

FALSE KILLER WHALE (*Pseudorca crassidens*): Pacific Islands Region Stock Complex - Hawaii Insular, 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 2005). One on-effort sighting of false killer whales was made during a 2002 shipboard survey of waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Figure 1; Barlow 2006). Smaller-scale surveys conducted around the main Hawaiian Islands (Figure 2) show that false killer whales are also encountered in nearshore waters (Baird et al. 2005, Mobley et al. 2000, Mobley 2001, 2002, 2003, 2004). This species also occurs in U.S. EEZ waters around Palmyra Atoll (Figure 1), Johnston Atoll (NMFS/PIR/PSD unpublished data), and American Samoa (Johnston et al. 2008, Oleson 2009).

Genetic analyses of tissue samples collected within the Eastern North Pacific (ENP) indicate restricted gene flow between false killer whales sampled near the main Hawaiian Islands and false killer whales sampled in all other regions of the ENP (Chivers et al. 2007). 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 2008, five false killer whale samples, three collected outside the Hawaiian EEZ and two collected within the EEZ but more than 100 nautical miles (185km) from the main Hawaiian Islands (see Figure 3), were determined to have ENP-like haplotypes. Based on sighting locations and results of the genetic analyses, Chivers et al. (2008) suggested implementing a stock boundary coincident with the longline exclusion zone, which is at about 75 nmi (139 km) from the main Hawaiian Islands, until more information is available about the ecology of false killer whales, and especially the movement patterns of the insular stock animals.

For the 2008-2009 stock assessment reports, a provisional stock boundary for insular and pelagic stocks of false killer whales was recognized as the February-September longline exclusion boundary (at roughly 75 miles from the islands), with the expectation that this boundary would be refined as additional studies of false killer whale movements became available. Recent satellite telemetry studies, boat-based surveys, and photo-identification analyses of false killer whales around Hawaii have demonstrated that these two stocks have overlapping ranges, rather than a clear separation in distribution.

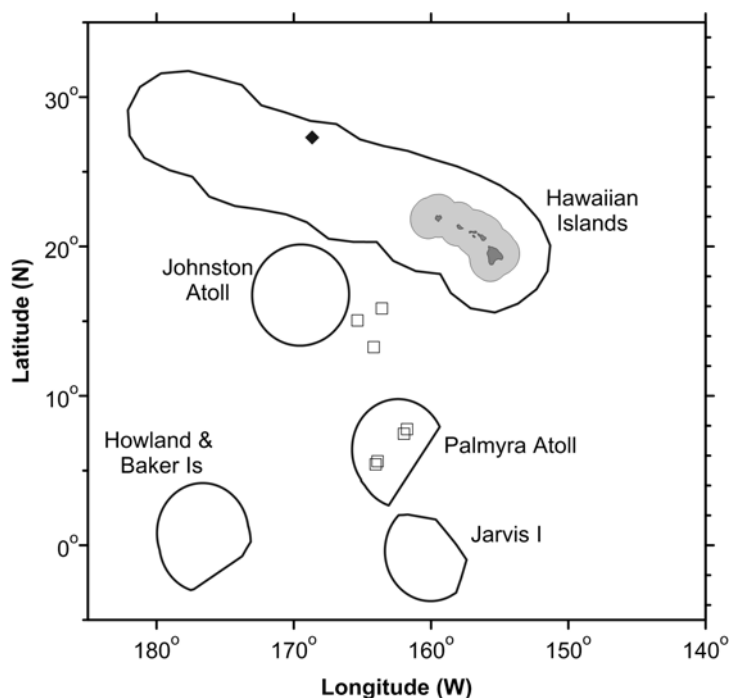


Figure 1. False killer whale sighting locations during standardized shipboard surveys of the Hawaiian U.S. EEZ (2002, black diamond, Barlow 2006), the Palmyra U.S. EEZ and pelagic waters of the central Pacific south of the Hawaiian Islands (2005, open squares, Barlow and Rankin 2007). Outer lines represent approximate boundary of U.S. EEZs; shaded gray area is the insular false killer whale stock area, including overlap zone between insular and pelagic false killer whale stocks .

Insular false killer whales have been documented as far as 100 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). Based on a review of new information (Forney et al. 2010), this stock assessment report recognizes 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 1).

