Revised 6/4/2014

HARBOR PORPOISE (*Phocoena phocoena*): Northern Oregon/Washington Coast Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the eastern North Pacific Ocean, harbor porpoise are found in coastal and inland waters from Point Barrow, along the Alaskan coast, and down the west coast of North America to Point Conception, California (Gaskin 1984). Harbor porpoise are known to occur year-round in the inland trans-boundary waters of Washington and British Columbia, Canada (Osborne *et al*. 1988) and along the Oregon/Washington coast (Barlow 1988, Barlow *et al*. 1988, Green *et al*. 1992). Aerial survey data from coastal Oregon and Washington, collected during all seasons, suggest that harbor porpoise distribution varies by depth (Green *et al*. 1992). Although distinct seasonal changes in abundance along the west coast have been noted, and attributed to possible shifts in distribution to deeper offshore waters during late winter (Dohl *et al*. 1983, Barlow 1988), seasonal movement patterns are not fully understood.

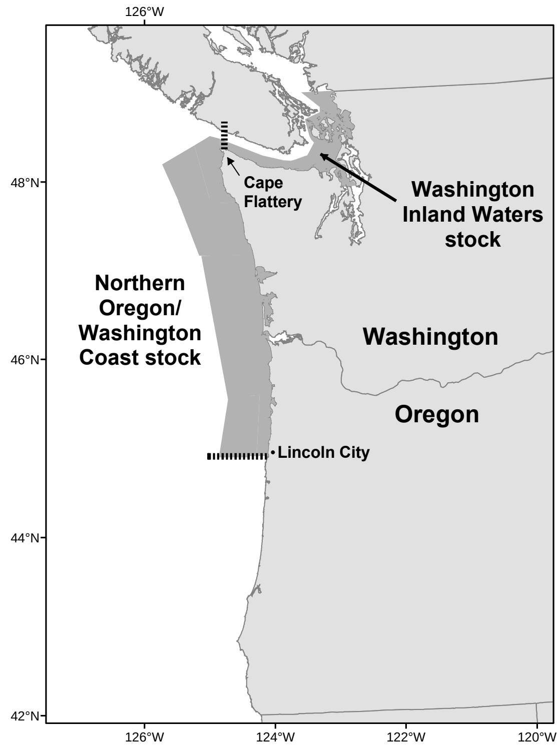

Figure 1. Stock boundaries (dashed lines) and approximate distribution (shaded areas) of harbor porpoise along the coasts of Washington and northern Oregon.

Investigation of pollutant loads in harbor porpoise ranging from California to the Canadian border suggests restricted harbor porpoise movements (Calambokidis and Barlow 1991). Stock discreteness in the eastern North Pacific was analyzed using mitochondrial DNA from samples collected along the west coast (Rosel 1992) and is summarized in Osmek *et al*. (1994). Two distinct mtDNA groupings or clades exist. One clade is present in California, Washington, British Columbia, and Alaska (no samples were available from Oregon), while the other is found only in California and Washington. Although these two clades are not geographically distinct by latitude, the results may indicate a low mixing rate for harbor porpoise along the west coast of North America. Further genetic testing of the same data, along with additional samples, found significant genetic differences for four of the six pair-wise comparisons between the four areas investigated: California, Washington, British Columbia, and Alaska (Rosel *et al*. 1995). These results demonstrate that harbor porpoise along the west coast of North America are not panmictic or migratory and that movement is sufficiently restricted that genetic differences have evolved. Recent preliminary genetic analyses of samples ranging from Monterey Bay, California, to Vancouver Island, British Columbia, indicate that there is small-scale subdivision within the U.S. portion of this range (Chivers *et al*. 2002, 2007). This is consistent with low movement suggested by genetic analysis of harbor porpoise specimens from the North Atlantic, where numerous stocks have been delineated with clinal differences over areas as small as the waters surrounding the British Isles.

