~ 2010. Further, takes of false killer whales of unknown stock ~~origin~~ ~~with~~in the insular/pelagic stock overlap zone are prorated assuming that ~~the density~~ densities of ~~the~~ insular stock animals declines and ~~the density of the~~ pelagic stock increase~~s~~ with ~~increasing~~ distance from shore (McCracken 2010~~b~~). No genetic samples are available to establish stock identity for these takes, but both stocks are considered at risk of interacting with longline gear ~~within this region~~. 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. 2008). Insular false killer whales have been documented via telemetry to move ~~sufficiently~~ far enough offshore (112km) to reach longline fishing areas, and animals from this stock have a high rate of dorsal fin disfigurements consistent with injuries from unidentified fishing line (Baird and Gorgone 2005). Based on these considerations, and as outlined in the NMFS Guidelines for Assessing Marine Mammal Stocks (NMFS 2005), bycatch within the overlap zone has been prorated based on the estimated densities of each stock (McCracken and Forney 2010).

Table 1. Summary of available information on incidental mortality and serious injury of false killer whales (Hawaiian Islands ~~Pacific Islands~~ Stock Complex) and unidentified blackfish in commercial fisheries, by stock and EEZ area, as applicable (McCracken 2010 ~~a,b~~). Mean annual takes are based on ~~2005-2009~~ 2006-2010 estimates unless otherwise indicated. Information on all observed takes (T) and combined mortality events & serious injuries (MSI) is included. Total takes were prorated to deaths, serious injuries, and non-serious injuries based on the observed proportions of each outcome ~~(see McCracken 2010a for details)~~. Unidentified blackfish are pro-rated as either false killer whales or short-finned pilot whales according to their distance from shore (see McCracken 2010~~b~~ for details). CVs are estimated based on the methods of McCracken & Forney (2010) and do not yet incorporate additional uncertainty introduced by prorating false killer whales in the overlap zone and prorating the unidentified blackfish.

Fishery Name	Year	Data Type	Percent Observer Coverage	Observed total interactions (T) and mortality events ~~(M)~~, and serious injuries (MSI) ~~and non-serious injuries (NSI)~~, and total estimated mortality and serious injury (M&SI) of false killer whales by stock / EEZ region							
				Hawaii Pelagic Stock				**Hawaii Insular Stock**		**~~Palmyra Atoll Stock~~**	
				Outside of U.S. EEZs		Hawaiian Islands EEZ					
				Obs. FKW T/MSI Obs. UB T/MSI	Estimated M&SI (CV)	Obs. FKW T/MSI Obs. UB T/MSI	Estimated M&SI (CV)	Obs. FKW T/MSI Obs. UB T/MSI	Estimated M&SI (CV)	~~Obs. FKW T/MSI~~ ~~Obs. UB T/MSI~~	~~Estimated M&SI (CV)~~
Hawaii-based deep-set longline fishery	~~2005~~	Observer data	~~28%~~	~~1/1~~ ~~0/0~~	~~3 (1.6)~~	~~1/1~~ ~~1/1*~~	~~3 (1.9)~~	~~0/0~~ ~~1/1*~~	~~0.5 (-)~~	~~0/0~~ ~~0/0~~	~~0 (-)~~
	2006		22%	2/2 0/0	8 (0.7)	2/1* 2/2*	13 (1.7)	1/0* 1/1*	2.2 (0.7)	~~0/0~~ ~~0/0~~	~~0 (-)~~
	2007		20%	1/0 0/0	2 (3.7)	2/1 0/0	8 (0.8)	0/0 0/0	0 (-)	~~1/1~~ ~~0/0~~	~~2 (0.7)~~
	2008		22%	0/0 0/0	0 (-)	4/3 3/3	17 (0.4)	0/0 0/0	0 (-)	~~0/0~~ ~~0/0~~	~~0 (-)~~
	2009		20%	7/7 0/0	39 (0.2)	2/2 0/0	12 (0.5)	0/0 0/0	0 (-)	~~0/0~~ ~~0/0~~	~~0 (-)~~
	2010		21%	1/1 0/0	6 (1.3)	2/3 1/1	14 (0.5)	0/0 0/0	0 (-)	~~0/0~~ ~~0/0~~	~~0 (-)~~
Mean Estimated Annual Takes (CV)					**~~10.4 (0.31)~~ 11.2 (0.3)**		**~~10.6 (0.4)~~ 13.6 (0.3)**		**~~0.6 (1.67)~~ 0.5 (1.7)**		**~~0.3 (1.67)~~**
Hawaii-based shallow-set longline fishery	~~2005~~	Observer data	~~100%~~	~~0/0~~ ~~0/0~~	~~0~~	~~0/0~~ ~~0/0~~	~~0~~	~~0/0~~ ~~0/0~~	~~0~~	~~No fishing effort~~	
	2006		100%	0/0 0/0	0	0/0 0/0	0	0/0 0/0	0		
	2007		100%	0/0 0/0	0	0/0 0/0	0	0/0 0/0	0		
	2008		100%	0/0 1/1	0.5	1/0 0/0	0	0/0 0/0	0		
	2009		100%	0/0 0/0	0	1/1 0/0	1	0/0 0/0	0		
	2010		100%	0/0 0/0	0	0/0 0/0	0	0/0 0/0	0		
Mean Annual Takes (100% coverage)					**0.1**		**0.2**		**0**		
Minimum total annual takes within U.S. EEZs						**~~10.8 (0.4)~~**	**13.8 (0.3)**	**~~0.6 (1.67)~~**	**~~0.5 (1.7)~~**	**~~0.3 (1.67)~~**	

