Revised 6/4/2014

BLAINVILLE'S BEAKED WHALE (*Mesoplodon densirostris*): Hawaii Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Blainville's beaked whale has a cosmopolitan distribution in tropical and temperate waters, apparently the most extensive known distribution of any *Mesoplodon* species (Mead 1989). Forty-five sightings over 13 years were reported from the main islands by Baird et al (2013), who indicated that Blainville's beaked whale represent a small proportion (2-3%) of all odontocete sightings in the main Hawaiian Islands. Shallenberger (1981) suggested that Blainville's beaked whales were present off the Waianae Coast of Oahu for prolonged periods annually. Summer/fall shipboard surveys of the waters within the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands, resulted in three sightings in 2002 and one in 2010; however, several sightings of unidentified *Mesoplodon* whales may have also been Blainville's beaked whale (Figure 1; Barlow 2006, Bradford et. al. 2013).

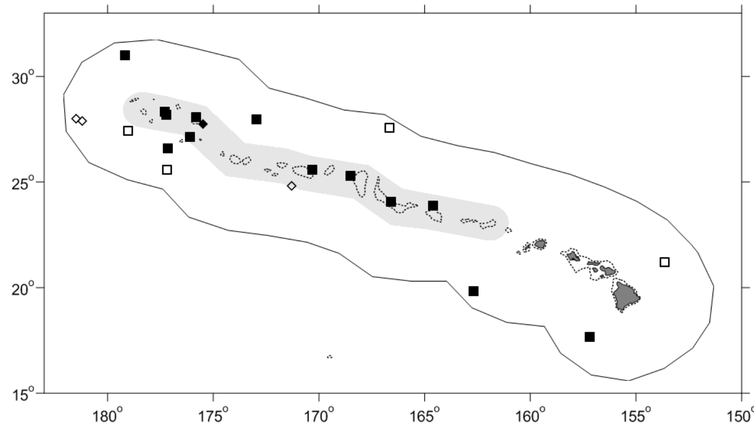

Figure 1. Sighting locations of *Mesoplodon densirostris* (diamonds) and unidentified *Mesoplodon* beaked whales (squares) during the 2002 (open symbols) and 2010 (black symbols) shipboard cetacean surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006; see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area and U.S. EEZ. Gray shading indicates area of Papahanaumokuakea Marine National Monument. Dotted line represents the 1,000m isobath.

Recent analysis of Blainville's beaked whale resightings and movements near the main Hawaiian Islands (MHI) suggest the existence of insular and offshore (pelagic) populations of this species in Hawaiian waters (McSweeney et al. 2007, Schorr et al., 2009, Baird et al. 2013). Photo-identification of individual Blainville's beaked whales from Hawaii Island since 1986 reveal repeated use of this area by individuals for over 17 years (Baird et al. 2011) and 75% of individuals seen off Hawaii Island link by association into a single social network (Baird et al. 2013). Those individuals seen farthest from shore and in deep water (>2100m) have not been resighted, suggesting they may be part of an offshore, pelagic population (Baird et al. 2011). Eleven Blainville's beaked whales linked to the social network have been satellite tagged off Hawaii Island. All 11 individuals had movements restricted to the MHI, extending to nearshore waters of Oahu, with average distance from shore of 21.6 km (Baird et al. 2013). One individual tagged 32km from Hawaii Island did not link to the social network and had movements extending far from shore, moving over 900km from the tagging location in 20 days, approaching the edge of the Hawaiian EEZ west of Nihoa (Baird et al. 2011). Division of this population into a separate island-associated stock may be warranted in the future.

For the Marine Mammal Protection Act (MMPA) stock assessment reports, three *Mesoplodon* stocks are defined within the Pacific U.S. EEZ: 1) *M. densirostris* in Hawaiian waters (this report), 2) *M. stejnegeri* in Alaskan waters, and 3) all *Mesoplodon* species off California, Oregon and Washington. The Hawaii stock of Blainville's beaked whales includes animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters. Because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

POPULATION SIZE

A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 2,872 (CV=1.17) Blainville's beaked whales (Barlow 2006). The recent 2010 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in an abundance estimate of 2,338 (CV = 1.13) Blainville's beaked whales (Bradford et al. 2013) in the Hawaii stock. This is currently the best available abundance estimate for this 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 or 1,088 Blainville's beaked whales within the Hawaiian Islands EEZ.

