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Abundance of Marine Mammals in Waters of the Southeastern U.S. Atlantic During Summer 2021

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BACKGROUND AND STUDY OBJECTIVES

In this report, we describe the results of a large vessel, visual line-transect survey conducted by the National Marine Fisheries Service (NMFS), Southeast Fisheries Science Center (SEFSC) in offshore waters of the U.S. Atlantic coast during the summer of 2021. The primary objective of the survey was to collect data to support assessment of the abundance, habitats, and spatial distribution of marine mammals (whales and dolphins) within U.S. waters. These data and resulting abundance estimates support the assessment of marine mammal stocks as required under the Marine Mammal Protection Act (MMPA). The MMPA requires that stocks of marine mammal species in U.S. waters be maintained at or above their optimum sustainable population level (OSP), defined as the number of animals which results in the maximum net productivity. To meet this requirement, the NMFS conducts research to define stock structure, and for each stock, estimates annual human-caused mortality and potential biological removal (PBR), the maximum number of animals that may be removed from a stock due to human activities (*e.g.*, fisheries bycatch) while allowing the stock to reach or maintain its OSP. PBR is calculated following specific criteria using the estimated minimum abundance of the stock, its maximum net productivity rate (theoretical or estimated), and a recovery factor (Barlow et al., 1995; Wade and Angliss, 1997). The NMFS is required to prepare a Stock Assessment Report (SAR) for each stock to update abundance, stock structure, maximum net productivity, human-caused mortality, PBR, and status (*e.g.*, Hayes et al., 2019). This study describes the results of a summer 2021 vessel-based survey and resulting abundance estimates for U.S. Western North Atlantic oceanic stocks of marine mammals.

METHODS

Survey Methods

The survey was conducted aboard the NOAA Ship *Gordon Gunter*, a 68-m (length) oceanographic research vessel, in waters off the southeast Atlantic coast of the U.S. The survey was conducted along "zig-zag" tracklines between central Florida and the Maryland/Delaware border and included shelf-break and inner continental slope waters within the U.S. Economic Exclusive Zone (EEZ) (Figure 1). Survey effort was stratified into four geographic strata reflecting regional differences in hydrographic and bathymetric structure and spatial variation in the density and occurrence of different marine mammal species (Table 1).

Visual marine mammal surveys were conducted from 12 June – 31 August 2021. Standard ship-based, line-transect survey methods for marine mammals, similar to those used in the Pacific Ocean, Atlantic Ocean, and Gulf of Mexico were used (*e.g.*, Barlow, 1995; Mullin and Fulling, 2003). The survey employed the "independent observer" methodology to improve estimates of sighting probability. This approach was similar to that used during the summer of 2016 (Garrison, 2020). The observer teams were stationed on the flying bridge (height above water = 13.9 m) and the bridge wings (height above water = 11.2 m). The two teams were isolated from one another to avoid "cueing" each other to the presence of marine mammals. Both teams consisted of four observers rotating through two positions at 30 min. intervals. A recorder position stationed inside the ship maintained communication with both teams and recorded data on sightings by each team using a computerized data entry program interfaced with a global positioning system (GPS) receiver. The central data recorder identified duplicate sightings that were recorded by both teams. For each team, at least one observer experienced in ship-based, line-transect methods and identification of marine mammals was present on the flying bridge or bridge wings at all times. The left and right side observers searched to the horizon in the arc from 10° right and left of the ship's bow to the left and right beams (90°), respectively, using 25x "bigeye" binoculars. Survey speed was usually 18 km hr^{-1} (~10 kt) but varied with sea conditions. The effectiveness of visual line-transect survey effort is severely limited during high sea state and poor visibility conditions (*e.g.*, fog, haze, rain). Survey effort was therefore suspended during heavy seas (Beaufort sea state > 5) and rain.

A sighting is defined as a single or group of marine mammals observed in the same location and time. For each marine mammal sighting, time, position as the bearing (0°-90° left or right relative to the bow of the vessel) and reticle (a measure of radial distance) of the sighting, species, group size, behavior, , and associated animals (*e.g.*, seabirds, fish) were recorded. The bearing and radial distance for sightings observed without 25x "bigeye" binoculars and close to the ship were estimated in approximate degrees from the trackline and meters, respectively. Survey effort data were automatically recorded every 30 sec and included the ship's position and heading. Effort status, defined as "on" (ship steadily cruising on the trackline with observers looking through the bigeyes) and "off" (e.g. naked-eye observations), observer positions, and environmental conditions which could affect the observers' ability to sight animals (*e.g.*, Beaufort sea state, trackline glare, swell height, cloud cover, etc.) were also recorded and updated as changes occurred or every 20 minutes. Environmental parameters such as wind speed, sea surface temperature and salinity were recorded directly from the ship's scientific computing system. Marine mammals were identified to the lowest taxonomic level possible. Observers may have discussed species identifications but group size values, recorded as the minimum, best and maximum numbers per sighting were recorded independently by each observer present during the entirety of the sighting.

Analytical Methods

Abundance estimates were derived using the independent observer approach assuming point independence (Laake and Borchers, 2004) implemented in package mrds (version 2.2.6, Laake et al., 2022) in the R statistical programming language. Briefly, this approach is an extension of standard line-transect distance analysis that includes direct estimation of sighting probability on the trackline. The probability of sighting a particular group is the product of two probability components. The first probability corresponds to the "standard" sighting function such that the probability of detection declines with increasing distance from the trackline following a known functional form (typically the half-normal or hazard function). The second component is the likelihood of detection on the trackline which is modeled using a logistic regression approach and the “capture histories” of each sighting (i.e., seen by one or both teams). The logistic model can include factors that may affect the probability of detection such as viewing or weather conditions. Details on the derivation, assumptions, and implementation of the estimation approach are provided in Laake and Borchers (2004). The double-observer methodology primarily accounts for “perception bias” or the probability that animals available to the survey (*i.e.*, at the surface during the observation window) are detected by the observers from both teams. Due to the long observation distance and slow movement of the vessel, this is the primary source of negative bias for most species. However, for long-diving species the probability that animals are available to the survey team is less than 1. Therefore, corrections for availability bias were applied for sperm whales, *Kogia* spp., and beaked whales based upon dive behavior information from tag telemetry studies (Palka et al., 2017).

Sighting probability was estimated separately for four groups of marine mammals: dolphins, small whales, large whales, and cryptic species to account for differences in body size and surface behavior and associated differences in sighting probability (Table 1; Barlow, 1995; Mullin and Fulling, 2003; Garrison, 2020). These taxa-groups included sightings identified to species-level as well as unidentified species (Table 2). “Cryptic” species including beaked whales and pygmy or dwarf sperm whales (*Kogia* spp.) were grouped because these taxa are deep divers that have only a limited availability to visual surveys due to the long time spent underwater and difficulty in seeing them when at the surface, especially in high sea states. The perpendicular sighting distances were right-truncated to remove roughly 10% of the sightings with the farthest distances (Buckland *et al.,* 2001). The form of the sighting function (hazard vs. half-normal) and the inclusion of covariates (including observer location – flying bridge vs. bridge wings, group size, sea state, glare, swell height, wind speed, cloud cover, and other survey conditions) in the mark-recapture and detection probability components of the models were evaluated using model selection based upon the Akaike Information Criterion (AIC, Laake and Borchers, 2004).