* False killer whale and unidentified blackfish takes within the insular/pelagic stock overlap zone are ~~is~~ shown once for each stock, but total estimates derived from these ~~is~~ takes are prorated among potentially affected stocks based on the distance from shore of the take location (see text above, and McCracken 2010a,b).

Finally, unidentified blackfish ~~cetaceans, known to be either false killer whales or short finned pilot whales (together termed "blackfish")~~, are prorated to each stock based on ~~their~~ distance from shore (McCracken 2010~~b~~). The distance-from-shore model was chosen following consultation with the Pacific Scientific Review Group, based on the model's performance and simplicity relative to a number of other more complicated models with similar output (~~see~~ McCracken 2010~~b for more information~~). Proration of false killer whales takes within the insular-pelagic overlap zone and of unidentified blackfish takes introduces ~~additional, yet~~ 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), this approach ensures that potential impacts to all stocks are assessed.

Based on these bycatch analyses, estimates of annual and 5-yr average annual mortality and serious injury of false killer whales, by stock and EEZ area, are shown in Table 1. Estimates of mortality and serious injury (M&SI) include a pro-rated portion of the animals categorized as unidentified blackfish (UB). Although M&SI estimates are shown as whole numbers of animals, the 5-yr average M&SI is calculated based on the unrounded annual estimates.

Because of high rates of false killer whale mortality and serious injury in Hawaii-based longline fisheries, a Take-Reduction Team (TRT) was established in January 2010 (75 FR 2853, 19 January 2010). The scope of the TRT was to reduce mortality and serious injury in the Hawaii pelagic, Hawaii insular, and Palmyra stocks of false killer whales and across the DSLL and SSLL fisheries. The Team submitted a Draft Take-Reduction Plan to NMFS for consideration (Available at: http://www.nmfs.noaa.gov/pr/pdfs/interactions/fkwtrp_draft.pdf), and NMFS has proposed regulations based on this TRP (76 FR 42082, 18 July 2011).

