

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.* 2017).

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). Twelve Blainville's beaked whales linked to the social network have been satellite tagged off Hawaii Island. All 12 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, Abecassis *et al.* 2015). 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). An assessment of foraging hotspots off Hawaii Island revealed tight association between satellite-tagged Blainville's beaked whales and the 250-2500m depth contour and the occurrence of the island-associated deep mesopelagic boundary community (Abecassis *et al.* 2015). The available movement, social structure, and habitat data suggest there is likely a separate island-associated population of Blainville's beaked whales within the MHI. Formal assessment of demographic-independence has not been completed, but 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).

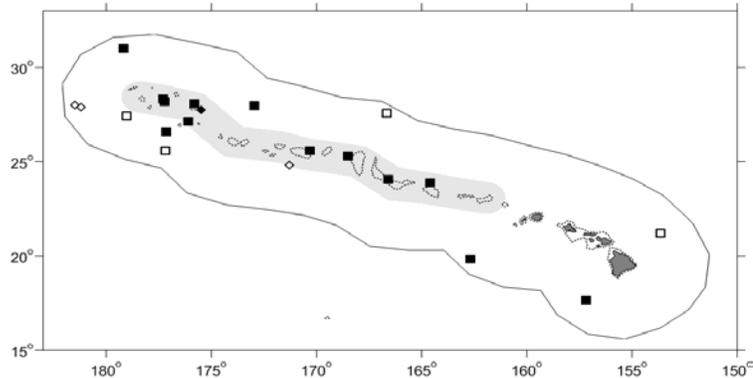


Figure 1. Sighting locations of *Mesoplodon densirostris* (diamonds) and unidentified *Mesoplodon* beaked whales (squares) during the 2002 (open symbols) and 2010 (black symbols) shipboard cetacean surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006, Bradford *et al.* 2017; see Appendix 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 Papahānaumokuākea Marine National Monument. Dotted line represents the 1,000m isobath.

POPULATION SIZE

Encounter data from a 2010 shipboard line-transect survey of the entire Hawaiian Islands EEZ was recently reevaluated using Beaufort sea-state-specific trackline detection probabilities for beaked whales. The new $g(0)$ values allow for use of all on-effort survey data, and resulted in an abundance estimate of 2,105 (CV = 1.13) Blainville's beaked whales (Bradford *et al.* 2017) in the Hawaii stock. A 2002 shipboard line-transect survey of the same region resulted in an abundance estimate of 2,872 (CV=1.17) Blainville's beaked whales (Barlow 2006). Species abundances estimated from the 2002 HICEAS survey used species-specific $g(0)$ values (Barlow 1999) (the probability of sighting and recording an animal directly on the track line) and limited the encounter data to beaufort 0-2 (Barlow 2006). Since then, Barlow (2015) developed a more robust method for estimating species-specific $g(0)$ values that are adjusted for the Beaufort sea states that are encountered during a survey. This new method was used for analyzing the data from the 2010 survey, but has not yet been used to analyze the 2002 data.

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 980 Blainville's beaked whales within the Hawaiian Islands EEZ.

Current Population Trend

Abundance analyses of the 2002 and 2010 datasets used different $g(0)$ values. This change in analysis methodology resulted in far less extrapolation over the survey area. The 2002 survey data have not been reanalyzed using this method. This change precludes evaluation of population trends at this time. Assessment of population trend will likely require additional survey data and reanalysis of all datasets using comparable methods.

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 (980) times one half the default maximum net growth rate for cetaceans ($\frac{1}{2}$ of 4%) times a recovery factor of 0.50 (for a 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 10 Hawaii Blainville's beaked whales per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

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.

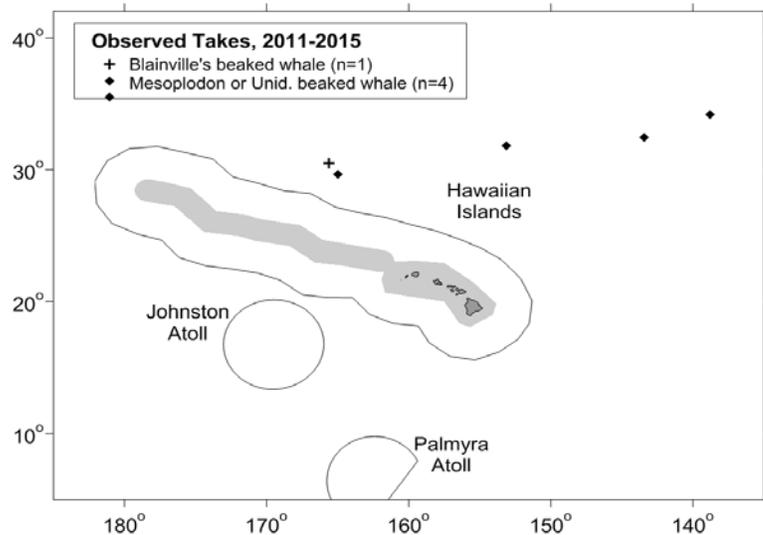


Figure 2. Location of the Blainville's beaked whale take (cross) and the possible takes of this species (filled diamond) in Hawaii-based longline fisheries, 2011-2015. Solid lines represent the U.S. EEZ. Gray shading notes areas closed to longline fishing. Fishery descriptions are provided in Appendix 1.

