U.S. PACIFIC MARINE MAMMAL DRAFT STOCK ASSESSMENTS: 2014

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Stock assessment reports and appendices revised in 2014. All others will be reprinted as they appear in the 2013 Pacific Region Stock Assessment Reports (Carretta *et al.* 2014).

PINNIPEDS

CETACEANS - U.S. WEST COAST

CETACEANS – HAWAII & WESTERN PACIFIC

APPENDICES

PREFACE

Under the 1994 amendments to the Marine Mammal Protection Act (MMPA), the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) are required to publish Stock Assessment Reports for all stocks of marine mammals within U.S. waters, to review new information every year for strategic stocks and every three years for non-strategic stocks, and to update the stock assessment reports when significant new information becomes available.

Pacific region stock assessments include those studied by the Southwest Fisheries Science Center (SWFSC, La Jolla, CA), the Pacific Islands Fisheries Science Center (PIFSC, Honolulu, HI), the National Marine Mammal Laboratory (NMML, Seattle, WA), and the Northwest Fisheries Science Center (NWFSC, Seattle, WA).

The 2014 Pacific marine mammal stock assessments include revised reports for 11 Pacific marine mammal stocks under NMFS jurisdiction, including six "strategic" stocks: Hawaiian monk seal, Southern Resident killer whale, Main Hawaiian Islands Insular false killer whale, Hawaii Pelagic false killer whale, California/Oregon/Washington sperm whale, and Western North Pacific gray whale. New abundance estimates are available for three stocks in the Pacific Islands region and five U.S. west coast stocks. New estimates of abundance for the California/Oregon/Washington stock of sperm whales are based on a Bayesian trend analysis that utilizes previously collected line-transect data (Moore and Barlow 2014), resulting in a more stable time series of abundance estimates. Mortality and serious injury estimates of California/Oregon/Washington sperm whales in California drift gillnets are updated, based on pooling additional years of data (>5 years) to reduce bias and improve precision in mean annual bycatch estimates (Carretta and Moore 2014). The combination of new abundance estimates and pooling of bycatch estimates over a longer time period for this stock of sperm whales results in mean annual bycatch estimates that no longer exceed PBR. In addition, a new stock assessment report for Western North Pacific gray whales is presented for the first time, prompted by new data showing that gray whales previously photographed in the western North Pacific utilize U.S. and Mexican waters. Stock Assessments for Alaska region marine mammals are published by the National Marine Mammal Laboratory (NMML) in a separate report.

This is a working document and individual stock assessment reports will be updated as new information on marine mammal stocks and fisheries becomes available. Background information and guidelines for preparing stock assessment reports are reviewed in Wade and Angliss (1997). The authors solicit any new information or comments which would improve future stock assessment reports.

Draft versions of the 2014 stock assessment reports were reviewed by the Pacific Scientific Review Group at the April 2014 meeting.

These Stock Assessment Reports summarize information from a wide range of original data sources and an extensive bibliography of all sources is given in each report. We recommend users of this document refer to and cite *original* literature sources cited within the stock assessment reports rather than citing this report or previous Stock Assessment Reports.

References:

Carretta, J.V. and J.E. Moore. 2014. Recommendations for pooling annual bycatch estimates when events are rare. NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-528. 11 p.

Carretta, J.V., E. Oleson, D.W. Weller, A.R. Lang, K.A. Forney, J. Baker, B. Hanson, K. Martien, M.M. Muto, A.J. Orr, H. Huber, M.S. Lowry, J. Barlow, D. Lynch, L. Carswell, R.L. Brownell Jr., and D.K. Mattila. 2014. U.S. Pacific Marine Mammal Stock Assessments: 2013. NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-532. 406 p.

Moore J.E., and Barlow J.P. 2014. Improved abundance and trend estimates for sperm whales in the eastern North Pacific from Bayesian hierarchical modeling. Endang. Species Res. 25:141-150.

Wade, P.R. and R.P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS workshop April 3-5, 1996, Seattle, Washington. NOAA Technical Memorandum NMFS-OPR-12. Available from Office of Protected Resources, National Marine Fisheries Service, Silver Spring, MD. 93p.

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HAWAIIAN MONK SEAL (*Monachus schauinslandi*)

STOCK DEFINITION AND GEOGRAPHIC RANGE

Hawaiian monk seals are distributed throughout the Northwestern Hawaiian Islands (NWHI), with subpopulations at French Frigate Shoals, Laysan Island, Lisianski Island, Pearl and Hermes Reef, Midway Atoll, Kure Atoll, and Necker and Nihoa Islands. They also occur throughout the main Hawaiian Islands (MHI). Genetic variation among monk seals is extremely low and may reflect a long-term history at low population levels and more recent human influences (Kretzmann *et al*. 1997, 2001, Schultz *et al*. 2009). ~~On average, 10-15% of the seals migrate among the NWHI subpopulations (Johnson and Kridler 1983; Harting 2002). Thus, the NWHI subpopulations are not isolated, though different island~~ Though monk seal subpopulations ~~have~~ exhibit~~ed~~ considerable demographic independence, they are connected by animal movement throughout the species' range (Johanos *et al*. 2013). ~~Observed interchange of individuals among the NWHI and MHI regions is uncommon, but genetic~~ Genetic stock structure analysis (Schultz *et al*. 2011) further supports management of the species as a single stock.

POPULATION SIZE

The best estimate of the total population size is 1,153 ~~1,209~~. This estimate is the sum of estimated abundance at the six main Northwestern Hawaiian Islands subpopulations, an extrapolation of counts at Necker and Nihoa Islands, and an estimate of minimum abundance in the main Hawaiian Islands. In 2012, there was a marked reduction in field effort in the NWHI due to reduced program funding. Researchers were in the field in the NWHI from 30 to 44 days at each field site; a reduction of some 50% to 80% compared to typical recent years. The short field season resulted in greater uncertainty in population abundance and trends. The number of individual seals identified was used as the population estimate at NWHI sites where total enumeration was achieved, according to the criteria established by Baker *et al*. (2006). Where total enumeration was not achieved, capture-recapture estimates from Program CAPTURE were used (Baker 2004; Otis *et al*. 1978, Rexstad & Burnham 1991, White *et al*. 1982). When no reliable estimator was obtainable in Program CAPTURE (i.e., the model selection criterion was < 0.75, following Otis *et al*. 1978), the total number of seals identified was the best available estimate. ~~Finally, s~~ Sometimes capture-recapture estimates are less than the known minimum abundance (Baker 2004), and in these cases, the total number of seals actually identified was used. In ~~2011~~ 2012, total enumeration was not achieved ~~at~~ for any subpopulation ~~Laysan Island, Lisianski Island, Pearl and Hermes Reef and Kure Atoll, based on analysis of discovery curves~~. Capture-recature estimates were available for French Frigate Shoals, Lisianski Island and Pearl and Hermes Reef. Minimum abundance was used for Laysan Island, Midway Atoll and Kure Atoll. ~~French Frigate Shoals and Midway Atoll. Thus, a~~ Abundance at the six main NWHI subpopulations was estimated to be ~~909~~ 862 (including ~~141~~ 111 pups). Counts at Necker and Nihoa Islands are conducted from zero to a few times in a single year. Abundance is estimated by correcting the mean of all beach counts accrued over the past five years. The mean (±SD) of all counts (excluding pups) conducted between ~~2007 and 2011~~ 2008 and 2012 was ~~17.0 ± 5.4~~ 16.1 ± 5.8 at Necker Island and ~~31.5 ± 7.2~~ 32.2 ± 6.4 at Nihoa Island. The relationship between mean counts and total abundance at the reproductive sites indicates that total abundance can be estimated by multiplying the mean count by a correction factor of 2.89 (NMFS unpubl. data). Resulting estimates (plus the average number of pups known to have been born during ~~2006-2010~~ 2008-2012 are ~~52.3 ± 15.6~~ 49.9 ± 16.8 at Necker Island and ~~101.6 ± 20.8~~ 103.1 ± 18.5 at Nihoa Island.

Complete, systematic surveys for monk seals in the MHI were conducted in 2000 and 2001 (Baker and Johanos 2004). NMFS continues to collect information on seal sightings reported by a variety of sources, including a volunteer network, ~~reports from~~ the public, and directed NMFS observation effort. The total number of individually identifiable seals documented in ~~2011~~ 2012 was ~~146~~ 138, the current best minimum abundance estimate for the MHI.

Minimum Population Estimate

The total number of seals (~~909~~ 853) identified at the six main NWHI reproductive sites is the best estimate of minimum population size at those sites. Minimum population sizes for Necker and Nihoa Islands (based on the formula provided by Wade and Angliss (1997)) are ~~41 and 86~~ 38 and 89, respectively. The minimum abundance estimate for the main Hawaiian Islands in 2011 is ~~146~~ 138 seals. The minimum population size for the entire stock (species) is the sum of these estimates, or ~~1,182~~ 1,118 seals.

Current Population Trend

Current population trend is based solely on the six NWHI subpopulations because these sites have historically comprised virtually the entire species, while information on the remaining smaller seal aggregations has been inadequate to reliably evaluate abundance or trends. The total of mean non-pup beach counts at the six main reproductive NWHI subpopulations in ~~2011~~ 2012 is 69% lower than in 1958. The trend in total abundance at the six main NWHI subpopulations estimated as described above is shown in Figure 1. A log-linear regression of estimated abundance on year for the past 10 years (~~2002-2011~~ 2003-2012) estimates that abundance declined ~~-3.4% yr^{-1} (95% CI = -4.3% to -2.5% yr^{-1})~~ -3.3% yr^{-1} (95% CI = -4.2% to -2.3% yr^{-1}). The MHI monk seal population appears to be increasing with an intrinsic population growth rate estimated at 6.5% per year based on simulation modeling (Baker *et al.* 2011). Likewise, sporadic beach counts at Necker and especially Nihoa Islands, suggest positive growth. While these sites have historically comprised a small fraction of the total species abundance, the decline of the six main NWHI subpopulations, coupled with growth at Necker, Nihoa and the MHI may mean that these latter three sites now substantially influence the total abundance trend. The MHI, Necker and Nihoa Islands estimates, uncertain as they are, comprised 25% of the stock's estimated total abundance in ~~2011~~2012. Unfortunately, because of a lack reliable abundance estimates for these areas, their influence cannot currently be determined. NMFS is experimenting with remote camera systems that may improve data collection at Necker and Nihoa Islands.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Trends in abundance vary considerably among subpopulations. Mean non-pup beach counts are used as a long-term index of abundance for years when data are insufficient to estimate total abundance as described above. Prior to 1999, beach count increases of up to 7% yr^{-1} were observed at Pearl and Hermes Reef, and this is the highest estimate of the maximum net productivity rate (R_{max}) observed for this species.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) is designed to allow stocks to recover to, or remain above, the maximum net productivity level (MNPL) (Wade 1998). An underlying assumption in the application of the PBR equation is that marine mammal stocks exhibit certain dynamics. Specifically, it is assumed that a depleted stock will naturally grow toward OSP (Optimum Sustainable Population), and that some surplus growth could be removed while still allowing recovery. The Hawaiian monk seal population is far below historical levels and has on average, declined ~~3.4%~~ 3.3% a year since 2002. Thus, the stock's dynamics do not conform to the underlying model for calculating PBR such that PBR for the Hawaiian monk seal is undetermined.