HAWAII INSULAR STOCK

POPULATION SIZE

A photographic mark-recapture study ~~of photo-identification data obtained~~ during 2000-2004 around the main Hawaiian Islands produced an estimate of 123 (CV=0.72) insular false killer whales (Baird et al. 2005). This abundance estimate is based in part on data collected more than 8 years ago, and is considered outdated ~~for estimating~~ as a measure of current abundance (NMFS 2005). A Status Review for the insular stock (Oleson et al. 2010) used recent, unpublished estimates for two time periods, 2000-2004 and 2006-2009 in a Population Viability Analysis (PVA). The new estimates were based on more recent sighting histories and open population models, yielding more precise estimates for the two time periods. 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 ~~, as these animals have not been seen to associate with others in the insular population~~ (Baird unpublished data). The animals seen near Kauai included in the higher estimate have now been associated with the NWHI stock (Baird et al 2012), such that the ~~The~~ best estimate of population size is ~~taken as~~ the ~~larger~~ smaller estimate of 151 animals. ~~including those animals seen near Kauai given the geographic range currently defined for this stock~~. However, it should be noted that even this smaller estimate may be positively-biased, ~~this is an overestimate~~, because missed photo-ID matches were discovered after the ~~mark-recapture~~ analyses were complete (discussed in Oleson *et al.* 2010). The best estimate will be updated when a new mark-recapture estimate accounting for the missed matches is available.

Minimum Population Estimate

The minimum population estimate for the insular stock of false killer whales is the number of distinct individuals identified during ~~2005-2009~~ 2008-2011 photo-identification studies, or ~~110~~ 129 false killer whales (Baird, unpublished data). Recent mark-recapture estimates (Oleson et al. 2010) of abundance are known to have a positive bias of unknown magnitude, and therefore are not suitable for deriving a minimum abundance estimate.

Current Population Trend

~~A recent study (Reeves et al. 2009) summarized information on false killer whale sightings near Hawaii between 1989 and 2007, based on various survey methods, and suggested that the insular stock of false killer whales may have declined during the last two decades.~~ Reeves et al. (2009) suggested that the 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. ~~More recently,~~ 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, Mobley 2001, 2002, 2003, 2004). Sighting rates during these surveys showed a statistically significant decline that could not be attributed to any weather or methodological changes. The ~~recent~~ Status Review of Hawaiian 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 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. ~~A variety of alternative scenarios were evaluated, with all~~ All plausible models ~~indicating~~ indicated the probability of decline to fewer than 20 animals within 75 years is greater than 20%. Though causation was not evaluated, all plausible models indicated current declines at an average rate of -9% since 1989 (95% probability intervals -5% to -12.5%; 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. ~~Obtaining information on rates of productivity for marine mammals is difficult (Wade 1998), and no estimate is available for this stock.~~

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the insular false killer whale stock is calculated as the minimum population size (~~110~~ 129) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.1 resulting in a PBR of ~~0.2~~ 0.3 false killer whales per year. The recovery factor was chosen to be 0.1 because the stock has been proposed for listing as endangered under the U.S Endangered Species Act (see below) and because of the significant recent decline experienced by this stock (Oleson et al. 2010).

