# RISSO'S DOLPHIN (*Grampus griseus*): Western North Atlantic Stock

## STOCK DEFINITION AND GEOGRAPHIC RANGE

Risso's dolphins are distributed worldwide in tropical and temperate seas (Jefferson *et al*. 2008, 2014), and in the Northwest Atlantic occur from Florida to eastern Newfoundland (Leatherwood *et al*. 1976; Baird and Stacey 1991). Off the northeastern U.S. coast, Risso's dolphins are distributed along the continental shelf edge from Cape Hatteras northward to Georges Bank during spring, summer, and autumn (CETAP 1982; Payne *et al*. 1984) (Figure 1). In winter, the range is in the mid-Atlantic Bight and extends outward into oceanic waters (Payne *et al*. 1984). In general, the population occupies the mid-Atlantic continental shelf edge year round, and is rarely seen in the Gulf of Maine (Payne *et al*. 1984). During 1990, 1991 and 1993, spring/summer surveys conducted along the continental shelf edge and in deeper oceanic waters sighted Risso's dolphins associated with strong bathymetric features, Gulf Stream warm-core rings, and the Gulf Stream north wall (Waring *et al*. 1992, 1993; Hamazaki 2002). Sightings during 2016 surveys were concentrated along the shelf break (NEFSC and SEFSC 2018; Figure 1).

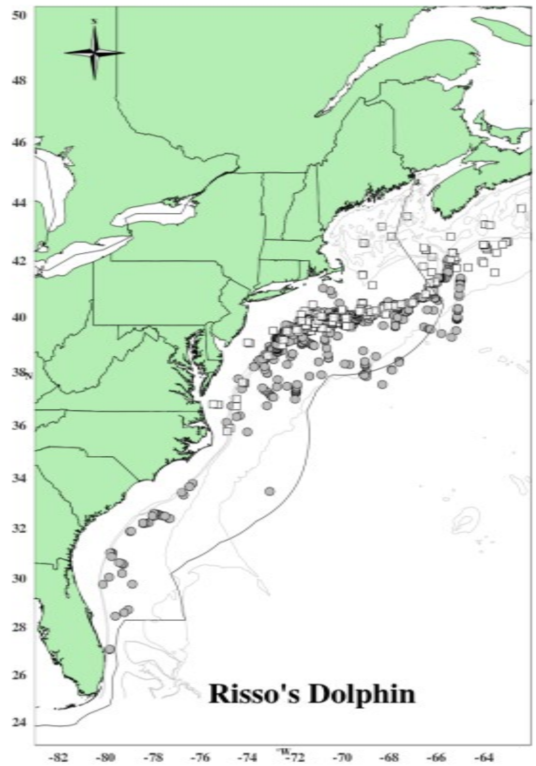


***Figure 1. Distribution of Risso's dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008 2010, 2011 and 2016 and Department of Fisheries and Oceans Canada 2007 TNASS and 2016 NAISS surveys. Isobaths are the 100m, 1,000m, and 4,000m depth contours. Circle symbols represent shipboard sightings and squares are aerial sightings.***

There is no information on stock structure of Risso's dolphin in the western North Atlantic, or to determine if separate stocks exist in the Gulf of Mexico and Atlantic. Thus, it is plausible that the stock could actually contain multiple demographically independent populations that should themselves be stocks, because the current stock spans multiple eco-regions (Longhurst 1998; Spalding *et al*. 2007). In 2006, a rehabilitated adult male Risso's dolphin stranded and released in the Gulf of Mexico off Florida was tracked via satellite-linked tag to waters off Delaware (Wells *et al*. 2009). The Gulf of Mexico and Atlantic stocks are currently being treated as two separate stocks.

## POPULATION SIZE

The best abundance estimate for Risso's dolphins is the sum of the estimates from the 2016 NEFSC and Department of Fisheries and Oceans Canada (DFO) surveys—35,493 (CV=0.19: Table 1). Because the survey areas did not overlap, the estimates from the two surveys were added together and the CV's pooled using a delta method to produce a species abundance estimate for the stock area. The 2016 estimate is larger than those from 2011 because the 2016 estimate is derived from a survey area extending from Newfoundland to Florida, which is about 1,300,000 km$^2$ larger than the 2011 survey area. In addition, some of the 2016 survey estimates in US waters were corrected for availability bias (due to diving behavior), whereas the 2011 estimates were not corrected (Table 1).

