# Species Status Assessment

**Common Name:** Humpback whale **Date Updated:** January 2024

**Scientific Name:** *Megaptera novaeangliae* **Updated by:** Meghan Rickard

**Class:** Mammalia

**Family:** Balaenopteridae

**Species Synopsis** *(a short paragraph which describes species taxonomy, distribution, recent trends, and habitat in New York):*

Humpback whales experienced significant declines throughout their range during commercial whaling in the 19th and early 20th centuries. Their long pectoral fins resulted in their scientific name, *Megaptera novaeangliae*, which means "big-winged New Englander" (NMFS 1991). Three subspecies of humpback whale are currently recognized: *M. n. novaeangliae*, the North Atlantic humpback whale; *M. n. australis*, the Southern humpback whale; and *M. n. kuzira*, the North Pacific humpback whale (Committee on Taxonomy 2024). After receiving protection from the International Whaling Commission in 1955, their numbers appear to have been increasing. IUCN 2018 assessment estimated the current global population at 135,000 individuals (Cooke 2018).

Humpback whales in the North Atlantic are found in six regions or feeding grounds. Each area represents a subpopulation; humpbacks show strong, maternally-driven site fidelity to these areas (Hayes et al. 2020). Regions include the eastern United States (primarily consisting of the Gulf of Maine), Gulf of St. Lawrence, Newfoundland/Labrador, western Greenland, Iceland, and northern Norway stocks (Hayes et al. 2020). In the past these subpopulations were managed as one stock but in 2002 the International Whaling Commission (IWC) acknowledged the evidence for managing the Gulf of Maine feeding stock separately (Waring et al 1999, Waring et al. 2000, IWC 2002). The stock feeds in the Gulf of Maine generally from March through December, and most individuals migrate during the winter to the West Indies to calve and mate with whales from other North Atlantic feeding grounds, though some whales remain in the high latitudes throughout the year (Katona and Beard 1990, Kowarski et al. 2018).

A comprehensive status review conducted under the Endangered Species Act (ESA) for humpback whales recognized 14 distinct population segments (DPSs) globally based on breeding location (Bettridge et al. 2015). Most significantly, the review concluded that the West Indies DPS, which includes Gulf of Maine humpback whales, was no longer endangered (Bettridge et al. 2015, Robbins and Pace 2018). Therefore, in 2016, the Gulf of Maine humpback stock was removed from the endangered species list (81 FR 62260, September 8, 2016). Also in 2016, an Unusual Mortality Event (UME) involving the Gulf of Maine humpback whale stock was declared by NMFS; this UME is still ongoing and involves 252 cases, 47 of which occurred in New York (as of March 2025; NMFS 2025a). Most of the dead whales involved in the UME, coast-wide and in New York, have been killed by vessel strike. Despite this current conservation concern, NMFS states that humpback populations are increasing in most areas of their distribution (NMFS 2024).

From the 1970s to early 1990s, humpback whale abundance in the New York Bight region varied widely year to year (Sadove and Cardinale 1993). Since 2011, they have gradually increased in number and distribution within the Bight (Brown et al. 2017, Brown et al. 2022, Zoidis et al. 2021). Humpbacks are seen in shallow waters, including Long Island Sound and New York Harbor, and also farther offshore, with recent sightings spanning the New York Bight region and out to the continental shelf break (Sadove and Cardinale 1993, Zoidis et al. 2021, Stepanuk et al. 2021). Humpbacks of all age classes are seen in New York, sometimes in large groups, and are often seen feeding on menhaden (Sadove and Cardinale 1993, Zoidis et al. 2021, Brown et al. 2022, Lomac-MacNair et al. 2022). Humpback whales, particularly juveniles, are now present year-round in New York though there are overall seasonal fluctuations (Zoidis et al. 2021). It appears that New York is becoming an established feeding ground, perhaps supplemental to the primary Gulf of Maine feeding ground, and because of their nearshore distribution, a large, summer population of humpback whales is at high-risk of vessel strikes and entanglements.