STATUS OF STOCK

The status of insular stock false killer whales relative to OSP ~~of false killer whales belonging to the insular stock~~ is unknown, although this stock appears to have declined during the past two decades (Oleson et al. 2010, Reeves et al. 2009; Baird 2009). ~~A recent study (~~Ylitalo et al. 2009~~)~~ documented elevated levels of polychlorinated biphenyls (PCBs) in three of nine insular false killer whales sampled, and biomass of some false killer whale prey species may have declined around the main Hawaiian Islands (Oleson et al. 2010, Boggs & Ito 1993, Reeves et al. 2009). Insular false killer whales have been proposed for listing as "endangered" under the Endangered Species Act (1973) (75 FR 70169, 17 November 2010). The proposed listing follows receipt of a petition from the Natural Resources Defense Council on October 1, 2009, requesting that Hawaiian insular false killer whales be listed as endangered under the ESA. NMFS determined that the petition presented substantial scientific information indicating that a listing may be warranted and thus was required to conduct an ESA status review of the stock (75 FR 316; January 5, 2010) and established a Biological Review Team (BRT) for this purpose. The Status Review report produced by the 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 based on behavioral, ecological, genetic, and cultural factors. The BRT evaluated risk to the population, including identification and ranking of threats to the population, quantitative assessment of extinction probability using a PVA, and an assessment of the overall risk of extinction to the population. The PVA analysis indicated the probability of near-extinction (less than 20 animals) within 75 years (3 generations) was greater than 20% for all biologically plausible models and given a wide range of input variables. Of the 29 indentified threats to the population, the BRT considered the effects of small population size, including inbreeding depression and Allee effects, exposure to environmental contaminants, competition for food with commercial fisheries, ~~and~~ hooking, entanglement, or intentional harm by fishers to be the most substantial threats to the population. The BRT concluded that Hawaiian insular false killer whales were at high risk of extinction. The final listing decision is not yet available. False killer whales are not listed as "depleted" under the MMPA.

Based on the best available scientific information (Oleson et al. 2010), Hawaiian insular false killer whales are declining, therefore the ~~insular false killer whale~~ stock is considered "strategic" under the 1994 amendments to the MMPA. The estimated average annual human-caused mortality and serious injury for this stock (~~0.60~~ 0.5 animals per year) is greater than the PBR (~~0.2~~ 0.3), providing further support for the "strategic" designation.

HAWAII PELAGIC STOCK

POPULATION SIZE

Analyses of a 2002 shipboard line-transect survey of the Hawaiian Islands EEZ ~~(HICEAS survey)~~ resulted in an abundance estimate of ~~236 (CV=1.13) false killer whales (Barlow 2006) outside of 75 nm of the main Hawaiian Islands. A recent 2007 re-analysis of the HICEAS 2002 data using improved methods and incorporating additional sighting information obtained on line-transect surveys south of the Hawaiian EEZ during 2005, resulted in a revised 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). This abundance estimate ~~for the pelagic stock of false killer whales~~ is now more than 8 years old and therefore will no longer be used based on NMFS Guidelines for

Assessing Marine Mammal Stocks (NMFS 2005). A new abundance survey was ~~recently~~ completed in 2010 within the Hawaiian Islands EEZ and resulted in five ~~several acoustic and visual~~ on-effort detections of false killer whales ~~within the pelagic stock area.~~ attributed to the Hawaii pelagic stock. Analysis of 2010 shipboard line-transect data resulted in an abundance estimate of 1,503 (CV=0.66) false killer whales outside of 40 km of the main Hawaiian Islands (Bradford et al. 2012). Behavioral observations and assessment of the line-transect detection function indicate that false killer whales are attracted to the survey vessel (Bradford et al. 2012). This abundance estimate has not been corrected for vessel attraction and is considered an over-estimate of population abundance. Vessel attraction can result in overestimation of abundance by as much as 4-times in some populations (Turnock and Quinn 1991). The acoustic data collected during the 2010 survey are still being analyzed and additional refinements to this estimate are expected. ~~The detection process during the recent survey is different from that during the 2002 survey due to the inclusion of acoustic techniques; therefore a thorough analysis of the visual and acoustic detections will be required before a new abundance estimate will be available.~~