**Earlier abundance estimates**

Please see Appendix IV for a summary of abundance estimates, including earlier estimates and survey descriptions. As recommended in the GAMMS II Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable for the determination of the current PBR.

**Recent surveys and abundance estimates**

An abundance estimate of 15,197 (CV=0.55) Risso's dolphins was generated from a shipboard and aerial survey conducted during June–August 2011 (Palka 2012). The aerial portion that contributed to the abundance estimate covered 5,313 km of tracklines that were over waters north of New Jersey from the coastline to the 100-m depth contour, through the U.S. and Canadian Gulf of Maine and up to and including the lower Bay of Fundy. The shipboard portion covered 3,107 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 outer limit of the U.S. EEZ). Both sighting platforms used a double-platform data-collection procedure, which allows estimation of abundance corrected for perception bias of the detected species (Laake and Borchers, 2004). Shipboard data were inspected to determine if there was significant responsive movement to the ship (Palka and Hammond 2001). Because there was evidence of responsive (evasive) movement of this species to the ship, estimation of the abundance was based on Palka and Hammond (2001) and the independent-observer approach assuming full independence (Laake and Borchers 2004), and calculated using the mark-recapture distance sampling option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009).

An abundance estimate of 3,053 (CV=0.44) Risso's dolphins was generated from a shipboard survey conducted concurrently (June–August 2011) in waters between central Virginia and central Florida (Garrison 2016). This shipboard survey included shelf-break and inner continental slope waters deeper than the 50-m depth contour within the U.S. EEZ. The survey employed the double-platform methodology searching with 25×150 "bigeye" binoculars. A total of 4,445 km of tracklines was surveyed, yielding 290 cetacean sightings. The majority of sightings occurred along the continental shelf break with generally lower sighting rates over the continental slope. Estimation of the abundance was based on the independent-observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009).

The Department of Fisheries and Oceans, Canada (DFO) generated Risso's dolphin estimates from a large-scale aerial survey of Atlantic Canadian shelf and shelf break habitats 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 of effort were flown over the Gulf of St. Lawrence/Bay of Fundy/Scotian Shelf strata and 21,037 over the Newfound/Labrador strata. The Bay of Fundy/Scotian shelf portion of the Risso's dolphin population was estimated as 6,073 (CV=0.445).

Abundance estimates of 75,079 (CV=0.38) and 7,245 (CV=0.44) Risso's 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 limit 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 limit 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 2018). 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 recent abundance estimates for the western North Atlantic Risso's dolphin (Grampus griseus), by month, year, and area covered during each abundance survey, resulting abundance estimate (Nbest) and coefficient of variation (CV).***

| Month/Year | Area | $N_{best}$ | CV |
|---|---|---|---|
| Jun–Aug 2011 | Central Virginia to lower Bay of Fundy | 15,197 | 0.55 |
| Jun–Aug 2011 | Central Florida to Central Virginia | 3,053 | 0.44 |
| Jun–Aug 2011 | Central Florida to lower Bay of Fundy (COMBINED) | 18,250 | 0.46 |
| Jun–Sep 2016 | Central Florida to Central Virginia | 7,245 | 0.44 |
| Jun–Sep 2016 | Central Virginia to lower Bay of Fundy | 22,175 | 0.23 |
| Aug–Sep 2016 | Gulf of St. Lawrence/Bay of Fundy/Scotian Shelf | 6,073 | 0.445 |
| Jun–Sep 2016 | Central Florida to Gulf of St. Lawrence/Bay of Fundy/Scotian Shelf - COMBINED | 35,493 | 0.19 |

**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 20$^{th}$ percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for Risso's dolphins is 35,493 (CV=0.19), obtained from the 2016 surveys. The minimum population estimate for the western North Atlantic Risso's dolphin is 30,289.

**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 strata.

**CURRENT AND MAXIMUM NET PRODUCTIVITY RATES**

Current and maximum net productivity rates are unknown for this stock. Due to uncertainties about the stock-specific life history parameters, the maximum net productivity rate was assumed to be the default value of 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 is 30,289. The maximum productivity rate is 0.04, the default value for cetaceans (Barlow *et al.* 1995). The recovery factor is 0.5, the default value for stocks of unknown status relative to 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 Risso's dolphin is 303.