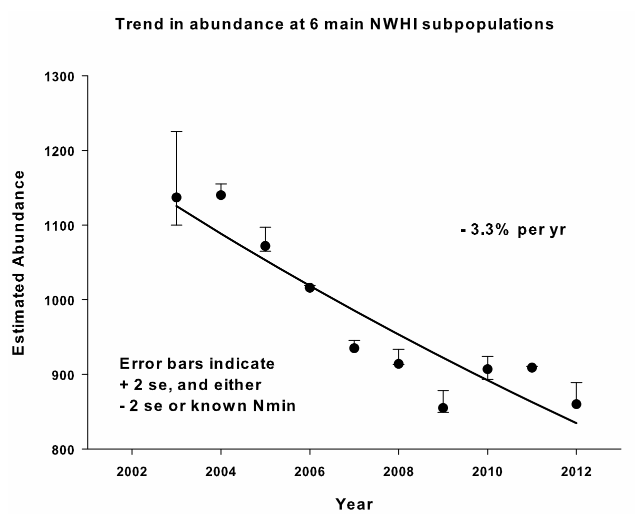

Figure 1. Trend in abundance of monk seals at the six main Northwestern Hawaiian Islands subpopulations, based on a combination of total enumeration and capture–recapture estimates. Error bars indicate ±2 s.e. (from variances of capture-recapture estimates). Fitted log-linear regression line is shown.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Serious Injury Guidelines

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

Human-related mortality has caused two major declines of the Hawaiian monk seal (Ragen 1999). In the 1800s, this species was decimated by sealers, crews of wrecked vessels, and guano and feather hunters (Dill and Bryan 1912; Wetmore 1925; Bailey 1952; Clapp and Woodward 1972). Following a period of at least partial recovery in the first half of the 20th century (Rice 1960), most subpopulations again declined. This second decline has not been fully explained, but long-term trends at several sites appear to have been driven both by variable oceanic productivity (represented by the Pacific Decadal Oscillation) and by human disturbance (Baker *et al*. 2012, Ragen 1999, Kenyon 1972, Gerrodette and Gilmartin 1990). Currently, human activities in the NWHI are limited and human disturbance is relatively rare, but human-seal interactions, have become an important issue in the MHI. Intentional killing of seals in the MHI is a relatively new and alarming trend (Table 1).

Table 1. Intentional and potentially intentional killings of Hawaiian monk seals in the MHI since 2009.

Year	**Age/sex**	**Island**	**Cause of Death**	**Comments**
2009	Subadult male	Kauai	Gunshot wound	
	Adult female	Kauai	Gunshot wound	Pregnant
	Adult male	Molokai	Gunshot wound	
2010	Juvenile female	Kauai	Multiple skull fractures, blunt force trauma	Intent unconfirmed
2011	Adult male	Molokai	Skull fracture, blunt force trauma	Intent unconfirmed
	Juvenile female	Molokai	Skull fracture, blunt force trauma	Intent unconfirmed
2012	Juvenile male	Kauai	Gunshot wound	
	Subadult male	Kauai	Skull fracture	Intent unconfirmed

~~In 2009, three seals (including a pregnant female) were shot and killed in the MHI (Baker *et al*. 2010). In 2010, a juvenile female seal was found dead died on Kauai due to multiple skull fractures caused by blunt force trauma. Whether this was an intentional killing or an accidental occurrence (e.g., boat strike) is not known. In 2011, two seals were found on the same general area of Molokai dead with skull fractures from blunt force trauma.~~ It is extremely unlikely that all carcasses of intentionally killed monk seals are discovered and reported. Studies of the recovery rates of carcasses for other marine mammal species have shown that the probability of detecting and documenting most deaths (whether from human or natural causes) is quite low (Peltier *et al*. 2012; Williams *et al*. 2011; Perrin *et al*. 2011; Punt and Wade 2010).

Fishery Information

Fishery interactions with monk seals can include direct interaction with gear (hooking or entanglement), seal consumption of discarded catch, and competition for prey. Entanglement of monk seals in derelict fishing gear, which is believed to originate outside the Hawaiian archipelago, is described in a separate section. Fishery interactions are a serious concern in the MHI, especially involving nearshore fisheries managed by the State of Hawaii. ~~Nearshore gillnets have become a more common source of mortality recently. Three seals have been confirmed dead in these gillnets (2006, 2007, and 2010), and one additional seal in 2010 may have also died in similar circumstances but the carcass was not recovered. Numerous cases of seals with embedded hooks are observed each year in the MHI.~~ In 2012 ~~2011, 9~~ 16 seals were observed hooked, four of which died as a result of ingesting hooks ~~none of which constituted serious injuries~~. The remaining 12 were non-serious hookings, although 5 of these would have been deemed serious had they not been mitigated by capture and hook removal. Several incidents involved hooks used to catch ulua (jacks, *Caranx* spp.). Nearshore gillnets became a more common source of mortality in the 2000's, with three seals confirmed dead in these gillnets (2006, 2007, and 2010), and one additional seal in 2010 may have also died in similar circumstances but the carcass was not recovered. No gillnet-related mortality or injuries have been documented since 2010. Most reported hookings and gillnet entanglements have occurred since 2000 (NMFS unpubl. data). The MHI monk seal population appears to have been increasing in abundance during this period (Baker *et al*. 2011). No mortality or serious injuries have been attributed to the MHI bottomfish handline fishery (Table 1). Published studies on monk seal prey selection based upon scat/spew analysis and video from seal-mounted cameras revealed evidence that monk seals fed on families of bottomfish which contain commercial species (many prey items recovered from scats and spews were identified only to the level of family; Goodman-Lowe 1998, Longenecker *et al*. 2006, Parrish *et al*. 2000). Recent quantitative fatty acid signature analysis (QFASA) results support previous studies illustrating that monk seals consume a wide range of species (Iverson *et al*. 2011). However, deepwater-slope species, including two commercially targeted bottomfishes and other species not caught in the fishery, were estimated to comprise a large portion of the diet for some individuals.

Similar species were estimated to be consumed by seals regardless of location, age or gender, but the relative importance of each species varied. Diets differed considerably between individual seals. These results highlight the need to better understand potential ecological interactions with the MHI bottomfish handline fishery.

Table 2 ~~1~~. Summary of mortality, ~~and~~ serious and non-serious injury of Hawaiian monk seals due to fisheries and calculation of annual mortality rate. n/a indicates that sufficient data are not available.

Fishery Name	Year	Data Type	% Obs. coverage	Observed/Reported Mortality/Serious Injury	Estimated Mortality/ Serious Injury	Non-serious (Mi~~g~~tigated serious)[1]	Mean Takes (CV)
Pelagic Longline	~~2007~~ 2008 2009 2010 2011 2012	observer observer observer observer observer	~~20.1% & 100%~~[2 ~~1~~] 21.7% & 100%[2] 20.6% & 100%[2] 21.1% & 100%[2] 20.3% & 100%[2] 20.4% & 100%[2]	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 (0)
MHI Bottomfish[3]	~~2007~~ 2008 2009 2010 2011 2012	Incidental observations of seals	none	0 0 0 0 0	n/a	0 0 0 0 0	n/a
Nearshore[4]	~~2007~~ 2008 2009 2010 2011 2012	Incidental observations of seals	none	~~2~~ 0 0 1 0 4	n/a	9(3) 12(3) 11(2) 9 (3) 12 (5)	≥~~0.6~~ 1.0
Minimum total annual takes							≥~~0.6~~ 1.0

There are no fisheries operating in or near the NWHI. In the past, interactions between the Hawaii-based domestic pelagic longline fishery and monk seals were documented (Nitta and Henderson 1993). This fishery targets swordfish and tunas and does not compete with Hawaiian monk seals for prey. In October 1991, in response to 13 unusual seal wounds thought to have resulted from interactions with this fishery, NMFS established a Protected Species Zone extending 50 nautical miles around the NWHI and the corridors between the islands. Subsequently, no additional monk seal interactions with the swordfish or tuna components of the longline fishery have been observed.

Fishery Mortality Rate

Total fishery mortality and serious injury is not considered to be insignificant and approaching a rate of zero. Monk seals are being hooked and entangled in the MHI at a rate that has not been reliably assessed but is certainly greater than zero. The information above represents only reported direct interactions, and without purpose-designed observation effort the true interaction rate cannot be estimated. Monk seals also die from entanglement in fishing gear and other debris throughout their range (likely originating from various sources outside of Hawaii), and NMFS along with partner agencies is pursuing a program to mitigate entanglement (see below). Indirect interactions

[1] Total non-serious injuries documented. In parentheses, number of injuries that would have been deemed serious had they not been mitigated (e.g., by de-hooking or disentangling).

[2] Observer coverage for deep and shallow-set components of the fishery, respectively.

[3] Data for MHI bottomfish and nearshore fisheries are based upon incidental observations (i.e., hooked seals and those entangled in active gear). All hookings not clearly attributable to either fishery with certainty were attributed to the bottomfish fishery, and hookings, which resulted in injury of unknown severity were classified as serious.

[4] Includes seals entangled/drowned in nearshore gillnets and hooked/entangled in hook-and-line gear, recognizing that it is not possible to determine whether the nets or hook-and-line gear involved were being used for commercial purposes.

(i.e., involving competition for prey or consumption of discards) remain a topic of ongoing investigation.

Entanglement in Marine Debris

Hawaiian monk seals become entangled in fishing and other marine debris at rates higher than reported for other pinnipeds (Henderson 2001). A total of ~~323~~ 331 cases of seals entangled in fishing gear or other debris have been observed from 1982 to 2012 (Henderson 2001; NMFS, unpubl. data). ~~, including eight~~ Nine documented deaths resulted from entanglement in marine debris, including a pup at Midway Atoll in 2012 (Henderson 1990, 2001; NMFS, unpubl. data). The fishing gear fouling the reefs and beaches of the NWHI and entangling monk seals only rarely includes types used in Hawaii fisheries. For example, trawl net and monofilament gillnet accounted for approximately 35% and 34%, respectively, of the debris removed from reefs in the NWHI by weight, and trawl net alone accounted for 88% of the debris by frequency (Donohue *et al*. 2001). Yet, trawl fisheries have been prohibited in Hawaii since the 1980s.

The NMFS and partner agencies continue to mitigate impacts of marine debris on monk seals as well as turtles, coral reefs and other wildlife. Marine debris is removed from beaches and seals are disentangled during annual population assessment activities at the main reproductive sites. Since 1996, annual debris survey and removal efforts in the NWHI coral reef habitat have been ongoing (Donohue *et al*. 2000, Donohue *et al*. 2001, Dameron *et al*. 2007).

Other Mortality

In the past 10 years (2003-2012 ~~2002-2011~~) two monk seals died during enhancement activities (in 2005 and 2006) and one died during research in 2007 (NMFS unpubl. data).