# I. Status

## a. Current legal protected Status

i. **Federal:** Not listed **Candidate:** No

ii. **New York:** Endangered

## b. Natural Heritage Program

i. **Global:** G4

ii. **New York:** SNA **Tracked by NYNHP?:** Yes

### Other Ranks:

-New York 2025 SGCN status: High Priority Species of Greatest Conservation Need

-IUCN Red List: Endangered

-CITES: Appendix I

-Northeast Regional SGCN: High conservation concern

-Canada Species at Risk Act (SARA): Not at risk

-Marine Mammal Protection Act (MMPA): N/A

### Status Discussion:

Humpback whales were heavily exploited because of their slow-moving nature, coastal distribution, and high oil yield. The species is believed to be the fourth most numerically depleted species during the time of whaling, behind the North Atlantic right whale (*Eubalaena glacialis*), the blue whale (*Balaenoptera musculus*), and the bowhead whale (*Balaena mysticetus*) (NMFS 1991). Humpback whales were hunted in the North Atlantic as early as the 1600s, when catches were documented in the West Indies and Bermuda (Reeves et al. 2001, Stone et al. 1987). Shore-based whaling off of Cape Cod and the surrounding islands occurred until the Civil War (Mitchell and Reeves 1983). In the early 1800s, significant hunting of humpback whales on their wintering grounds in the West Indies and Cape Verde Islands began (Smith and Reeves 2003, Michell and Reeves 1983). For about a century, this pre-modern whaling on the wintering grounds is estimated to have killed about 8,600 humpback whales (Reeves et al. 2001). At the same time, small hunts occurred in the Gulf of St. Lawrence and continued from New England ports (Mitchell and Reeves 1983). Whaling shifted focus in the late 1800s and exploitation of humpback whales was focused on their summer feeding grounds, especially off Canada, Iceland, and Norway (Mitchell and Reeves 1983, Jonsgard 1977). From 1880-1916, an estimated 5,000 humpbacks were taken off Norway and Iceland, and west of Iceland, at least 9,000 humpback whales were killed from 1850-1971 (Mitchell and Reeves 1983). Catch levels became very low by the 1920s, and by 1932, it's estimated that commercial whaling could have reduced the North Atlantic humpback whale populations to as few as 700 animals (Breiwick et al. 1983).

Humpback whales in the North Atlantic first received protection in 1955, when the IWC placed a prohibition on non-subsistence hunting. Under this initial protection, humpbacks continued to be killed in three different locations: off eastern Canada under scientific permit from 1969-1971 and subsistence whaling in western Greenland and the Lesser Antilles (Mitchell 1973, Kapel 1979).

Today humpback whales are only hunted under aboriginal subsistence whaling agreements and only in Greenland and St. Vincent and the Grenadines (IWC 2025a, 2025b). Some small-scale hunting around the island of Pagalu in the Gulf of Guinea may occur but no information is available (IWC 2025a).

Prior to commercial whaling, the world population of humpback whales was estimated to be over 125,000 individuals. American whalers alone killed about 18,000 humpbacks between 1805 and 1909 (Best 1987, NMFS 1991). By 1991, there was thought to be no more than 12,000 humpback whales globally, just 10% of the initial global population estimate (Braham 1984). While there are no definitive pre-whaling estimates of humpback whales, the current population level is probably considerably higher than it was in 1942 because only a small number of humpbacks (377) were caught between 1942 and 1979, which begins the period over which an increase has been documented. (IWC 2002, Punt 2006).

Humpback whales were listed as endangered in 1970 under the Endangered Species Conservation Act of 1969, the precursor to the Endangered Species Act (ESA). When the ESA was enacted in 1973, humpback whales were included as endangered. The National Marine Fisheries Service (NMFS) conducted a global status review of humpback whales published in 2015 and revised the ESA listing of the species in 2016 (Bettridge et al. 2015; 81 FR 62259, September 8, 2016). As established in the Final Rule, humpback whales occurring in waters under U.S. jurisdiction were divided into Distinct Population Segments (DPSs) based on distribution, ecology, genetics, and other factors (Bettridge et al. 2015). The humpback whales occurring on the U.S. East Coast are considered part of the West Indies DPS, which was considered neither endangered nor threatened under the global status review, and therefore the West Indies DPS is not currently listed under the ESA and therefore cannot be considered depleted. However, the species remains on the New York State Endangered Species List.

