Revised 6/4/2014

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 monk seal subpopulations have exhibited considerable demographic independence. Observed interchange of individuals among the NWHI and MHI regions is uncommon, but genetic stock structure analysis (Schultz et al. 2011) supports management of the species as a single stock.

POPULATION SIZE

The best estimate of the total population size is 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. 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, 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, total enumeration was achieved at Laysan Island, Lisianski Island, Pearl and Hermes Reef and Kure Atoll, based on analysis of discovery curves. Minimum abundance was used for French Frigate Shoals and Midway Atoll. Thus, abundance at the six main NWHI subpopulations was estimated to be 909 (including 141 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 was 17.0 ± 5.4 at Necker Island and 31.5 ± 7.2 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 are 52.3 ± 15.6 at Necker Island and 101.6 ± 20.8 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 was 146 , the current best minimum abundance estimate for the MHI.

Minimum Population Estimate

The total number of seals (909) 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, respectively. The minimum abundance estimate for the main Hawaiian Islands in 2011 is 146 seals. The minimum population size for the entire stock (species) is the sum of these estimates, or 1,182 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 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) estimates that abundance declined -3.4% yr^{-1} (95% CI = -4.3% to -2.5% 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. 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% 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.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

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 distinguishing 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.

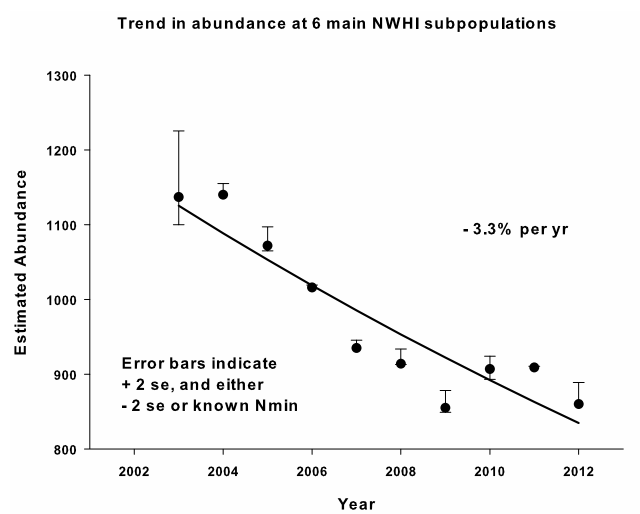

Figure 1. Trend in abundance of monk seals at the six main Northwestern Hawaiian Islands subpopulations, based on a combination of total enumeration and capture–recapture estimates. Error bars indicate ±2 s.e. (from variances of capture-recapture estimates). Fitted log-linear regression line is shown.

Human-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.

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 2011, 9 seals were observed hooked none of which constituted serious injuries. Several incidents involved hooks used to catch ulua (jacks, *Caranx* spp.). 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.

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 (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 cases of seals entangled in fishing gear or other debris have been observed from 1982 to (Henderson 2001; NMFS, unpubl. data), including eight documented deaths result from entanglement in marine debris (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).

Table 1. Summary of mortality, and 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	Mean Takes (CV)
Pelagic Longline	2007 2008 2009 2010 2011	observer observer observer observer observer	20.1% & 100%[1] 21.7% & 100%[1] 20.6% & 100%[1] 21.1% & 100%[1] 20.3% & 100%[1]	0 0 0 0 0	0 0 0 0 0	0 (0)
MHI Bottomfish[2]	2007 2008 2009 2010 2011	Incidental observations of seals	none	0 0 0 0 0	n/a	n/a
Nearshore[3]	2007 2008 2009 2010 2011	Incidental observations of seals	none	2 0 0 1 0	n/a	≥0.6
<u>Minimum total annual takes</u>						≥0.6

Other Mortality

In the past 10 years (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

---

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

[2] 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.

[3] Includes seals entangled/drowned in nearshore gillnets, recognizing that it is not possible to determine whether the nets involved were being used for commercial purposes.

an experimental approach in coming years (Baker and Littnan 2008). 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) 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 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 (2007-2011) was at least 1.8 animals, including fishery-caused nearshore gillnets (>= 0.6/ yr, Table 1), shooting-related deaths (>= 0.6 / yr), and blunt-force trauma deaths of unknown origin (>= 0.6 / yr).

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 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

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

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.
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.