Sources of mortality that impede recovery include food limitation (see Habitat Issues), single and multiple-male intra-species aggression (mobbing), shark predation, and disease/parasitism. Male seal aggression has caused episodes of mortality and injury. Past interventions to remove aggressive males greatly mitigated, but have not eliminated, this source of mortality (Johanos *et al*. 2010). Galapagos shark predation on monk seal pups has been a chronic and significant source of mortality at French Frigate Shoals since the late 1990s, despite mitigation efforts by NMFS (Gobush 2010). While disease effects on monk seal demographic trends are uncertain, there is concern that diseases of livestock, feral animals, pets or humans could be transferred to naïve monk seals in the MHI and potentially spread to the core population in the NWHI. In 2003 and 2004, two deaths of free-ranging monk seals were attributable to diseases not previously found in the species: leptospirosis and toxoplasmosis (R. Braun, pers. comm.). *Leptospira* bacteria are found in many of Hawaii's streams and estuaries and are associated with livestock and rodents. Cats, domestic and feral, are a common source of toxoplasma.

Habitat Issues

Poor juvenile survival rates and variability in the relationship between weaning size and survival suggest that prey availability is likely limiting recovery of NWHI monk seals (Baker and Thompson 2007, Baker *et al*. 2007, Baker 2008). Multiple strategies for improving juvenile survival are being considered and will be developed through an experimental approach in coming years (Baker and Littnan 2008, Baker *et al*. 2013). NMFS has produced a draft Programmatic Environmental Impact Statement on current and future anticipated research and enhancement activities[1]. A major habitat issue involves loss of terrestrial habitat at French Frigate Shoals, where pupping and resting islets have shrunk or virtually disappeared (Antonelis *et al*. 2006). Projected increases in global average sea level may further significantly reduce terrestrial habitat for monk seals in the NWHI (Baker *et al*. 2006, Reynolds *et al*. 2012).

Goodman-Lowe (1998) provided information on prey selection using hard parts in scats and spewings. Information on at-sea movement and diving is available for seals at all six main subpopulations in the NWHI using satellite telemetry (Stewart *et al*. 2006). Cahoon (2011) and Cahoon *et al*. (2013) described diet and foraging behavior of MHI monk seals, and found no striking difference in prey selection between the NWHI and MHI.

Remains of the seawall at Tern Island, French Frigate Shoals, is an entrapment hazard for seals. Vessel groundings pose a continuing threat to monk seals and their habitat, through potential physical damage to reefs, oil spills, and release of debris into habitats.

Monk seal abundance is increasing in the main Hawaiian Islands (Baker *et al*. 2011). Further, the excellent condition of pups weaned on these islands suggests that there may be ample prey resources available, perhaps in part due to fishing pressure that has reduced monk seal competition with large fish predators (sharks and jacks) (Baker

[1] http://www.nmfs.noaa.gov/pr/permits/eis/hawaiianmonksealeis.htm

and Johanos 2004). If the monk seal population continues to expand in the MHI, it may bode well for the species' recovery and long-term persistence. In contrast, there are many challenges that may limit the potential for growth in this region. The human population in the MHI is approximately 1.4 million compared to fewer than 100 in the NWHI, so that the potential impact of disturbance in the MHI is great. Intentional killing of seals (noted above) poses a very serious new concern. Also, the same fishing pressure that may have reduced the monk seal's competitors, is a source of injury and mortality. Finally, vessel traffic in the populated islands carries the potential for collision with seals and impacts from oil spills. The causes of two recent non-serious injuries (in 2010 and 2011) to seals were attributed to boat propellers. Thus, issues surrounding monk seals in the main Hawaiian Islands will likely become an increasing focus for management and recovery of this species.

STATUS OF STOCK

In 1976, the Hawaiian monk seal was designated depleted under the Marine Mammal Protection Act of 1972 and as endangered under the Endangered Species Act of 1973. The species is well below its optimum sustainable population (OSP) and has not recovered from past declines. Therefore, the Hawaiian monk seal is a strategic stock. Annual human-caused mortality for the most recent 5-year period (2008-2012 ~~2007-2011~~) was at least 2.6 ~~1.8~~ animals, including fishery-~~caused~~related mortality in nearshore gillnets and hook-and-line gear (>=1 ~~0.6~~/ yr, Table 2 ~~1~~), shooting-related deaths (>=0.8 ~~0.6~~ / yr), and blunt-force trauma deaths of unknown origin (>=0.8 ~~0.6~~ / yr, Table 1).

REFERENCES

Antonelis, G. A., J. D. Baker, T. C. Johanos, R. C. Braun, and A. L. Harting. 2006. Hawaiian monk seal (*Monachus schauinslandi*): Status and Conservation Issues.Atoll Res. Bull. 543:75-101.Bailey, A. M. 1952. The Hawaiian monk seal. Museum Pictorial, Denver Museum of Natural History 7:1-32.

Baker, J. D. 2004. Evaluation of closed capture-recapture methods to estimate abundance of Hawaiian monk seals, *Monachus schauinslandi*. Ecological Applications 14:987-998.

Baker J.D. 2008. Variation in the relationship between offspring size and survival provides insight into causes of mortality in Hawaiian monk seals. Endangered Species Research 5:55-64.

Baker J.D., A.L. Harting, and C.L. Littnan. 2013. A two-stage translocation strategy for improving juvenile survival of Hawaiian monk seals. Endangered Species Research 21: 33–44.

Baker, J.D., A.L. Harting, and T.C. Johanos. 2006. Use of discovery curves to assess abundance of Hawaiian monk seals. Marine Mammal Science 22:847-861.

Baker J.D., A. L. Harting, T. A. Wurth, and T. C, Johanos. 2011. Dramatic shifts in Hawaiian monk seal distribution predicted from divergent regional trends. Marine Mammal Science 27(1): 78–93.

Baker, J.D. and T. C. Johanos. 2004. Abundance of Hawaiian monk seals in the main Hawaiian Islands. Biological Conservation 116:103-110.

Baker J.D., and Littnan C.L. 2008. Report of the Hawaiian Monk Seal Captive Care Workshop, Honolulu, Hawaii, June 11–13, 2007. Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396. Pacific Islands Fish. Sci. Cent. Admin. Rep. H-08-02, 42 p.

Baker J.D., E.A. Howell, and J.J. Polovina. 2012. Relative influence of climate variability and direct anthropogenic impact on a sub-tropical Pacific top predator, the Hawaiian monk seal. Mar. Ecol. Prog. Ser. 469:175-189.

Baker J.D., C. L. Littnan, and D. W. Johnston. 2006. Potential effects of sea-level rise on the terrestrial habitats of endangered and endemic megafauna in the Northwestern Hawaiian Islands. Endangered Species Research 4:1-10.

Baker, J.D., J.J. Polovina, and E.A. Howell. 2007. Effect of variable oceanic productivity on the survival of an upper trophic predator, the Hawaiian monk seal, Monachus schauinslandi. Marine Ecology Progress Series 346:277-283.

Baker J.D. and P.M. Thompson. 2007. Temporal and spatial variation in age-specific survival rates of a long-lived mammal, the Hawaiian monk seal. Proceedings of the Royal Society B 274:407-415.

Cahoon, M.K. 2011. The foraging ecology of monk seals in the main Hawaiian Islands. MSc thesis, University of Hawaii, 172 p.

Cahoon M.K., C.L. Littnan, K. Longenecker, and J.R. Carpenter. 2013. Dietary comparison of two Hawaiian monk seal populations: the role of diet as a driver of divergent population trends. Endangered Species Research 20:137-146.

Clapp, R. B., and P. W. Woodward. 1972. The natural history of Kure Atoll, Northwestern Hawaiian Islands, Atoll Res. Bull. 164:303-304.

Dameron O.J., M. Park, M. Albins, and R.Brainard. 2007. Marine debris accumulation in the Northwestern Hawaiian Islands: An examination of rates and processes. Marine Pollution Bulletin 54(4): 423-433.
Dill, H. R., and W. A. Bryan. 1912. Report on an expedition to Laysan Island in 1911. U.S. Dept. of Agric. Surv. Bull. 42:1-30.
Donohue, M. J., R. Brainard, M. Parke, and D. Foley. 2000. Mitigation of environmental impacts of derelict fishing gear through debris removal and environmental monitoring. *In* Hawaiian Islands Humpback Whale National Marine Sanctuary, Proceedings of the International Marine Debris Conference on Derelict Fishing Gear and the Ocean Environment, 6-11 August 2000, Honolulu, Hawaii. p. 383-402. http://hawaiihumpbackwhale.noaa.gov/special_offerings/sp_off/proceedings.html.
Donohue, M.J., R.C. Boland, C.M. Sramek, and G.A. Antonelis. 2001. Derelict fishing gear in the Northwestern Hawaiian Islands: diving surveys and debris removal in 1999 confirm threat to coral reef ecosystems. Marine Pollution Bulletin 42(12):1301_1312.
Gerrodette, T. M., and W. G. Gilmartin. 1990. Demographic consequences of changed pupping and hauling sites of the Hawaiian monk seal. Conserv. Biol. 4:423-430.
Gobush, K. S. 2010. Shark predation on Hawaiian monk seals: Workshop II & post-workshop developments, November 5-6, 2008. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-PIFSC-21, 43 p. + Appendices.
Goodman-Lowe, G. D. 1998. Diet of the Hawaiian monk seal (*Monachus schauinslandi*) from the northwestern Hawaiian islands during 1991 to 1994. Marine Biology 132:535-546.
~~Harting, A.L. 2002. Stochastic simulation model for the Hawaiian monk seal. PhD thesis, Montana State University, 328 p.~~
Henderson, J. R. 1990. Recent entanglements of Hawaiian monk seals in marine debris. In R. S. Shomura and M. L. Godfrey (eds.), Proceedings of the Second International Conference on Marine Debris, April 2-7, 1989, Honolulu, Hawaii, p. 540-553. U.S. Dep. Commer., NOAA, Tech. Memo. NMFS-SWFSC-154.
Henderson, J.R. 2001. A Pre_ and Post_MARPOL Annex V Summary of Hawaiian Monk Seal Entanglements and Marine Debris Accumulation in the Northwestern Hawaiian Islands, 1982_1998. Marine Pollution Bulletin 42:584-589.
Iverson, S., J. Piché, and W. Blanchard. 2011. Hawaiian monk seals and their prey: assessing characteristics of prey species fatty acid signatures and consequences for estimating monk seal diets using Quantitative Fatty Acid Signature Analysis. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-PIFSC-23, 114 p. + Appendices.
Johanos, T. C. and J. D. Baker (editors). 2001. The Hawaiian monk seal in the Northwestern Hawaiian Islands, 1999. U.S. Dep. Commer., NOAA Tech. Memo. NOAA-TM-NMFS-SWFSC-310, 130 p.
Johanos T. C., B. L. Becker, J. D. Baker, T. C. Ragen, W. G. Gilmartin, and T. Gerrodette. 2010. Impacts of sex ratio reduction on male aggression in the critically endangered Hawaiian monk seal *Monachus schauinslandi*. Endangered Species Research 11: 123–132.
Johanos, T. C., A. L. Harting, T. A. Wurth, and J. D. Baker. 2013. Range-wide movement patterns of Hawaiian monk seals. Marine Mammal Science. doi: 10.1111/mms.12084.
~~Johnson, A. M., and E. Kridler. 1983. Interisland movement of Hawaiian monk seals. 'Elepaio 44(5):43-45.~~
Kenyon, K. W. 1972. Man versus the monk seal. J. Mammal. 53(4):687-696.
Kretzmann, M. B., W. G. Gilmartin, A. Meyer, G. P. Zegers, S. R. Fain, B. F. Taylor, and D. P. Costa. 1997. Low genetic variability in the Hawaiian monk seal. Conserv. Biol. 11(2):482-490.
Kretzmann, M. B., N. J. Gemmell, and A. Meyer. 2001. Microsatellite analysis of population structure in the endangered Hawaiian monk seal. Conserv. Biol. 15(2):457-466.
Nitta, E. T., and Henderson, J. R. 1993. A review of interactions between Hawaii's fisheries and protected species. Marine Fisheries Review, 55(2), 83-92.
Otis, D. L., K. P. Burnham, G. C. White, and D. R. Anderson. 1978. Statistical inference from capture data on closed animal populations. Wildl. Monogr. 62:1-135.
Punt, A. E., and P. R. Wade. 2010. Population status of the eastern North Pacific stock of gray whales in 2009. U.S. Dep. Commer. NOAA Tech. Memo. NMFS-AFSC-207, 43 p.
Parrish, F. A., M. P. Craig, T. J. Ragen, G. J. Marshall, and B. M. Buhleier. 2000. Identifying diurnal foraging habitat of endangered Hawaiian monk seals using a seal-mounted video camera. Mar. Mamm. Sci. 16:392-412.
Peltier, H., W. Dabin, P. Daniel, O. Van Canneyt, G. Dorémus, M. Huon, and V. Ridoux. 2012. The significance of stranding data as indicators of cetacean populations at sea: Modelling the drift of cetacean carcasses.