Current Population Trend

The broad and overlapping confidence intervals around the 2002 and 2010 estimates preclude assessment of population trend for the Hawaii stock with the available data.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population estimate for the U.S. EEZ of the Hawaiian Islands (1,088) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no recent fishery mortality or serious injury within the Hawaiian Islands EEZ; Wade and Angliss 1997), resulting in a PBR of 11 Hawaii Blainville's beaked whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

New 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 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.

Fishery Information

Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaii fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. No interactions between nearshore fisheries and Blainville's beaked whales have been reported in Hawaiian waters. No estimates of human-caused mortality or serious injury are currently available for nearshore hook and line fisheries because these fisheries are not observed or monitored for protected species bycatch.

There are currently 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. Between 2007 and 2011, no Blainville's beaked whale was observed killed or seriously injured in the SSLL fishery (100% observer coverage) or the DSLL

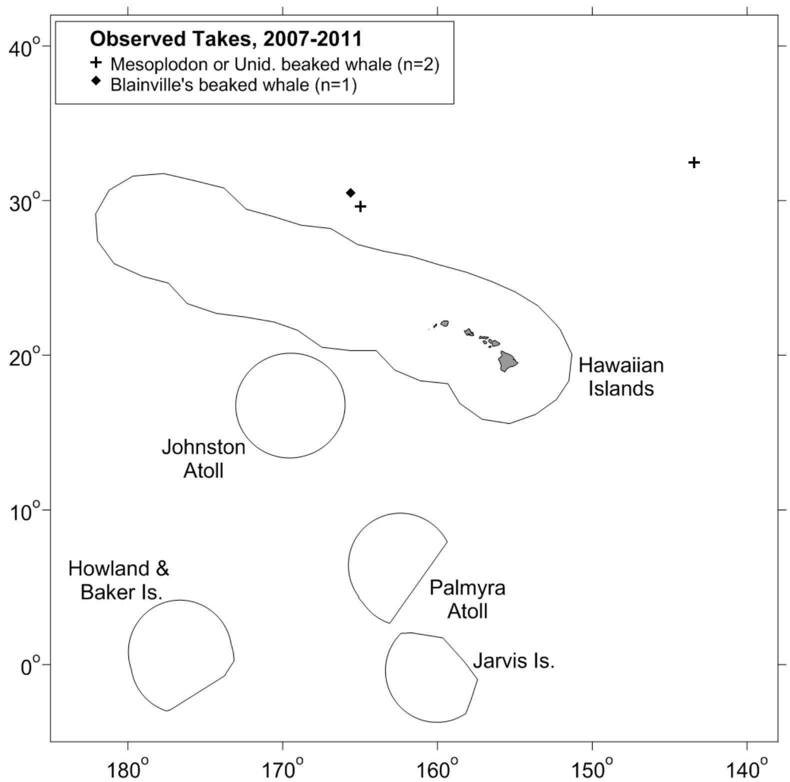

Figure 2. Location of the Blainville's beaked whale take (filled diamond) and the possible takes of this species (cross) in Hawaii-based longline fisheries, 2007-2011. Solid lines represent the U.S. EEZ. Fishery descriptions are provided in Appendix 1.

fishery (20-22% observer coverage) (Bradford & Forney 2013 , McCracken 2013) within the Hawaiian EEZ. One Blainville's beaked whale was observed taken, but not seriously injured, on the high seas in the SSLL fishery (Bradford & Forney 2013). One unidentified *Mesoplodon* whale and one unidentified beaked whale were taken in the SSLL fishery and both were considered to be seriously injured based on an evaluation of the observer's description of the interaction and following the most recently developed criteria for assessing serious injury in marine mammals (NMFS 2012). Average 5-yr estimates of annual mortality and serious injury for 2007-2011 are zero Blainville's beaked whales within or outside of the U.S. EEZs, and 0.4 (CV = 0) *Mesoplodon* or unidentified beaked whales outside the U.S. EEZs (Table 1). Eight unidentified cetaceans were taken in the DSLL fishery, and two unidentified cetaceans were taken in the SSLL fishery, some of which may have been Blainville's beaked whales.

Table 1. Summary of available information on incidental mortality and serious injury of Blainville's beaked whales (Hawaii stock) in commercial longline fisheries, within and outside of the Hawaiian Islands EEZ (McCracken 2013). Mean annual takes are based on 2007-2011 data unless otherwise indicated. Information on all observed takes (T) and combined mortality events & serious injuries (MSI) is included. Total takes were prorated to deaths, serious injuries, and non-serious injuries based on the observed proportions of each outcome.

