

## CLYMENE DOLPHIN (*Stenella clymene*): Western North Atlantic Stock

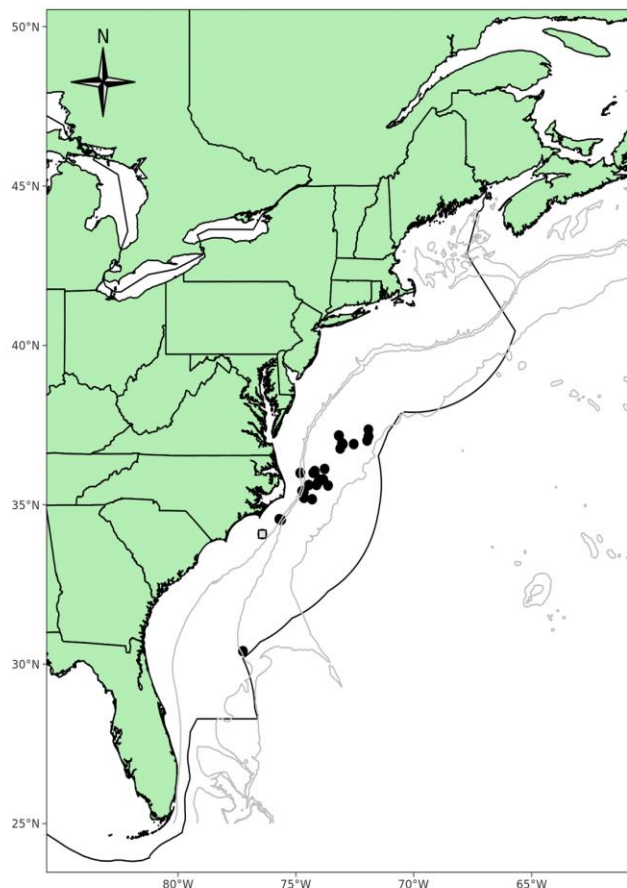
### STOCK DEFINITION AND GEOGRAPHIC RANGE

The Clymene dolphin is endemic to tropical and subtropical waters of the Atlantic Ocean (Jefferson and Curry 2003). Clymene dolphins have been commonly sighted in the Gulf of Mexico since 1990 (Mullin et al. 1994; Fertl et al. 2003). Sightings of this species in the western North Atlantic along the U.S. East Coast are rare (Figure 1); there have generally been only one or two sightings in any given survey year. However, the sightings in addition to stranding records (Fertl et al. 2003) indicate that this species does occur in the western North Atlantic. Nara et al. (2017) analyzed mitochondrial DNA sequence data from samples collected in the western North Atlantic, Gulf of Mexico, and western South Atlantic and found significant genetic differentiation among all three regions, supporting delimitation of separate western North Atlantic and Gulf of Mexico stocks. Given the paucity of sightings, there are insufficient data to determine whether the western North Atlantic stock comprises multiple demographically independent populations. However, those sightings do encompass multiple marine ecoregions (Spalding et al. 2007), and include Cape Hatteras, a known biogeographic break for other marine species, so it is possible that multiple demographically independent populations of *S. clymene* exist within this stock. Additional morphological, acoustic, genetic and/or behavioral data are needed to further delineate population structure in this region.

### POPULATION SIZE

The best abundance estimate available for Clymene dolphins in the western North Atlantic is 21,778 (CV=0.72; Garrison and Dias 2023; Palka 2023). This estimate is from summer 2021 surveys covering waters from central Florida to the lower Bay of Fundy. Clymene dolphins were not sighted during surveys of the U.S. Atlantic coast conducted in the summers of 2004 and 2011.

Abundance estimates of 0 and 4,237 (CV=1.03) Clymene 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 38°N latitude and consisted of 5,354 km of on-effort trackline along the shelf break and offshore to the U.S. EEZ (NEFSC and SEFSC 2018). No Clymene dolphins were observed during this survey. Clymene dolphins were observed in the second vessel survey, which covered waters from Central Florida to approximately 38°N latitude between the 100-m isobaths and 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; Garrison 2020; Palka 2020). 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.



**Figure 1.** Distribution of Clymene 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.

More recent abundance estimates of 2,268 (CV=0.50) and 19,510 (CV=0.80) Clymene 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 36°N 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 (25°N latitude) to approximately 38°N 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 recent abundance estimates for the western North Atlantic Clymene dolphin (*Stenella clymene*) 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 lower Bay of Fundy	0	-
Jun–Aug 2016	Central Florida to New Jersey	4,237	1.03
Jun–Aug 2016	Central Florida to lower Bay of Fundy (COMBINED)	4,237	1.03
Jun–Aug 2021	New Jersey to lower Bay of Fundy	2,268	0.50
Jun–Aug 2021	Central Florida to New Jersey	19,510	0.80
<b>Jun–Aug 2021</b>	<b>Central Florida to lower Bay of Fundy (COMBINED)</b>	<b>21,778</b>	<b>0.72</b>

#### 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 21,778 (CV=0.72). The minimum population estimate based on the 2021 abundance estimates is 12,622 (Table 2).

