ATLANTIC SPOTTED DOLPHIN (*Stenella frontalis*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Atlantic spotted dolphins are distributed in tropical and warm temperate waters of the western North Atlantic (Leatherwood et al. 1976). Their distribution ranges from southern New England, south through the Gulf of Mexico and the Caribbean to at least Venezuela (Leatherwood et al. 1976; Perrin et al. 1994). Atlantic spotted dolphins regularly occur in continental shelf and continental slope waters (Figure 1; Payne et al. 1984; Mullin and Fulling 2003). Sightings have also been made along the north wall of the Gulf Stream and warm-core ring features (Waring et al. 1992). Because there are confirmed sightings within waters of Canada and the Bahamas, this is likely a transboundary stock (e.g., Halpin et al. 2009; Dunn 2013; DFO 2017; Emery 2020; Figure 1).

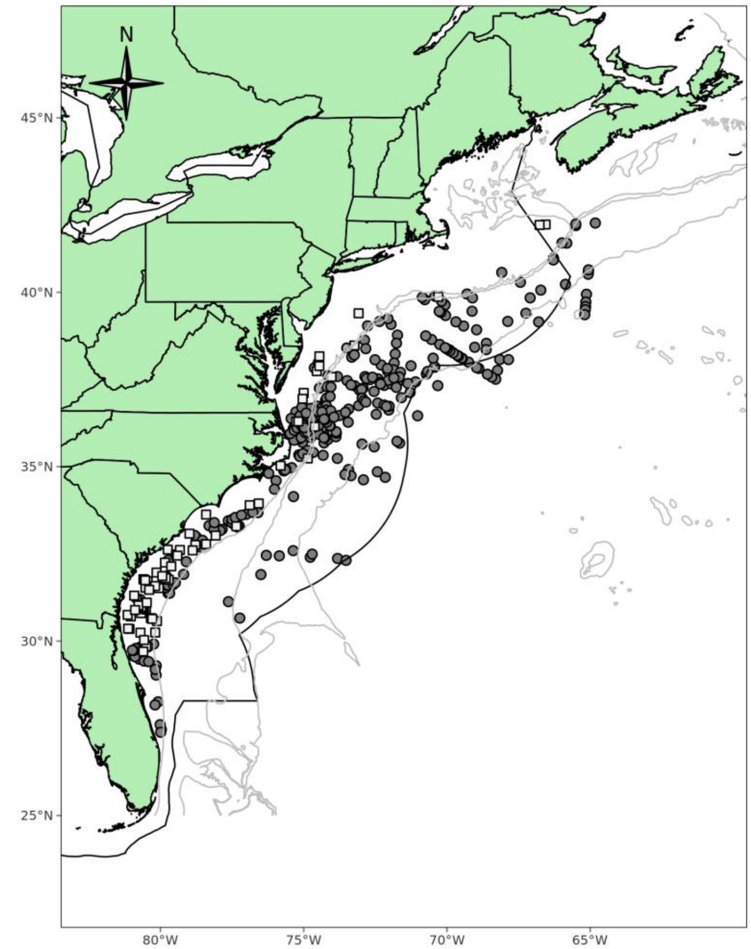

Figure 1. Distribution of Atlantic spotted dolphin sightings from NEFSC and SEFSC shipboard (circles) and aerial (squares) surveys during 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010, 2011, 2016 and 2021. Isobaths are the 200-m, 1,000-m, and 4,000-m depth contours. The darker line indicates the U.S. EEZ.

The Atlantic spotted dolphin occurs in two forms or ecotypes, which may be distinct subspecies (Perrin et al. 1987, 1994; Rice 1998): a large, heavily spotted form that inhabits the continental shelf and is usually found inside or near the 200 m isobath in continental shelf waters south of Cape Hatteras; and a smaller, less spotted island and offshore form which occurs in the western North Atlantic in continental slope waters particularly north of Cape Hatteras (Mullin and Fulling 2003). Where they co-occur, the offshore ecotype of the Atlantic spotted dolphin and the pantropical spotted dolphin, *Stenella attenuata*, can be difficult to differentiate at sea.