Stratified abundance estimates for each species were calculated using stratum and species-level encounter rates (groups per km of trackline) and mean (best) group size. For ambiguously identified sightings, that is Atlantic spotted dolphin or common bottlenose dolphin, stenellid dolphins, unidentified mesoplodonts, and unidentified ziphiids, we partitioned their estimated abundance and included those in the final abundance estimates for selected species. For example, the estimated abundance in each stratum for sightings that were identified only as Atlantic spotted dolphin or common bottlenose dolphin was multiplied by the proportion of confirmed sightings of Atlantic spotted dolphins and common bottlenose dolphins, respectively. The resulting final abundance estimate for a given species is then the sum of the abundance of unambiguous sightings (*i.e.*, identified to species level) and a proportion of the abundance of ambiguous sightings. This approach was used only for the aforementioned sightings but not for other unidentified sightings of baleen whales, dolphins, large whales, odontocete, rorqual and small whales.

We examined trends in the abundance of selected species across four available survey years: 2004, 2011, 2016, and 2021. Each of these years included surveys conducted during summer months, had a similar design and execution, and included surveys by both the Northeast and Southeast Fisheries Science centers spanning waters from the shelf-break to the U.S. EEZ from Florida to Maine. These prior-year estimates are shown in Appendix 1 (Hayes et al. 2019, Waring et al. 2010 and references therein). For species occurring in waters outside of the SEFSC survey area (*i.e.*, south of Maryland/Delaware border), estimates reported in this study were combined with those from NEFSC surveys conducted during the summer 2021 (Palka et al., in prep). Abundance estimates in prior years for sperm whales and *Kogia* spp. were not corrected for availability bias. Therefore, the corrections used for the current estimates were applied to obtain comparable estimates (Appendix 1). It was not possible to conduct trend analyses for beaked whale species as species-specific estimates were not derived for all prior years. We applied a generalized linear model with a log link to evaluate trends and weighted each estimate by the inverse of the standard error. A "year" main effect was included in the model to test for linear trends over time. The low precision of the estimates and the small number of available estimates (4 over a 17-year period) limit the power to detect meaningful trends in abundance.

RESULTS

A total of 5,371 km of trackline were completed on-effort within the survey strata (Figure 1, Table 1), and 541 on-effort marine mammal sightings were included in this analysis. Weather conditions were good to fair throughout much of the survey, with sea states of 2-4 on most survey days, averaging 3.3 throughout the cruise.

Marine mammal sightings by stratum included in this analysis are summarized in Table 2. The most common species encountered were common bottlenose dolphins and pilot whales. While pilot whales (*Globicephala* spp.) were not identified explicitly to species during the survey, the spatial range of the survey, depth, and environmental conditions indicate that encountered pilot whales were likely exclusively short-finned pilot whales (*Globicephala macrorhynchus*, Garrison and Palka, 2018). Marine mammal sightings were most frequent along the shelf break in the mid-Atlantic north of Cape Hatteras, NC (Figure 1). Sperm whales were observed in high densities along the outer mid-Atlantic shelf break and in deeper waters. Other large whale sightings included fin whales and humpback whales (Figure 2). Pilot whales and Risso's dolphins were the primary small whales sighted during the survey with pilot whales primarily along the mid-Atlantic shelf break (Figure 3). A variety of delphinids were encountered during the survey dominated by common bottlenose dolphins and Atlantic spotted dolphins with greater numbers of *Stenella* spp. dolphins in the northern portion of the survey area (Figure 4). Pygmy or dwarf sperm whales and beaked whales were observed sporadically in deeper waters of the survey area, with notable high concentrations in the offshore southern Atlantic stratum (Figure 5).

Selected models for the detection functions for each taxonomic group are shown in Table 3. The selected models provided adequate fits to the data as indicated by non-significant (p-value > 0.05) Goodness of Fit tests. Detection probability functions for each species group are shown in Figures 6-9. Notably, there was no apparent effect of distance (or other factors) in the mark-recapture component of the cryptic species model, and no evidence of a decline in resighting rates with increasing distance from the trackline (Figure 9).

Abundance estimates for each species are shown in Table 4. The uncertainty around all abundance estimates is relatively high, with the best CVs ranging between 0.25 – 0.49 for the more common species. Rare species with a smaller number of sightings had higher CVs that exceeded 0.9 (Table 4). The majority of this variability was associated with variation in encounter rates among different tracklines rather than variation in group sizes or uncertainty in the detection function. Therefore, spatially explicit estimation methods or alternative stratification may be able to reduce the uncertainty in resulting abundance estimates. The trend analysis indicated a statistically significant ($p = 0.028$) positive trend in abundance for Atlantic spotted dolphins and a possible ($p = 0.108$) increasing trend for Risso's dolphins. No other statistically significant trends were detected. The abundance estimates presented in Table 4 will be included in the annual stock assessment reports required by the MMPA.

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LITERATURE CITED

Barlow, J. 1995. The abundance of cetaceans in California waters. Part I: Ship surveys in summer and fall of 1991. Fishery Bulletin 93:1-14.

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. NOAA Tech. Mem. NMFS-OPR-6. 73 p.

Buckland, S.T., D.R. Andersen, K.P Burnham, J.L. Laake, D.L. Borchers and L. Thomas. 2001. Introduction to Distance Sampling estimating abundance of biological populations. Oxford University Press, New York. 432 pp.

Garrison, L.P. 2020. Abundance of Marine Mammals in waters of the U.S. Southeastern Atlantic During Summer 2016. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, PRD-2020-04, 23 pp.

Garrison, L.P. and Palka, D. 2018. Abundance of short-finned pilot whales along the U.S. east coast from summer 2016 vessel surveys. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, PRD-2018-07, 17 pp.

Hayes, S., Josephson, E., Maze-Foley, K., Rosel, P.E. 2019. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2018. NOAA Technical Memorandum NMFS-NE-258.

Laake, J.L. and D.L. Borchers. 2004. Methods for incomplete detection at distance zero. pp. 108-189. *In:* S.T. Buckland, D.R. Andersen, K.P. Burnham, J.L. Laake and L. Thomas (eds.) Advanced distance sampling. Oxford University Press, New York.

Laake, J., Borchers, D., Thomas, L. , Miller, D., and Bishop, J. 2022. mrds: Mark-Recapture Dist ance Sampling. R package version 2.2.6. https://CRAN.R-project.org/package=mrds

Marques, F.F.C. and S.T. Buckland. 2004. Covariate models for the detection function. pp. 31-47. *In:* S.T. Buckland, D.R. Andersen, K.P. Burnham, J.L. Laake and L. Thomas (eds.) Advanced distance sampling. Oxford University Press, New York.

Mullin, K.D. and G.L. Fulling. 2003. Abundance of cetaceans in the southern U.S. North Atlantic Ocean during summer 1998. Fishery Bulletin 101:603-613.

Palka, D.L., Chavez-Rosales, S., Josephson, E., Cholewiak, D., Haas, H.L., Garrison, L., Jones, M., Sigourney, D., Waring, G., Jech, M., Broughton, E., Soldevilla, M., Davis, G., DeAngelis, A., Sasso, C.R., Winton, M.V., Smolowitz, R.J., Fay, G., LaBrecque, E., Leiness, J.B., Warden, M., Murray, K., Orphanides, C. 2017. Atlantic Marine Assessment Program for Protected Species: 2010-2014. US Dept. of the Interior, Bureau of Ocean Energy Management, Atlantic OCS Region, Washington, DC. OCS Study BOEM 2017-071; 211 pp.

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

Waring, G. et al. 2010. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2018. NOAA Technical Memorandum NMFS-NE-219.

TABLES

Table 1. Survey effort and strata during GU2103. SAB = South Atlantic Bight, MAB = Mid-Atlantic Bight.

Stratum	Area (km^2)	Effort (km)	Marine mammal sightings
SAB-Inshore	148705	1618	43
SAB-Offshore	124614	1480	143
MAB-Inshore	16082	419	125
MAB-Offshore	127099	1853	230
Total	416501	5371	541

Table 2. Number of marine mammal sightings (sum of group sizes in parentheses) in each stratum sighted on-effort during GU2103.