#### Current Population Trend

Clymene dolphins are rarely sighted during abundance surveys, and the resulting estimates of abundance are both highly variable between years and highly uncertain. The rare encounter rates limit the ability to assess or interpret trends in population size.

#### 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 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 Clymene dolphin is 12,622. 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 western North Atlantic stock of Clymene dolphins is 126 (Table 2).

**Table 2. Best and minimum abundance estimates for the western North Atlantic *Clymene dolphin* with Maximum Productivity Rate ( $R_{max}$ ), Recovery Factor ( $F_r$ ) and PBR.**

$N_{est}$	CV $N_{est}$	$N_{min}$	$F_r$	$R_{max}$	PBR
21,778	0.72	12,622	0.5	0.04	126

## 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 *Clymene dolphin* in the western North Atlantic. Recorded takes of *Clymene dolphin* 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 *Clymene dolphin* 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 *Clymene dolphin* by this fishery in the Atlantic Ocean during 2017–2021 (Garrison and Stokes 2020a; 2020b; 2021; 2023a; 2023b).

## STATUS OF STOCK

*Clymene dolphin* 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; therefore, total fishery-related mortality and serious injury can be considered insignificant and approaching the zero mortality and serious injury rate. The status of *Clymene dolphin* in the U.S. EEZ relative to optimum sustainable population is unknown. There are insufficient data to determine population trends for this stock.

## OTHER FACTORS THAT MAY BE AFFECTING THE STOCK

### Strandings

During 2017–2021, one *Clymene dolphin* was reported stranded along the U.S. East Coast (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 13 October 2022 (Southeast Region) and 18 September 2022 (Northeast Region)). This animal stranded in South Carolina in 2018, and no evidence of human interaction was detected.

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.

### 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., Schwacke et al. 2002; Jepson et al.

2016; Hall et al. 2018), but research on contaminant levels for this stock is lacking.

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.

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). There is uncertainty in how, if at all, the changes in distribution and population size of cetacean species may interact with change in distribution of prey species and how the ecological shifts will affect human impacts to the species.

## REFERENCES CITED

- Barlow, J., S.L. Swartz, T.C. Eagle and P.R. Wade. 1995. U.S. marine mammal stock assessment: guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6, National Marine Fisheries Service, Seattle, WA. 73 pp. <https://repository.library.noaa.gov/view/noaa/6219>
- Buckland, S.T., D.R. Anderson, 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.
- Byrd, B.L., A.A. Hohn, G.N. Lovewell, K.M. Altman, S.G. Barco, A. Friedlaender, C.A. Harms, W.A. McLellan, K.T. Moore, P.E. Rosel and V.G. Thayer. 2014. Strandings illustrate marine mammal biodiversity and human impacts off the coast of North Carolina, USA. *Fish. Bull.* 112:1–23.
- Carretta, J.V., K. Danil, S.J. Chivers, D.W. Weller, D.S. Janiger, M. Berman-Kowalewski, K.M. Hernandez, J.T. Harvey, R.C. Dunkin, D.R. Casper, S. Stoudt, M. Flannery, K. Wilkinson, J. Huggins and D.M. Lambourn. 2016. Recovery rates of bottlenose dolphin (*Tursiops truncatus*) carcasses estimated from stranding and survival rate data. *Mar. Mamm. Sci.* 32(1):349–362.
- Carroll, A.G., R. Przeslawski, A. Duncan, M. Gunning, B. Bruce. 2017. A critical review of the potential impacts of marine seismic surveys on fish & invertebrates. *Mar. Pollut. Bull.* 114:9–24.
- Fertl, D., T.A. Jefferson, I.B. Moreno, A.N. Zerbini and K.D. Mullin. 2003. Distribution of the Clymene dolphin *Stenella clymene*. *Mammal Review* 33(3):253–271.
- Garrison, L.P. 2020. Abundance of cetaceans along the southeast U.S. east coast from a summer 2016 vessel survey. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, FL 33140. PRD Contribution # PRD-2020-04, 17 pp.
- Garrison, L.P. and L.A. Dias. 2023. Abundance of marine mammals in waters of the southeastern U.S. Atlantic during summer 2021. SEFSC MMTD Contribution: #MMTD-2023-01. 23 pp. <https://repository.library.noaa.gov/view/noaa/49152>
- Garrison, L.P. and L. Stokes. 2020a. Estimated bycatch of marine mammals and sea turtles in the U.S. Atlantic pelagic longline fleet during 2017. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, Florida 33140. PRD Contribution # PRD-2020-05. 61 pp.
- Garrison, L.P. and L. Stokes. 2020b. Estimated bycatch of marine mammals and sea turtles in the U.S. Atlantic pelagic longline fleet during 2018. Southeast Fisheries Science Center, Protected Resources and Biodiversity Division, 75 Virginia Beach Dr., Miami, Florida 33140. PRD Contribution # PRD-2020-08. 56 pp.
- Garrison, L.P. and L. Stokes. 2021. Estimated bycatch of marine mammals and sea turtles in the U.S. Atlantic pelagic longline fleet during 2019. NOAA Tech. Memo. NMFS-SEFSC-750. 59 pp.
- Garrison, L.P. and L. Stokes. 2023a. Estimated bycatch of marine mammals and sea turtles in the U.S. Atlantic pelagic longline fleet during 2020. NOAA Tech. Memo. NMFS-SEFSC-764. 66 pp.
- Garrison, L.P. and L. Stokes. 2023b. Estimated bycatch of marine mammals and sea turtles in the U.S. Atlantic pelagic longline fleet during 2021. NOAA Tech. Memo. NMFS-SEFSC-765. 65 pp.
- Gomez, C., J.W. Lawson, A.J. Wright, A.D. Buren, D. Tollit and V. Lesage. 2016. A systematic review on the behavioural responses of wild marine mammals to noise: The disparity between science and policy. *Can. J. Zool.* 94:801–819.
- Grieve, B.D., J.A. Hare and V.S. Saba. 2017. Projecting the effects of climate change on *Calanus finmarchicus* distribution within the US Northeast continental shelf. *Sci. Rep.* 7:6264.