Using the 1990-1991 aerial survey data of Calambokidis *et al*. (1993) for water depths <50 fathoms, Osmek *et al*. (1996) found significant differences in harbor porpoise mean densities ($Z=6.9$, $P<0.001$) between the waters of coastal Oregon/Washington and inland Washington/southern British Columbia, Canada (i.e., Strait of Juan de Fuca/San Juan Islands). Following a risk-averse management strategy, two stocks were recognized in the waters of Oregon and Washington, with a boundary at Cape Flattery, Washington. Based on recent genetic evidence, which suggests that the population of eastern

North Pacific harbor porpoise is more finely structured (Chivers *et al*. 2002, 2007), stock boundaries on the Oregon/Washington coast have been revised, resulting in three stocks in Oregon/Washington waters: a Northern California/Southern Oregon stock (Point Arena, CA, to Lincoln City, OR), a Northern Oregon/Washington Coast stock (Lincoln City, OR, to Cape Flattery, WA), and the Washington Inland Waters stock (in waters east of Cape Flattery). Additional analyses are needed to determine whether to adjust the stock boundaries for harbor porpoise in Washington inland waters (Chivers *et al*. 2007).

In their assessment of California harbor porpoise, Barlow and Hanan (1995) recommended two stocks be recognized in California, with the stock boundary at the Russian River. Based on recent genetic findings (Chivers *et al*. 2002, 2007), California coast stocks were re-evaluated and significant genetic differences were found among four identified sampling sites. Revised stock boundaries, based on these genetic data and density discontinuities identified from aerial surveys, resulted in six California/Oregon/Washington stocks where previously there had been four (e.g., Carretta *et al*. 2001): 1) the Washington Inland Waters stock, 2) the Northern Oregon/Washington Coast stock, 3) the Northern California/Southern Oregon stock, 4) the San Francisco-Russian River stock, 5) the Monterey Bay stock, and 6) the Morro Bay stock. The stock boundaries for animals that occur in northern Oregon/Washington waters are shown in Figure 1. This report considers only the Northern Oregon/Washington Coast stock. Stock assessment reports for Washington Inland Waters, Northern California/Southern Oregon, San Francisco-Russian River, Monterey Bay, and Morro Bay harbor porpoise also appear in this volume. Stock assessment reports for the three harbor porpoise stocks in the inland and coastal waters of Alaska, including 1) the Southeast Alaska stock, 2) the Gulf of Alaska stock, and 3) the Bering Sea stock, are reported separately in the Stock Assessment Reports for the Alaska Region. The harbor porpoise occurring in British Columbia have not been included in any of the U.S. stock assessment reports.

POPULATION SIZE

Two separate aerial surveys for leatherback turtles were conducted during 2010 and 2011 from the coast approximately to the 2,000 m isobath between Cape Blanco, Oregon, and Cape Flattery, Washington. Some additional adaptive surveys were conducted in areas of special interest for leatherback turtles; although these transects were not included in the analysis, the corresponding harbor porpoise sightings were included for estimation of the detection function in this study. Using a correction factor of 3.42 (1/g(0); g(0)=0.292, CV=0.366) (Laake *et al*. 1997a), to adjust for groups missed by aerial observers, the corrected estimate of abundance for harbor porpoise in the coastal waters of northern Oregon (north of Lincoln City) and Washington in 2010-2011 is 21,487 (CV = 0.44) (Forney et al. 2013).

Minimum Population Estimate

The minimum population estimate for this stock is calculated as the lower 20th percentile of the log-normal distribution (Wade and Angliss 1997) of the 2010-2011 population estimate of 21,487, which is 15,123 harbor porpoise.