Humpback whales are federally protected under the Marine Mammal Protection Act (MMPA) of 1972. Under the MMPA, the Gulf of Maine humpback whale stock is not considered strategic because NMFS calculated the Potential Biological Removal (PBR) defined by the MMPA to be 22. For the period 2013-2017, the average human-caused mortality and serious injury averaged 12 animals per year (Hayes et al. 2020). NMFS assumes all humpbacks on the U.S. East Coast are from the Gulf of Maine stock unless they are identified as belonging to another stock. If taking undetected mortality into account, even if only 0.37 is attributed to anthropogenic causes, annual anthropogenic mortality exceeds PBR and “it is very likely that it has exceeded PBR for the past several years” (Hayes et al. 2020). Further mounting evidence of the Gulf of Maine stock being over PBR for some time is the NMFS declaration of an Unusual Mortality Event (UME) in 2016. As NMFS states, “the literature and review of records…suggest that there are significant human impacts beyond those recorded in the data assessed for serious injury and mortality” (Hayes et al. 2020). The best abundance estimate of the Gulf of Maine stock is 1,396 animals, derived from a state-space model of sighting histories of individually identified whales through October 2016 (Hayes et al. 2020). The minimum population estimate for this stock is 1,380 animals (Hayes et al. 2020). The minimum number alive (MNA) for 2015 was 896 individuals (Hayes et al. 2020).

Based on the UME and other anthropogenic stressors, as well as the influx of a large number of individuals into the New York Bight year-round and especially during the summer, we recommend that the humpback whale SGCN status be raised to High Priority.

## II. Abundance and Distribution Trends

| Region | Present? | Abundance | Distribution | Time Frame | Listing status | SGCN? |
|---|---|---|---|---|---|---|
| **North America** | Yes | Choose an item. | Choose an item. | | | Choose an item. |
| **Northeastern US** | Yes | Choose an item. | Choose an item. | | | Choose an item. |
| **New York** | Yes | Increasing | Increasing | | Endangered | Yes |
| **Connecticut** | Yes | Choose an item. | Choose an item. | | | No |
| **Massachusetts** | Yes | Choose an item. | Choose an item. | | Endangered | Yes |
| **Rhode Island** | Yes | Choose an item. | Choose an item. | | Endangered | Yes |
| **New Jersey** | Yes | Increasing | Increasing | | Endangered | Yes |
| **Pennsylvania** | No | Choose an item. | Choose an item. | | | Choose an item. |
| **Vermont** | No | Choose an item. | Choose an item. | | | Choose an item. |
| **Ontario** | No | Choose an item. | Choose an item. | | | Choose an item. |
| **Quebec** | Yes | Choose an item. | Choose an item. | | | No |

*Column options*
**Present?:** Yes; No; Unknown; No data; (blank) or Choose an Item
**Abundance and Distribution:** Declining; Increasing; Stable; Unknown; Extirpated; N/A; (blank) or Choose an item
**SGCN?:** Yes; No; Unknown; (blank) or Choose an item

**Monitoring in New York** *(specify any monitoring activities or regular surveys that are conducted in New York):*

All species of whales are inherently difficult to study due to their limited availability at the surface and migratory nature. In addition, funding for monitoring, especially visual surveys, is extremely limited. Humpback whales on the U.S. East Coast are one of the most well-studied species but until 2016, monitoring of large whales in New York was very narrow in scope. Previous examples of surveys that included the New York area and recorded large whales were done coast-wide, seasonally, and/or focused on multiple taxa and were therefore not carried out at the most appropriate temporal or spatial scale for an assessment of large whale species in the New York Bight (CETAP 1982).

