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COMMON BOTTLENOSE DOLPHIN (*Tursiops truncatus*): California Coastal Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins are distributed world-wide in tropical and warm-temperate waters. In many regions, including California, separate coastal and offshore populations are known (Walker 1981; Ross and Cockcroft 1990; Van Waerebeek et al. 1990). The California coastal stock of bottlenose dolphins is distinct from the offshore stock, based on significant differences in genetics and cranial morphology (Perrin et al. 2011, Lowther-Thielking *et al.* 2015). Of 56 haplotypes found among coastal and offshore bottlenose dolphins in the region, only one is shared by both populations (Perrin et al. 2011). California coastal bottlenose dolphins are found within about one kilometer of shore (Hansen, 1990; Carretta et al. 1998; Defran and Weller 1999) from central California south into Mexican waters, at least as far south as San Quintin, Mexico (Figure 1). In southern California, animals are found within 500 m of the shoreline 99% of the time and within 250 m 90% of the time (Hanson and Defran 1993). Oceanographic events appear to influence the distribution of animals along the coasts of California and Baja California, Mexico, as indicated by a change in residency patterns along Southern California and a northward range extension into central California after the 1982-83 El Niño (Hansen and Defran 1990; Wells et al. 1990). Since the 1982-83 El Niño, which increased water temperatures off California, they have been consistently sighted in central California as far north as San Francisco. Photo-identification studies have documented north-south movements of coastal bottlenose dolphins (Hansen 1990; Defran et al. 1999), and monthly counts based on surveys between the U.S./Mexican border and Point Conception are variable (Carretta et al. 1998), indicating that animals are moving into and out of this area. There is little site fidelity of coastal bottlenose dolphins along the California coast; over 80% of the dolphins identified in Santa Barbara, Monterey, and Ensenada have also been identified off San Diego (Defran et al. 1999, Feinholz 1996, Defran *et al.* 2015). The area between Ensenada and San Quintin, Mexico may represent a southern boundary for the California coastal population, as very low rates of photo-ID overlap of individuals (3%) have been found between the two areas, compared to higher overlap rates to the north (Defran *et al.* 2015, Figure 1). Although coastal bottlenose dolphins are not restricted to U.S. waters, cooperative management agreements with Mexico exist only for the tuna purse seine fishery and not for other fisheries which may take this species. Therefore, the management stock includes only animals found within U.S. waters. For the Marine Mammal Protection Act (MMPA) stock assessment reports, bottlenose dolphins within the Pacific U.S. Exclusive Economic Zone are divided into seven stocks: 1) California coastal stock (this report), 2) California, Oregon and Washington offshore stock, and five stocks in Hawaiian waters: 3) Kauai/Niihau, 4) Oahu, 5) 4-Islands (Molokai, Lanai, Maui, Kahoolawe), 6) Hawaii Island and 7) the Hawaiian Pelagic Stock.

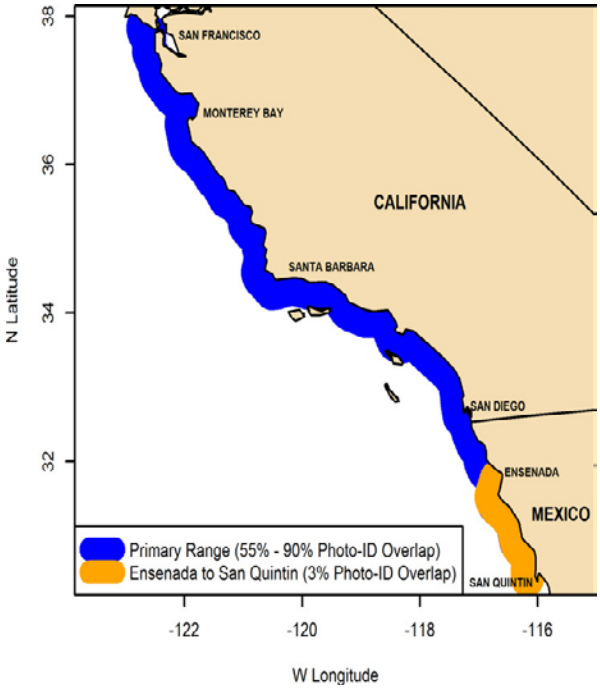

Figure 1. Approximate range of California coastal bottlenose dolphins, based on aerial and boat-based sighting surveys. This population of bottlenose dolphins is found within about 1 km of shore.