This report also clarifies that 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 revealed restricted gene flow, although the sample size remains low for robust comparisons (Chivers et al. 2007). 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 four Pacific Islands Region management stocks (Chivers et al. 2008): 1) the Hawaii insular stock, which includes animals inhabiting waters within 140 km (approx. 75 nmi) of the main Hawaiian Islands, and 2) the Hawaii pelagic stock, which includes false killer whales inhabiting waters greater than 40 km (22 nmi) from the main Hawaiian Islands, 3) the Palmyra Atoll stock, which includes false killer whales found within the U.S. EEZ of Palmyra Atoll, and 4) the American Samoa stock, which includes 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 American Samoa Stock is covered in a separate report.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Interactions with cetaceans have been reported for Hawaiian pelagic fisheries, and false killer whales have been identified in fishermen's logs and NMFS observer records as taking catches from 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*, 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 interactions with marine mammals in the commercial Hawaii shortline fishery, which was developed to target bigeye tuna, *Thunnus obesus*, and lustrous pomfret, *Eumegistus illustris*, at Cross Seamount and may also set gear around the main Hawaiian Islands. Fishing is permitted through the State of Hawaii Commercial Marine License program, and until recently there were no reporting systems in place 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 on the extent of interactions between shortlines and marine mammals and to document the species involved. Baird and Gorgone (2005) documented a high rate 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 is unknown

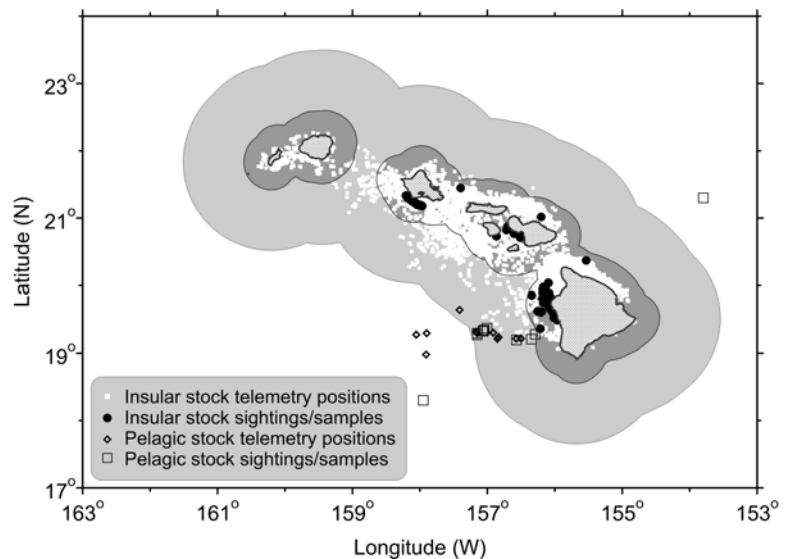


Figure 2. Sighting, biopsy, and telemetry records of false killer whales identified as being from insular (closed symbols) vs. pelagic (open symbols) stocks. The dark gray area is the 40-km insular stock core area; light gray area is the 40-km to 140-km overlap zone (Baird et al. 2010; Baird, unpublished data; reproduced from Forney et al. 2010).

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 (DSL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSL) 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 2004 and 2008, one false killer whale was observed hooked or entangled in the SSL fishery (100% observer coverage) within the U.S. EEZ of the Hawaiian Islands, and 19 false killer whales were observed taken in the DSL fishery ($\geq 20\%$ observer coverage) (Forney 2010). Two of the false killer whale takes in the DSL fishery in Hawaiian EEZ waters resulted in the death of the animal. 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), the single animal taken in the SSL fishery was considered not seriously injured. In the DSL fishery, one false killer whale taken within the range of the insular stock, one taken in Hawaiian waters within the range of the pelagic stock, and one taken in international waters were considered not seriously injured. The remaining 15 false killer whales (six in international waters, seven in the Hawaiian Islands EEZ pelagic stock range, and one in the EEZ of Palmyra Atoll) were considered seriously injured (Forney 2010). Eight additional unidentified cetaceans that may have been false killer whales were also seriously injured during 2004-2008 (Forney 2010). Seven of these were taken in the DSL fishery within U.S. EEZ waters, including two animals within the insular stock range, and one was taken in the SSL fishery in international waters (Figure 3).