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 log-normal 20th percentile of the 2002 abundance estimate for the Hawaiian Islands EEZ outside of 75 nmi from the main Hawaiian Islands (Barlow & Rankin 2007) is 249 false killer whales. This minimum population estimate is more than 8 years old, and therefore would generally be considered outdated under NMFS Guidelines for Assessing Marine Mammal Stocks (2005). unless there were compelling evidence that the abundance has not dropped below the 2002 minimum level within the EEZ of the Hawaiian Islands. The 2010 survey had a significantly higher encounter rate than the 2002 survey (6 on effort sightings versus one) for approximately the same level of effort and in the same study area.~~ The log-normal 20th percentile of the 2010 abundance estimate for the Hawaiian Islands EEZ outside of 40 km from the main Hawaiian Islands (Bradford et al. 2012) is 906 false killer whales. The minimum abundance estimate has not been corrected for vessel attraction and may be an over-estimate of minimum population size. The acoustic data collected during the 2010 survey are still being analyzed and additional refinements to this estimate are expected. ~~Although the detection process has been improved with the inclusion of acoustic methods designed to increase the probability of detection for false killer whales, NMFS considers the significant increase in encounter rate during the 2010 survey as evidence that the abundance in the EEZ has not dropped below the 2002 minimum estimate. Therefore, the minimum estimate will be retained at this time, particularly given that a new minimum estimate will be available following thorough analysis of data collected during the 2010 HICEAS survey.~~

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 specifically intended to increase encounter rates, 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, 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. ~~Obtaining information on rates of productivity for marine mammals is difficult (Wade 1998), and no estimate is available for this stock.~~

POTENTIAL BIOLOGICAL REMOVAL

Following the NMFS Guidelines for Assessing Marine Mammal Stocks (NMFS 2005), the PBR is calculated only within the U.S. EEZ of the Hawaiian Islands, because estimates of human-caused mortality and serious injury are not available from all U.S. and non-U.S. sources in international waters where this stock may occur. The potential biological removal (PBR) level for the Hawaii pelagic stock of false killer whale is thus calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (~~249~~ 906) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of ~~0.48~~ 0.50 (for a stock of unknown status with a Hawaiian Islands EEZ mortality and serious injury rate CV = 0.30 ~~between 0.30 and 0.60~~; Wade and Angliss 1997), resulting in a PBR of ~~2.4~~ 9.1 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. No habitat issues are known to be of concern for this stock. They are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor 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 international waters are not available, and because the geographic range of this stock beyond the Hawaiian Islands EEZ is poorly known. Because the rate of mortality and serious injury to false killer whales within the Hawaiian Islands EEZ (~~10.8~~ 13.5 animals per year) exceeds the PBR (~~2.4~~ 9.1 animals per year), this stock is considered a "strategic stock" under the 1994 amendments to the MMPA. 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, because it has exceeded the PBR for more than 10 years.

~~The National Marine Fisheries Service~~ NMFS ~~recognizes that the assessment of this transboundary stock based only on abundance and human-caused mortality and serious injury within the U.S. EEZ of Hawaii introduces uncertainty; and~~ has considered whether the status assessment of this transboundary stock would change if animals outside the Hawaiian Islands EEZ are considered. Using all available peer-reviewed information on the abundance of false killer whales on the high-seas and within the EEZ of Johnston Atoll, a PBR can be calculated as the lower 20th percentile of the Barlow and Rankin (2007) abundance estimate (~~530~~ 539), times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of ~~0.48~~ 0.50 (for a stock of unknown status with a mortality and serious injury rate CV = 0.30 ~~between 0.30 and 0.60~~; Wade and Angliss 1997), resulting in ~~5.1~~ 5.4 false killer whales per year. This minimum abundance estimate may be based on a smaller geographic area than the (unknown) full range of the pelagic stock, because areas to the north of the Hawaiian Islands EEZ are not included; however, the estimate meets the definition of a 'minimum population estimate' under the MMPA. Bycatch information for the high seas is incomplete, because the levels of false killer whale takes in non-U.S. fisheries are not known. The average annual estimated mortality and serious injury by U.S. longline vessels operating on the high seas and within the EEZ of Johnston Atoll is ~~10.4~~ 11.3 ~~(CV=0.31;~~ McCracken 2011 ~~2010)~~. This value is greater than the PBR of ~~5.1~~ 5.4, and the combined U.S. and international mortality and serious injury is likely substantially higher, because fishing effort by foreign vessels may be up to six times greater than that of the U.S. fleet (NMFS, unpublished data). Better information on the full geographic range of this stock and quantitative estimates of bycatch in international fisheries are needed to reduce the uncertainties regarding impacts of false killer whale takes on the high seas, but these uncertainties do not change the current assessment that the pelagic false killer whale stock is strategic.