One of the first NYB-focused large whale surveys was a passive acoustic monitoring effort that took place from 2008 to 2009 (Muirhead et al. 2018). The 258-day project included 10 sites, with a line of moored receivers perpendicular to Long Island and 3 sites around the entrance to NY Harbor. The data was analyzed for blue, fin, and North Atlantic right whales only.

In 2010, the Atlantic Marine Assessment for Program for Protected Species (AMAPPS) joint program between the National Oceanic and Atmospheric Administration (NOAA) and the Bureau of

Ocean Energy Management (BOEM) began, with the goal of determining the abundance and distribution of protected species along the U.S East Coast. The NOAA Northeast Fisheries Science Center (NEFSC) Protected Species Branch leads the surveys which are conducted by plane and ship and includes both visual and acoustic monitoring methods. AMAPPS is a broadscale survey and therefore does not match the specific needs of New York Bight monitoring in time or space but has, however, recorded sightings of humpback whales in and around New York. AMAPPS II (2015-2019) and AMAPPS III (2019-2024) have both been completed but AMAPPS was not picked up for continued funding by BOEM (NMFS 2025b, 2025c). Instead, the U.S. Navy plans to work with NOAA on similar surveys beginning in 2025 (US Navy 2024).

NOAA conducts regular, year-round monitoring focused on North Atlantic right whales (i.e., the North Atlantic Right Sighting Advisory System) that also collects data on other taxa including humpback whales (Johnson et al. 2021). In addition, the New England Aquarium also conducts regular aerial surveys, and sometimes shipboard surveys, in the Southern New England area and very commonly records sightings of humpback whales year-round.

In 2016, to support the state's commitment to offshore wind energy, the New York State Energy Research and Development Authority (NYSERDA) began a seasonal 3-year ultra-high resolution digital aerial survey of all marine taxa within the New York Bight (e.g., the offshore planning area delineated by NY Dept. of State; NYSERDA 2021). All large whale species were observed during the digital aerial survey. Also in 2016, the Woods Hole Oceanographic Institute (WHOI) deployed the first of an ongoing succession of real-time monitoring buoys, and later gliders, to record the presence of large whales in the New York Bight (WHOI 2025). This effort had first been introduced off the coast of Massachusetts and proved helpful for both data collection and real-time management of vessel speeds to prevent collision with whales. Currently, the data shared publicly is limited to four large whale species: sei, humpback, fin, and North Atlantic right whales. Humpback whales are regularly detected throughout the year on the near-real time buoys in New York.

Beginning in 2017, DEC launched the first three years of a monitoring program for large whales (Tetra Tech and LGL 2020, Estabrook et al. 2021). Using monthly visual aerial surveys and 24/7 passive acoustic monitoring over a three-year period, the NYS Whale Monitoring Program gathered enough data to estimate large whale abundance in the NYB and identify probable discreet periods of space and/or time that humpback whales – the most common whale species during the project – are likely to be found. The NYS Whale Monitoring Program will conduct another three years of visual aerial surveys for a total of 18 surveys beginning in November 2024. Additionally, DEC funds a long-term Indicators of Ocean Health monitoring program. Data collection on whales during the 10-year program has at various times included gliders outfitted with PAM (i.e., the WHOI real-time system), shipboard line transect surveys, and recording opportunistic sightings. Currently, this effort is set to be completed in 2027.

Marine mammal stranding response is performed by two federally permitted groups in New York: the New York Marine Rescue Center (NYMRC) and the Atlantic Marine Conservation Society (AMSEAS). For all live and dead large whale events, AMSEAS is the lead response team. The DEC has supplied funding for stranding response in New York since the program began in 1980. Humpback whales strand more frequently than any other large whale species in New York and these events provide valuable data, making stranding response an essential component of monitoring.