- Hall, A.J., B.J. McConnell, L.J. Schwacke, G.M. Ylitalo, R. Williams and T.K. Rowles. 2018. Predicting the effects of polychlorinated biphenyls on cetacean populations through impacts on immunity and calf survival. *Environ. Poll.* 233:407–418.
- Jefferson, T.A. and B.E. Curry. 2003. *Stenella clymene*. *Mammalian Species* 726:1–5.
- Jepson, P.D., R. Deaville, J.L. Barber, A. Aguilar, A. Borrell, S. Murphy, J. Barry, A. Brownlow, J. Barnett, S. Berrow and A.A. Cunningham. 2016. PCB pollution continues to impact populations of orcas and other dolphins in European waters. *Sci. Rep.-U.K.* 6:18573.
- MacLeod, C.D. 2009. Global climate change, range changes and potential implications for the conservation of marine cetaceans: a review and synthesis. *Endang. Species Res.* 7:125–136.
- Morley, J.W., R.L. Selden, R.J. Latour, T.L. Frolicher, R.J. Seagraves and M.L. Pinsky. 2018. Projecting shifts in thermal habitat for 686 species on the North American continental shelf. *PLoS ONE* 13(5):e0196127.
- Mullin, K.D. and G.L. Fulling. 2003. Abundance of cetaceans in the southern U.S. North Atlantic Ocean during summer 1998. *Fish. Bull.* 101:603–613.
- Mullin, K.D., T.A. Jefferson and L.J. Hansen. 1994. Sightings of the clymene dolphin (*Stenella clymene*) in the Gulf of Mexico. *Mar. Mamm. Sci.* 10:464–470.
- Nara, L., A.C.O. de Meirelles, L.R.A. Souto, J.M. Silva-Jr. and A.P.C. Farro. 2017. An initial population structure and genetic diversity analysis for *Stenella clymene* (Gray, 1850): Evidence of differentiation between the North and South Atlantic Ocean. *Aquat. Mamm.* 43:507–516.
- NMFS [National Marine Fisheries Service]. 1999. Cruise results: Summer Atlantic Ocean marine mammal survey, NOAA Ship Oregon II Cruise OT 99-05 (236). Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.
- NMFS [National Marine Fisheries Service]. 2018. 2018 Revisions to: Technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing (Version 2.0): Underwater thresholds for onset of permanent and temporary threshold shifts. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-OPR-59, 167 pp. <https://repository.library.noaa.gov/view/noaa/17892>
- Northeast Fisheries Science Center (NEFSC) and Southeast Fisheries Science Center (SEFSC). 2022. 2021 Annual report of a comprehensive assessment of marine mammal, marine turtle, and seabird abundance and spatial distribution in US waters of the Western North Atlantic Ocean – AMAPPS III. 125 pp. <https://repository.library.noaa.gov/view/noaa/41734>
- Northeast Fisheries Science Center (NEFSC) and Southeast Fisheries Science Center (SEFSC). 2018. Annual report of a comprehensive assessment of marine mammal, marine turtle, and seabird abundance and spatial distribution in US Waters of the Western North Atlantic Ocean. *Northeast Fish. Sci. Cent. Ref. Doc.* 18-04. 141 pp. <https://www.fisheries.noaa.gov/resource/publication-database/atlantic-marine-assessment-program-protected-species>
- Nowacek, D.P., C.W. Clark, D. Mann, P.J.O. Miller, H.C. Rosenbaum, J.S. Golden, M. Jasny, J. Kraska and B.L. Southall. 2015. Marine seismic surveys and ocean noise: time for coordinated and prudent planning. *Front. Ecol. Environ.* 13:378–386.
- Nye, J., J. Link, J. Hare and W. Overholtz. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. *Mar. Ecol. Prog. Ser.* 393:111–129.
- Palka, D. 2020. Cetacean abundance estimates in US northwestern Atlantic Ocean waters from summer 2016 line transect surveys conducted by the Northeast Fisheries Science Center. *Northeast Fish. Sci. Cent. Ref. Doc.* 20-05.
- Palka, D. 2023. Cetacean abundance in the U.S. Northwestern Atlantic Ocean, summer 2021. *US Dept Commer Northeast Fish Sci Cent Ref Doc* 23-08. 59 p.
- Peltier, H., W. Dabin, P. Daniel, O. Van Canneyt, G. Dorémus, M. Huon and V. Ridoux. 2012. The significance of stranding data as indicators of cetacean populations at sea: Modelling the drift of cetacean carcasses. *Ecol. Indic.* 18:278–290.
- Pinsky, M.L., B. Worm, M.J. Fogarty, J.L. Sarmiento and S.A. Levin. 2013. Marine taxa track local climate velocities. *Science* 341:1239–1242.
- Poloczanska, E.S., C.J. Brown, W.J. Sydeman, W. Kiessling, D.S. Schoeman, P.J. Moore, K. Brander, J.F. Bruno, L.B. Buckley, M.T. Burrows, C.M. Duarte, B.S. Halpern, J. Holding, C.V. Kappel, M.I. O’Connor, J.M. Pandolfi, C. Parmesan, F. Schwing, S.A. Thompson and A.J. Richardson. 2013. Global imprint of climate change on marine life. *Nat. Clim. Change* 3:919–925.
- Schwacke, L.H., E.O. Voit, L.J. Hansen, R.S. Wells, G.B. Mitchum, A.A. Hohn and P.A. Fair. 2002. Probabilistic risk assessment of reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the southeast United States coast. *Env. Toxic. Chem.* 21(12):2752–2764.
- Sousa, A., F. Alves, A. Dinis, J. Bentz, M.J. Cruz and J.P. Nunes. 2019. How vulnerable are cetaceans to climate