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 2017). Mean annual takes are based on 2011-2015 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.

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 Blainville's beaked whales (MD), unidentified Mesoplont whales (UM) and unidentified beaked whales (ZU)			
				Outside U.S. EEZs		Hawaiian EEZ	
				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	2011	Observer data	20%	0	0 (-)	0	0 (-)
	2012		20%	0	0 (-)	0	0 (-)
	2013		20%	0	0 (-)	0	0 (-)
	2014		21%	0	0 (-)	0	0 (-)
	2015		21%	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	2011	Observer data	100%	1/0 2/2	0 2	0	0
	2012		100%	0	0	0	0
	2013		100%	0 2/1	0 1	0	0
	2014		100%	0	0	0	0
	2015		100%	0	0	0	0
Mean Annual MD Takes (100% coverage)					0		0
Mean Annual UM + ZU Takes (100% coverage)					0.6		0
Minimum total annual MD takes within U.S. EEZ							0 (-)

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 (SSL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2011 and 2015, no Blainville’s beaked whale was observed killed or seriously injured in the SSL fishery (100% observer coverage) or the DSLL fishery (20-22% observer coverage) (Bradford 2017, Bradford and Forney 2017, McCracken 2017) within the Hawaiian EEZ. One Blainville’s beaked whale was observed taken, but not seriously injured, on the high seas in the SSL fishery (Bradford 2017, Bradford and Forney 2017). One unidentified *Mesoplodon* whale and two unidentified beaked whale were taken outside of the Hawaiian EEZ in the SSL fishery and all were considered to be seriously injured. Average 5-yr estimates of annual mortality and serious injury for 2011-2015 are zero Blainville’s beaked whales within or outside of the U.S. EEZs, and 0.6 (CV = 0) *Mesoplodon* or unidentified beaked whales outside the U.S. EEZs (Table 1). Four unidentified cetaceans were taken in the DSLL fishery, and one unidentified cetacean was taken in the SSL fishery, some of

which may have been Blainville's beaked whales (Bradford 2017, Bradford and Forney 2017).

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 *et al.* 2016). The presence of *morbillivirus* in the 3 known species of beaked whales in Hawaiian waters, raises concerns about the history and prevalence of this disease in Hawaii and the potential population impacts, including the cumulative impacts of disease with other stressors.

REFERENCES

- Abecassis, M., J. Polovina, R.W. Baird, A. Copeland, J.C. Drazen, R. Domokos, E.M. Oleson, Y. Jia, G.S. Schorr, D.L. Webster, D. Andrews. 2015. Characterizing a foraging hotspot for short-finned pilot whales and Blainville's beaked whales located off the west side of Hawaii Island by using tagging and oceanographic data. *PLoS ONE* 10(11): e0142628, doi:10.1371/journal.pone.0142628.
- 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 1999. Trackline detection probability for long diving whales. In *Marine mammal survey and assessment methods* (G. W. Garner, S. C. Amstrup, J. L. Laake, B. F.J. Manly, L. L. McDonald, and D. G. Robertson, eds).
- Barlow, J. 2006. Cetacean abundance in Hawaiian waters estimated from a summer/fall survey in 2002. *Marine Mammal Science* 22: 446–464.
- Barlow 2015. Inferring trackline detection probabilities, $g(0)$, for cetaceans from apparent densities in different survey conditions. *Mar. Mamm. Sci.* 31:923–943.
- 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. 2017. Injury Determinations for Marine Mammals Observed Interacting with Hawaii and American Samoa Longline Fisheries During 2015–2016. NOAA Tech Memo NMFS-PIFSC-xxx.
- Bradford, A.L. and K.A. Forney. In press. Injury determinations for cetaceans observed interacting with Hawaii and American Samoa longline fisheries during 2010-2014. NOAA-TM-NMFS-PIFSC-62, doi:10.7289/V5/TM-PIFSC-62
- Bradford, A.L., K.A. Forney, J. E.M. Oleson, J. Barlow. 2017. Abundance estimates of cetaceans from a line-transect survey within the U.S Hawaiian Islands Exclusive Economic Zone. *Fishery Bulletin* 115: 129-142.
- 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 JE, Perrin WF, Reeves RR, Montgomery S, Ragen TJ, editors. *Marine mammal research: conservation beyond crisis*. Baltimore: Johns Hopkins University. pp. 101 – 123.
- Jacob, J.M., K.L. West, G. Levine, S. Sanchez, B.A. Jensen. 2016. Initial characterization of novel beaked whale morbillivirus in Hawaiian cetaceans. *Disease of Aquatic Organisms* 117:215-227. doi:10.3354/dao02941.
- Jepson, P.D., M. Arbelo, R. Deaville, I. A.P. Patterson, P. Castro, J.R. Baker, E. Degollada, H.M. Ross, P. Herraéz, 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. 2017. Preliminary assessment of incidental interactions with marine mammals in the Hawaii longline deep and shallow set fisheries from 2011 to 2015. PIFSC Internal Report IR-17-003.
- 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.](#)
- 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.
- 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.