Atlantic spotted dolphin	2 (84)	15 (632)	0	1 (20)	Dolphins
Blainville's beaked whale	0	1 (2)	0	1 (4)	Cryptic
Clymene dolphin	0	2 (259)	0	0	Dolphins
Common bottlenose dolphin	17 (307)	12 (236)	20 (398)	0	Dolphins
Common bottlenose or Atlantic spotted dolphin*	4 (52)	1 (8)	1 (6)	0	Dolphins
Cuvier's beaked whale	2 (10)	1 (3)	0	4 (12)	Cryptic
Dwarf sperm whale	0	6 (9)	0	9 (16)	Cryptic
False killer whale	0	4 (33)	0	0	Small whales
Fin whale	0	1 (2)	0	0	Large whales
Gervais' beaked whale	0	3 (13)	0	3 (8)	Cryptic
Humpback whale	1 (2)	0	0	0	Large whales
Killer whale	0	0	0	1 (8)	Small whales
Melon-headed or Pygmy killer or False killer whale	0	1 (12)	0	0	Small whales
Pantropical spotted dolphin	0	1 (22)	0	3 (53)	Dolphins
Pilot whales	28 (510)	17 (190)	2 (18)	2 (32)	Small whales
Pygmy or Dwarf sperm whale	0	13 (28)	0	22 (39)	Cryptic
Risso's dolphin	9 (96)	10 (102)	1 (11)	0	Dolphins
Sei or Fin or Bryde's-like whale	0	1 (1)	0	0	Large whales
Short-beaked common dolphin	2 (224)	0	0	0	Dolphins
Sperm whale	2 (2)	44 (132)	0	5 (17)	Large whales
Stenellid dolphin*	3 (231)	5 (190)	0	3 (58)	Dolphins
Striped dolphin	5 (532)	1 (40)	0	0	Dolphins
Unidentified baleen whale	1 (1)	2 (2)	0	0	Large whales
Unidentified dolphin	35 (897)	45 (588)	13 (131)	10 (132)	Dolphins
Unidentified large whale	2 (6)	5 (5)	0	2 (3)	Large whales
Unidentified mesoplodont*	4 (10)	11 (32)	0	36 (84)	Cryptic
Unidentified odontocete	2 (5)	13 (24)	3 (5)	16 (30)	Small whales
Unidentified rorqual	1 (2)	0	0	0	Large whales
Unidentified small whale	2 (7)	3 (3)	1 (1)	1 (1)	Small whales
Unidentified ziphiid*	3 (16)	12 (26)	2 (8)	24 (53)	Cryptic

* These ambiguous sightings were apportioned among confirmed species sightings to obtain final abundance estimates.

Table 3. Detection probability model parameters and estimated detection probabilities for each taxa-group. GOF = Goodness of Fit, CV = coefficient of variation.

Taxa group	Strip half-width (m)	Detection function	Distance sampling model	Mark-recapture model	Detection probability on the trackline (CV)	Average detection probability (CV)	Cramer von-Mises GOF Statistic (p-value)
Large whales	7000	Half-normal	sea state + visibility + conditions	sea state + distance	0.8164 (0.2150)	0.4101 (0.2870)	0.0479 (0.8891)
Small whales	6000	Hazard-rate	sea state	cloud cover + distance	0.7415 (0.1708)	0.2401 (0.2933)	0.0440 (0.9114)
Dolphins	6000	Hazard-rate	glare + cloud cover + swell	cloud cover + distance	0.8189 (0.0626)	0.2107 (0.2359)	0.0397 (0.9347)
Cryptic	5000	Hazard-rate	sea state + cloud cover + swell	no covariates	0.4711 (0.1573)	0.1775 (0.1963)	0.0728 (0.7347)

Table 4. Abundance estimates for cetacean species during GU2103. N = abundance, CV = coefficient of variation, SE = standard error.

Species	Density (N km^{-2})	Abundance	CV	SE
Atlantic spotted dolphin	0.05617	23394	0.366	8574
Blainville's beaked whale*	0.00705	2936	0.257	753
Clymene dolphin	0.04684	19510	0.804	15692
Common bottlenose dolphin	0.06450	26866	0.336	9031
Cuvier's beaked whale*	0.00703	2928	0.311	910
False killer whale	0.00131	545	0.682	372
Fin whale	0.00003	12	1.023	13
Gervais' beaked whale*	0.02064	8595	0.244	2095
Humpback whale	0.00002	7	1.043	8
Killer whale	0.00017	73	0.991	72
Pantropical spotted dolphin	0.00662	2757	0.498	1372
Pygmy or Dwarf sperm whale*	0.01311	5462	0.475	2593
Risso's Dolphin	0.01070	4455	0.445	1984
Short-beaked common dolphin	0.01936	8065	0.858	6922
Short-finned Pilot Whale	0.03602	15004	0.376	5636
Sperm whale*	0.00506	2106	0.441	928
Striped dolphin	0.02342	9752	0.490	4782

*These estimates include corrections for availability bias: sperm whales = 0.613 (CV = 0.247); beaked whales = 0.764 (CV = 0.246); pygmy or dwarf sperm whales = 0.538 (CV = 0.307; Palka et al., 2017).

Table 5. Trend analysis for each species sighting. The "Year Effect" indicates the parameter value for a linear-year effect in a generalized linear model with positive values indicating an increase over time and negative values indicated a decrease. A significant deviation of the year effect from zero (no trend) is indicated by p-value < 0.05. NA indicates cases where available data do not allow an analysis of trends.

Species	Year Effect	Std. Error	Pvalue	Result
Dwarf or Pygmy Sperm Whale	0.031	0.068	0.728	No significant trend
Atlantic Spotted Dolphin	-0.027	0.0046	0.028	Significant negative trend
Clymene Dolphin	NA	NA	NA	NA
Common Bottlenose Dolphin	0.008	0.0106	0.546	No significant trend
False Killer Whale	0.078	0.0995	0.786	No significant trend
Pantropical Spotted Dolphin	-0.017	0.0323	0.659	No significant trend
Spinner Dolphin	NA	NA	NA	NA
(Short-finned) Pilot Whale	-0.009	0.0198	0.697	No significant trend
Risso's dolphin	0.062	0.0223	0.108	Possible increasing trend
Common Dolphin	0.006	0.044	0.896	No significant trend
Sperm Whale	-0.0001	0.0416	0.991	No significant trend
Striped Dolphin	-0.033	0.0174	0.198	No significant trend

FIGURES

Figure 1. Survey tracklines and marine mammal sightings during GU2103. Stratum boundaries are indicated with the inner boundary defined by the 200m isobath and the outer boundary defined primarily by the U.S. EEZ. On-effort tracklines are indicated along with the locations of marine mammal sightings.