POPULATION SIZE

Based on photographic mark-recapture surveys conducted along the San Diego coast from 2009 to 2011 (Weller *et al.* 2016), two separate population size estimates were generated from open and closed

mark-recapture models. The best open model generated an estimate of 515 (95% CI = 470–564, CV= 0.05) animals, while the best closed model produced an estimate of 453 (95% CI = 411–524, CV=0.06) animals. These estimates are for *marked animals only* and do not include an estimated ~ 40% of animals that are not individually recognizable (Weller *et al.* 2016). The estimated fraction of unmarked animals is highly uncertain because it is unknown how often unmarked animals are resighted. The new estimates are the largest obtained for this stock, dating back to the 1980s (Defran and Weller 1999, Dudzik 1999, Dudzik *et al.* 2006). For comparison with previous estimates of this stock, the closed population estimate of 453 (CV=0.06) animals is used as the best estimate of abundance.

Minimum Population Estimate

The minimum population size is based on the minimum number of individually identifiable animals documented during surveys in 2009-2011, or 346 animals (Weller *et al*. 2016). This number of individually recognizable dolphins exceeds the number recorded in previous survey periods: 1984-1986 (160 dolphins); 1987-1989 (284); 1996-1998 (260); and 2004-2005 (164) (Weller *et al.* 2016).

Current Population Trend

Based on a comparison of mark-recapture abundance estimates for the periods 1987-89 ($\hat{N}$= 354), 1996-98 ($\hat{N}$= 356), and 2004-05 ($\hat{N}$= 323), Dudzik et al. (2006) stated that the population size had remained stable over this period. New estimates of 450 – 515 animals based on 2009-2011 surveys are the highest to date and include a high proportion (~75%) of previously uncatalogued dolphins (Weller *et al.* 2016). The number of individually-identifiable animals from 2009-2011 surveys (346) is equal to or exceeds previous mark-recapture *abundance estimates* for this stock. This suggests that the population may be growing, although the movement of dolphins north from Mexican waters may also contribute to the observed increase in unique individuals.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No information on current or maximum net productivity rates is available for California coastal bottlenose dolphins.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for this stock is calculated as the minimum population size (346) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.48 (for a species of unknown status with mortality rate CV $\geq$ 0.3 and $\leq$ 0.6; Wade and Angliss 1997), resulting in a PBR of 3.3 coastal bottlenose dolphins per year. Not all California coastal bottlenose dolphins are present in U.S. waters at any given moment and approximately 18% of the stock's range occurs in Mexican waters. Thus, the PBR is prorated by a minimum factor of 0.82 to account for time that animals spend outside of U.S. waters. Without additional data on the residence times of dolphins in Mexican waters, this factor cannot be improved upon. Because this stock spends some of its time outside the U.S. EEZ, the PBR allocation for U.S. waters is 3.3 x 0.82 = 2.7 dolphins per year.

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Due to its exclusive use of coastal habitats, this bottlenose dolphin population is susceptible to fishery-related mortality in coastal gillnet fisheries, such as the halibut and yellowtail set gillnet fishery, which was responsible for one documented coastal bottlenose dolphin death in 2003. Observer coverage in this fishery from 2010-2014 has been 9% (806 observed sets from an estimated 8,654 sets fished), with no observations of coastal bottlenose dolphin entanglements. Between 2010 and 2014, there were two fishery-related deaths of coastal bottlenose dolphins (stock ID confirmed via genetics, Lowther-Thielking *et al*. 2015). Both animals had evidence of entanglement with rope of unknown origin. A summary of information on fishery mortality and injury for this stock of bottlenose dolphin is shown in Table 1. Coastal gillnet fisheries exist in Mexico and may take animals from this population, but no details are available.