Current Population Trend

There are no reliable data on population trends of harbor porpoise for coastal Oregon, Washington, or British Columbia waters; however, the uncorrected estimates of abundance for the Northern Oregon/Washington Coast stock in 1997 (6,406; SE=826.5) and 2002 (4,583) were not significantly different (Z=-1.73, P=0.08), although the survey area in 1997 (Regions I-S through III) was slightly larger than in 2002 (Strata D-G) (Laake *et al*. 1998a; J. Laake, unpublished data). The 2010-2011 Northern Oregon/Washington Coast stock estimate (21,487, CV = 0.44) is greater than the previous 2002 estimate of 15,674 (CV = 0.39), but the previous estimate is within the confidence limit of the current abundance estimate (Forney et al. 2013).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Based on what are argued to be biological limits of the species (i.e. females give birth first at age 4 and produce one calf per year until death), the theoretical, maximum-conceivable growth rate of a closed harbor porpoise population was estimated as 9.4% per year based on a human survivorship curve (Barlow and Boveng 1991). This maximum theoretical rate represents maximum survival in a protected environment and may not be achievable for any wild population (Barlow and Boveng 1991). Woodley and Read (1991) calculate a maximum growth rate of approximately 5% per year, but their argument for this being a maximum (i.e. that porpoise survival rates cannot exceed those of Himalayan thar) is not well justified. Population growth rates have not actually been measured for any harbor porpoise population. Because a reliable estimate of the maximum net productivity rate is not available for harbor porpoise, we use the default maximum net productivity rate (R_{MAX}) of 4% for cetaceans (Wade and Angliss 1997).

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (15,123) times one-half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.5 (for a stock of unknown status, Wade and Angliss 1997), resulting in a PBR of 151 harbor porpoise per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fisheries Information

Within the EEZ boundaries of the coastal waters of northern Oregon and Washington, harbor porpoise deaths are known to occur in the northern Washington marine set gillnet tribal fishery. Total fishing effort in this fishery is conducted within the range of both harbor porpoise stocks (Northern Oregon/Washington Coast and Washington Inland Waters) occurring in Washington State waters (Gearin *et al.* 1994). Some movement of harbor porpoise between Washington's coastal and inland waters is likely, but it is currently not possible to quantify the extent of such movements. For the purposes of this stock assessment report, the animals taken in waters south and west of Cape Flattery, WA, are assumed to have belonged to the Northern Oregon/Washington Coast stock, and Table 1 includes data only from that portion of the fishery. Fishing effort in the coastal marine set gillnet tribal fishery has declined since 2004. A test set gillnet fishery, with 100% observer coverage, was conducted in coastal waters in 2008 and 2011. This test fishery required the use of nets equipped with acoustic alarms, and no harbor porpoise deaths were reported (Makah Fisheries Management, unpublished data). The mean estimated mortality for this fishery in 2007-2011 is 0 (CV=0) harbor porpoise per year from observer data.

Table 1. Summary of incidental mortality and serious injury of harbor porpoise (Northern Oregon/Washington Coast stock) in commercial and tribal fisheries that might take this species and calculation of the mean annual mortality rate; n/a indicates that data are not available. Mean annual takes are based on 2007-2011 data unless noted otherwise.

Fishery name	Years	Data type	Percent observer coverage	Observed mortality	Estimated mortality	Mean annual takes (CV in parentheses)
Northern WA marine set gillnet (tribal test fishery in coastal waters)[1]	2007 2008 2009 2010 2011	observer	no fishery 100% no fishery 100% no fishery	0 0 0 0 0	0 (0) 0 (0) 0 (0) 0 (0) 0 (0)	0 (0)
Unknown West Coast fisheries	2007-2011	stranding		2, 1, 3, 3, 6	n/a	>3.0 (n/a)
Minimum total annual takes						>3.0 (n/a)

[1]This is a tribal fishery; therefore, it is not listed in the NMFS list of commercial fisheries.

In 1995-1997, data were collected for the coastal portions (areas 4 and 4A) of the northern Washington marine set gillnet fishery as part of an experiment, conducted in cooperation with the Makah Tribe, designed to explore the merits of using acoustic alarms to reduce bycatch of harbor porpoise in salmon gillnets. Results in 1995-1996 indicated that the nets equipped with acoustic alarms had significantly lower entanglement rates, as only 2 of the 49 deaths occurred in alarmed nets (Gearin *et al.* 1996, 2000; Laake *et al.* 1997b). In 1997, 96% of the sets were equipped with acoustic alarms and 13 deaths were observed (Gearin *et al.* 2000; P. Gearin, unpublished data). Harbor porpoise were displaced by an acoustic buffer around the alarmed nets, but it is unclear whether the porpoise or their prey were repelled by the alarms (Kraus *et al.* 1997, Laake *et al.* 1998b). However, the acoustic alarms did not appear to affect the target catch (chinook salmon and sturgeon) in the fishery (Gearin *et al.* 2000). For the past decade, Makah tribal regulations have required nets set in coastal waters (areas 4 and 4A) to be equipped with acoustic alarms.

