ATLANTIC WHITE-SIDED DOLPHIN (*Lagenorhynchus acutus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The dolphin genus *Lagenorhynchus* is currently proposed to be revised (Vollmer *et al.* 2019); though until the revision is officially accepted, the previous definitions will be used. White-sided dolphins are found in temperate and sub-polar waters of the North Atlantic, primarily in continental shelf waters to the 100-m depth contour. In the western North Atlantic the species inhabits waters from multiple marine ecoregions (Spalding 2007) within the region from central West Greenland to North Carolina (about 35˚N) and perhaps as far east as 29˚W in the vicinity of the mid-Atlantic Ridge (Evans 1987; Hamazaki 2002; Doksaeter *et al.* 2008; Waring *et al.* 2008). Distribution of sightings, strandings and incidental takes suggest the possible existence of three population units: Gulf of Maine, Gulf of St. Lawrence and Labrador Sea populations (Palka *et al.* 1997). Evidence for a separation between the population in the southern Gulf of Maine and the Gulf of St. Lawrence population comes from the reduced density of summer sightings along the Atlantic side of Nova Scotia. This was reported in Gaskin (1992), is evident in Smithsonian stranding records and in Canadian/west Greenland bycatch data (Stenson *et al.* 2011), and was obvious during summer abundance surveys that covered waters from Virginia to the Gulf of St. Lawrence and during the Canadian component of the Trans-North Atlantic Sighting Survey in the summer of 2007 (Lawson and Gosselin 2009, 2011). White-sided dolphins were seen frequently in Gulf of Maine waters and in waters at the mouth of the Gulf of St. Lawrence, but only a relatively few sightings were recorded between these two regions. This gap has been less obvious since 2007 and could be related to an increasing number of animals being distributed more northwards due to climatic/ecosystem changes that are occurring in the Gulf of Maine (Nye *et al*. 2009; Head *et al*. 2010; Pinsky *et al*. 2013; Hare *et al*. 2016; Grieve *et al.* 2017). No comparative genetic analyses of samples from U.S. waters and the Gulf of St. Lawrence and/or Newfoundland have been made.

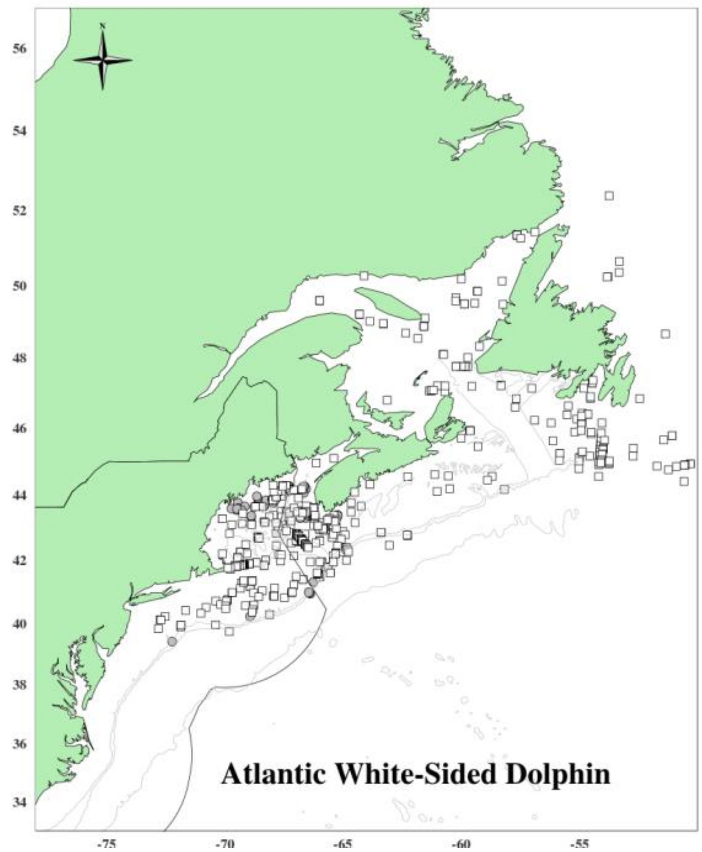

Figure 1. Distribution of white-sided dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010, 2011, 2016 and Department of Fisheries and Oceans Canada 2007 TNASS and 2016 NAISS surveys. Isobaths are the 200-m, 1000-m and 4000-m depth contours.