Human-caused mortality and injury documentation is often based on stranding data, where raw counts are negatively-biased because only a fraction of carcasses are detected (Williams *et al.* 2011), even for extremely coastal species (Wells *et al.* 2015). Carretta *et al*. (2016b) estimated the mean recovery rate of carcasses of California coastal bottlenose dolphins to be 25% (95% CI 20% - 33%). Given the extremely coastal habits of California coastal bottlenose dolphins, Carretta *et al*. (2016b) argue that carcass recovery

rates for this population represent a maximum rate, compared to more pelagic dolphin species in the region. Therefore, in this stock assessment report and others involving dolphins along the U.S. west coast, human-related deaths and injuries counted from beach strandings are multiplied by a factor of 4 to account for the non-detection of most carcasses (Carretta *et al*. 2016b).

Other removals

Seven coastal bottlenose dolphins were collected during the late 1950s in the vicinity of San Diego (Norris and Prescott 1961). Twenty-seven additional bottlenose dolphins were captured off California between 1966 and 1982 (Walker 1975; Reeves and Leatherwood 1984), but based on the locations of capture activities, these animals probably were offshore bottlenose dolphins (Walker 1975). No additional captures of coastal bottlenose dolphins have been documented since 1982, and no live-capture permits are currently active for this species.

In 2012, a coastal bottlenose dolphin (stock ID confirmed via genetics) was found floating under a U.S. Navy marine mammal program dolphin pen enclosure dock and was assumed to have become entangled in the net curtain (Carretta *et al.* 2016a). Another, presumed coastal bottlenose dolphin (based on proximity to shore) became entrapped and drowned in a sea otter research net in 2012. The average annual non-fishery related mortality and serious injury of coastal bottlenose dolphins from 2010-2014 is 0.4 animals (2 animals / 5 years).

Table 1. Summary of available information on the incidental mortality and serious injury of bottlenose dolphins (California Coastal Stock) in commercial fisheries that might take this species. Human-caused mortality values based on strandings recovered on the outer U.S. West Coast are multiplied by a correction factor of 4 to account for undetected mortality (Carretta *et al.* 2016b).

Fishery Name	Data Type	Year(s)	Percent Observer Coverage	Observed Mortality	Estimated Annual Mortality	Mean Annual Takes (CV in parentheses)
CA angel shark/ halibut and other species large mesh (>3.5in) set gillnet fishery	observer	2010-2014	9%	0	0	0
Unknown fishery	stranding	2010-2014	Two strandings with evidence of entanglement in rope or braided material.			≥ 0.4 x 4 (correction factor) = 1.6 (0.46)[1]
Minimum total annual takes (includes correction for unobserved beach strandings)						≥ 1.6 (0.46)

STATUS OF STOCK

The status of coastal bottlenose dolphins in California relative to OSP is not known, and there is no evidence of a trend in abundance. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. Coastal bottlenose dolphins are not classified as a "strategic" stock under the MMPA because total annual fishery (1.6) and other anthropogenic mortality (0.4) and serious injury for this stock (≥ 2.0 per year) is less than the PBR (2.7). The total human-caused mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero. Recent population size estimates of 450 to 515 marked individuals are the highest recorded to date (Weller *et al.* 2016), but it is unknown how much of this increase is due to population growth versus immigration.

Habitat Issues

Pollutant levels, especially DDT residues, found in Southern California coastal bottlenose dolphins have been found to be among the highest of any cetacean examined (O'Shea et al. 1980; Schafer et al. 1984). Although the effects of pollutants on cetaceans are not well understood, they may affect reproduction or make the animals more prone to other mortality factors (Britt and Howard 1983; O'Shea et al. 1999). This population of bottlenose dolphins may also be vulnerable to the effects of morbillivirus

[1] The coefficient of variation (CV) for corrected carcass counts was derived from the results of Carretta *et al*. (2016b), who estimated that 25% (95% CI = 20% - 33%) of all available carcasses were recovered / documented.

outbreaks, which were implicated in the 1987-88 mass mortality of bottlenose dolphins on the U.S. Atlantic coast (Lipscomb et al. 1994).