Ecological Indicators 18:278-290.
Perrin, W.F., J.L. Thieleking, W.A. Walker, F.I. Archer, and K.M. Robertson. 2011. Common bottlenose dolphins (*Tursiops truncatus*) in California waters: Cranial differentiation of coastal and offshore ecotypes. Marine Mammal Science 27(4):769-792.
Ragen, T. J. 1993. Status of the Hawaiian monk seal in 1992. Admin. Rep. H-93-05. Southwest Fisheries Science Center, National Marine Fisheries Service, 2570 Dole St., Honolulu, HI 96822-2396. 79 pp.
Ragen, T.J. 1999. Human activities affecting the population trends of the Hawaiian monk seal. Pages 183-194 *in* J.A. Musick, ed. Life in the slow lane: Ecology and conservation of long-lived marine animals. American Fisheries Society Symposium 23, American Fisheries Society, Bethesda, MD.
Reynolds, M.H., P. Berkowitz, K.N. Courtot, and C.M. Krause, eds. 2012. Predicting sea-level rise vulnerability of terrestrial habitat and wildlife of the Northwestern Hawaiian Islands: U.S. Geological Survey Open-File Report 2012–1182, 139 p.
Rexstad, E. A., and K. P. Burnham. 1991. User's manual for interactive Program CAPTURE. Colorado Cooperative Fish and Wildlife Research Unit, Colorado State University, Fort Collins, CO. 29 pp.
Rice, D. W. 1960. Population dynamics of the Hawaiian monk seal. J. Mammal. 41:376-385.
Schultz JK, Baker JD, Toonen RJ, Bowen BW. 2009. Extremely low genetic diversity in the endangered Hawaiian monk seal (*Monachus schauinslandi*). Journal of Heredity 100:25-33.
Schultz J.K., Baker J.D., Toonen RJ, Harting AL, Bowen BW. 2011. Range-wide genetic connectivity of the Hawaiian monk seal and implications for translocation. Conservation Biology 25:124-132.
Stewart B. S., G. A. Antonelis, J. D. Baker, and P.Y.Yochem. 2006. Foraging biogeography of the Hawaiian monk seal in the Northwestern Hawaiian Islands. Atoll Res Bull 543:131-145.
Wade, P. R. and R. P. Angliss. 1997. Guidelines for Assessing Marine Mammal Stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. U. S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12. 93 pp.
Wade, P. R. 1998. Calculating limits to the allowable human-caused mortality of cetaceans and pinnipeds. Marine Mammal Science 14:1-37.
Wetmore, A. 1925. Bird life among lava rock and coral sand. The Natl. Geograp. Mag. 48:77-108.
White, G. C., D. R. Anderson, K. P. Burnham, and L. Otis. 1982. Capture-recapture and removal methods for sampling closed populations. Los Alamos National Laboratory, Los Alamos, New Mexico.
Williams, R., S. Gero, L. Bejder, J. Calambokidis, S.D. Kraus, D. Lusseau, A.J. Read, and J. Robbins. Underestimating the damage: interpreting cetacean carcass recoveries in the context of the Deepwater Horizon/BP incident. Conservation Letters 4:228-233.

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 ~~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 seven stranding records from Hawaiian waters since 1974 (Nitta 1991; Maldini et al. 2005, NMFS PIR Marine Mammal Response Network database), including one since 2007.~~ 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, Bradford et al. ~~2012~~ 2014). Smaller-scale surveys conducted around the main Hawaiian Islands (Figure 2) show that false killer whales are also encountered in near shore waters (Baird et al. 2005, Mobley et al. 2000), and a single on-effort and three off-effort sightings during ~~a~~ the 2010 Hawaiian Islands Cetacean Ecosystem Assessment Survey (HICEAS) shipboard survey reveal that the species also occurs near shore in the Northwestern Hawaiian Islands (Baird et al. 2013). This species also occurs in U.S. EEZ waters around Palmyra and Johnston Atolls (e.g., Barlow et al. 2008, Bradford & Forney 2013 ~~NMFS/PIR/PSD unpublished data~~) and American Samoa (Johnston et al. 2008, Oleson 2009).

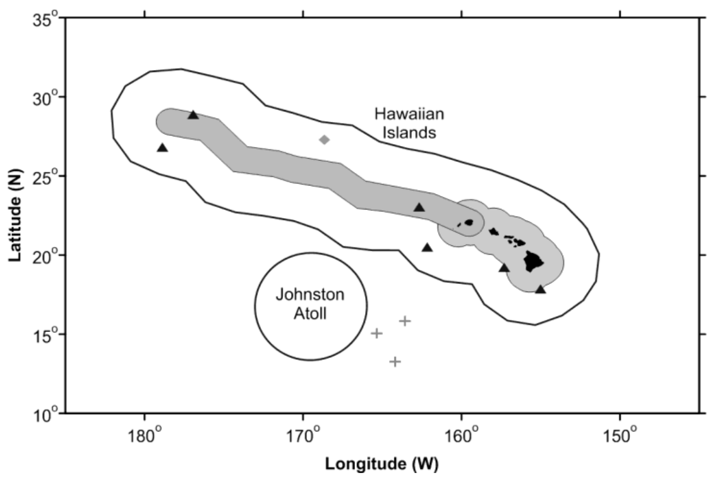

Figure 1. False killer whale on-effort sighting locations during standardized shipboard surveys of the Hawaiian Islands U.S. EEZ (2002, gray diamond, Barlow 2006; 2010, black triangles, Bradford et al. ~~2012~~ 2014, pelagic waters of the central Pacific south of the Hawaiian Islands (2005, gray crosses, Barlow and Rankin 2007) and the Johnston Atoll EEZ. Outer 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.

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 on previous analyses ~~with~~ using additional samples and including 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 HICEAS in ~~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 south of Kauai (Baird et al. 2013). 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 suggests the occurrence of three separate social clusters (Baird et al. 2012, Martien et al. 2011), where mating ~~primarily~~ occurs primarily, though not exclusively within clusters~~, though some mating is known to occur between males and females of different social clusters~~ (Martien et al. 2011).

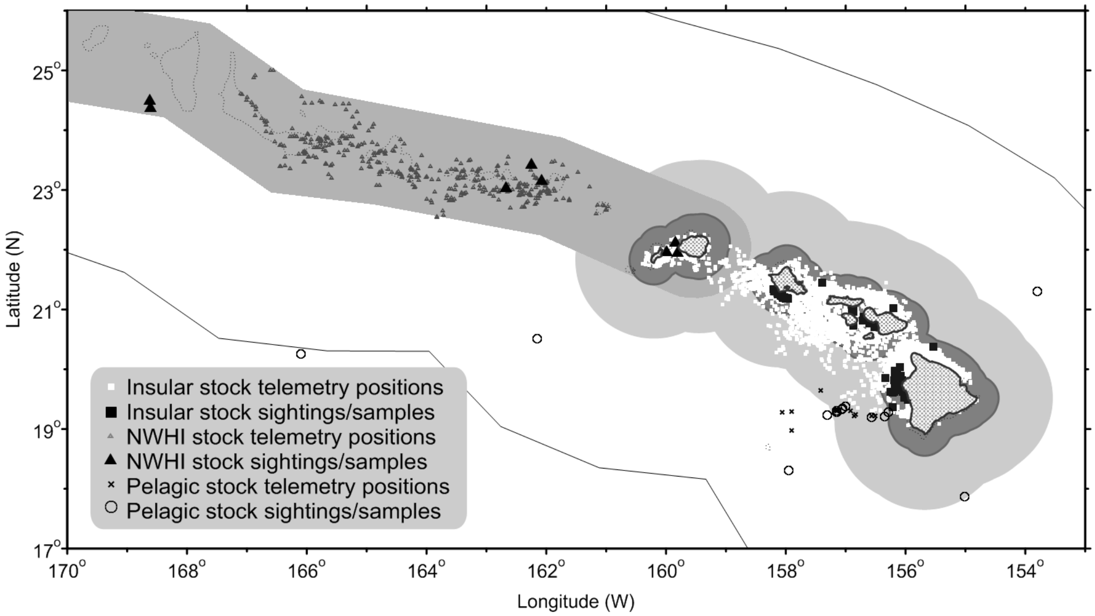

Figure 2. Sighting, biopsy, and telemetry records of false killer whale identified as being part of the MHI insular (square symbols), NWHI (triangle symbols), or pelagic (open and cross symbols) stocks. The dark gray area is the 40-km MHI insular core area; light gray area is the 40-km to 140-km MHI insular-pelagic overlap zone (Baird et al. 2010, Baird et al. 2013, 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 MHI insular, pelagic, and NWHI stocks overlap in the vicinity of Kauai.