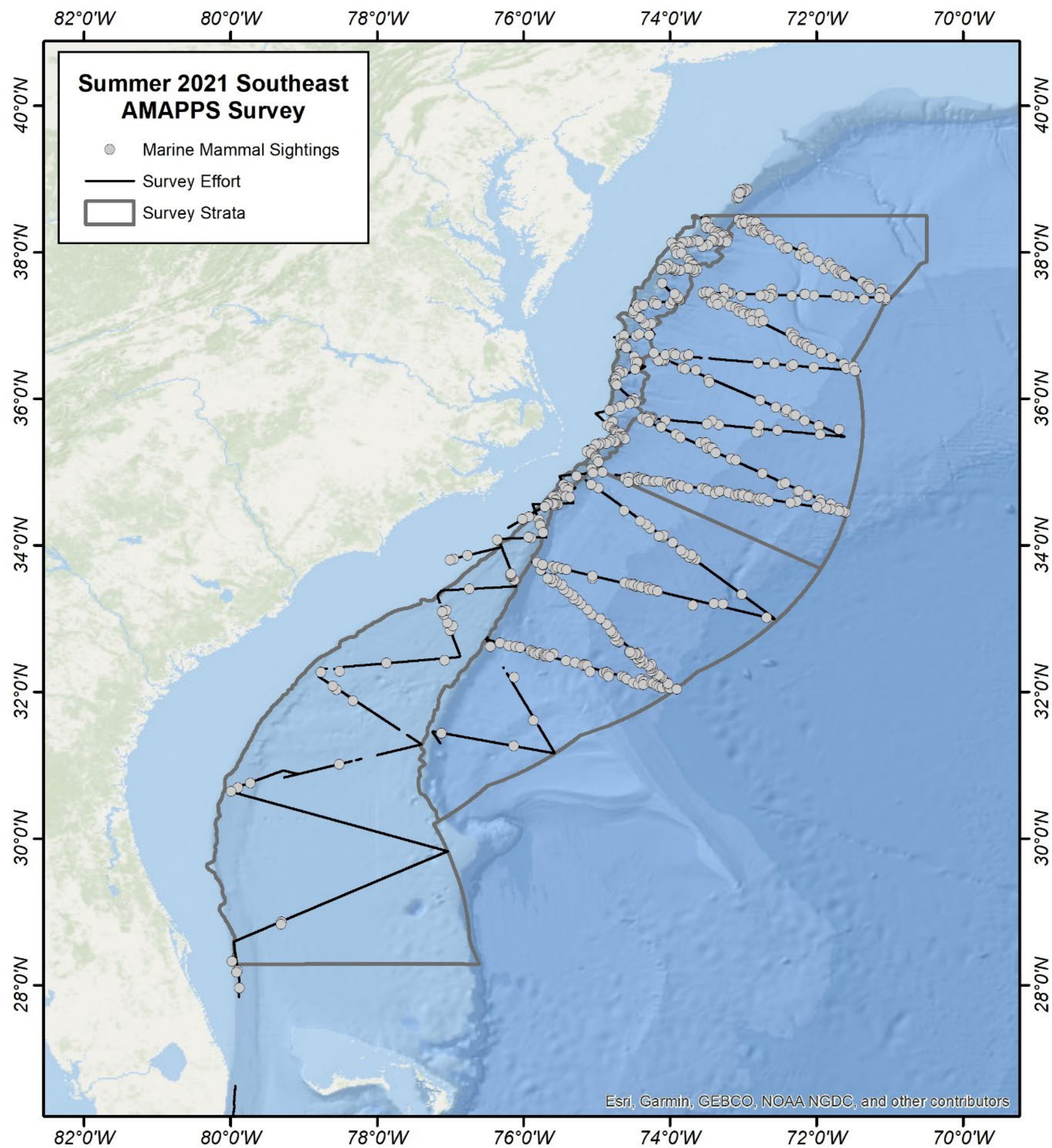


Figure 2. Large whale sightings during GU2103.

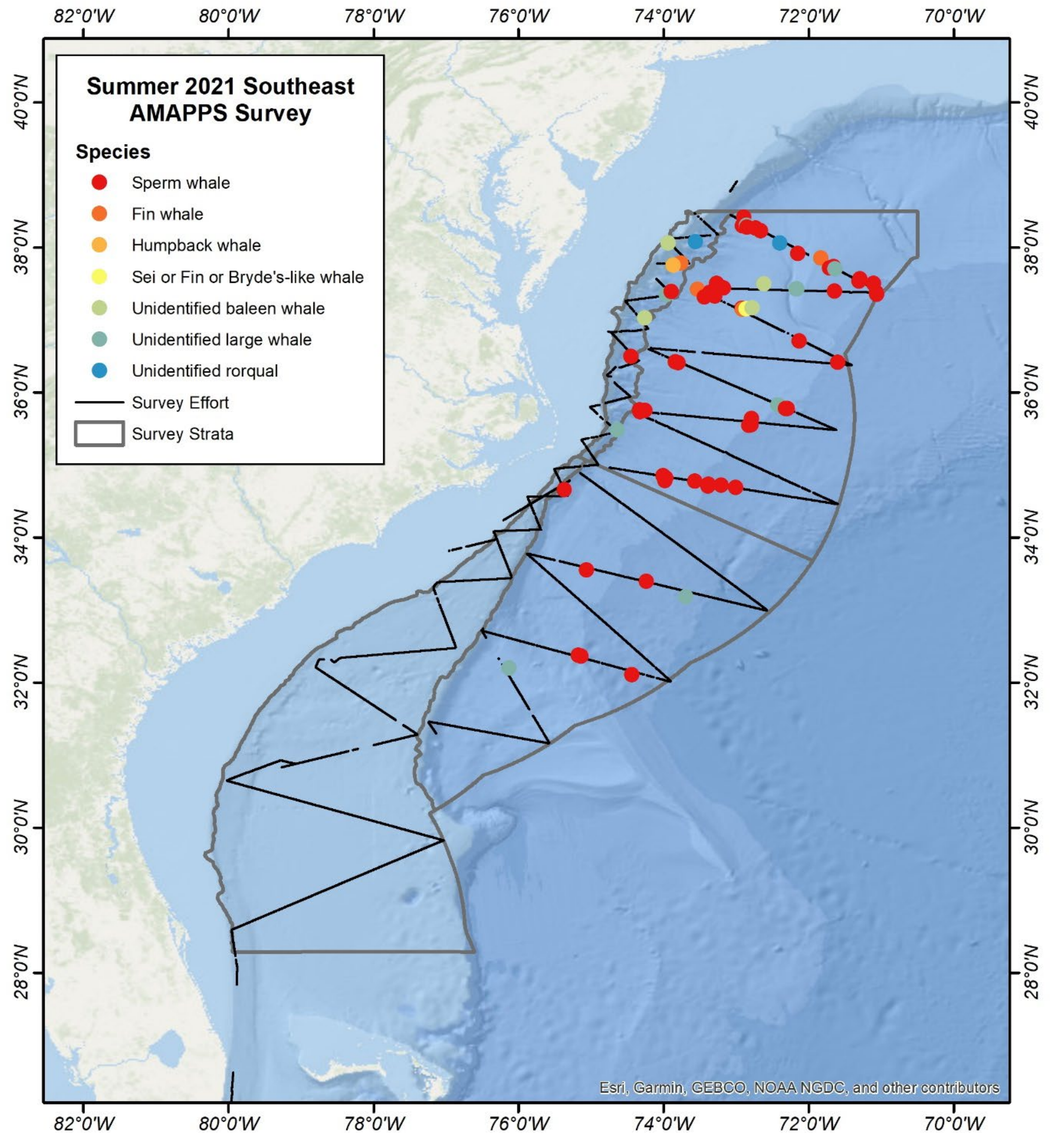


Figure 3. Small whale sightings during GU2103.