REFERENCES

Britt, J.O. and E. B. Howard. 1983. Tissue residues of selected environmental contaminants in marine mammals. *In:* Howard, E. B. (ed.), Pathobiology of Marine Mammal Diseases. CRC Press, Boca Raton, Florida.

Carretta, J. V., K. A. Forney and J. L. Laake. 1998. The abundance of southern California coastal bottlenose dolphins estimated from tandem aerial surveys. Mar. Mamm. Sci. 14:655-675.

Carretta, J.V., M.M. Muto, S. Wilkin, J. Greenman, K. Wilkinson, M. DeAngelis, J. Viezbicke, and J. Jannot. 2016a. Sources of human-related injury and mortality for U.S. Pacific west coast marine mammal stock assessments, 2010-2014. U.S. Department of Commerce, NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-554. 102 p.

Carretta, J.V., Danil, K., Chivers, S.J., Weller, D.W., Janiger, D.S., Berman-Kowalewski, M., Hernandez, K.M., Harvey, J.T., Dunkin, R.C., Casper, D.R., Stoudt, S., Flannery, M., Wilkinson, K., Huggins, J., and Lambourn, D.M. 2016b. Recovery rates of bottlenose dolphin (*Tursiops truncatus*) carcasses estimated from stranding and survival rate data. Marine Mammal Science, 32(1), pp. 349-362.Defran, R. H. and D. W. Weller. 1999. Occurrence, distribution, site fidelity and school size of bottlenose dolphins (*Tursiops truncatus*) off San Diego, California. Mar. Mamm. Sci. 15:366-380.

Defran, R. H., D. W. Weller, D. L. Kelly, and M. A. Espinosa. 1999. Range characteristics of Pacific coast bottlenose dolphins (*Tursiops truncatus*) in the Southern California Bight. Mar. Mamm. Sci. 15:381-393.

Defran, R. H., M. Caldwell, E. Morteo, A. R. Lang, M. G. Rice and D. W. Weller. 2015. Possible stock structure of coastal bottlenose dolphins off Baja California and California revealed by photo-identification research. Bulletin of the Southern California Academy of Sciences 14:1–11.

Dudzik, K.J. 1999. Population dynamics of the Pacific coast bottlenose dolphin (*Tursiops truncatus*). M.S. Thesis, San Diego State University, San Diego, California 92182. 63pp.

Dudzik, K.J., K.M. Baker, and D.W. Weller. 2006. Mark-recapture abundance estimate of California coastal stock bottlenose dolphins: February 2004 to April 2005. SWFSC Administrative Report LJ-06-02C, available from Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA 92037. 15p.

Feinholz, D.M. 1996. Pacific coast bottlenose dolphins (Tursiops truncatus) in Monterey Bay, California. M.S. Thesis, San Jose State University, San Jose, CA. 78p.

Forney, K.A., J. Barlow, M.M. Muto, M. Lowry, J. Baker, G. Cameron, J. Mobley, C. Stinchcomb, and J.V. Carretta. 2000. U.S. Pacific Marine Mammal Stock Assessments: 2000. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-300. 276p.

Hansen, L. J. 1990. California coastal bottlenose dolphins. *In*: S. Leatherwood and R.R. Reeves (eds.), The Bottlenose Dolphin, p. 403-420. Academic Press, Inc., San Diego.

Hansen, L. J. and R. H. Defran. 1990. A comparison of photo-identification studies of California coastal bottlenose dolphins. Rep. Int. Whal. Commn. Special Issue 12:101-104.

Hanson, M.T. and R.H. Defran. 1993. The behavior and feeding ecology of the Pacific coast bottlenose dolphin, *Tursiops truncatus*. Aquatic Mammals 19:127-142.

Lipscomb, T. P., F. Y. Schulman, D. Moffett, and S. Kennedy. 1994. Morbilliviral disease in Atlantic bottlenose dolphins (*Tursiops truncatus*) from the 1987-88 epizootic. Journal of Wildlife Diseases 30:567-571.