**Trends Discussion** *(insert map of North American/regional distribution and status):*

The Gulf of Maine humpback whale population appears to have undergone noteworthy changes over the past two decades. Zerbini et al. (2010) found that the species cannot increase at a rate higher than 11.8% per year. The entire North Atlantic is believed to have been increasing at an average rate of 3.1% from 1979–1993 (Stevick et al. 2003a). Rate of increase for the Gulf of Maine humpback whale stock has varied over the years due to differing methods, data availability, and uncertainty in calf survival (Clapham et al. 2003). Barlow and Clapham (1997) estimated the stock was growing at 6.5% per year from 1979-1991 but the rate of increase was less than 4% per year from 1992-2000 (Clapham et al. 2003). Robbins et al. (2024) estimated apparent survival, abundance, and growth of the Gulf of Maine humpback whale population from 2000 through 2019. Analyses determined that abundance increased with an average annual growth of 4.6%. In addition, over time, adult males had higher survival rates than adult females, and the calf and juvenile age classes declined.

NMFS's best abundance estimate for the Gulf of Maine humpback whale stock is 1,396 with a minimum population estimate of 1,380 based on surveys in Summer 2016 (Hayes et al. 2020). Robbins and Pace (2018) confirmed this estimate, stating that the best estimate of 2016 abundance was 1,317 individuals. The authors propose that the population "was likely never below 701 individuals during the study period" despite some of the previous abundance estimates. Roberts et al. (2022) used density modeling to estimate humpback whale abundance along the entire U.S. East Coast. Peak abundance was found to be 2,981 individuals in June with a low of 188 individuals in January. In comparison, Canada's estimate of the size of the northwest Atlantic humpback whale population is about 4,000 individuals (DFO 2024).

| **Month/Year** | **Type** | **$N_{best}$** | **CV** |
|---|---|---|---|
| Jun-Aug 2011 | Virginia to lower Bay of Fundy | 335 | 0.42 |
| Jun-Oct 2015 | Gulf of Maine and Bay of Fundy | 896 | 0 |
| Jun-Sep 2016 | Central Virginia to lower Bay of Fundy | 2,368 | 0.48 |
| Mid-Summer 2016 | State-space mark-recapture estimates | 1,396 | n/a |

**Table 1**. Summary of abundance estimates for Gulf of Maine humpback whales with month, year, and area covered during each abundance survey, and resulting abundance estimate ($N_{best}$) and coefficient of variation (CV; Hayes et al. 2020).

*Mid-Atlantic Increase*

Particularly important events seemed to have occurred around 2009-2010, when the summer population of humpback whales in the U.S. stopped growing and declined for several years, while at the same time humpbacks began appearing close to the Florida and Georgia coast in winter and important shifts in the Gulf Stream occurred (Hayes et al. 2020, Gonçalves Neto et al. 2021) that caused changes to the distributions of cetacean species (Meyer-Gutbrod et al. 2021, Thorne et al. 2022). The stock identity of humpbacks seen in the mid- and south Atlantic U.S. was investigated using fluke photos from living and dead whales (Barco et al. 2002). Of 21 live whales, 9 (43%) matched to the Gulf of Maine, 4 (19%) to Newfoundland, and 1 (4.8%) to the Gulf of St Lawrence. Of 19 dead whales, 6 (31.6%) were known Gulf of Maine whales. Barco et al. (2002) suggested that the southern region of the U.S. East Coast might represent a supplemental feeding ground, as an increasing number of humpback whales were documented in the mid-Atlantic beginning in the early 1990s (Wiley et al. 1995). Wiley et al. (1995) reported that 38 humpback whale strandings occurred during 1985–1992 in the region. particularly along the Virginia and North Carolina coasts, and most stranded animals were sexually immature. The authors concluded that these mid-Atlantic areas were becoming an increasingly important habitat for juvenile humpback whales. Increased sightings of humpback whales in the vicinity of the Chesapeake and Delaware Bays likewise occurred in the early 1990s (Swingle et al. 1993).