Genetic analyses of mtDNA and microsatellite DNA data from samples collected in the Gulf of Mexico and the western North Atlantic revealed significant genetic differentiation between these two areas (Adams and Rosel 2006; Viricel and Rosel 2014; do Amaral et al. 2021), supporting delineation of a demographically independent population for each area. In addition, the genetic data provided evidence for separation of dolphins within the western North Atlantic, suggesting the Western North Atlantic stock of Atlantic spotted dolphins may comprise multiple demographically independent populations (Adams and Rosel 2006; Viricel and Rosel 2014). One population consists of the smaller, pelagic form and occupies waters over the continental slope and deeper. The second population is restricted to continental shelf waters at and south of Cape Hatteras. The two genetically-identified populations correspond with the two morphological forms identified by Perrin et al. (1987), and the level of genetic differentiation between them indicates they are independent evolutionary pathways with dispersal rates of less than 0.3% per generation (Viricel and Rosel 2014). Population-level differentiation appears to exist within the Gulf of Mexico as well, with a break between western and eastern populations occurring in the north central Gulf of Mexico (Viricel and Rosel 2014).

POPULATION SIZE

The best abundance estimate available for Atlantic spotted dolphins in the western North Atlantic is 31,506 (CV=0.28; Table 1; Garrison and Dias 2023; Palka 2023). This estimate is from summer 2021 surveys covering waters from central Florida to the lower Bay of Fundy. Distinction between the two Atlantic spotted dolphin ecotypes has not regularly been made during surveys, and at their November 1999 meeting, the Atlantic SRG recommended that without a genetic determination of stock structure for the two ecotypes, the abundance estimates for the coastal and offshore forms should be combined. The abundance estimate provided here is a species-specific estimate combining both ecotypes of Atlantic spotted dolphins.

Earlier Abundance Estimates

Please see Appendix IV for a summary of abundance estimates, including earlier estimates and survey descriptions.

Recent Surveys and Abundance Estimates

Abundance estimates of 8,247 (CV=0.24) and 31,674 (CV=0.33) Atlantic spotted dolphins were generated from vessel surveys conducted in U.S. waters of the western North Atlantic during the summer of 2016 (Table 1; Garrison 2020; Palka 2020). One survey was conducted from 27 June to 25 August in waters north of 38ºN latitude and consisted of 5,354 km of on-effort trackline along the shelf break and offshore to the outer edge of the U.S. EEZ (NEFSC and SEFSC ?2018). The second vessel survey covered waters from Central Florida to approximately 38ºN latitude between the 100-m isobaths and the outer edge of the U.S. EEZ during 30 June–19 August. A total of 4,399 km of trackline was covered on effort (NEFSC and SEFSC 2016). Both surveys utilized two visual teams and an independent observer approach to estimate detection probability on the trackline (Laake and Borchers 2004). Mark-recapture distance sampling was used to estimate abundance. Estimates from the two surveys were combined and CVs pooled to produce a species abundance estimate for the stock area.

More recent abundance estimates of 8,112 (CV=0.22) and 23,394 (CV=0.37) Atlantic spotted dolphins were generated from vessel surveys conducted in U.S. waters of the western North Atlantic during the summer of 2021 (Table 1; Garrison and Dias 2023; Palka 2023). One survey was conducted from 16 June to 23 August in waters north of 36ºN latitude and consisted of 5,871 km of on-effort trackline along the shelf break and offshore to the outer edge of the U.S. EEZ (NEFSC and SEFSC 2022). The second vessel survey covered waters from central Florida (25ºN latitude) to approximately 38ºN latitude between the 200-m isobaths and the outer edge of the U.S. EEZ during 12 June–31 August. A total of 5,659 km of trackline was covered on effort (NEFSC and SEFSC 2022). Both surveys utilized two visual teams and an independent observer approach to estimate detection probability on the trackline (Laake and Borchers 2004). Mark-recapture distance sampling was used to estimate abundance. Estimates from the two surveys were combined and CVs pooled to produce a species abundance estimate for the stock area.

Table 1. Summary of abundance estimates for the Atlantic spotted dolphin (**Stenella frontalis*****) in the western North Atlantic by month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV). The estimate considered best is in bold font.***

Month/Year	Area	N_{best}	CV
Jun–Aug 2016	New Jersey to Bay of Fundy	8,247	0.24
Jun–Aug 2016	Central Florida to New Jersey	31,674	0.33
Jun–Aug 2016	Central Florida to Bay of Fundy (COMBINED)	39,921	0.27
Jun–Aug 2021	New Jersey to lower Bay of Fundy	8,112	0.22
Jun–Aug 2021	Central Florida to New Jersey	23,394	0.37
Jun–Aug 2021	**Central Florida to lower Bay of Fundy (COMBINED)**	**31,506**	**0.28**

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log- normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best abundance estimate is 31,506 (CV=0.28). The minimum population estimate based on the 2021 abundance estimates is 25,042 (Table 2).