The Gulf of Maine population of white-sided dolphins is most common in continental shelf waters from Hudson Canyon (approximately 39˚N) to Georges Bank, and in the Gulf of Maine and lower Bay of Fundy. Sighting data indicate seasonal shifts in distribution (Northridge *et al.* 1997). During January to May, low numbers of white-sided dolphins are found from Georges Bank to Jeffreys Ledge (off New Hampshire), with even lower numbers south of Georges Bank, as documented by a few strandings collected on beaches of Virginia to South Carolina. From June through September, large numbers of white-sided dolphins are found from Georges Bank to the lower Bay of Fundy. From October to December, white-sided dolphins occur at intermediate densities from southern Georges Bank to the southern Gulf of Maine (Payne and Heinemann 1990). Sightings south of Georges Bank, particularly around Hudson Canyon, occur year-round but at low densities. The Virginia and North Carolina observations appear to represent the southern extent of the species' range during the winter months. On 4 May 2008 a stranded 17-year old male white-sided dolphin with severe pulmonary distress and reactive lymphadenopathy stranded in South Carolina (Powell *et al.* 2012). In the absence of additional strandings or sightings, this stranding seems to be an out-of-range anomaly. The seasonal spatial distribution of this species appears to be changing during the last few years. There is evidence for an earlier distributional shift during the 1970s, from primarily offshore waters into the Gulf of Maine, hypothesized to be related to shifts in abundance of pelagic fish stocks resulting from depletion of herring by foreign distant-water fleets (Kenney *et al*. 1996).

Stomach-content analysis of both stranded and incidentally caught white-sided dolphins in U.S. waters determined that the predominant prey were silver hake (*Merluccius bilinearis*), spoonarm octopus (*Bathypolypus bairdii*) and haddock (*Melanogrammus aeglefinus*). Sand lances (*Ammodytes* spp.) were only found in the stomach of one stranded white-sided dolphin. Seasonal variation in diet was indicated; pelagic Atlantic herring (*Clupea harengus*) was the most important prey in summer, but was rare in winter (Craddock *et al.* 2009).

Within the Gulf of Maine population a genetic analysis comparing samples from Maine to samples from Massachusetts found no significant differentiation (Banguera-Hinestroza *et al.* 2014). Abrahams (2014) compared samples collected between Connecticut and Maine to those collected between New York and North Carolina and found no evidence for genetic differentiation between these two regions. Sample sizes in these studies in some cases were low, and the potential for seasonal movement, as suggested by Northridge *et al.* (1997), has the potential to confound these studies if season was not considered in the sampling scheme.

As a consequence of these distribution patterns and genetic analyses, this report assumes white-sided dolphins in U.S. waters are from the Gulf of Maine population, which is separate from the neighboring Gulf of St. Lawrence population. In summary, the Western North Atlantic stock of white-sided dolphins may contain multiple demographically-independent populations, where the animals in U.S. waters are part of the Gulf of Maine population. However, further research is necessary to support this hypothesis and eliminate the uncertainties.

POPULATION SIZE

The best available current abundance estimate for white-sided dolphins in the western North Atlantic stock is 93,233 (CV=0.71), resulting from the June–September 2016 surveys conducted by the U.S. and Canada that ranged from Labrador to the U.S. east coast, which covered nearly the entire western North Atlantic stock: all of the Gulf of Maine and Gulf of St. Lawrence populations and part of the Labrador population. Because the survey areas did not overlap, the estimates from the surveys were added together and the CVs pooled using a delta method to produce a species abundance estimate for the stock area.

Earlier Abundance Estimates

Please see Appendix IV for earlier abundance estimates. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable to determine the current PBR.

Recent Surveys and Abundance Estimates

An abundance estimate of 31,912 (CV=0.61) U.S. Gulf of Maine white-sided dolphins was generated from a shipboard and aerial survey conducted during 27 June–28 September 2016 (Palka 2020) in a region covering 425,192 km^2 (Table 1). The aerial portion included 11,782 km of tracklines that were over waters north of New Jersey from the coastline to the 100-m depth contour, throughout the U.S. waters. The shipboard portion included 4,351 km of tracklines that were in waters offshore of central Virginia to Massachusetts (waters that were deeper than the 100-m depth contour out to beyond the U.S. EEZ). Both sighting platforms used a two-team data-collection procedure, which allows estimation of abundance to correct for perception bias of the detected species (Laake and Borchers 2004). The estimates were also corrected for availability bias.