				Observed total interactions (T) and mortality events, and serious injuries (MSI), and total estimated mortality and serious injury (M&SI) of Blainville's beaked whales (MD), unidentified Mesoplont whales (UM) and unidentified beaked whales (ZU)			
				Outside U.S. EEZs		**Hawaiian EEZ**	
Fishery Name	**Year**	**Data Type**	**Percent Observer Coverage**	**Obs. MD T/MSI Obs. UM+ZU T/MSI**	**Estimated MD M&SI (CV) Estimated UM+ZU MSI (CV)**	**Obs. MD T/MSI Obs. UM+ZU T/MSI**	**Estimated MD M&SI (CV) Estimated UM+ZU MSI (CV)**
Hawaii-based deep-set longline fishery	2007	Observer data	20%	0	0 (-)	0	0 (-)
	2008		22%	0	0 (-)	0	0 (-)
	2009		21%	0	0 (-)	0	0 (-)
	2010		21%	0	0 (-)	0	0 (-)
	2011		20%	0	0 (-)	0	0 (-)
Mean Estimated Annual MD Take (CV)					**0 (-)**		**0 (-)**
Mean Estimated Annual UM+ZU Take (CV)					**0 (-)**		**0 (-)**
Hawaii-based shallow-set longline fishery	2007	Observer data	100%	0	0	0	0
	2008		100%	0	0	0	0
	2009		100%	0	0	0	0
	2010		100%	0	0	0	0
	2011		100%	1/0 2/2	0 0.4	0	0
Mean Annual MD Takes (100% coverage)					**0**		**0**
Mean Annual UM + ZU Takes (100% coverage)					**0.4**		**0**
Minimum total annual MD takes within U.S. EEZ							**0 (-)**

Other Mortality

Anthropogenic sound sources, such as military sonar and seismic testing have been implicated in the mass strandings of beaked whales, including atypical events involving multiple beaked whale species (Simmonds and Lopez-Jurado 1991, Frantiz 1998, Anon. 2001, Jepson et al. 2003, Cox et al. 2006). While D'Amico et al. (2009) note that most mass strandings of beaked whales are unassociated with documented sonar activities, lethal or sub-lethal effects of such activities would rarely be documented, due to the remote nature of such activities and the low probability that an injured or dead beaked whale would strand. Filadelpho et al. (2009) reported statistically significant correlations between military sonar use and mass strandings of beaked whales in the Mediterranean and Caribbean Seas, but not in Japanese and Southern California waters, and hypothesized that regions with steep bathymetry adjacent to coastlines are more conducive to stranding events in the presence of sonar use. In Hawaiian waters, Faerber & Baird (2010) suggest that the probability of stranding is lower than in some other regions due to nearshore currents carrying animals away from beaches, and that stranded animals are less likely to be detected due to low human population density near many of Hawaii's beaches. Actual and simulated sonar are known to interrupt the foraging dives and echolocation activities of tagged beaked whales (Tyack et al. 2011, DeRuiter et al. 2013). Cuvier's beaked whales tagged and tracked during simulated mid-frequency sonar exposure showed avoidance reactions, including prolonged diving, cessation of echolocation click production associated with foraging, and directional travel away from the simulated sonar source (DeRuiter et al. 2013). Blainville's beaked whale presence was monitored on hydrophone arrays before, during, and after sonar activities on a Caribbean military range, with evidence of avoidance behavior: whales were detected throughout the range prior to sonar exposure, not detected in the center of the range coincident with highest sonar use, and gradually returned to the range center after the cessation of sonar activity (Tyack et al. 2011). Fernández et al. (2013) report that there have been no mass strandings of beaked whales in the Canary Islands following a 2004 ban on sonar activities in that region. The absence of beaked whale bycatch in California drift gillnets following the introduction of acoustic pingers into the fishery implies additional sensitivity of beaked whales to anthropogenic sound (Carretta et al. 2008, Carretta and Barlow 2011). The impact of sonar exercises on resident versus offshore beaked whales may be significantly different with offshore animals less frequently exposed, and possibly subject to more extreme reactions (Baird *et al.* 2009). No estimates of potential mortality or serious injury are available for U.S. waters.

STATUS OF STOCK

The Hawaii stock of Blainville's beaked whales is not considered strategic under the 1994 amendments to the MMPA The status of Blainville's beaked whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Blainville's beaked whales are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. Given the absence of recorded recent fishery-related mortality or serious injuries within U.S. EEZs, the total fishery mortality and serious injury can be considered to be insignificant and approaching zero. The impacts of anthropogenic sound on beaked whales remain a concern (Barlow and Gisiner 2006, Cox et al. 2006, Hildebrand et al. 2005, Weilgart 2007). One Blainville's beaked whale found stranded on the main Hawaiian Islands has tested positive for *Morbillivirus* (Jacob 2012). Although *morbillivus* is known to trigger lethal disease in cetaceans (Van Bressem et al. 2009), its impact on the health of the stranded animal is not known as it was found in only a few tested tissues (Jacob 2012). The presence of *morbillivirus* in 10 species of cetacean in Hawaiian waters, including all 3 known species of beaked whales (Jacob 2012), raises concerns about the history and prevalence of this disease in Hawaii and the potential population impacts on Hawaiian cetaceans.