Current Population Trend

There are four available coastwide abundance estimates for Atlantic spotted dolphins from the summers of 2004, 2011, 2016, and 2021. Each of these is derived from vessel surveys with similar survey designs and all four used the two-team independent observer approach to estimate abundance. The resulting estimates were 50,978 (CV=0.42) in 2004, 44,715 (CV=0.43) in 2011, 39,921 (CV=0.27) in 2016, and 31,506 (CV=0.28) in 2021 (Garrison 2020; Garrison and Dias 2023). A generalized linear model indicated a statistically significant (p=0.028) linear decrease in these abundance estimates. A key uncertainty in this assessment of trend is that interannual variation in abundance may be caused by either changes in spatial distribution associated with environmental variability or changes in the population size of the stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow et al. 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a recovery factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for the Atlantic spotted dolphin is 25,042. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is set to 0.5 because this stock is of unknown status. PBR for the combined offshore and coastal forms of Atlantic spotted dolphins is 250 (Table 2).

Table 2. Best and minimum abundance estimates for Atlantic spotted dolphins of the Western North Atlantic with Maximum Productivity Rate (R_{max}), Recovery Factor (F_r) and PBR.

N_{est}	CV N_{est}	N_{min}	F_r	R_{max}	PBR
31,506	0.28	25,042	0.5	0.04	250

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated human-caused mortality and serious injury to this stock during 2017–2021 was presumed to be zero, as there were no reports of mortalities or serious injuries to Atlantic spotted dolphins in the western North Atlantic. Recorded takes of Atlantic spotted dolphins in fisheries in the western North Atlantic are rare. However, observer coverage in the fisheries is relatively low. Furthermore, the likelihood is low that a dolphin killed at sea due to a fishery interaction or vessel strike will be recovered (Williams et al. 2011). These factors introduce some uncertainty into estimating the true level of human-caused mortality and serious injury for this stock.

Fishery Information

There are two commercial fisheries that interact, or that could potentially interact, with this stock in the Atlantic Ocean. These are the Category I Atlantic Highly Migratory Species longline and the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagics longline fisheries (Appendix III). Percent observer coverage (percentage of sets observed) for these longline fisheries in the Atlantic for each year during 2017–2021 was 11, 10, 10, 9, and 8, respectively.

The Atlantic Highly Migratory Species longline fishery operates outside the U.S. EEZ. No takes of Atlantic spotted dolphins within high seas waters of the Atlantic Ocean have been observed or reported thus far.

The Atlantic Ocean, Caribbean, Gulf of Mexico large pelagics longline fishery operates in the U.S. Atlantic (including Caribbean) and Gulf of Mexico EEZ, and pelagic swordfish, tunas and billfish are the target species. There were no observed mortalities or serious injuries to Atlantic spotted dolphins by this fishery in the Atlantic Ocean during 2017–2021 (Garrison and Stokes 2020a; 2020b; 2021; 2023a; 2023b).

Total fishery-related mortality and serious injury cannot be estimated separately for the two species of spotted dolphins in the U.S. Atlantic EEZ because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that either species might have been subject to the observed fishery-related mortality and serious injury.

STATUS OF STOCK

Atlantic spotted dolphins are not listed as threatened or endangered under the Endangered Species Act, and the Western North Atlantic stock is not considered strategic under the Marine Mammal Protection Act. No fishery-related mortality or serious injury has been observed during recent years; therefore, total fishery-related mortality and serious injury can be considered insignificant and approaching the zero mortality and serious injury rate. The status of Atlantic spotted dolphins relative to optimum sustainable population is unknown. Available abundance estimates indicate a decline in population size for this species between 2004 and 2021, but it is uncertain if this is a true decline or simply a change in distribution with animals moving outside of the study area.

OTHER FACTORS THAT MAY BE AFFECTING THE STOCK

Strandings

During 2017–2021, 21 Atlantic spotted dolphins were reported stranded along the U.S. East Coast (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 13 October 2022 (Southeast Region [SER]) and 18 September 2022 (Northeast Region [NER])). Evidence of human interaction was detected for four of the strandings (all animals pushed out to sea by members of the public). No evidence of human interaction was detected for seven strandings, and for the remaining ten strandings, it could not be determined if there was evidence of human interaction. It should be noted that evidence of human interaction does not necessarily mean the interaction caused the animal's stranding or death.