**ANNUAL HUMAN-CAUSED MORTALITY**

Total annual estimated average human-caused mortality or serious injury to this stock during 2013–2017 was 54.3 Risso's dolphins, derived from 2 components: 1) 53.9 estimated mortalities in observed fisheries (CV=0.24; Table 2) and 2) 0.4 from average 2013–2017 non-fishery related, human interaction stranding mortalities (NMFS unpublished data). Key uncertainties include the potential that the observer coverage was not representative of the fishery during all times and places.

## Fishery Information

Detailed fishery information is reported in Appendix III.

## Earlier Interactions

See Appendix V for more information on historical takes.

## Pelagic Longline

Pelagic longline bycatch estimates of Risso's dolphins for 2013–2017 are documented in Garrison and Stokes (2014, 2016, 2017, 2019, 2020). Most of the estimated marine mammal bycatch was from U.S. Atlantic EEZ waters between South Carolina and Cape Cod. There is a high likelihood that dolphins released alive with ingested gear or gear wrapped around appendages will not survive (Wells *et al.* 2008). See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

## Northeast Bottom Trawl

One Risso's dolphin was observed taken in northeast bottom trawl fisheries in 2014 and 2 in 2016 (Table 2). Annual Risso's dolphin mortalities were estimated using annual stratified ratio-estimator methods (Lyssikatos *et al.* 2020). See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

## Mid-Atlantic Bottom Trawl

Risso's dolphins have been observed taken in mid-Atlantic bottom trawl fisheries (Table 2). Annual Risso's dolphin mortalities were estimated using annual stratified ratio-estimator methods (Lyssikatos *et al.* 2020). See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

## Northeast Sink Gillnet

In the northeast sink gillnet fishery, Risso's dolphin interactions have historically been rare, but in 2013 one animal was observed in the waters south of Massachusetts (Hatch and Orphanides 2015, 2016; Orphanides 2019, 2020). See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

***Table 2. Summary of the incidental serious injury and mortality of Risso's dolphin (Grampus griseus) by commercial fishery including the years sampled, the type of data used, the annual observer coverage, the observed mortalities and serious injuries recorded by on-board observers, the estimated annual mortality and serious injury, the combined annual estimates of mortality and serious injury, the estimated CV of the combined estimates and the mean of the combined estimates (CV in parentheses).***

| Fishery | Years | Data Type [a] | Observer Coverage [b] | Observed Serious Injury[c] | Observed Mortality | Estimated Serious Injury[c] | Estimated Mortality | Estimated Combined Mortality | Estimated CVs | Mean Combined Annual Mortality |
|---|---|---|---|---|---|---|---|---|---|---|
| Pelagic Longline | 2013 | Obs. Data, Logbook | 0.09 | 1 | 0 | 1.9 | 0 | 1.9 | 1 | 6.9 (0.39) |
| | 2014 | | 0.10 | 1 | 0 | 7.7 | 0 | 7.7 | 1 | |
| | 2015 | | 0.12 | 2 | 0 | 8.4 | 0 | 8.4 | 0.71 | |
| | 2016 | | 0.15 | 1 | 1 | 10.5 | 5.6 | 16.1 | 0.57 | |
| | 2017 | | 0.12 | 1 | 0 | 0.2 | 0 | 0.2 | 1 | |
| Northeast Sink Gillnet | 2013 | Obs. Data, Trip Logbook, Allocated Dealer Data | 0.11 | 0 | 1 | 0 | 23 | 23 | 1 | 5.8 (0.79) |
| | 2014 | | 0.18 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | 2015 | | 0.14 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | 2016 | | 0.10 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | 2017 | | 0.12 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Northeast Bottom Trawl | 2013 | Obs. Data, Weighout | 0.15 | 0 | 0 | 0 | 0 | 0 | 0 | 4.2 (0.73) |
| | 2014 | | 0.17 | 0 | 1 | 0 | 4.2 | 4.2 | 0.91 | |
| | 2015 | | 0.19 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | 2016 | | 0.12 | 0 | 2 | 0 | 17 | 17 | 0.88 | |
| | 2017 | | 0.16 | 0 | 0 | 0 | 0 | 0 | 0 | |