- change? Developing and testing a new index. *Ecol. Indic.* 98:9–18.
- Spalding, M.D., H.E. Fox, G.R. Allen, N. Davidson, Z.A. Ferdaña, M. Finlayson, B.S. Halpern, M.A. Jorge, A. Lombana, S.A. Lourie, K.D. Martin, E. McManus, J. Molnar, C.A. Recchia and J. Robertson. 2007. Marine ecoregions of the world: a bioregionalization of coastal and shelf areas. *BioScience* 57:573–583.
- Thomas, L., J.L. Laake, J.F. Derry, S.T. Buckland, D.L. Borchers, D.R. Anderson, K.P. Burnham, S. Strindberg, S.L. Hedley, F.F.C. Marques, J.H. Pollard and R.M. Fewster. 1998. *Distance 3.5*. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.
- 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. <https://repository.library.noaa.gov/view/noaa/15963>
- Wells, R.S., J.B. Allen, G. Lovewell, J. Gorzelany, R.E. Delynn, D.A. Fauquier and N.B. Barros. 2015. Carcass-recovery rates for resident bottlenose dolphins in Sarasota Bay, Florida. *Mar. Mamm. Sci.* 31(1): 355–368.
- Williams, R., S. Gero, L. Bejder, J. Calambokidis, S.D. Kraus, D. Lusseau, A.J. Read and J. Robbins. 2011. Underestimating the damage: Interpreting cetacean carcass recoveries in the context of the Deepwater Horizon/BP incident. *Conserv. Lett.* 4:228–233.