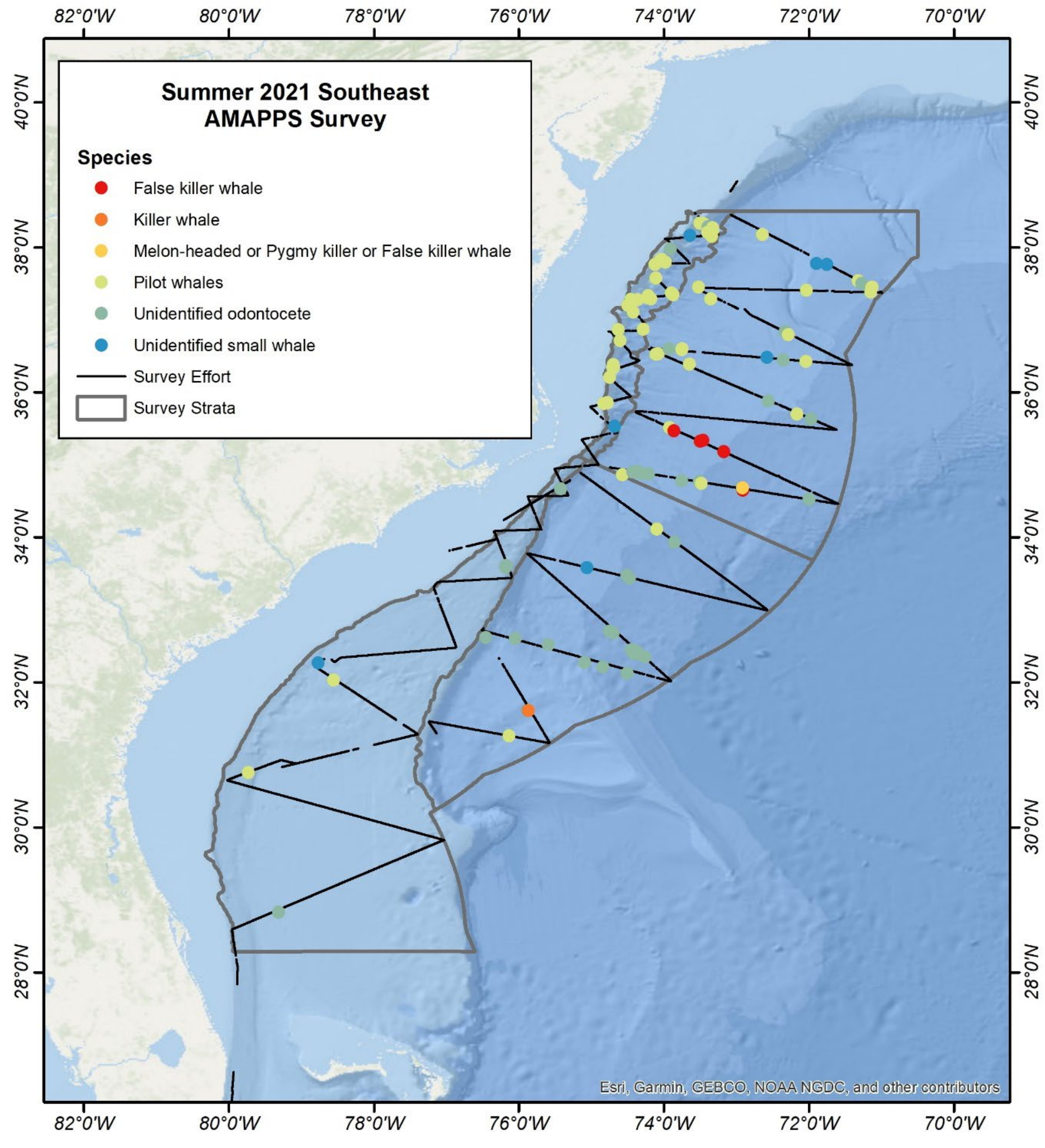


Figure 4. Dolphin sightings during GU2013.

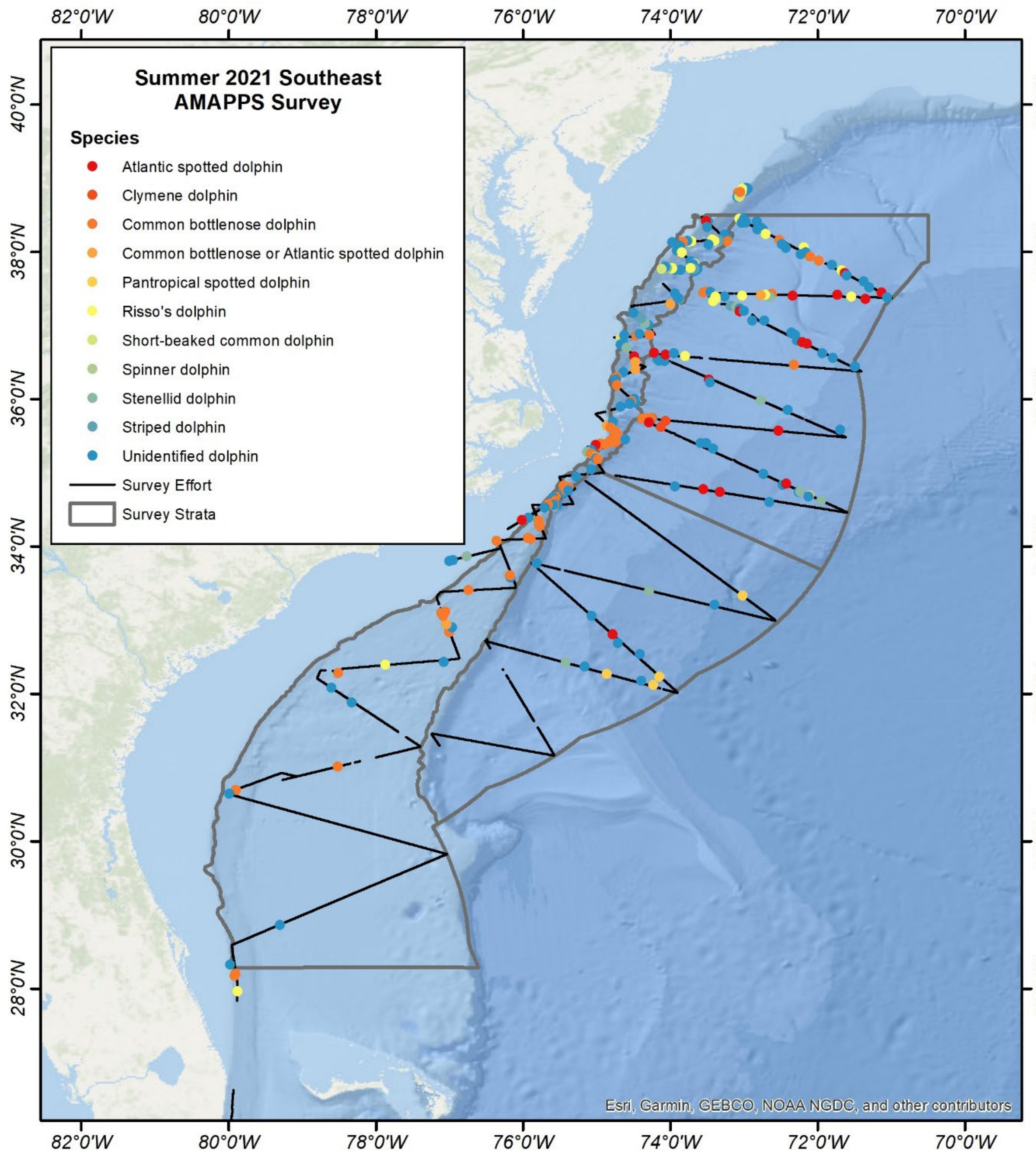


Figure 5. Cryptic species sightings during GU2103.