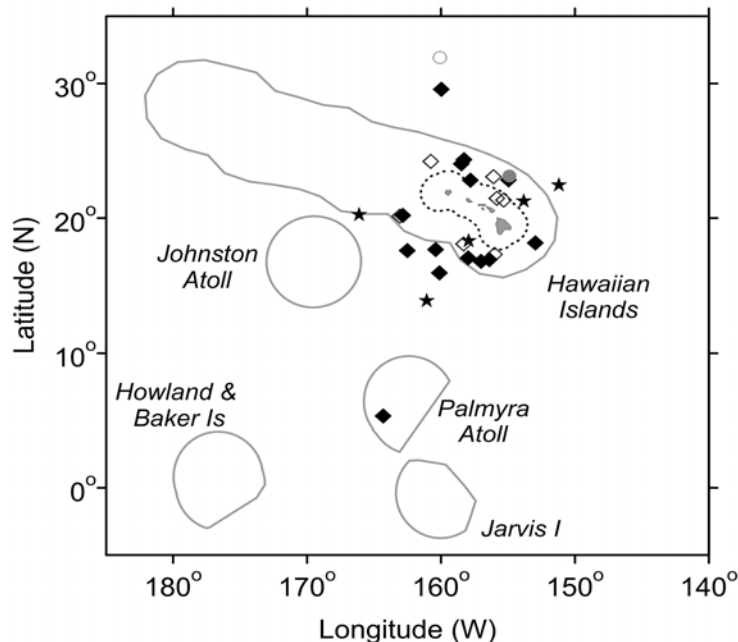


Figure 3. Locations of observed false killer whale takes (filled symbols) and possible takes of this species (open symbols) in the Hawaii-based longline fisheries, 2004-2008. Deep-set fishery takes are shown in black; shallow-set fishery takes are shown in gray. Stars are locations of genetic samples 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. Fishery descriptions are provided in Appendix 1.

The total observed mortality and serious injury of cetaceans in the SSL fishery (with 100% coverage), and the estimated annual and 5-yr average mortality and serious injury of cetaceans in the DSL fishery are reported by McCracken and Forney (2010). Their methodology includes prorating all estimated takes of false killer whales based on the proportions of observed interactions that resulted in death or serious injury (89%), or non-serious injury (11%). Further, takes of false killer whales of unknown stock origin within the insular/pelagic stock overlap zone are prorated based on the density of each stock in that area. 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 offshore (112 km) 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). This introduces an additional element of uncertainty into the bycatch estimates, but until methods of determining stock identity for animals observed taken within the overlap zone are available (e.g., photos, tissue samples), this approach ensures that potential impacts to both 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 do not include any of the unidentified animals that may have been false killer whales and are therefore minimum estimates. Efforts are currently underway to develop methods of prorating the unidentified animals by species and stock, taking into account geographic differences in their ranges and observed rates of documented interactions with each species.

Table 1. Summary of available information on incidental mortality and serious injury of false killer whales (Pacific Islands Stock Complex) in commercial fisheries, by stock and EEZ area, as applicable (McCracken and Forney 2010). Mean annual takes are based on 2004-2008 estimates unless otherwise indicated. Information on all observed mortality events (M), serious injuries (SI) and non-serious injuries (NSI) is included, because total takes were prorated to deaths, serious injuries, and non-serious injuries based on the observed proportions of each outcome (see McCracken and Forney 2010 for details).