REFERENCES

Anderson, M.S., K.A. Forney, T.V.N. Cole, T. Eagle, R.P. Angliss, K. Long, L. Barre, L. VanAtta, D. Borggaard, T. Rowles, B. Norberg, J. Whaley, L. Engleby. Differentiating serious and non-serious injury of marine mammals: Report of the Serious Injury Technical Workshop 10-13 September 2007, Seattle, WA. NOAA Tech Memo NMFS-OPR-39, 108 p.

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.

Anon. 2001. Joint Interim Report, Bahamas Marine Mammal Stranding Event of 15_16 March 2000. Available from NOAA, NMFS, Office of Protected Resources, Silver Spring, MD.

Baird, R.W., G.S. Schorr, D.L. Webster, S.D. Mahaffy, D.J. McSweeney, M.B. Hanson, and R.D. Andrews. 2011. Open-ocean movements of a satellite-tagged Blainville's beaked whale (*Mesoplodon densirostris*); Evidence for an offshore population in Hawaii? Aquatic Mammals 37(4): 506-511.

Baird, R.W., G.S. Schorr, D.L. Webster, S.D. Mahaffy, D.J. McSweeney, M.B. Hanson, and K.D. Andrews. 2009. Movements of satellite-tagged Cuvier's and Blainville's beaked whales in Hawaii: Evidence for an offshore population of Blainville's beaked whales. Report to Southwest Fisheries Science Center, 15p.

Baird, R.W., G.S. Schorr, M.B. Hanson, D.L. Webster, S.D. Mahaffy, D.J. McSweeney, and R.D. Andrews. 2013. Niche partitioning of beaked whales: Comparing diving behavior and habitat use of Cuvier's and Blainville's beaked whales off the Island of Hawaii. Draft document PSRG-2013-B09 presented to the Pacific Scientific Review Group, April 2-4, 2013. Del Mar, CA.

Baird, R.W., D.L. Webster, J.M. Aschettino, G.S. Schorr, D.J. McSweeney. 2013. Odontocete cetaceans around the main Hawaiian Islands: Habitat use and relative abundance from small-boat sighting surveys. Aquatic Mammals 39:253-269.

Barlow, J. and R. Gisiner. 2006. Mitigating, monitoring, and assessing the effects of anthropogenic sound on beaked whales. J. Cet. Res. Manage. 7(3):239-249.

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.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.

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., K.A. Forney, E.M. Oleson, and J. Barlow. 2013. Line-transect abundance estimates of cetaceans in the Hawaiian EEZ. PIFSC Working Paper WP-13-004.

Carretta, J., J. Barlow, and L. Enriquez. 2008. Acoustic pingers eliminate beaked whale bycatch in a gillnet fishery. Marine Mammal Science 24(4): 956-961.

Carretta, J.V. and J. Barlow. 2011. Long-term effectiveness, failure rates, and "dinner bell" properties of acoustic pingers in a gillnet fishery. Marine technology Society Journal 45(5): 7-19.

Cox, T.M., T.J. Ragen, A.J. Read, E. Vos, R.W. Baird, K. Balcomb, J. Barlow, J. Caldwell, T. Cranford, L. Crum, A. D'Amico, G. D'Spain, A. Fernandez, J. Finneran, R. Gentry, W. Gerth, F. Gulland, J.A. Hildebrand, D. Houser, T. Hullar, P.D. Jepson, D. Ketten, C.D. Macleod, P. Miller, S. Moore, D. Mountain, D. Palka, P. Ponganis, S. Rommel, T. Rowles, B. Taylor, P. Tyack, D. Wartzok, R. Gisiner, J. Mead, and L. Brenner. 2006. Understanding the impacts of anthropogenic sound on beaked whales. J.Cetacean Res. Manag. 7: 177-187.

D'Amico A., Gisiner R.C., Ketten D.R., Hammock J.A., Johnson C., et al. 2009. Beaked whale strandings and naval exercises. Aquat. Mamm. 34: 452–472.