Lowther-Thieleking, J., F. Archer, A. Lang and D. Weller. 2015. Genetic differentiation among coastal and offshore bottlenose dolphins, Tursiops truncatus, in the eastern North Pacific Ocean. Marine Mammal Science 31:1–20.

O'Shea, T. J., R. L. Brownell, Jr., D. R. Clark, W. A. Walker, M. L. Gray, and T. G. Lamont. 1980. Organochlorine pollutants in small cetaceans from the Pacific and South Atlantic Oceans, November 1968-June 1976. Pesticides Monitoring Journal 14:35-46.

O'Shea, T. J., R. R. Reeves, and A. Kirk Long (eds.). 1999. Marine Mammals and Persistent Ocean Contaminants: Proceedings of the Marine Mammal Commission Workshop, Keystone, Colorado, 12-15 October 1998. Marine Mammal Commission, Bethesda, MD. 150pp.

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 27:769–792.

Norris, K. S. and J. H. Prescott. 1961. Observation on Pacific cetaceans of Californian and Mexican waters. University of California Publications in Zoology 63:291-402. University of California Press, Berkeley and Los Angeles.

Reeves, R. R. and S. Leatherwood. 1984. Live-capture fisheries for cetaceans in USA and Canadian waters, 1973-1982. Rep. Int. Whal. Commn. 34:497-507.

Ross, G.J.B. and V.G. Cockcroft. 1990. Comments on Australian bottlenose dolphins and the taxonomic status of *Tursiops aduncus* (Ehrenberg, 1832). *In*: The Bottlenose Dolphin (eds. S. Leatherwood and R. R. Reeves). pp. 101-128. Academic Press, 653pp.

Schafer, H. A., R.W. Gossett, C.F. Ward, and A.M. Westcott. 1984. Chlorinated hydrocarbons in marine mammals. Biennial Report, 1983-84, Southern California Coastal Water Research Project, Long Beach, California.

Van Waerebeek, K., J.C. Reyes, A.J. Read, and J.S. McKinnon. 1990. Preliminary observations of bottlenose dolphins from the Pacific coast of South America. *In*: The Bottlenose Dolphin (eds. S. Leatherwood and R. R. Reeves). pp. 143-154. Academic Press, 653 pp.

Walker, W.A. 1975. Review of the live-capture fishery for smaller cetaceans taken in Southern California waters for public display, 1966-77. J. Fish. Res. Board. Can. 32:1197-1211.

Walker, W.A. 1981. Geographical variation in morphology and biology of bottlenose dolphins (*Tursiops*) in the eastern North Pacific. Admin. Rep. LJ-81-03C. Southwest Fisheries Science Center, National Marine Fisheries Service, P.O. Box 271, La Jolla, CA 92038, USA. 52p.

Ward, B.G. 1999. Movement patterns and feeding ecology of the Pacific coast bottlenose dolphin (*Tursiops truncatus*). M.S. Thesis, San Diego State University, San Diego, California, 92182. 98pp.

Weller, D.W., G.S. Campbell, A. Debich, A.G. Kesaris, and R.H. Defran. 2016. Mark-recapture abundance estimate of California coastal stock bottlenose dolphins: November 2009 to April 2011. NOAA Technical Memorandum. NOAA-TM-NMFS-SWFSC-563. 18 p.

Wells, R. S., J. B. Allen, G. Lovewell, J. Gorzelany, R. E. Delynn, D. A. Fauquier and N. B. Barros. 2015. Carcass-recovery rates for resident bottlenose dolphins in Sarasota Bay, Florida. Marine Mammal Science 31:355–368.

Wells, R. S., L. J. Hansen, A. B. Baldridge, T. P. Dohl, D. L. Kelly and R. H Defran. *In*: S. Leatherwood and R. R. Reeves (eds.), The Bottlenose Dolphin, p. 421-431. Academic Press, Inc., San Diego.

Williams, R., S. Gero, L. Bejder, et al. 2011. Underestimating the damage: Interpreting cetacean carcass recoveries in the context of the Deepwater Horizon/BP incident. Conservation Letters 4:228–233.

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. Commerce, NOAA Tech. Memo. NMFS-OPR-12. 93 pp.