According to Northwest Marine Mammal Stranding Network records, maintained by the NMFS Northwest Region (NMFS, Northwest Regional Office, unpublished data), there were 15 fishery-related strandings of harbor porpoise from this stock reported on the northern Oregon/Washington coast in 2007-2011 (2 in 2007, 1 in 2008, 3 in 2009, 3 in 2010, and 6 in 2011), resulting in a mean annual mortality of 3.0 harbor porpoise in 2007-2011. Evidence of fishery interactions included net marks, rope marks, and knife cuts (Carretta et al. 2013). Since these deaths could not be attributed to a particular fishery, and were the only confirmed fishery-related deaths in this area in 2007-2011, they are listed in Table 1 as occurring in unknown West Coast fisheries. Seven additional strandings reported in 2007-2011 (2 in 2007, 1 in 2008, 1 in 2009 , and 3 in 2011) were considered possible fishery-related strandings but were not included in the estimate of mean annual mortality. This estimate is considered a minimum because not all stranded animals are found, reported, or examined for cause of death (via necropsy by trained personnel).

Other Mortality

A significant increase in the number of harbor porpoise strandings reported throughout Oregon and Washington in 2006 prompted the Working Group on Marine Mammal Unusual Mortality Events to declare an Unusual Mortality Event (UME) on 3 November 2006 (Huggins 2008). A total of 114 harbor porpoise strandings were reported and confirmed throughout Oregon/Washington coast and Washington inland waters in 2006 and 2007 (Huggins 2008). The cause of the UME has not been determined, and several factors, including contaminants, genetics, and environmental conditions, are still being investigated. Cause of death, determined for 48 of 81 porpoise that were examined in detail, was attributed mainly to trauma and infectious disease. Suspected or confirmed fishery interactions were the primary cause of adult/subadult traumatic injuries, while birth-related trauma was responsible for the neonate deaths. Although six of the Northern Oregon/Washington Coast harbor porpoise deaths examined as part of the UME were suspected to have been caused by fishery interactions, only two could be confirmed as fishery-related deaths; these two deaths are listed in Table 1 as occurring in unknown West Coast fisheries in 2007.

STATUS OF STOCK

Harbor porpoise are not listed as "depleted" under the MMPA or listed as "threatened" or "endangered" under the Endangered Species Act. Based on currently available data, the minimum annual level of total human-caused mortality and serious injury (3.0 per year) does not exceed the PBR (151). Therefore, the Northern Oregon/Washington Coast stock of harbor porpoise is not classified as "strategic." The minimum annual fishery mortality and serious injury for this stock (3.0) is not known to exceed 10% of the calculated PBR (15.1) and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate The status of this stock relative to its Optimum Sustainable Population (OSP) level and population trends is unknown.

REFERENCES

Barlow, J. 1988. Harbor porpoise, *Phocoena phocoena,* abundance estimation for California, Oregon, and Washington: I. Ship surveys. Fish. Bull. 86:417-432.

Barlow, J., and D. Hanan. 1995. An assessment of the status of harbor porpoise in central California. Rep. Int. Whal. Commn. Special Issue 16:123-140.

Barlow, J., C. W. Oliver, T. D. Jackson, and B. L. Taylor. 1988. Harbor porpoise, *Phocoena phocoena,* abundance estimation for California, Oregon, and Washington: II. Aerial surveys. Fish. Bull. 86:433-444.

Calambokidis, J., and J. Barlow. 1991. Chlorinated hydrocarbon concentrations and their use for describing population discreteness in harbor porpoises from Washington, Oregon, and California. Pp. 101-110, *In:* Reynolds, J. E., III, and D. K. Odell (eds.), Proceedings of the second marine mammal stranding workshop: 3-5 December 1987, Miami, Florida. U.S. Dep. Commer., NOAA Tech. Rep. NMFS 98.