An abundance estimate of 61,321 (CV=1.04) white-sided dolphins from the Canadian side of the Gulf of Maine population and the entire Gulf of St. Lawrence population was generated from an aerial survey conducted by the Department of Fisheries and Oceans, Canada (DFO, Table 1). No white-sided dolphins were detected on the east side of Labrador in the Labrador population. This survey covered Atlantic Canadian shelf and shelf break waters extending from the northern tip of Labrador to the U.S. border off southern Nova Scotia in August and September of 2016 (Lawson and Gosselin 2018). A total of 29,123 km was flown over the Gulf of St. Lawrence/Bay of Fundy/Scotian Shelf stratum using two Cessna Skymaster 337s, and 21,037 km were flown over the Newfound/Labrador stratum using a DeHavilland Twin Otter. The estimate was derived from the Skymaster data using single-team multi-covariate distance sampling with left truncation (to accommodate the obscured area under the plane) where size-bias was also investigated. The Otter-based perception bias correction, which used double-platform mark-recapture methods, was applied. An availability bias correction factor, which was based on the cetaceans' surface intervals, was also applied.

Table 1. Summary of recent abundance estimates for western North Atlantic stock of white-sided dolphins (Lagenorhynchus acutus), by month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{est}) and coefficient of variation (CV).

Month/Year	Area	N_{est}	CV
Jun–Sep 2016	Central Virginia to Maine (US part of Gulf of Maine population)	31,912	0.61
Aug–Sep 2016	Bay of Fundy to Gulf of St. Lawrence (Canadian part of Gulf of Maine and all of Gulf of St. Lawrence population)	61,321	1.04
Aug–Sep 2016	Newfoundland and Labrador (part of the Labrador population)	0	0
Jun–Sep 2016	Central Virginia to Labrador – COMBINED	93,233	0.71

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 estimate of abundance for the western North Atlantic stock of white-sided dolphins is 93,233 (CV=0.71). The minimum population estimate for these white-sided dolphins is 54,443.

Current Population Trend

A trend analysis has not been conducted for this stock. The statistical power to detect a trend in abundance for this stock is poor due to the relatively imprecise abundance estimates and long survey interval. For example, the power to detect a precipitous decline in abundance (i.e., 50% decrease in 15 years) with estimates of low precision (e.g., CV>0.30) remains below 80% (alpha=0.30) unless surveys are conducted on an annual basis (Taylor *et al.* 2007). There is current work to standardize the strata-specific previous abundance estimates to consistently represent the same regions and include appropriate corrections for perception and availability bias. These standardized abundance estimates will be used in state-space trend models that incorporate environmental factors that could potentially influence the process and observational errors for each stratum.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity include: calving interval is 2–3 years; lactation period is 18 months; gestation period is 10–12 months and births occur from May to early August, mainly in June and July; length at birth is 110 cm; length at sexual maturity is 230–240 cm for males, and 201–222 cm for females; age at sexual maturity is 8–9 years for males and 6–8 years for females; mean adult length is 250 cm for males and 224 cm for females (Evans 1987); and maximum reported age for males is 22 years and for females, 27 years (Sergeant *et al.* 1980).

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). Key uncertainties about the maximum net productivity rate are due to the limited understanding of stock-specific life history parameters; thus the default value was used.

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 is 54,443. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor is 0.5, the default value for stocks of unknown status relative to Optimum Sustainable Population (OSP), and the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the western North Atlantic stock of white-sided dolphin is 544 (Table 2).

Table 2. Best and minimum abundance estimates for the western North Atlantic stock of white-sided dolphins (Lagenorhynchus acutus), with Maximum Productivity Rate (R_{max}), Recovery Factor (F_r) and PBR.

N_{est}	CV	N_{min}	F_r	R_{max}	PBR
93,233	0.71	54,443	0.5	0.04	544

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality or serious injury to this stock during 2015–2019 was 27 (CV=0.21) white-sided dolphins from fisheries observer data and 0.2 from non-fishery stranding data (Table 3).

Table 3. Total annual estimated average human-caused mortality and serious injury for the North Atlantic stock of white-sided dolphins (Lagenorhynchus acutus).

Years	Source	Annual Avg.	CV
2015–2019	U.S. fisheries using observer data	27	0.21
2015–2019	Possible non-fishery human-caused stranding mortalities	0.2	
TOTAL		27.2	0.21

Key uncertainties include the potential that the observer coverage in the Mid-Atlantic gillnet may not be representative of the fishery during all times and places, since the observer coverage was relatively low in some times and areas (0.02–0.10). The effect of this is unknown.

There are no major known sources of unquantifiable human-caused mortality or serious injury for the U.S. portion of the Gulf of Maine population. When considering the entire western North Atlantic stock, mortality in Canadian Atlantic waters is largely unquantified.

Fishery Information

Detailed fishery information is reported in Appendix III.

Earlier Interactions

See Appendix V for more information on historical takes.