Fishery O 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 demonstrate the existence of a previously unknown stock of island-associated false killer whales in the NHWI, and support the current recognized boundaries of the MHI insular and pelagic stocks. The three Hawaiian stocks of false killer whales have overlapping ranges. MHI 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 each of the main Hawaiian Islands from Hawaii Island to Oahu are considered to belong to the MHI insular stock. Waters within 40 km of Kauai and Niihau are an overlap zone between the MHI insular and NWHI stocks, as individuals from both populations are known to occur there. 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 MHI insular and pelagic stocks overlap between 40 km and 140 km from shore contiguously between Oahu and Hawaii Island. All three stocks overlap within 40 km and 93 km around Kauai and Niihau, and the MHI insular and pelagic stocks overlap from 93 km to 140 km around these islands (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 isare 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. 2007, 2010). NMFS will obtain and analyze additional 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 Pacific Islands Region management stocks (Forney et al. 2011, Martien et al. 2011): 1) the Main Hawaiian Islands insular stock, which includes animals inhabiting waters within 140 km (approx. 75 nmi) of the main Hawaiian Islands, 2) the Northwestern Hawaiian Islands stock, which includes animals inhabiting waters within 93 km (50 nmi) of the NWHI and Kauai, 3) the Hawaii pelagic stock, which includes false killer whales inhabiting waters greater than 40 km (22 nmi) 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 Ssstocks are covered in separate reports.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Serious Injury Guidelines

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

Fishery Information

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, NMFS/PIR unpublished data). 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 shortline fishery is permitted through the State of Hawaii Commercial Marine License program, and until recently, no reporting systems existed to document marine mammal interactions.

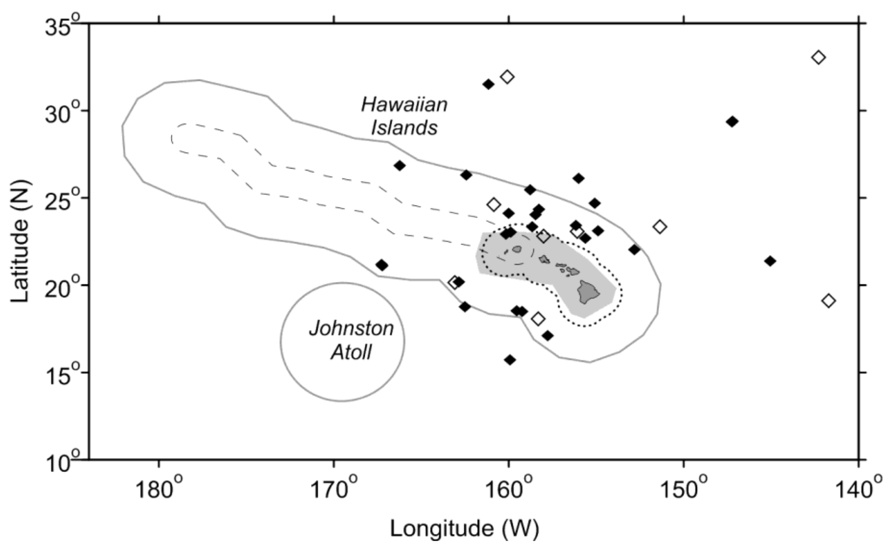

Figure 3. Locations of observed false killer whale takes (black diamonds) and possible takes (blackfish) of this species (open diamonds) in the Hawaii-based longline fisheries, 2008-2012 ~~2007-2011~~. Some take locations overlap. Solid gray lines represent the U.S. EEZ; the dotted line is the outer (140-km) boundary of the overlap zone between MHI 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.

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). It is unknown whether these injuries might have been caused by longline gear, shortline gear, or other commercial or recreational hook-and-line gear used around the main Hawaiian Islands. 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 gillnet fisheries because these fisheries are not observed or monitored for protected species bycatch.

Table 1. Summary of available information on incidental mortality and serious injury (MSI) of false killer whales (Hawaiian Islands Stock Complex) and unidentified blackfish in commercial longline fisheries, by stock and EEZ area, as applicable (McCracken ~~2013~~2014). Mean annual takes are based on ~~2007-2011~~2008-2012 estimates unless otherwise indicated (a new alternative was explored in this report for prorating among three stocks). Information on all observed takes (T) and combined mortality ~~events~~ & serious injury~~ies (MSI)~~ is included. Total takes were prorated to deaths, serious injuries, and non-serious injuries based on the observed proportions of each outcome. 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 do not yet incorporate additional uncertainty introduced by prorating false killer whale~~s~~ takes in the overlap zone and prorating the takes of unidentified blackfish.

Fishery Name	**Year**	**Data Type**	**Percent Observer Coverage**	**Observed total interactions (T), observed mortality events~~,~~ and serious injuries (MSI), and total estimated mortality and serious injury (MSI) of false killer whales by stock / EEZ region**							
				Hawaii Pelagic Stock				**Main Hawaiian Islands Insular Stock**		**Northwestern Hawaiian Islands Stock**	
				Outside U.S. EEZs		**Hawaiian EEZ**					
				Obs. FKW T/MSI **Obs. UB T/MSI**	**Estimated MSI (CV)**	**Obs. FKW T/MSI** **Obs. UB T/MSI**	**Estimated MSI (CV)**	**Obs. FKW T/MSI** **Obs. UB T/MSI**	**Estimated MSI (CV)**	**Obs. FKW T/MSI** **Obs. UB T/MSI**	**Estimated MSI (CV)**
Hawaii-based deep-set longline fishery	2008	Observer data	22%	0 0	0 (-)	3/3 3/3	17 (0.4)	0 0	0 (-)	0 0	0 (-)
	2009		21%	7/7 0	39 (0.2)	3/3 0	12 (0.6)	0 0	0 (-)	0 0	0 (-)
	2010		21%	1/1 0	6 (1.4)	3/2 1/1	14 (0.4)	0 0	0 (-)	0 0	0 (-)
	2011		20%	0 1/0	2 (2.0)	3/2 1/1*	12 (0.5)	0 1/1*	0 (-)	0 0	0 (-)
	2012		20%	0 1/1	4 (2.0)	3/2* 0/0	8 (0.4)	2/2* 0/0	4 (0.4)	2/2* 0/0	1 (0.4)
Mean Estimated Annual Take (CV)					**9.9 (0.4)**		**12.7 (0.2)**		**0.9 (2.0)**		**0.4 (1.5)**
Hawaii-based shallow-set longline fishery	2008	Observer data	100%	0 1/1	~~0~~1	1/0 0	0	0 0	0	0 0	0
	2009		100%	0 0	0	1/1 0	1	0 0	0	0 0	0
	2010		100%	0 0	0	0 0	0	0 0	0	0 0	0
	2011		100%	0 1/1	~~0~~1	1/0 0	0	0 0	0	0 0	0
	2012		100%	0 0	0	1/0 0	0	0 0	0	0 0	0
Mean Annual Takes (100% coverage)					**0.3**		**0.3**		**0**		**0**
Minimum total annual takes within U.S. EEZ							**13.0 (0.2)**		**0.9 (2.0)**		**0.4 (1.5)**

Fishery Name	Year	Data Type	Percent Observer Coverage	Observed total interactions (T) and mortality events, and serious injuries (MSI), and total estimated mortality and serious injury (M&SI) of false killer whales by stock / EEZ region							
				Hawaii Pelgic Stock				Main Hawaiian Islands Insular Stock		Northwestern Hawaiian Islands Stock	
				Outside U.S. EEZs		Hawaiian 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	2007	Observer data	20%	1/0 0	2 (3.4)	2/1 0	8 (-)	0 0	0 (-)	0 0	0 (-)
	2008		22%	0 0	0 (-)	3/3 3/3	17 (-)	0 0	0 (-)	0 0	0 (-)
	2009		21%	7/7 0	38 (0.2)	3/3 0	12 (-)	0 0	0 (-)	0 0	0 (-)
	2010		21%	1/1 0	6 (1.4)	3/2 1/1	14 (-)	0 0	0 (-)	0 0	0 (-)
	2011		20%	0 1/0	2 (0.6)	2/2 1/1*	11 (-)	0 1/1*	1 (-)	0 0	0 (-)
Mean Estimated Annual Take (CV)					9.6 (0.4)	-	12.4 (0.3)	-	0.1 (0.3)	-	0 (-)
Hawaii-based shallow-set longline fishery	2007	Observer data	100%	0 0	0	0 0	0	0 0	0	0 0	0
	2008		100%	0 1/1	1	1/0 0	0	0 0	0	0 0	0
	2009		100%	0 0	0	1/1 0	1	0 0	0	0 0	0
	2010		100%	0 0	0	0 0	0	0 0	0	0 0	0
	2011		100%	0 1/1	1	1/0 0	0	0 0	0	0 0	0
Mean Annual Takes (100% coverage)					0.3	-	0.2	-	0	-	0
Minimum total annual takes within U.S. EEZ				-	-	-	12.6 (0.3)	-	0.1 (0.3)	-	0

* False killer whale and unidentified blackfish takes within the Hawaiian stock overlap zones ~~MHI insular/pelagic stock overlap zone~~ are shown once for each stock. Within the MHI insular and pelagic overlap zones,~~, but~~ total estimates derived from these takes are first prorated among potentially affected stocks based on the distance from shore of the take location (see text~~ above~~, and McCracken 2010). Then, within the 3-way NWHI/MHI insular/pelagic overlap zone, the estimates were further prorated based on the relative level of fishing effort in each zone and the density of each stock within each zone, as an alternative to assigning the entire estimated insular take to both insular stocks (MHI and NWHI).

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 Papahanaumokuakea Marine National Monument and within the Longline Exclusion Area around the main Hawaiian Islands. Between ~~2007~~ 2008 and ~~2011~~ 2012, ~~three~~ four 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 ~~22~~ 23 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 2014 ~~2013~~). 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), two animals taken in the SSLL fishery within the Hawaii EEZ were considered not seriously injured, ~~and~~ one was considered seriously injured., and the level of injury could not be determined for one additional animal based on the observer's descriptions of the interaction. In the DSLL fishery, ~~two~~ one taken in Hawaiian waters within the range of the pelagic stock ~~and one taken on the high seas were~~ was considered not seriously injured and the level of injury could not be determined for ~~one~~ two additional animals based on the observers' descriptions of the interactions. The remaining ~~19~~ 20 false killer whales taken in the DSLL fishery, eight in high seas waters, ~~and eleven~~ ten in the Hawaiian Islands EEZ pelagic stock range, and two in the three-way overlap zone between the pelagic, MHI insular, and NWHI stocks were considered seriously injured (Bradford & Forney 2013 2014). Seven Eight additional unidentified "blackfish" (unidentified cetaceans known to be either false killer whales or short-finned pilot whales) that may have been false killer whales were also seriously injured during 2007-2011 2008-2012 (Bradford & Forney 2014 2013). Additionally, one unidentified blackfish was taken on the high seas in the deep set longline fishery in 2011, but was not seriously injured (Table 1). Five of the seven Six of the eight seriously injured false killer whales injuries were taken in the DSLL fishery within U.S. EEZ waters, including one animal within the MHI insular/pelagic stock overlap zone range, and the remaining two seriously injured injuries false killer whales were taken by the SSLL fishery on the high seas (Table 1 and Figure 3).