Stranding data underestimate the extent of human and fishery-related mortality and serious injury because not all of the marine mammals that die or are seriously injured in human interactions wash ashore, or, if they do, they are not all recovered (Peltier et al. 2012; Wells et al. 2015; Carretta et al. 2016). In particular, shelf and slope stocks in the western North Atlantic are less likely to strand than nearshore coastal stocks. Additionally, not all carcasses will show evidence of human interaction, entanglement or other fishery-related interaction due to decomposition, scavenger damage, etc. (Byrd et al. 2014), and decomposition can also introduce uncertainty in visual species identification of a carcass, particularly for closely related species like those in the genus Stenella. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of human interaction.

Table 3. Atlantic spotted dolphin (**Stenella frontalis*****) reported strandings along the U.S. Atlantic coast, 2017–2021. Data are from the NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 13 October 2022 (SER) and 18 September 2022 (NER).***

STATE	2017	2018	2019	2020	2021	TOTALS
New York	0	0	1	0	0	1
New Jersey	0	0	0	2	1	3
North Carolina	1	3	2	0	2	8
South Carolina	0	1	1	3	2	7
Florida	0	0	0	2	0	2
TOTALS	1	4	4	7	5	21

Habitat Issues

Anthropogenic sound in the world's oceans has been shown to affect marine mammals, with vessel traffic, seismic surveys, and active naval sonars being the main anthropogenic contributors to low- and mid-frequency noise in oceanic waters (e.g., Nowacek et al. 2015; Gomez et al. 2016; NMFS 2018). The long-term and population consequences of these impacts are less well-documented and likely vary by species and other factors. Impacts on marine mammal prey from sound are also possible (Carroll et al. 2017), but the duration and severity of any such prey effects on marine mammals are unknown.

Offshore wind development in the U.S. Atlantic may also pose a threat to this stock, particularly south of Cape Hatteras, where development approaches the shore. Activities associated with development include geophysical and geotechnical surveys, installation of foundations and cables, and operation, maintenance and decommissioning of facilities (BOEM 2018). The greatest threat from these activities is likely underwater noise, however other potential threats include vessel collision due to increased vessel traffic, benthic habitat loss, entanglement due to increased fishing around structures, marine debris, dredging, and contamination/degradation of habitat (BOEM 2018).

The chronic impacts of contaminants (polychlorinated biphenyls [PCBs] and chlorinated pesticides [DDT, DDE, dieldrin, etc.]) on marine mammal reproduction and health are of concern (e.g., Schwacke et al. 2002; Jepson et al. 2016; Hall et al. 2018), but research on contaminant levels for this stock is lacking. Méndez-Fernandez et al. (2018) examined persistent organic pollutant (POP) concentrations (PCBs, DDTs, PBDEs, chlordanes, mirex, and HCB) in Atlantic spotted dolphins from different parts of the Atlantic Ocean, including the Azores, Canary Islands, São Paulo (southeastern Brazil), and Guadalupe Island (Caribbean Sea). Their findings indicated that POP concentrations and accumulation patterns varied by location, so dolphins in different geographical areas were subjected to different types of contamination. When PCB concentrations were compared to established toxicity thresholds, 33.9% of animals sampled from all locations exceeded the lowest threshold (9µg/g lw). It was suggested two of the populations examined, from São Paulo and Canary Islands, should be considered vulnerable given the results of the POP concentrations (Méndez-Fernandez et al. 2018).

Climate-related changes in spatial distribution and abundance, including poleward and depth shifts, have been documented in or predicted for plankton species and commercially important fish stocks (Nye et al. 2009; Pinsky et al. 2013; Poloczanska et al. 2013; Grieve et al. 2017; Morley et al. 2018) and cetacean species (e.g., MacLeod 2009; Sousa et al. 2019). Chavez-Rosales et al. (2022) documented an overall 178 km northeastward spatial distribution shift of the seasonal core habitat of Northwest Atlantic cetaceans that was related to changing habitat/climatic factors. Results varied by season and species. This study used sightings data collected during seasonal aerial and shipboard line transect abundance surveys during 2010 to 2017. During this time frame, the weighted centroid of the Atlantic spotted dolphin moved farthest in winter (165 km towards the northeast) and least in fall (25 km towards the southeast). There is uncertainty in how, if at all, the changes in distribution and population size of cetacean species may interact with changes in distribution of prey species and how the ecological shifts will affect human impacts to the species.

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