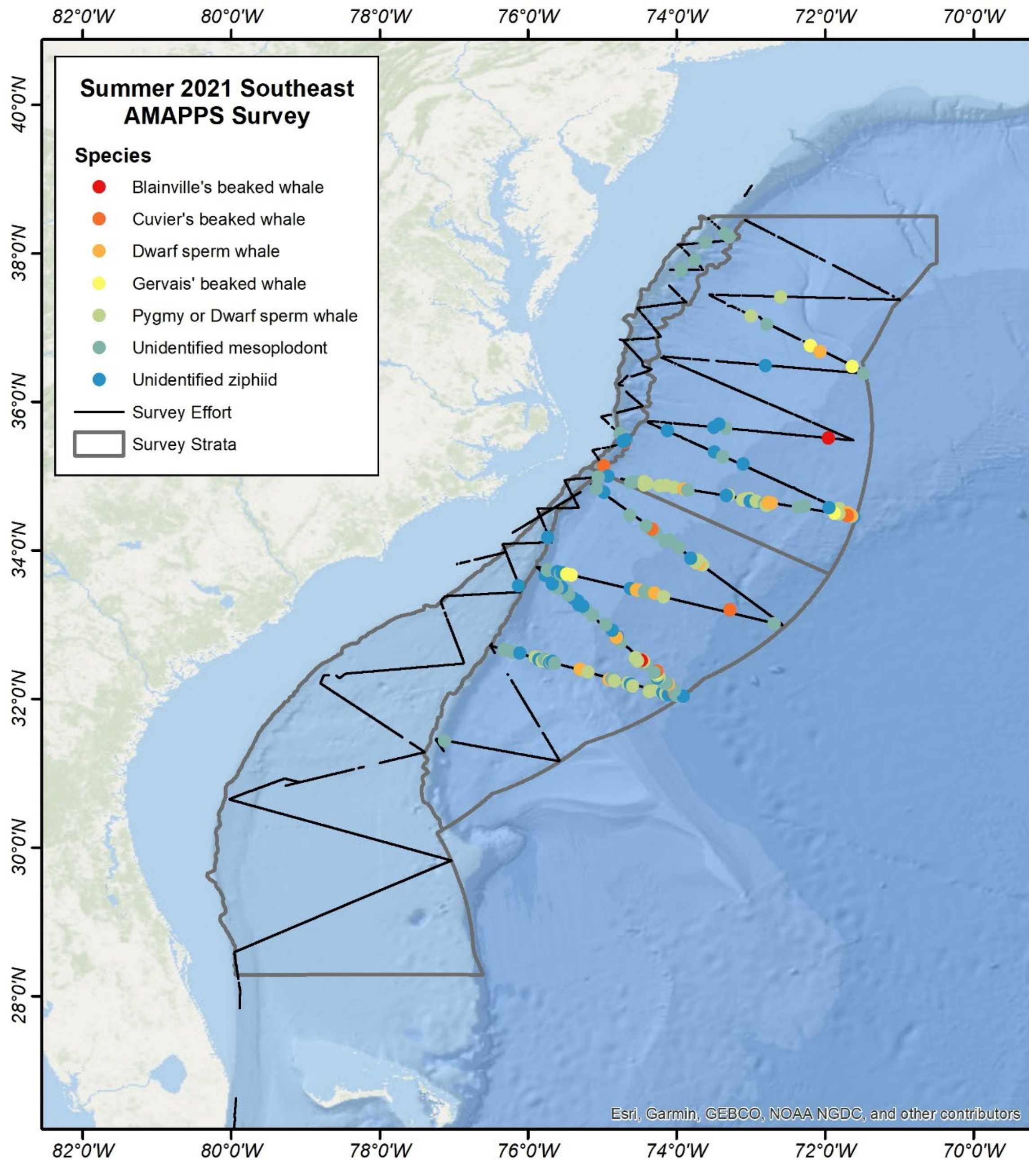


Figure 6. Detection probability functions for large whales.

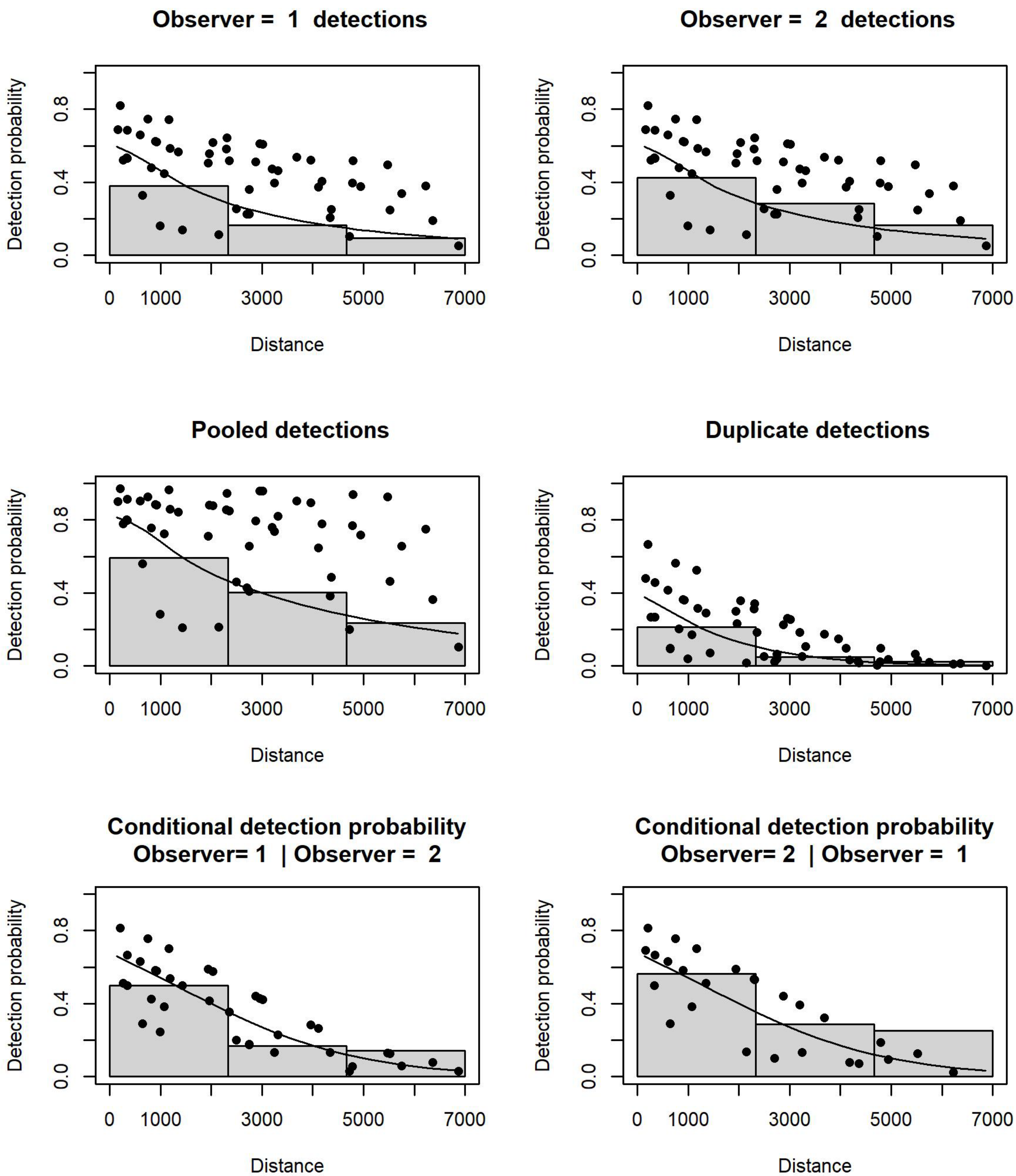


Figure 7. Detection functions for small whales.