United States

Northeast Bottom Trawl

White-sided dolphins have been bycaught year-round in the Gulf of Maine, where most occurred outside of summer (May–August) and offshore near the outer edge of the EEZ. Fishery-related bycatch rates were estimated using an annual stratified ratio-estimator (Lyssikatos and Chavez-Rosales 2022). See Table 4 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for long-term bycatch information.

Table 4. Summary of the incidental mortality of western North Atlantic stock of white-sided dolphins (Lagenorhynchus acutus) by commercial fishery including the years sampled, the type of data used, the annual observer coverage, the serious injuries and mortalities recorded by on-board observers, the estimated annual serious injury and mortality, the estimated CV of the combined annual mortality and the mean annual mortality (CV in parentheses).

Fishery	Years	Data Type [a]	Observer Coverage [b]	Observed Serious Injury[c]	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Combined Annual Mortality
Northeast Bottom Trawl	2015	Obs. Data, Trip Logbook	0.19	0	3	0	15	15	0.52	27 (0.21)
	2016		0.12	0	3	0	28	28	0.46	
	2017		0.12	1	1	7.4	7.4	14.8	0.64	
	2018		0.12	0	0	0	0	0	na	
	2019		0.16	0	14	0	79	79	0.28	
TOTAL										27 (0.21)

a. Observer data (Obs. Data), used to measure bycatch rates, are collected within the Northeast Observer Program and At-sea Monitoring Program. NEFSC collects landings data (unallocated Dealer Data or Allocated Dealer Data) which are used as a measure of total landings. Mandatory Vessel Trip Reports (VTR; Trip Logbook) are used to determine the spatial distribution of landings and fishing effort in the sink gillnet, bottom trawl and mid-water trawl fisheries. In addition, the Trip Logbooks are the primary source of the measure of total effort (tow duration) in the mid-water and bottom trawl fisheries.
b. Observer coverage is defined as the ratio of observed to total metric tons of fish landed for the gillnet fisheries, and the ratio of observed to total trips for bottom trawl and Mid-Atlantic mid-water trawl (including pair trawl) fisheries. Total observer coverage reported for bottom trawl and gillnet gear includes samples collected from the at-sea monitoring program in addition to traditional observer coverage through the Northeast Fisheries Observer Program (NEFOP).
c. Serious injuries were evaluated for the 2015–2019 period and include both at-sea monitor and traditional observer data (Josephson *et al.* 2022).

Canada

There is little information available that quantifies fishery interactions involving white-sided dolphins in Canadian waters. Two white-sided dolphins were reported caught in groundfish gillnet sets in the Bay of Fundy during 1985 to 1989, and 9 were reported taken in West Greenland between 1964 and 1966 in the now non-operational salmon drift nets (Gaskin 1992). Several (number not specified) were also taken during the 1960s in now non-operational Newfoundland and Labrador groundfish gillnets. A few (number not specified) were taken in an experimental drift gillnet fishery for salmon off West Greenland that took place from 1965 to 1982 (Read 1994).

Hooker *et al.* (1997) summarized bycatch data from a Canadian fisheries observer program that placed observers on all foreign fishing vessels operating in Canadian waters, on 25–40% of large Canadian fishing vessels (greater than 100 feet long), and on approximately 5% of smaller Canadian fishing vessels. Bycaught marine mammals were noted as weight in kilos rather than by the numbers of animals caught. Thus the number of individuals was estimated by dividing the total weight per species per trip by the maximum recorded weight of each species. During 1991 through 1996, an estimated 6 white-sided dolphins were observed taken. One animal was from a longline trip south of the Grand Banks (43º 10'N 53º 08'W) in November 1996 and the other 5 were taken in the bottom trawl fishery off Nova Scotia in the Atlantic Ocean; 1 in July 1991, 1 in April 1992, 1 in May 1992, 1 in April 1993, 1 in June 1993 and 0 in 1994 to 1996.

Estimation of small cetacean bycatch for Newfoundland fisheries using data collected during 2001 to 2003 (Benjamins *et al.* 2007) indicated that, while most of the estimated 862 to 2,228 animals caught were harbor porpoises, a few were white-sided dolphins caught in the Newfoundland nearshore gillnet fishery and offshore monkfish/skate gillnet fisheries.

Other Mortality

United States

Recent Atlantic white-sided dolphin strandings on the U.S. Atlantic coast are documented in Table 5 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 17 October 2020). Sixteen of these animals were released alive. Human Interaction (HI) was indicated in 4 records during this period, though in only one of these was the HI a possible contributor to the mortality (signs of an entanglement wound). None of these were classified as fishery interactions.