Calambokidis, J., J. C. Cubbage, J. R. Evenson, S. D. Osmek, J. L. Laake, P. J. Gearin, B. J. Turnock, S. J. Jeffries, and R. F. Brown. 1993. Abundance estimates of harbor porpoise in Washington and Oregon waters. Final Report by Cascadia Research, Olympia, WA, to National Marine Mammal Laboratory, AFSC, NMFS, Seattle, WA. 55 pp.

Carretta, J. V., J. Barlow, K. A. Forney, M. M. Muto, and J. Baker. 2001. U.S. Pacific marine mammal stock assessments: 2001. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SWFSC-317. 280 pp.

Carretta, J. V., K. A. Forney, M. S. Lowry, J. Barlow, J. Baker, D. Johnston, B. Hanson, M. M. Muto, D. Lynch, and L. Carswell. 2009. U.S. Pacific marine mammal stock assessments: 2008. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SWFSC-434. 336 pp.

Carretta, J. V., S. M. Wilkin, M. M. Muto, and K. Wilkinson. 2013. Sources of human-related injury and mortality for U.S. Pacific west coast marine mammal stock assessments, 2007-2011. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SWFSC-514, 83 p.Chivers, S. J., A. E. Dizon, P. J. Gearin, and K. M. Robertson. 2002. Small-scale population structure of eastern North Pacific harbour porpoises (*Phocoena phocoena*) indicated by molecular genetic analyses. J. Cetacean Res. Manage. 4(2):111-122.

Chivers, S. J., B. Hanson, J. Laake, P. Gearin, M. M. Muto, J. Calambokidis, D. Duffield, T. McGuire, J. Hodder, D. Greig, E. Wheeler, J. Harvey, K. M. Robertson, and B. Hancock. 2007. Additional genetic evidence for population structure of *Phocoena phocoena* off the coasts of California, Oregon, and Washington. Southwest Fisheries Science Center Administrative Report LJ-07-08. 14 pp. Available at SWFSC, NMFS, 3333 North Torrey Pines Road, La Jolla, CA 92037.

Dohl, T.P., R. C. Guess, M. L. Duman, and R. C. Helm. 1983. Cetaceans of central and northern California, 1980-1983: status, abundance, and distribution. OCS Study MMS 84-0045. Pacific OCS Region Minerals Management Service, 1340 Sixth Street, Los Angeles, CA 90014. 284 pp.

Forney, K. A., J.V. Carretta, and S. R. Benson. 2013. Preliminary estimates of harbor porpoise abundance in Pacific Coast waters of California, Oregon and Washington, 2007-2012. Draft Document PSRG-2013-10 submitted to the Pacific Scientific Review Group, 2-4 April 2013, San Diego, CA.

Gaskin, D. E. 1984. The harbour porpoise *Phocoena phocoena* (L.): regional populations, status, and information on direct and indirect catches. Rep. Int. Whal. Commn. 34:569-586.

Gearin, P. J. National Marine Mammal Laboratory, AFSC, NMFS, 7600 Sand Point Way NE, Seattle, WA 98115.

Gearin, P. J., S. R. Melin, R. L. DeLong, H. Kajimura, and M. A. Johnson. 1994. Harbor porpoise interactions with a chinook salmon set-net fishery in Washington State. Rep. Int. Whal. Commn. Special Issue 15:427-438.

Gearin, P. J., M. E. Gosho, L. Cooke, R. DeLong, and J. Laake. 1996. Acoustic alarm experiment in the 1995 northern Washington marine setnet fishery: methods to reduce by-catch of harbor porpoise. Paper SC/48/SM10 presented to the International Whaling Commission, June 1996 (unpublished). 15 pp. Available at National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115.

Gearin, P. J., M. E. Gosho, J. L. Laake, L. Cooke, R. L. DeLong, and K. M. Hughes. 2000. Experimental testing of acoustic alarms (pingers) to reduce bycatch of harbour porpoise, *Phocoena phocoena*, in the state of Washington. J. Cetacean Res. Manage. 2(1):1-9.