Takes of false killer whales of unknown stock within 140km of the Main Hawaiian Islands must be prorated to MHI insular, pelagic, or NWHI stocks. in the MHI insular/pelagic stock overlap zone are prorated to one stock or the other assuming that densities of MHI insular stock animals decline and pelagic stock densities increase with distance from shore (McCracken 2010). No genetic samples are available to establish stock identity for these takes, but allboth 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. 2008). MHI insular and NWHI false killer whales have been documented via telemetry to move far enough offshore (112km) to reach longline fishing areas, and animals from thisthe 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). Finally, t Takes of unidentified blackfish are prorated to each stock species 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 and simplicity relative to a number of other more complicated models with similar output (McCracken 2010). Proration of false killer whale takes within the MHI insular-pelagic overlap zone 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), this approach ensures that potential impacts to all stocks are assessed. Following proration of unidentified blackfish takes to species, total false killer whale take estimates within 140km of the MHI are first prorated to the MHI insular or pelagic stock assuming that the density of MHI insular stock animals declines and pelagic stock density increases with distance from shore as in the methods of McCracken (2010).

With the McCracken (2010) proration between MHI insular and pelagic stocks as a starting point, two alternatives were examined for allocating takes among the 3-stocks in the 140-km overlap zone. The first alternative partitioned the take within the 140-km zone among the 2 and 3-way overlap zones based on the relative level of fishing effort in each zone. Because a much greater proportion of fishing has occurred in the 2-way overlap zone between MHI insular and pelagic false killer whales than in the smaller overlap zone between all three stocks, the majority of takes were assigned to the 2-way overlap zone. The distance-from-shore model implemented by McCracken (2010) provides a relative probability of occurrence and density of MHI insular versus pelagic stock take within the 140km region given individual take locations in each year. Relative density and take rate were used within the 3-way overlap zone to compute an assumed constant proportion of take between these two stocks among the overlap zones. The NWHI stock density was then joined with these adjusted MHI insular and pelagic stock densities, and the total take estimate for that zone was prorated among the three stocks based on their relative densities in this zone. A similar approach was used to prorate take between the NWHI and pelagic stocks in a small area of overlap outside of 140km that is open to longline fishing. First, total pelagic stock take outside of 140km was partitioned based on the distribution of fishing effort in the NWHI-pelagic stock overlap and pelagic-only zones, then the take assigned to the small NWHI-pelagic overlap zone- was prorated between stocks based on the relative densities of each stock. Using this approach, the 5-yr annual mortality and serious injury estimates of MHI insular, NWHI, and pelagic stocks are 0.9, 0.4, and 13.0, respectively.

As an alternative to this approach, GAMMS suggests assigning all take within an overlap zone to all potentially affected stocks. Using this approach all MHI insular stock take within the 140-km zone estimated following the initial proration (McCracken 2010) could be assigned to both MHI insular and NWHI stocks. This approach results in 5-yr annual mortality and serious injury estimates of MHI insular and NWHI stocks of 1.0, and a pelagic stock estimated take of 13.0. The overall status of each stock relative to PBR does not change versus the first approach described above.

The first proration approach is preferable, as it uses fishing location data and the relative densities of false killer whales to partition take among stocks. Based on these bycatch analyses, including the new alternative 3-way proration, 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 annual M&SI estimates are shown as whole numbers of animals, the 5-yr average M&SI is calculated based on the unrounded annual estimates. 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.

Because of high rates of false killer whale mortality and serious injury in Hawaii-based longline fisheries, a Take Reduction Team (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 the DSLL and SSLL fisheries. The Team submitted a draft Take Reduction Plan (Plan) to NMFS (http://www.nmfs.noaa.gov/pr/pdfs/interactions/fkwtrp_draft.pdf), and NMFS published a final Plan 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 Plan became effective December 31, 2012, with gear requirements effective February 27, 2013. Additionally, the Plan includes non-regulatory measures that NMFS will implement to improve data quality and dissemination to the Team and the public. These measures were not in effect during 2008-2012, the period for which bycatch was estimated in this report. Bycatch estimation methods will need to be adjusted when 2013 takes are considered to account for changes in fishing gear and captain training intended to reduce the false killer whale serious injury rate.

MAIN HAWAIIAN ISLANDS INSULAR STOCK

POPULATION SIZE

A photographic mark-recapture study during 2000-2004 around the main Hawaiian Islands produced an estimate of 123 (CV=0.72) MHI 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 as a measure of current abundance (NMFS 2005). 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 new estimates were based on more recent sighting histories and open population models, yielding more precise estimates for the two time periods. The new 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 ~~(Baird unpublished data)~~. 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 distinct individuals identified during ~~2008-2011~~ 2009-2012 photo-identification studies, or ~~129~~ 138 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 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 (~~129~~138) 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 0.3 false killer whales per year.

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 fishers 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. Because the rate of mortality and serious injury to MHI insular false killer whales (0.9 animals per year) exceeds the PBR (0.3 animals per year), 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. ~~The estimated average annual human-caused mortality and serious injury from longline fisheries for this stock (0.1 animals per year) is less than the PBR (0.3), but is not approaching zero mortality and serious injury rate because it exceeds 10% of PBR (NMFS 2004). .~~

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 ~~1,503~~ 1,552 (CV=0.66) false killer whales outside of 40 km of the main Hawaiian Islands (Bradford et al. ~~2012~~ 2014). Bradford et al. (~~2012~~ 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 ~~significant~~ increase in sightings close to the trackline, these ~~this~~ behavioral data suggests vessel attraction is likely occurring and may be significant. Although Bradford et al. (~~2012~~ 2014) employed a half-normal model to minimize the effect of vessel attraction, the abundance estimate may ~~is likely~~ 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, 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 40 km from the main Hawaiian Islands (Bradford et al. ~~2012~~ 2014) or ~~906~~ 935 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 ~~very similar~~ data~~sets~~, such that the resulting abundance estimates are not statistically independent estimates and cannot be compared in standard statistical tests ~~of population size~~. 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 (~~906~~ 935) 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 ~~9.1~~ 9.4 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. 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. Because the rate of mortality and serious injury to false killer whales within the Hawaiian Islands EEZ (~~12.6~~ 13.0 animals per year) exceeds the PBR (~~9.1~~ 9.4 animals per year), this stock is considered a "strategic stock" under 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.

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~~ 2014). This is the best available abundance estimate for false killer whales within the Northwestern Hawaiian Islands. Bradford et al. (~~2012~~ 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 ~~significant~~ increase in sightings close to the trackline, this behavioral data suggests vessel attraction is likely occurring and may be significant. Although Bradford et al. (~~2012~~ 2014) 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 data, ~~the abundance estimate is likely still positively biased as a result of vessel attraction,~~ 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. ~~2012~~ 2014) or 262 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- (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 Northwestern Hawaiian Islands stock of false killer whales is not considered "strategic" under the 1994 amendments to the MMPA.~~ 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 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 estimated average annual human-caused mortality and serious injury from longline fisheries for this stock (0.4 animals per year) is less than the PBR (2.6), but is not approaching zero mortality and serious injury rate because it exceeds 10% of PBR (NMFS 2004). ~~The rate of fishery mortality and serious injury to Northwestern Hawaiian Islands false killer whales is unknown but may be insignificant and approaching zero,~~ However, given the current recognized geographic range of this stock is largely within the Marine National Monument, this stock is not likely 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. ~~Mortality and serious injury does not exceed the PBR (2.6) for this stock.~~

REFERENCES

Andersen, M. S., K. A. Forney, T. V. N. Cole, T. Eagle, R. Angliss, K. Long, L. Barre, L. Van Atta, D. Borggaard, T. Rowles, B. Norberg, J. Whaley, and L. Engleby. 2008. Differentiating Serious and Non-Serious Injury of Marine Mammals: Report of the Serious Injury Technical Workshop, 10-13 September 2007, Seattle, Washington. NOAA Technical Memorandum NMFS-OPR-39. 94p.

Angliss, R.P. and D.P. DeMaster. 1997. Differentiating serious and non-serious injury of marine mammals taken incidental to commercial fishing operations: Report of the Serious Injury Workshop 1-2 April. 1997, Silver Spring, MD. NOAA Tech Memo NMFS-OPR-13, 48 p.

Baird, R.W., S.D. Mahaffy, A.M. Gorgone, T. Cullins, D.J. McSweeney, E.M. Oleson, A.L. Bradford, J. Barlow and D.L. Webster. 2014. False killer whales and fisheries interactions in Hawaiian waters: evidence for sex bias and variation among populations and social groups. Marine Mammal Science doi: 10.1111/mms.12177.

Baird, R.W. 2009. A review of false killer whales in Hawaiian waters: biology, status, and risk factors. Report prepared for the U.S. Marine Mammal Commission under Order No. E40475499, December 23, 2009. 40p.

Baird, R.W., A.M. Gorgone, D.J. McSweeney, D.L. Webster, D.R. Salden, M.H. Deakos, A.D. Ligon, G.S. Schorr, J. Barlow and S.D. Mahaffy. 2008. False killer whales (*Pseudorca crassidens*) around the main Hawaiian Islands: long-term site fidelity, inter-island movements, and association patterns. Marine Mammal Science 24:591-612

Baird, R.W., A.M. Gorgone, D.L. Webster, D.J. McSweeney, J.W. Durban, A.D. Ligon, D.R. Salden, and M.H. Deakos. 2005. False killer whales around the main Hawaiian Islands: An assessment of inter-island movements and population size using individual photo-identification. Contract Report JJ133F04SE0120 prepared for the Pacific Islands Fisheries Science Center, National Marine Fisheries Service, 2570 Dole Street, Honolulu, Hawaii, 96822. 24pp.

Baird, R.W., and A.M. Gorgone. 2005. False killer whale dorsal fin disfigurements as a possible indicator of long-line fishery interactions in Hawaiian waters. Pacific Science 59:593-601.

Baird, R.W., E.M. Oleson, J. Barlow, A.D. Ligon, A.M. Gorgone, and S.D. Mahaffy. 2013. ~~Photo-identification and satellite-tagging of false killer whales during HICEAS 2010: e~~Evidence of an island-associated population of false killer whales (*Pseudorca* crassidens) in the Northwestern Hawaiian Islands~~within the Papahanaumokuakea Marine National Monument~~. Pacific Science 67(4): 513-521.

Baird, R.W, G.S. Schorr, D.L. Webster, D.J. McSweeney, M.B. Hanson, and R.D. Andrews. 2010. Movements and habitat use of satellite-tagged false killer whales around the main Hawaiian Islands. Endangered Species Research 10:107-121.

Barlow, J., S.L. Swartz, T.C. Eagle, and P.R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background, and a Summary of the 1995 Assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 p.

Barlow, J. 2006. Cetacean abundance in Hawaiian waters estimated from a summer/fall survey in 2002. Marine Mammal Science 22: 446–464.

Barlow, J., S. Rankin, A. Jackson, and A. Henry. 2008. Marine mammal data collected during the Pacific Islands Cetacean and Ecosystem Assessment Survey (PICEAS) conducted aboard the NOAA ship *McArthur II*, July-November, 2005. NOAA Tech. Memo. NMFS-TM-NMFS-SWFSC-420, 27p.

Barlow, J. and S. Rankin. 2007. False killer whale abundance and density: Preliminary estimates for the PICEAS study area south of Hawaii and new estimates for the US EEZ around Hawaii. Administrative Report LJ-07-02. Southwest Fisheries Science Center, National Marine Fisheries Service, 8604 La Jolla Shores Drive, La Jolla, CA 92037.