| Fishery | Years | Data Type [a] | Observer Coverage [b] | Observed Serious Injury[c] | Observed Mortality | Estimated Serious Injury[c] | Estimated Mortality | Estimated Combined Mortality | Estimated CVs | Mean Combined Annual Mortality |
|---|---|---|---|---|---|---|---|---|---|---|
| Mid-Atlantic Bottom Trawl | 2013<br>2014<br>2015<br>2016<br>2017 | Obs. Data, Dealer Data | 0.06<br>0.08<br>0.09<br>0.10<br>0.10 | 0<br>0<br>2<br>0<br>2 | 4<br>2<br>1<br>4<br>5 | 0<br>0<br>27<br>0<br>12 | 42<br>21<br>13<br>39<br>31 | 42<br>21<br>40<br>39<br>31 | 0.71<br>0.93<br>0.63<br>0.56<br>0.51 | 37 (.29) |
| TOTAL | - | - | - | - | - | - | - | - | - | 53.9 (0.24) |

[a] Observer data (Obs. Data) are used to measure bycatch rates and the data are collected within the Northeast Fisheries Observer Program. NEFSC collects landings data (unallocated Dealer Data and Allocated Dealer Data) which are used as a measure of total landings and mandatory Vessel Trip Reports (VTR) (Trip Logbook) are used to determine the spatial distribution of landings and fishing effort. Total landings are used as a measure of total effort for the coastal gillnet fishery.
[b] The observer coverages for the northeast and mid-Atlantic sink gillnet fishery are ratios based on tons of fish landed. Northeast bottom trawl, mid-Atlantic bottom trawl, northeast mid-water and mid-Atlantic mid-water trawl fishery coverages are ratios based on trips. Total observer coverage reported for gillnet and bottom trawl gear include samples collected from traditional fisheries observers in addition to fishery at-sea monitors through the Northeast Fisheries Observer Program (NEFOP).
[c] Serious injuries were evaluated for the 2013–2017 period and include both at-sea monitor and traditional observer data (Josephson *et al*. 2019).

## Other Mortality

From 2013 to 2017, 38 Risso's dolphin strandings were recorded along the U.S. Atlantic coast (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 23 October 2018). Three animals had indications of human interaction, none of which were classified as fishery interactions. Indications of human interaction are not necessarily the cause of death (Table 3).

***Table 3. Risso's dolphin (Grampus griseus) reported strandings along the U.S. Atlantic coast and Puerto Rico, 2013–2017.***

| STATE | 2013 | 2014 | 2015 | 2016 | 2017 | TOTALS |
|---|---|---|---|---|---|---|
| Massachusetts[b] | 3 | 2 | 1 | 2 | 14 | 22 |
| Rhode Island | 0 | 0 | 0 | 0 | 1 | 1 |
| New York | 2 | 0 | 2 | 0 | 0 | 4 |
| New Jersey | 0 | 0 | 0 | 0 | 1 | 1 |
| Maryland | 1 | 0 | 0 | 0 | 0 | 1 |
| Virginia[c] | 0 | 1 | 0 | 0 | 0 | 1 |
| North Carolina | 1 | 1 | 0 | 0 | 1 | 3 |
| Florida[a] | 2 | 0 | 0 | 2 | 1 | 5 |
| TOTAL | **9** | **4** | **4** | **4** | **4** | **38** |

a. One animal in 2013 classified as human interaction due to linear wound on face.
b. One animal in 2014 was classified as CBD for human interaction due to signs of ear trauma.
c. One animal in 2014 classified as HI due to plastic ingestion.

Stranding data probably underestimate the extent of fishery-related 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.

## 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., Storelli and Macrotrigiano 2000; 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 Risso's 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; 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

Risso's 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. The 2013–2017 average annual human-related mortality does not exceed PBR. The total U.S. fishery 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 a zero mortality and serious injury rate. The status of Risso's dolphins relative to OSP in the U.S. Atlantic EEZ is unknown. Population trends for this species have not been investigated. Based on the low levels of uncertainties described in the above sections, it expected these uncertainties will have little effect on the designation of the status of this stock.

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