Acoustic monitoring and visual surveys reported humpbacks present southwest of Cape Cod and down the mid-Atlantic shelf throughout the year and particularly winter and spring. Whitt et al. (2015) documented humpback whales off southern New Jersey in 2008-2009, mainly from December to April, and GMI (2010) recorded 17 sightings across all seasons in nearshore New Jersey waters. Humpback whale sightings continue to increase off of Virginia, North Carolina, and down to Florida, including winter sightings in nearshore waters (Palka 2012, Zoodsma et al. 2016, Surrey-Marsden et al. 2018, Aschettino et al. 2020). As recently as January-February 2025, the AMAPPS surveys sighted humpbacks throughout the area surveyed, from North Carolina to New York. Notably, they were sighted in a range of habitats, "from less than 1 mile off the coasts of New Jersey and Virginia, to warm Gulf Stream waters off North Carolina, and to waters deeper than 3,000 meters off Maryland" (NMFS 2025a). Collectively, these mid-Atlantic sightings support the theory that the area may be a supplemental feeding ground used by juvenile and adult humpback whales of both U.S. and Canadian stocks, as photo identification evidence indicates that not all overwintering whales are from the Gulf of Maine stock (Barco et al. 2002, Brown et al. 2022). Further research is still needed to confirm the proportion of stock identities using these waters (Hayes et al. 2020).

Evidence for this range expansion and influx into areas that were previously uncommon exists in other parts of the global humpback whale species distribution. As noted by the IWC, as many populations of humpback whales increase following the cessation of whaling, "the species appears to be expanding its range, and is observed more frequently in areas where it was previously thought to be only vagrant", including off of the Netherlands, parts of the Red Sea, and the Mediterranean (IWC 2025a). However, population growth may not be the only factor contributing to increased use of the U.S. mid-Atlantic by humpback whales.

*Mortality & Serious Injury Trends*

There is mounting evidence that humpback whales have been over PBR for some time (Hayes et al. 2020). Anthropogenic mortality is traditionally biased low; roughly 20% of mortalities since 2000 are estimated to have been observed. Because of this, when undocumented deaths are accounted for, the total annual mortality is likely closer to 60-70 individuals from the Gulf of Maine stock (Hayes et al. 2020). Importantly, this stock has been involved in three Unusual Mortality Events (UMEs) since 2000: one in 2003, one in 2005, and the currently ongoing UME that began in January 2016. The current UME is large, with a total of 252 mortalities along the U.S. east coast and 47 in New York, as of April 2025 (NMFS 2025a). Serious injury and mortality from the current UME are not reflected in any of the estimates reported here, and it's unknown what impact, if any, the event is having on the overall population. The current UME is discussed further in *Threats*.