Boggs, C.H. and R.Y. Ito. 1993. Hawaii's pelagic fisheries. In: Boehlert GW (ed.). The fisheries of Hawaii and U.S.-associated Pacific Islands. Mar. Fish. Rev. 55(2): 61-68.

~~Bradford, A.L., K.A. Forney, E.M. Oleson, and J. Barlow. 2012. Line-transect abundance estimates of false killer whales (Pseudorca crassidens) in the pelagic region of the Hawaiian Exclusive Economic Zone and in the insular waters of the Northwestern Hawaiian Islands. Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Serv, NOAA, Honolulu, HI 96822. Pacific Islands Fish. Sci. Cent. Admin. Rep. H-12-02, 23 p.~~

Bradford, A.L., K.A. Forney, E.M. Oleson, and J. Barlow. 2014. Accounting for subgroup structure in line-transect abundance estimates of false killer whales (*Pseudorca crassidens*) in Hawaiian waters. PLoS ONE 9(2): e90464. doi:10.1371/journal.pone.0090464.

Bradford, A.L. and K.A. Forney. 2013. Injury determinations for cetaceans observed interacting with Hawaii and American Samoa longline fisheries during 2007-2011. PIFSC Working Paper WP-13-002.

Bradford, A. L., and K. A. Forney. 2014. Injury determinations for cetaceans observed interacting with Hawaii and American Samoa longline fisheries during 2008–2012. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM NMFS-PIFSC-41, 38 p. + Appendices.

Chivers, S. J., R. W. Baird, D. J. McSweeney, D. L. Webster, N. M. Hedrick, and J. C. Salinas. 2007. Genetic variation and evidence for population structure in eastern North Pacific false killer whales (*Pseudorca crassidens*). Can. J. Zool. 85: 783-794.

Chivers S. J., K. A. Forney, and D. Johnston. 2008. Rationale for the 2008 revision to Hawaiian stock boundaries for false killer whales, Pseudorca crassidens. SWFSC Administrative Report LJ-08-04. Available from SWFSC, 8604 La Jolla Shores Drive, La Jolla, CA 92038. 5p.

Chivers, S. J., R. W. Baird, K. M. Martien, B. Taylor, L., E. Archer, A. M. Gorgone, B. L. Hancock, N. Hedrick, M., D. K. Mattila, D. J. McSweeney, E. M. Oleson, C. L. Palmer, V. Pease, K. M. Robertson, J. Robbins, J. C. Salinas, G. S. Schorr, M. Schultz, J. L. Theileking and D. L. Webster. 2010. Evidence of genetic differentiation for Hawai'i insular false killer whales (*Pseudorca crassidens*). 44p. NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-458.

Forney, K. A., R. W. Baird, and E. M. Oleson. 2010. Rationale for the 2010 revision of stock boundaries for the Hawai‘i insular and pelagic stocks of false killer whales, *Pseudorca crassidens*. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SWFSC-471. 7p.

Johnston, D. W., J. Robbins, M. E. Chapla, D. K. Mattila & K. R. Andrews. 2008. Diversity, habitat associations and stock structure of odontocete cetaceans in the waters of American Samoa, 2003-2006. Journal of Cetacean Research and Management 10: 59-66.

Maldini, D., L. Mazzuca, and S. Atkinson. 2005. Odontocete stranding patterns in the main Hawaiian Islands (1937-2002): How do they compare with live animal surveys? Pacific Science 59(1):55-67.

Martien, K, R.W. Baird, B.L. Taylor, E.M. Oleson, S.J. Chivers. 2011. Population structure and mechanisms of gene flow within island-associated false killer whales (*Pseudorca crassidens*) around the Hawaiian Archipelago. PSRG-11-14, 19pp.

McCracken, M.L. 2010. Adjustments to false killer whale and short-finned pilot whale bycatch estimates. NMFS, Pacific Islands Fisheries Science Center Working paper WP-10-007, 23p.

McCracken, M. 2014. Assessment of Incidental Interactions with Marine Mammals in the Hawaii Longline Deep and Shallow Set Fisheries from 2008 through 2012. PIFSC Internal Report, IR-14-006.

~~McCracken, M. 2013. Preliminary assessment of incidental interactions with marine mammals in the Hawaii longline deep and shallow set fisheries from 2007 to 2011. PIFSC Working Paper WP-13-XXX.~~

Mobley, J.R., Jr, S. S. Spitz, K. A. Forney, R. A. Grotefendt, and P. H. Forestall. 2000. Distribution and abundance of odontocete species in Hawaiian waters: preliminary results of 1993-98 aerial surveys Admin. Rep. LJ-00-14C. Southwest Fisheries Science Center, National Marine Fisheries Service, P.O. Box 271, La Jolla, CA 92038. 26 pp.

Nitta, E. 1991. The marine mammal stranding network for Hawaii: an overview. *In*: J.E. Reynolds III, D.K. Odell (eds.), Marine Mammal Strandings in the United States, pp.56-62. NOAA Tech. Rep. NMFS 98, 157 pp.

Nitta, E. and J. R. Henderson. 1993. A review of interactions between Hawaii's fisheries and protected species. Mar. Fish. Rev. 55(2):83-92.

NMFS. 2004. Federal Register 69:43338. Authorization for commercial fisheries under the Marine Mammal Protection Act of 1972: Zero Mortality Rate Goal. Available at: www.nmfs.noaa.gov/pr/pdfs/fr/fr69-43338.pdf.

NMFS. 2005. Revisions to Guidelines for Assessing Marine Mammal Stocks. 24 pp. Available at: *http://www.nmfs.noaa.gov/pr/pdfs/sars/gamms2005.pdf*

NMFS. 2012. NOAA Fisheries Policy Directive 02-038-01 Process for Injury Determinations (01/27/12). Available at: http://www.nmfs.noaa.gov/pr/pdfs/serious_injury_policy.pdf

Oleson, E.M. 2009. Assessment of American Samoa longline fishery and estimates of cetacean bycatch, 2006-2008. NMFS, Pacific Islands Fisheries Science Center Working Paper WP-09-006, 12p.

Oleson, E.M., C.H. Boggs, K.A. Forney, M.B. Hanson, D.R. Kobayashi, B.L. Taylor, P.R. Wade, and G.M. Ylitalo. 2010. Status Review of Hawaiian Insular False Killer Whales (*Pseudorca crassidens*) under the Endangered Species Act. U.S Dep. Commerc. NOAA Tech Memo., NOAA-TM-NMFS-PIFSC-22. 140 p. + Appendices.

Oleson, E.M., C.H. Boggs, K.A. Forney, M.B. Hanson, D.R. Kobayashi, B.L. Taylor, P.R. Wade, and G.M. Ylitalo. 2012. Reevaluation of the DPS designation for Hawaiian (now Main Hawaiian Islands) insular false killer whales. Pacific Islands Fisheries Science Center Internal Report IR-12-038. 39 pp. Available at: http://www.pifsc.noaa.gov/library/pubs/IR-12-038.pdf

Reeves, R.R., S. Leatherwood, and R.W. Baird. 2009. Evidence of a possible decline since 1989 in false killer whales (*Pseudorca crassidens*) around the main Hawaiian Islands. Pacific Science 63(2): 253–261.

Shallenberger, E.W. 1981. The status of Hawaiian cetaceans. Final report to U.S. Marine Mammal Commission. MMC-77/23, 79pp.

Stacey, P. J., S. Leatherwood, and R. W. Baird. 1994. *Pseudorca crassidens*. Mamm. Spec. 456:1-6.

Wade, P. R. and R. P. Angliss. 1997. Guidelines for Assessing Marine Mammal Stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. U. S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12. 93 pp.

Ylitalo, G. M., R. W. Baird, G. K. Yanagida, D. L. Webster, S. J. Chivers, J. L. Bolton, G. S. Schorr and D. J. McSweeney. 2009. High levels of persistent organic pollutants measured in blubber of island-associated false killer whales (*Pseudorca crassidens*) around the main Hawaiian Islands. *Marine Pollution Bulletin* 58: 1932-1937.

Appendix 3. 2014 Pacific Marine Mammal Stock Assessment Reports. S=strategic stock; N=non-strategic stock. Shaded lines indicate reports revised in 2014. unk=unknown, undet=undetermined, n/a=not applicable.