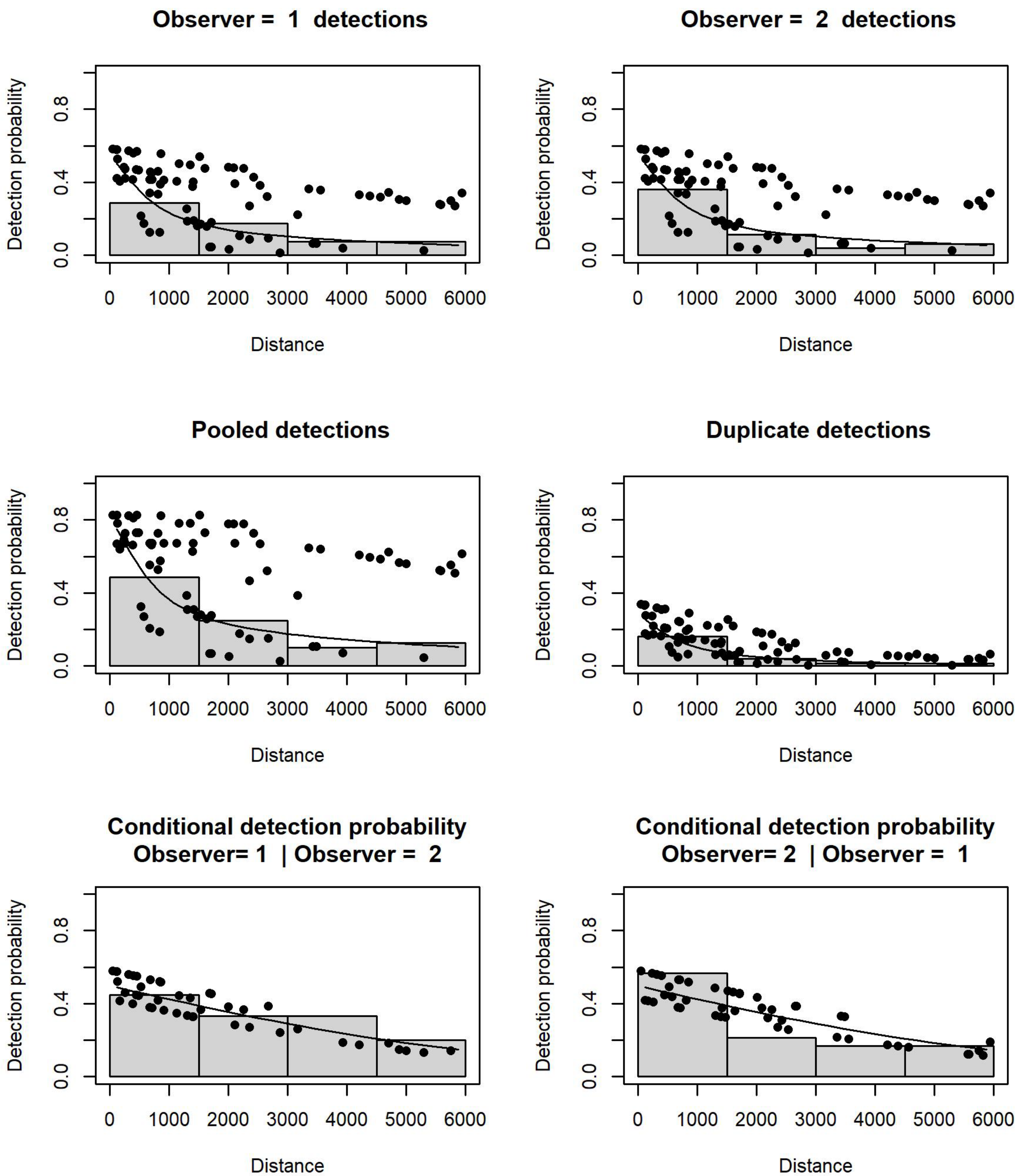


Figure 8. Detection functions for dolphins.

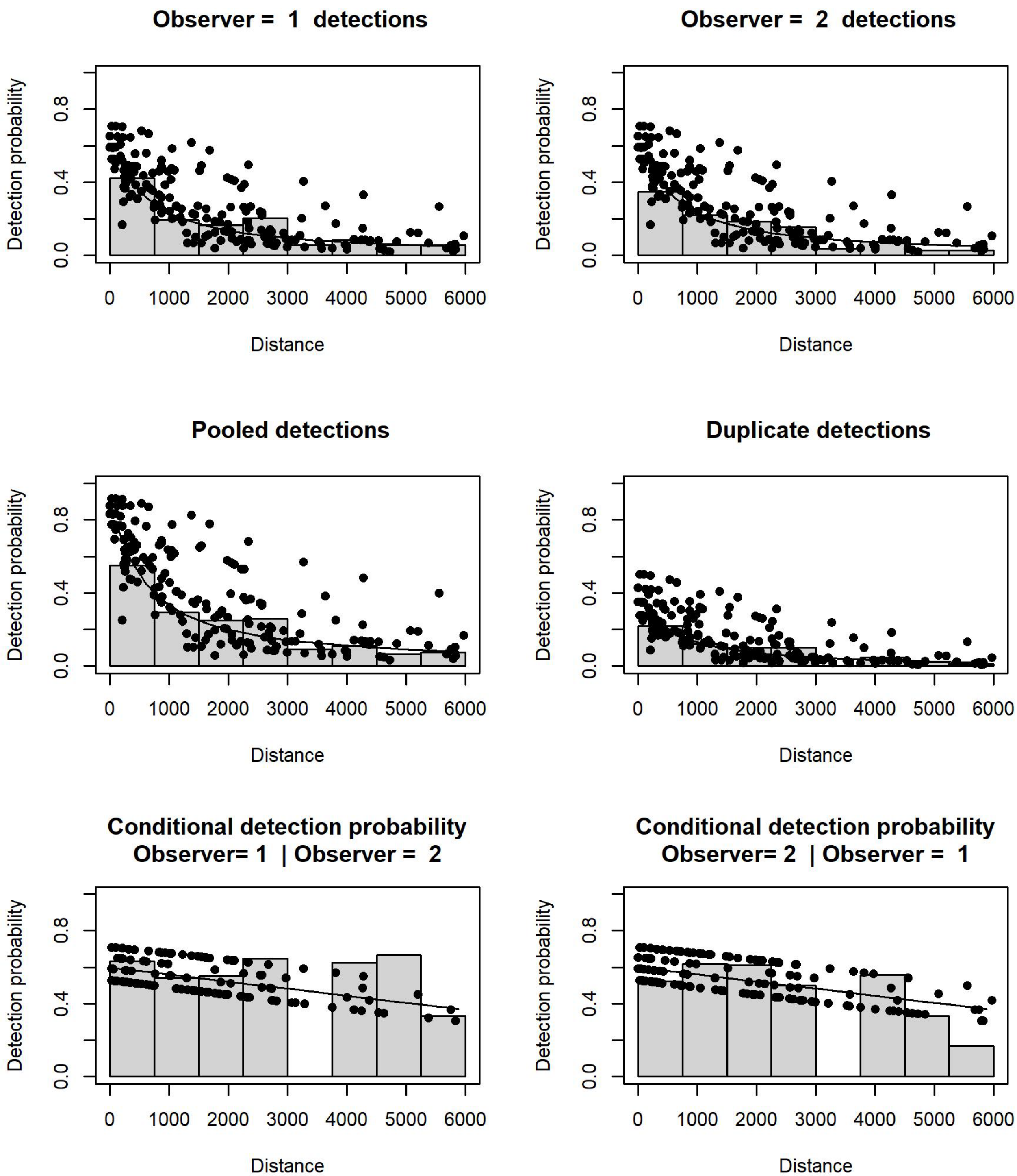
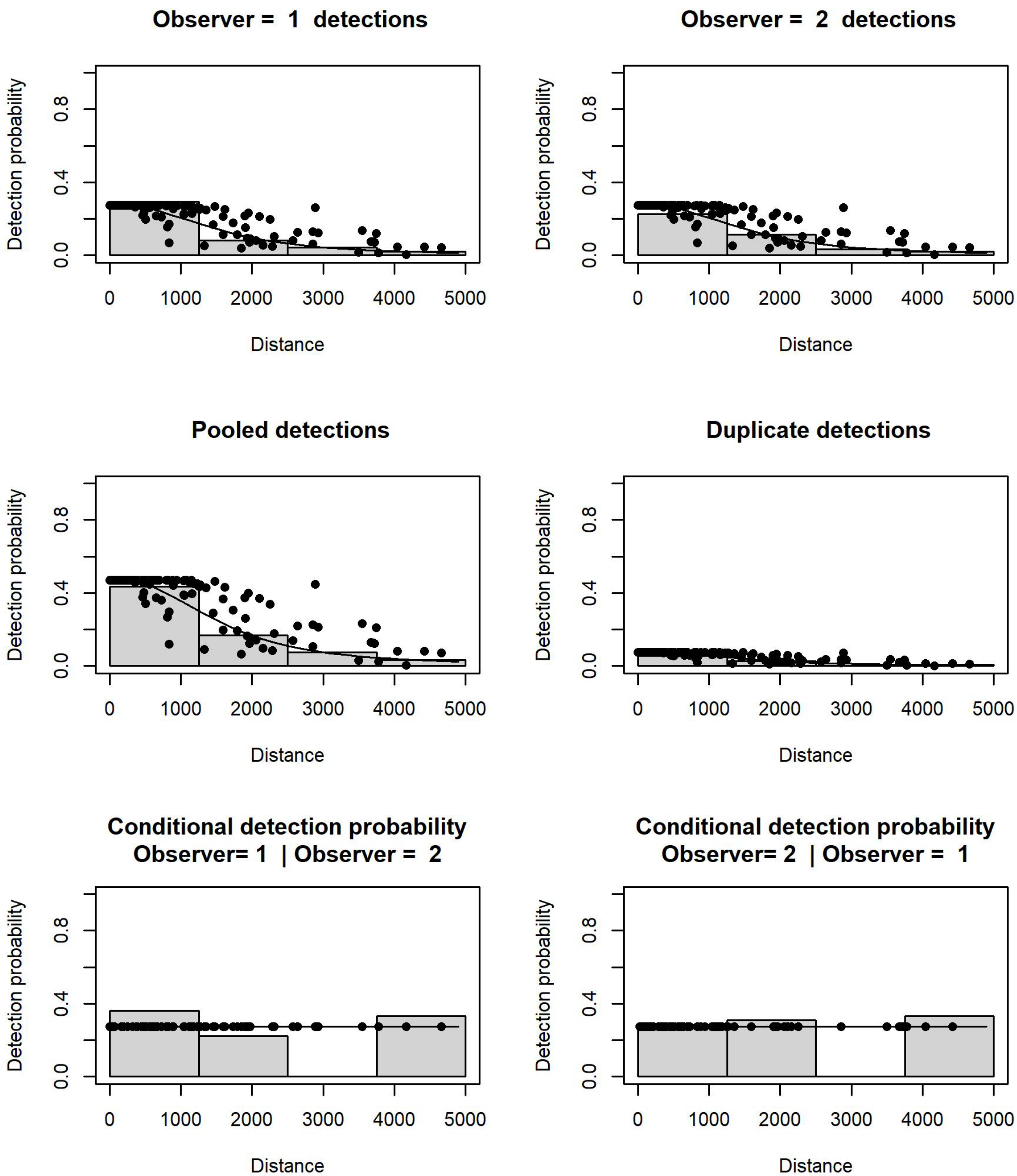