NORTHWESTERN HAWAIIAN ISLANDS STOCK

POPULATION SIZE

A 2010 line transect survey that included the waters surrounding the Northwestern Hawaiian Islands produced an estimate of 552 (CV = 1.09) false killer whales attributed to the Northwestern Hawaiian Islands stock (Bradford et al. 2012). This is the best available abundance estimate for false killer whales within the Northwestern Hawaiian Islands. Behavioral observations and assessment of the line-transect detection function indicate that false killer whales are attracted to the survey vessel (Bradford et al. 2012). The abundance estimate has not been corrected for vessel attraction and is considered an over-estimate of population abundance. The acoustic data collected during the 2010 survey are still being analyzed and additional refinements to this estimate are expected.

Minimum Population Estimate

The log-normal 20th percentile of the 2010 abundance estimate for the Northwestern Hawaiian Islands stock (Bradford et al. 2012) is 262 false killer whales. This 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.

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 size (262) 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, Wade and Angliss 1997), resulting in a PBR of 2.6 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. Ylitalo et al. 2009 documented elevated levels of polychlorinated biphenyls (PCBs) in three of nine Hawaii insular false killer whales sampled, and 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. 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 false killer whales within the Northwestern Hawaiian Islands is unknown but may be approaching zero if the stock remains entirely within Monument waters and the longline exclusion zone near Kauai. Mortality and serious injury does not exceed the PBR (2.6) for this stock and thus, this stock is not considered "strategic" under the 1994 amendments to the MMPA.

~~**PALMYRA STOCK**~~

~~**POPULATION SIZE**~~

~~Recent line transect surveys in the U.S. EEZ waters of Palmyra Atoll produced an estimate of 1,329 (CV = 0.65) false killer whales (Barlow & Rankin 2007). This is the best available abundance estimate for false killer whales within the Palmyra Atoll EEZ.~~

~~**Minimum Population Estimate**~~

~~The log-normal 20th percentile of the 2002 abundance estimate for the Palmyra Atoll EEZ (Barlow & Rankin 2007) is 806 false killer whales.~~

~~**Current Population Trend**~~

~~No data are available on current population trend.~~

~~**CURRENT AND MAXIMUM NET PRODUCTIVITY RATES**~~

~~No data are available on current or maximum net productivity rate for this species in Palmyra Atoll waters. Obtaining information on rates of productivity for marine mammals is difficult (Wade 1998), and no estimate is available for this stock.~~

~~**POTENTIAL BIOLOGICAL REMOVAL**~~

~~The potential biological removal (PBR) level for the Palmyra Atoll false killer whale stock is calculated as the minimum population size (806) 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 mortality and serious injury rate CV >0.80; Wade and Angliss 1997), resulting in a PBR of 6.4 false killer whales per year.~~

~~**STATUS OF STOCK**~~

~~The status of false killer whales in Palmyra Atoll EEZ waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. No habitat issues are known to be of concern for this stock. They are 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 false killer whales within the Palmyra Atoll EEZ in the Hawaii-based longline fishery (0.3 animals per year) does not exceed the PBR (6.4) for this stock and thus, this stock is not considered "strategic" under the 1994 amendments to the MMPA. The total fishery mortality and serious injury for Palmyra Atoll false killer whales is less than 10% of the PBR and, therefore, can be considered to be insignificant and approaching zero. Additional injury and mortality of false killer whales is known to occur in U.S and international longline fishing operations in international waters, and the potential effect on the Palmyra stock is unknown.~~

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