Species	Stock Area	NMFS Center	N est	CV N est	N min	R max	Fr	PBR	Total Annual Mortality + Serious Injury	Annual Fishery Mortality + Serious Injury	Strategic Status	Recent Abundance Surveys			SAR Last Revised
California sea lion	U.S.	SWC	296,750	n/a	153,337	0.12	1	9,200	389	331	N	2007	2008	2011	2014
Harbor seal	California	SWC	30,968	n/a	27,348	0.12	1	1,641	43	30	N	2004	2009	2012	2014
Harbor seal	Oregon/Washington Coast	AKC	unk	unk	unk	0.12	1	unk	10.6	7.4	N	1999			2013
Harbor seal	Washington Northern Inland Waters	AKC	unk	unk	unk	0.12	1	unk	9.8	2.8	N	1999			2013
Harbor seal	Southern Puget Sound	AKC	unk	unk	unk	0.12	1	unk	3.4	1	N	1999			2013
Harbor seal	Hood Canal	AKC	unk	unk	unk	0.12	1	unk	0.2	0.2	N	1999			2013
Northern Elephant Seal	California breeding	SWC	179,000	n/a	81,368	0.12	1	4,882	8.8	4	N	2002	2005	2010	2014
Guadalupe Fur Seal	Mexico to California	SWC	7,408	n/a	3,028	0.12	0.5	91	0	0	S	1993			2000
Northern Fur Seal	California	AKC	12,844	n/a	6,722	0.12	1	403	2.6	≥0.4	N	2009	2010	2011	2013
Monk Seal	Hawaii	PIC	1,153	n/a	1,118	0.07	0.1	undet	≥2.6	≥1.0	S	2010	2011	2012	2014
Harbor porpoise	Morro Bay	SWC	2,917	0.41	2,102	0.04	0.5	21	≥0.6	≥0.6	N	2002	2007	2012	2013
Harbor porpoise	Monterey Bay	SWC	3,715	0.51	2,480	0.04	0.5	25	0	0	N	2002	2007	2011	2013
Harbor porpoise	San Francisco – Russian River	SWC	9,886	0.51	6,625	0.04	0.5	66	0	0	N	2002	2007	2011	2013
Harbor porpoise	Northern CA/Southern OR	SWC	35,769	0.52	23,749	0.04	1	475	≥0.6	≥0.6	N	2002	2007	2011	2013
Harbor porpoise	Northern Oregon/Washington Coast	AKC	21,487	0.44	15,123	0.04	0.5	151	≥3.0	≥3.0	N	2002	2010	2011	2013
Harbor porpoise	Washington Inland Waters	AKC	10,682	0.38	7,841	0.04	0.4	63	≥2.2	≥2.6	N	1996	2002	2003	2011
Dall's porpoise	California/Oregon/Washington	SWC	42,000	0.33	32,106	0.04	0.4	257	≥0.4	≥0.4	N	2001	2005	2008	2010
Pacific white-sided dolphin	California/Oregon/Washington	SWC	26,930	0.28	21,406	0.04	0.4	171	17.8	11.8	N	2001	2005	2008	2013
Risso's dolphin	California/Oregon/Washington	SWC	6,272	0.30	4,913	0.04	0.4	39	1.6	1.6	N	2001	2005	2008	2010
Common Bottlenose dolphin	California Coastal	SWC	323	0.13	290	0.04	0.5	2.4	0.2	0.2	N	2000	2004	2005	2008
Common Bottlenose dolphin	California/Oregon/Washington Offshore	SWC	1,006	0.48	684	0.04	0.4	5.5	≥2.0	≥2.0	N	2001	2005	2008	2013
Striped dolphin	California/Oregon/Washington	SWC	10,908	0.34	8,231	0.04	0.5	82	0	0	N	2001	2005	2008	2010
Common dolphin, short-beaked	California/Oregon/Washington	SWC	411,211	0.21	343,990	0.04	0.5	3,440	64	64	N	2001	2005	2008	2010
Common dolphin, long-beaked	California	SWC	107,016	0.42	76,224	0.04	0.4	610	13.8	13	N	2005	2008	2009	2012
Northern right whale dolphin	California/Oregon/Washington	SWC	8,334	0.40	6,019	0.04	0.4	48	4.8	3.6	N	2001	2005	2008	2010
Killer whale	Eastern North Pacific Offshore	SWC	240	0.49	162	0.04	0.5	1.6	0	0	N	2001	2005	2008	2010
Killer whale	Eastern North Pacific Southern Resident	NWC	82	n/a	82	0.032	0.1	0.13	0	0	S	2011	2012	2013	2014
Short-finned pilot whale	California/Oregon/Washington	SWC	760	0.64	465	0.04	0.4	4.6	0	0	N	2001	2005	2008	2010
Baird's beaked whale	California/Oregon/Washington	SWC	847	0.81	466	0.04	0.5	4.7	0	0	N	2001	2005	2008	2013
Mesoplodont beaked whales	California/Oregon/Washington	SWC	694	0.65	389	0.04	0.5	3.9	0	0	S	2001	2005	2008	2013
Cuvier's beaked whale	California/Oregon/Washington	SWC	6,590	0.55	4,481	0.04	0.5	45	0	0	S	2001	2005	2008	2013
Pygmy Sperm whale	California/Oregon/Washington	SWC	579	1.02	271	0.04	0.5	2.7	0	0	N	2001	2005	2008	2010
Dwarf sperm whale	California/Oregon/Washington	SWC	unk	unk	unk	0.04	0.5	undet	0	0	N	2001	2005	2008	2010
Sperm whale	California/Oregon/Washington	SWC	2,106	0.58	1,332	0.04	0.1	2.7	1.7	1.7	S	2001	2005	2008	2014
Gray whale	Eastern North Pacific	SWC	20,990	0.05	20,125	0.062	1.0	624	132	4.25	N	2009	2010	2011	2014
Gray whale	Western North Pacific (new report)	SWC	140	0.04	135	0.062	0.1	0.06	unk	unk	S			2011	2014
Humpback whale	California/Oregon/Washington	SWC	1,918	0.03	1,855	0.08	0.3	11.0	≥ 5.5	≥ 4.4	S	2009	2010	2011	2013
Blue whale	Eastern North Pacific	SWC	1,647	0.07	1,551	0.04	0.3	2.3	1.9	0	S	2005	2008	2011	2013
Fin whale	California/Oregon/Washington	SWC	3,051	0.18	2,598	0.04	0.3	16	2.2	0.6	S	2001	2005	2008	2013
Sei whale	Eastern North Pacific	SWC	126	0.53	83	0.04	0.1	0.17	0	0	S	2001	2005	2008	2010
Minke whale	California/Oregon/Washington	SWC	478	1.36	202	0.04	0.5	2.0	0	0	N	2001	2005	2008	2010
Rough-toothed dolphin	Hawaii	SWC	6,288	0.39	4,581	0.04	0.5	46	unk	unk	N		2002	2010	2013
Rough-toothed dolphin	American Samoa	PIC	unk	unk	unk	0.04	0.5	unk	unk	unk	unk	n/a	n/a	n/a	2010

Appendix 3. 2014 Pacific Marine Mammal Stock Assessment Reports. S=strategic stock; N=non-strategic stock.
Shaded lines indicate reports revised in 2014. unk=unknown, undet=undetermined, n/a=not applicable.

Species	Stock Area	NMFS Center	N est	CV N est	N min	R max	Fr	PBR	Total Annual Mortality + Serious Injury	Annual Fishery Mortality + Serious Injury	Strategic Status	Recent Abundance Surveys			SAR Last Revised
Risso's dolphin	Hawaii	SWC	7,256	0.41	5,207	0.04	0.5	42	0.6	0.6	N		2002	2010	2013
Common Bottlenose dolphin	Hawaii Pelagic	SWC	5,950	0.59	3,755	0.04	0.5	38	0.2	0.2	N		2002	2010	2013
Common Bottlenose dolphin	Kaua'I and Ni'ihau	SWC	184	0.11	168	0.04	0.5	1.7	unk	unk	N	2003	2004	2005	2013
Common Bottlenose dolphin	O'ahu	SWC	743	0.54	485	0.04	0.5	4.9	unk	unk	N	2002	2003	2006	2013
Common Bottlenose dolphin	4 Islands Region	SWC	191	0.24	156	0.04	0.5	1.6	unk	unk	N	2002	2003	2006	2013
Common Bottlenose dolphin	Hawaii Island	SWC	128	0.13	115	0.04	0.5	1.1	unk	unk	N	2002	2003	2006	2013
Pantropical Spotted dolphin	Hawaii Pelagic	PIC	15,917	0.40	11,508	0.04	0.5	115.0	0	0	N		2002	2010	2013
Pantropical Spotted dolphin	O'ahu	PIC	unk	unk	unk	0.04	0.5	undet	unk	unk	N			n/a	2013
Pantropical Spotted dolphin	4 Islands Region	PIC	unk	unk	unk	0.04	0.5	undet	unk	unk	N			n/a	2013
Pantropical Spotted dolphin	Hawaii Island	PIC	unk	unk	unk	0.04	0.5	undet	unk	unk	N			n/a	2013
Spinner dolphin	Hawaii Pelagic	PIC	unk	unk	unk	0.04	0.5	undet	0	0	N		2002	2010	2013
Spinner dolphin	Hawaii Island	PIC	820	0.04	793	0.04	0.5	7.9	unk	unk	N	1994	2003	2011	2013
Spinner dolphin	Oahu / 4 Islands	PIC	355	0.09	329	0.04	0.5	3.3	unk	unk	N	1993	1998	2007	2013
Spinner dolphin	Kaua'I / Ni'ihau	PIC	601	0	509	0.04	0.5	5.1	unk	unk	N	1995	1998	2005	2013
Spinner dolphin	Kure / Midway	PIC	unk	unk	unk	0.04	0.5	undet	unk	unk	N		1998	2010	2013
Spinner dolphin	Pearl and Hermes Reef	PIC	unk	unk	unk	0.04	0.5	undet	unk	unk	N			n/a	2013
Spinner dolphin	American Samoa	PIC	unk	unk	unk	0.04	0.5	unk	unk	unk	unk			n/a	2010
Striped dolphin	Hawaii Pelagic	PIC	20,650	0.36	15,391	0.04	0.5	154	unk	unk	N		2002	2010	2013
Fraser's dolphin	Hawaii	PIC	16,992	0.66	10,241	0.04	0.5	102	0	0	N		2002	2010	2010
Melon-headed whale	Hawaiian Islands	PIC	5,794	0.20	4,904	0.04	0.5	49	0	0	N		2002	2010	2013
Melon-headed whale	Kohala Resident	PIC	447	0.12	404	0.04	0.5	4.0	0	0	N			2009	2013
Pygmy killer whale	Hawaii	PIC	3,433	0.52	2,274	0.04	0.5	23.0	0	0	N		2002	2010	2013
False killer whale	Northwestern Hawaiian Islands	PIC	552	1.09	262	0.04	0.5	2.6	0.4	0.4	N			2010	2014
False killer whale	Hawaii Pelagic	PIC	1,552	0.66	935	0.04	0.5	9.4	13	13	S		2002	2010	2014
False killer whale	Palmyra Atoll	PIC	1,329	0.65	806	0.04	0.4	6.4	0.3	0.3	N			2005	2013
False killer whale	Main Hawaiian Islands Insular	PIC	151	0.20	129	0.04	0.1	0.3	0.9	0.9	S	2009	2010	2011	2014
False killer whale	American Samoa	PIC	unk	unk	unk	0.04	0.5	unk	unk	unk	unk	n/a	n/a	n/a	2010
Killer whale	Hawaii	PIC	101	1.00	50	0.04	0.5	1.0	0	0	N		2002	2010	2013
Pilot whale, short-finned	Hawaii	PIC	12,422	0.43	8,782	0.04	0.4	70	0.1	0.1	N		2002	2010	2013
Blainville's beaked whale	Hawaii Pelagic	PIC	2,338	1.13	1,088	0.04	0.5	11.0	0	0	N		2002	2010	2013
Longman's Beaked Whale	Hawaii	PIC	4,571	0.65	2,773	0.04	0.5	28.0	0	0	N		2002	2010	2013
Cuvier's beaked whale	Hawaii Pelagic	PIC	1,941	0.70	1,142	0.04	0.5	11.4	0	0	N		2002	2010	2013
Pygmy sperm whale	Hawaii	PIC	unk	unk	unk	0.04	0.5	undet	0	0	N		2002	2010	2013
Dwarf sperm whale	Hawaii	PIC	unk	unk	unk	0.04	0.5	undet	0	0	N		2002	2010	2013
Sperm whale	Hawaii	PIC	3,354	0.34	2,539	0.04	0.1	10.2	0.7	0.7	S		2002	2010	2013
Blue whale	Central North Pacific	PIC	81	1.14	38	0.04	0.1	0.1	0	0	S		2002	2010	2013
Fin whale	Hawaii	PIC	58	1.12	27	0.04	0.1	0.1	0	0	S		2002	2010	2013
Bryde's whale	Hawaii	PIC	798	0.28	633	0.04	0.5	6.3	0	0	N		2002	2010	2013
Sei whale	Hawaii	PIC	178	0.90	93	0.04	0.1	0.2	0.2	0.2	S		2002	2010	2013
Minke whale	Hawaii	PIC	unk	unk	unk	0.04	0.5	undet	0	0	N		2002	2010	2013
Humpback whale	American Samoa	SWC	unk	unk	150	0.106	0.1	0.4	0	0	S	2006	2007	2008	2009
Sea Otter	Southern	USFWS	2,826	n/a	2,723	0.06	0.1	8	≥0.8	≥0.8	S	2006	2007	2008	2008
Sea Otter	Washington	USFWS	n/a	n/a	1,125	0.2	0.1	11	≥0.2	≥0.2	N	2006	2007	2008	2008