Figure 9. Detection functions for cryptic species.



APPENDIX

Appendix 1. Coast-wide (Florida to Maine) abundance estimates from 2004-2021 for species included in trend analysis. Past estimates were corrected for availability bias where appropriate. N original = abundance estimate reported in prior-year stock assessment reports (Hayes et al. 2019, Waring et al. 2010). N = estimate corrected for availability bias. CV = coefficient of variation.

Species	Year	N original	CV original	Availability correction	Availability CV	N	CV
Atlantic Spotted Dolphin	2004	50978	0.42	1	0	50978	0.42
Atlantic Spotted Dolphin	2011	44714	0.43	1	0	44714	0.43
Atlantic Spotted Dolphin	2016	39921	0.27	1	0	39921	0.27
Atlantic Spotted Dolphin	2021	31506	0.28	1	0	31506	0.28
Clymene Dolphin	2004	0	0	1	0	0	0
Clymene Dolphin	2011	0	0	1	0	0	0
Clymene Dolphin	2016	4237	1.03	1	0	4237	1.03
Clymene Dolphin	2021	21778	0.72	1	0	21778	0.72
Dwarf or Pygmy Sperm Whale	2004	395	0.4	0.539	0.307	733	0.22
Dwarf or Pygmy Sperm Whale	2011	3785	0.47	0.539	0.307	7022	0.25
Dwarf or Pygmy Sperm Whale	2016	7750	0.38	0.539	0.307	14378	0.20
Dwarf or Pygmy Sperm Whale	2021	9474	0.36	1	0	9474	0.36
False Killer Whale	2004	0	0	1	0	0	0
False Killer Whale	2011	442	1.06	1	0	442	1.06
False Killer Whale	2016	1791	0.56	1	0	1791	0.56
False Killer Whale	2021	1298	0.72	1	0	1298	0.72
Common Bottlenose Dolphin	2004	54739	0.24	1	0	54739	0.24
Common Bottlenose Dolphin	2011	77532	0.4	1	0	77532	0.4
Common Bottlenose Dolphin	2016	62851	0.23	1	0	62851	0.23
Common Bottlenose Dolphin	2021	64587	0.24	1	0	64587	0.24
Pantropical Spotted Dolphin	2004	4439	0.49	1	0	4439	0.49
Pantropical Spotted Dolphin	2011	3333	0.91	1	0	3333	0.91
Pantropical Spotted Dolphin	2016	6593	0.52	1	0	6593	0.52
Pantropical Spotted Dolphin	2021	2757	0.5	1	0	2757	0.5
Short-finned Pilot Whale	2004	24674	0.52	1	0	24674	0.52
Short-finned Pilot Whale	2011	21515	0.36	1	0	21515	0.36
Short-finned Pilot Whale	2016	28924	0.24	1	0	28924	0.24
Short-finned Pilot Whale	2021	18749	0.33	1	0	18749	0.33
Spinner Dolphin	2004	0	0	1	0	0	0
Spinner Dolphin	2011	0	0	1	0	0	0
Spinner Dolphin	2016	4102	0.99	1	0	4102	0.99
Spinner Dolphin	2021	0	0	1	0	0	0
Risso's Dolphin	2004	20479	0.59	1	0	20479	0.59
Risso's Dolphin	2011	18250	0.46	1	0	18250	0.46

Species	Year	N original	CV original	Availability correction	Availability CV	N	CV
Risso's Dolphin	2016	35493	0.19	1	0	35493	0.19
Risso's Dolphin	2021	44067	0.45	1	0	44067	0.45
Short-beaked common dolphin	2004	120743	0.23	1	0	120743	0.23
Short-beaked common dolphin	2011	70184	0.28	1	0	70184	0.28
Short-beaked common dolphin	2016	172825	0.21	1	0	172825	0.21
Short-beaked common dolphin	2021	93100	0.56	1	0	93100	0.56
Sperm whale	2004	4804	0.38	0.613	0.247	7837	0.23
Sperm whale	2011	2288	0.28	0.613	0.247	3732	0.17
Sperm whale	2016	4349	0.28	0.613	0.247	7095	0.17
Sperm whale	2021	5895	0.29	1	0	5895	0.29
Striped dolphin	2004	94462	0.4	1	0	94462	0.4
Striped dolphin	2011	54807	0.3	1	0	54807	0.3
Striped dolphin	2016	67306	0.29	1	0	67306	0.29
Striped dolphin	2021	48274	0.29	1	0	48274	0.29