Fishery Name	Year	Data Type	Percent Observer Coverage	Observed mortality events (M), serious injuries (SI) 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. M/SI/NSI	Estimated M&SI (CV)	Obs. M/SI/NSI	Estimated M&SI (CV)	Obs. M/SI/NSI	Estimated M&SI (CV)	Obs. M/SI/NSI	Estimated M&SI (CV)
Hawaii-based deep-set longline fishery	2004	Observer data	25%	0/3/0	13 (0.4)	1/2/0	12 (0.3)	0/0/0	0 (-)	0/0/0	0 (-)
	2005		28%	0/1/0	3 (1.6)	1/0/0	3 (1.9)	0/0/0	0 (-)	0/0/0	0 (-)
	2006		22%	0/2/0	8 (0.7)	0/1/1*	3 (1.7)	0/0/1*	3 (0.7)	0/0/0	0 (-)
	2007		20%	0/0/1	2 (3.7)	0/1/1	8 (0.8)	0/0/0	0 (-)	0/1/0	2 (0.7)
	2008		22%	0/0/0	0 (-)	0/3/1	11 (0.4)	0/0/0	0 (-)	0/0/0	0 (-)
Mean Estimated Annual Takes (CV)					5.3 (0.5)		7.3 (0.3)		0.6 (1.3)		0.3 (1.3)
Hawaii-based shallow-set longline fishery	2004	Observer data	100%	0/0/0	0	0/0/0	0	0/0/0	0	No fishing effort	
	2005		100%	0/0/0	0	0/0/0	0	0/0/0	0		
	2006		100%	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		
	2008		100%	0/0/0	0	0/0/1	0	0/0/0	0		
Mean Annual Takes (100% coverage)					0		0		0		
Minimum total annual takes within U.S. EEZs					7.3 (0.3)			0.6 (1.3)			0.3 (1.3)

* The single NSI take within insular/pelagic stock overlap zone is shown once for each stock, but total estimates derived from this take are prorated by stock based on insular/pelagic false killer whale densities within the overlap zone (see text above, and McCracken and Forney 2010).

HAWAII INSULAR STOCK **POPULATION SIZE**

A 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).

Minimum Population Estimate

The minimum population estimate for the insular stock false killer whales is the number of distinct individuals identified in this population during the 2002-2004 photo-identification studies, 76 individuals (Baird et al. 2005). This is similar to the log-normal 20th percentile of the mark-recapture abundance estimate, 71 false killer whales.

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. 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 exhibited a statistically significant decline that could not be attributed to any weather or methodological changes.

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 insular false killer whale stock is calculated as the minimum population size (76) 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 human-caused mortality and serious injury rate $CV > 0.80$; Wade and Angliss 1997), resulting in a PBR of 0.61 false killer whales per year.

STATUS OF STOCK

The status 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 (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 (Boggs & Ito 1993, Reeves et al. 2009). False killer whales are not listed as “threatened” or “endangered” under the Endangered Species Act (1973), nor as “depleted” under the MMPA. In September 2009, a petition was submitted to NMFS to list the Hawaiian insular false killer whale stock as an endangered species under the ESA, and NMFS has initiated a status review to determine if such a listing is warranted. The estimated average annual human-caused mortality and serious injury for this stock (0.60 animals per year) is slightly less than the PBR (0.61); therefore, the insular false killer whale stock is not considered “strategic” under the 1994 amendments to the MMPA. However, the current estimate of mortality and serious injury does not include additional unidentified animals that may have been false killer whales and were taken within the insular stock range, and the status of this stock is likely to change once methods have been developed to prorate these additional takes.

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 re-analysis of the HICEAS 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 is the best available abundance estimate for the pelagic stock of false killer whales. The 2005 survey (Barlow and Rankin 2007) also 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.

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 Hawaiian waters.

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) times one half the default maximum net growth rate for cetaceans ($\frac{1}{2}$ of 4%) times a recovery factor of 0.50 (for a stock of unknown status with a Hawaiian Islands EEZ mortality and serious injury rate $CV \leq 0.30$; Wade and Angliss 1997), resulting in a PBR of 2.5 false killer whales per year.

STATUS OF STOCK

The status of the Hawaii pelagic stock of false killer whale 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. The stock is 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 (7.3 animals per year) exceeds the PBR (2.5), this stock is considered a “strategic stock” under the 1994 amendments to the MMPA. Furthermore, additional injury or mortality of unidentified cetaceans that may have been false killer whales is known to occur in the U.S. longline fisheries, but these animals have not yet been included in the Hawaii pelagic stock status assessment. 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 exceeds the PBR. .

The National Marine Fisheries Service 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 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), times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.5 (for a stock of unknown status with a mortality and serious injury rate $CV \leq 0.30$; Wade and Angliss 1997), resulting in 5.3 false killer whales per year. The 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 5.4 ($CV=0.3$; McCracken and Forney 2010). This value is greater than the PBR of 5.3, 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 US 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.

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.

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. The 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 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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