Green, G.A., J.J. Brueggeman, R.A. Grotefendt, C.E. Bowlby, M. L. Bonnel, and K. C. Balcomb, III. 1992. Cetacean distribution and abundance off Oregon and Washington, 1989-1990. Ch. 1, *In:* Brueggeman, J. J. (ed.), Oregon and Washington marine mammal and seabird surveys. Final Report, OCS Study MMS 91-0093, Minerals Management Service, U.S. Dept. of Interior, Los Angeles, CA.

Huggins, J. 2008. Request for event closure: 2006-2007 Northwest harbor porpoise unusual mortality event. Unpublished Report by Cascadia Research Collective to NMFS, Northwest Regional Office. 11 pp. Available at NMFS, Northwest Regional Office, 7600 Sand Point Way NE, Seattle, WA 98115.

Kraus, S. D., A. J. Read, A. Solow, K. Baldwin, T. Spradlin, E. Anderson, and J. Williamson. 1997. Acoustic alarms reduce porpoise mortality. Nature 388:525.

Laake, J.L. National Marine Mammal Laboratory, AFSC, NMFS, 7600 Sand Point Way NE, Seattle, WA 98115.

Laake, J.L., J. Calambokidis, S. D. Osmek, and D. J. Rugh. 1997a. Probability of detecting harbor porpoise from aerial surveys: estimating g(0). J. Wildl. Manage. 61(1):63-75.

Laake, J.L., P.J. Gearin, M.E. Gosho, and R.L. DeLong. 1997b. Evaluation of effectiveness of pingers to reduce incidental entanglement of harbor porpoise in a set gillnet fishery. Pp. 75-81, *In:* Hill, P. S., and D. P. DeMaster (eds.), MMPA and ESA implementation program, 1996. AFSC Processed

Report 97-10. 255 pp. Available at National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115.

Laake, J.L., J. Calambokidis, and S. Osmek. 1998a. Survey report for the 1997 aerial surveys for harbor porpoise and other marine mammals of Oregon, Washington and British Columbia outside waters. Pp. 77-97, *In:* Hill, P. S., and D. P. DeMaster (eds.), MMPA and ESA implementation program, 1997. AFSC Processed Report 98-10. 246 pp. Available at National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115.

Laake, J.L., D.J. Rugh, and L.S. Baraff. 1998b. Observations of harbor porpoise in the vicinity of acoustic alarms on a set gillnet. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-84. 40 pp.

Makah Fisheries Management, P.O. Box 115, Neah Bay, WA 98357.

National Marine Fisheries Service (NMFS), Northwest Regional Office, 7600 Sand Point Way NE, Seattle, WA 98115.

Osborne, R., J. Calambokidis, and E. M. Dorsey. 1988. A Guide to Marine Mammals of Greater Puget Sound. Island Publishers, Anacortes, WA. 191 pp.

Osmek, S., P. Rosel, A. Dizon, and R. DeLong. 1994. Harbor porpoise, *Phocoena phocoena*, population assessment in Oregon and Washington, 1993. Pp. 1-14, *In:* Braham, H. W., and D. P. DeMaster (eds.), Marine mammal assessment program: status of stocks and impacts of incidental take, 1993. National Marine Mammal Laboratory – MMPA Studies of 1993, NMML, AFSC, NMFS, NOAA. 153 pp. Available at National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115.

Osmek, S., J. Calambokidis, J. Laake, P. Gearin, R. DeLong, J. Scordino, S. Jeffries, and R. Brown. 1996. Assessment of the status of harbor porpoise, *Phocoena phocoena,* in Oregon and Washington waters. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-76. 46 pp.

Rosel, P.E. 1992. Genetic population structure and systematic relationships of some small cetaceans inferred from mitochondrial DNA sequence variation. Ph.D. Thesis, University of California - San Diego, La Jolla, CA. 191 pp.

Rosel, P.E., A. E. Dizon, and M. G. Haygood. 1995. Variability of the mitochondrial control region in populations of the harbour porpoise, *Phocoena phocoena*, on inter-oceanic and regional scales. Can. J. Fish. Aquat. Sci. 52:1210-1219.

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.