DeRuiter, S.L., Southall B.L.,Calambokidis J., Zimmer W.M.X., Sadykova D., Falcone E.A., Friedlaender A.S., Joseph J.E., Moretti D., Schorr G.S., Thomas L., Tyack P.L. 2013. First direct measurements of behavioural responses by Cuvier's beaked whales to mid-frequency active sonar. Biol Lett 9: 20130223. http://dx.doi.org/10.1098/rsbl.2013.0223

Faerber, M.M. and R.W. Baird. 2010. Does a lack of observed beaked whale strandings in military exercise areas mean no impacts have occurred? A comparison of stranding and detection probabilities in the Canary and main Hawaiian Islands. Mar. Mamm. Sci. 26(3); 602-613.

Fernández, A., Arbelo, M. and Martín, V. 2013. No mass strandings since sonar ban. Nature 497:317.

Filadelfo R., Mintz J., Michlovich E., D'Amico A., Tyack P.L. 2009. Correlating military sonar use with beaked whale mass strandings: what do the historical data show? Aquat. Mamm. 34: 435–444.

Frantzis, A. 1998. Does acoustic testing strand whales? Nature 392(5):29.

Galbreath, E. C. 1963. Three beaked whales stranded on the Midway Islands, central Pacific Ocean. J. Mamm. 44:422-423.

Hildebrand J.A. 2005. Impacts of anthropogenic sound. In: Reynolds III J.E., Perrin W.F., Reeves R.R., Montgomery S., Ragen T.J., editors. Marine mammal research: conservation beyond crisis. Baltimore: Johns Hopkins University. pp. 101 – 123.

Jacob, J. M. 2012. Screening and characterization of morbillivirus in Hawaiian cetaceans. M.S. Marine Science Thesis. Hawaii Pacific University, Kaneohe, HI,

Jepson, P.D., M. Arbelo, R. Deaville, I. A.P. Patterson, P. Castro, J.R. Baker, E. Degollada, H.M. Ross, P. Herraez, A.M. Pocknell, F. Rodriguez, F.E. Howie, A. Espinoza, R.J. Reid, J.R. Jaber, V. martin, A.A. Cunningham, and A. Fernandez. 2003. "Gas-bubble lesions in stranded cetaceans." *Nature* 425, no. 6958 (2003): 575-576.

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.

McSweeney, D.J., R.W. Baird, and S.D. Mahaffy. 2007. Site fidelity, associations, and movements of Cuvier's (*Ziphius cavirostris*) and Blainville's (*Mesoplodon densirostris*) beaked whales off the island of Hawaii. Mar. Mamm. Sci. 23(3):666-687.

Mead, J. G. 1989. Beaked whales of the genus *Mesoplodon. In*: S. H. Ridgway and R. Harrison (eds.), Handbook of Marine Mammals, Vol. 4: The River Dolphins and Larger Toothed Whales, pp. 349-430. Academic Press, 442 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.

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

Richardson, W.J., C.R. Greene, Jr., C.I. Malme, and D.H. Thompson. 1995. Marine Mammals and Noise. Academic Press, San Diego. 576 p.

Schorr, G.S., R.W. Baird, M.B. Hanson, D.L. Webster, D.J. McSweeney, and R.D. Andrews. 2009. Movements of satellite-tagged Blainville's beaked whales off the island of Hawaii. Endangered Species Res.10:203-213.

Simmonds, M. P., and L.F. Lopez-Jurado. 1991. Whales and the military. Nature, 351(6326): 448.Shallenberger, E. W. 1981. The status of Hawaiian cetaceans. Final report to U.S. Marine Mammal Commission. MMC-77/23, 79pp.

Tyack, P. L., W.M.X. Zimmer, D.Moretti, B.L. Southall, D.E. Claridge, J.W. Durban, C. W. Clark, A. D'Amico, N. DiMarzio, S. Jarvis, E. McCarthy, R. Morrissey, J. Ward, and I.L. Boyd. 2011. Beaked whales respond to simulated and actual navy sonar. PLoS One 6(3): e17009.

Van Bressem, M., J.A. Raga, G. Di Guardo, D.P. Jepson, P. J. Duignan, U. Siebert, T. Barrett, M. C. de Oliveira Santos, I.B. Moreno, S. Siciliano, A. Aguilar, K. Van Waerebeer. 2009. Emerging infectious diseases in cetaceans worldwide and the possible role of environmental stressors. Diseases of Aquatic Organisms. 85:143-157.

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.

Weilgart, L.S. 2007. The impacts of anthropogenic ocean noise on cetaceans and implications for management. Canadian Journal of Zoology 85:1091-1116.