Mass strandings involving up to a hundred or more animals at one time are common for this species. The causes of these strandings are not known. Because such strandings have been known since antiquity, it could be presumed that recent strandings are a normal condition (Gaskin 1992). It is unknown whether human causes, such as fishery interactions and pollution, have increased the number of strandings. In an analysis of mortality causes of stranded marine mammals on Cape Cod and southeastern Massachusetts between 2000 and 2006, Bogomolni *et al.* (2010) found 69% (46 of 67) of stranded white-sided dolphins were involved in mass-stranding events with no significant cause determined, and 21% (14 of 67) were classified as disease-related.

It should be recognized that evidence of human interaction does not always indicate cause of death, but rather only that there was evidence of interaction with a fishery (e.g., line marks, net marks) or evidence of a boat strike, gunshot wound, mutilation, etc., at some point, including post-stranding. Stranding data probably underestimate the extent of mortality and serious injury because all of the marine mammals that die or are seriously injured may not wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Canada

The Nova Scotia Stranding Network documented whales and dolphins stranded on the coast of Nova Scotia during 1991 to 1996 (Hooker *et al.* 1997). Researchers with the Dept. of Fisheries and Oceans, Canada documented strandings on the beaches of Sable Island during 1970 to 1998 (Lucas and Hooker 2000). More recently, whales and dolphins stranded on the coast of Nova Scotia have been recorded by the Marine Animal Response Society and the Nova Scotia Stranding Network (Table 3; Marine Animal Response Society, pers. comm.). In addition, stranded white-sided dolphins in Newfoundland and Labrador are being recorded by the Whale Release and Strandings Program (Table 5; Ledwell and Huntington 2015, 2017, 2018, 2019, 2020).

Table 5. Atlantic white-sided dolphin (Lagenorhynchus acutus) reported strandings along the U.S. and Canadian Atlantic coast, 2015–2019.

Area	2015	2016	2017	2018	2019	Total
Maine[b]	1	0	0	6	5	12
New Hampshire	0	0	0	0	2	2
Massachusetts[a, b, c, d]	3	27	8	41	65	144
Connecticut	0	1	1	0	0	2
TOTAL US	4	28	9	47	72	160
Nova Scotia[e]	11	11	8	0	0	30
Newfoundland and Labrador[f]	0	13	1	0	0	14
TOTAL US & CANADA	15	38	38	47	72	204

a. Records of mass strandings in Massachusetts during this period are: March 2016 - 2 animals (1 released alive), July 2016 - 2 animals (1 released alive), 3 animals (all released alive); September 2016 - 17 animals (all released alive).
b. In 2016, 2 animals (one of which was released alive) in Massachusetts were classified as human interaction due to intervention on the beach.
c. In 2018, 1 white-sided dolphin mortality had signs of human interaction indicated due to entanglement wounds found on tailstock and beach-protection mesh wrapped on torso.
d. In 2019, 2 white-sided dolphin mortalities had signs of human interaction indicated, although neither of these likely contributed to mortality. One was coded as HI due to public attempts to refloat, and the other due to tag applied by standing responders.
e. Data supplied by Nova Scotia Marine Animal Response Society (pers. comm.). 2015 data include a mass stranding of 5 animals.
f. Ledwell and Huntington (2015, 2017, 2018, 2019, 2020).

HABITAT ISSUES

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., Pierce *et al.* 2008; Jepson *et al.* 2016; Hall *et al.* 2018; Murphy *et al.* 2018), but research on contaminant levels for the western North Atlantic stock of Atlantic white-sided dolphins is lacking.

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; Head *et al*. 2010; Pinsky *et al*. 2013; Poloczanska *et al.* 2013; Hare *et al*. 2016; Grieve *et al.* 2017; Morley *et al.* 2018) and cetacean species (e.g., MacLeod 2009; Sousa *et al.* 2019). There is uncertainty in how, if at all, the distribution and population size of this species will respond to these changes and how the ecological shifts will affect human impacts to the species.

STATUS OF STOCK

White-sided dolphins are not listed as threatened or endangered under the Endangered Species Act. The Western North Atlantic stock of white-sided dolphins is not considered strategic under the Marine Mammal Protection Act. The estimated average annual human-related mortality does not exceed PBR and is less than 10% of the calculated PBR; therefore, it is considered to be insignificant and approaching zero mortality and serious injury rate. The status of white-sided dolphins, relative to OSP, in the U.S. Atlantic EEZ is unknown. A trend analysis has not been conducted for this species.

Even with the levels of uncertainties regarding the stock structure within the western North Atlantic white-sided dolphin stock described above, it is expected these uncertainties will have little effect on the designation of the status of this population.

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