**Figure 1.** Conservation status of humpback whale in North America (NatureServe 2024).

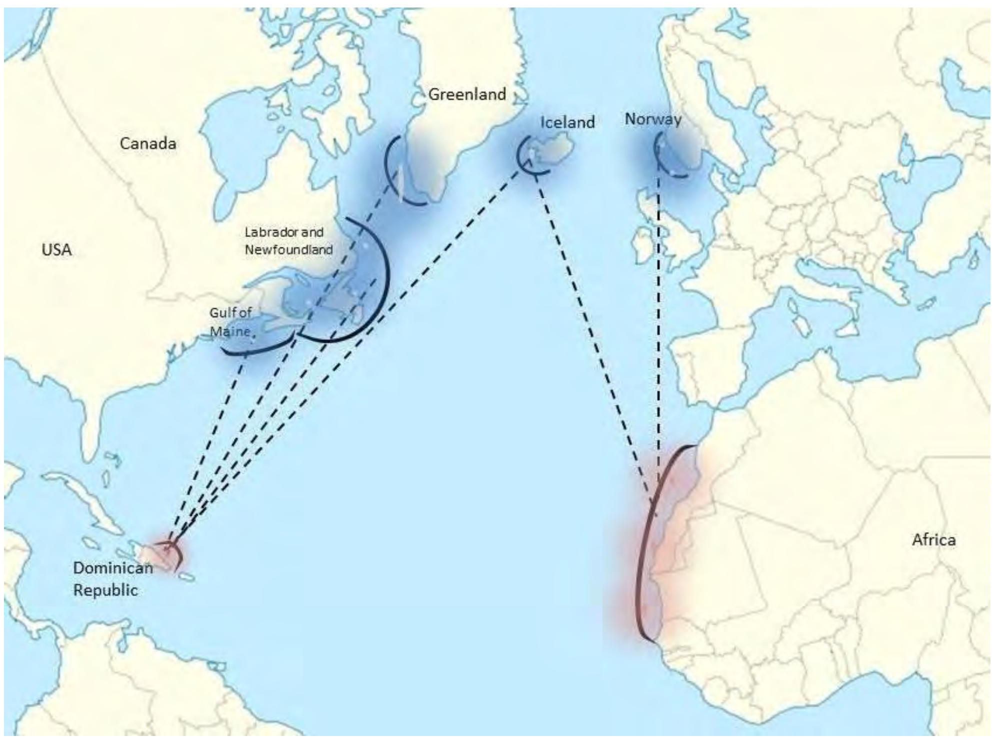


**Figure 2**. Migration patterns of humpback whales in the North Atlantic Ocean. Dotted lines are not representations of the actual migration routes, which remain unknown. Blue indicates the area of summer feeding grounds and pink indicates winter grounds. Feeding grounds (blue shaded areas) include the Gulf of Maine, areas off Newfoundland and Labrador, Canada (including the Gulf of St. Lawrence), Greenland, Iceland and Norway. Winter (breeding and calving) grounds (pink shaded areas) include the West Indies and Cape Verde Islands (Mackay 2015).

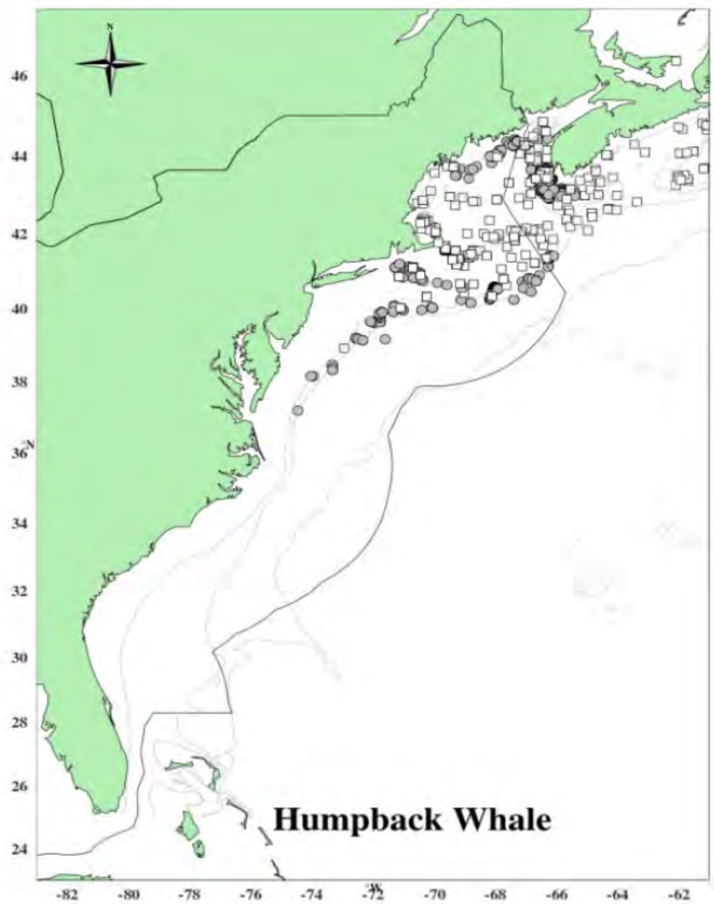


**Figure 3**. Distribution of humpback whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010, 2011, and 2016. Isobaths are the 200-m, 1000-m and 4000-m depth contours. Circle symbols represent shipboard sightings and squares are aerial sightings (Hayes et al. 2020).

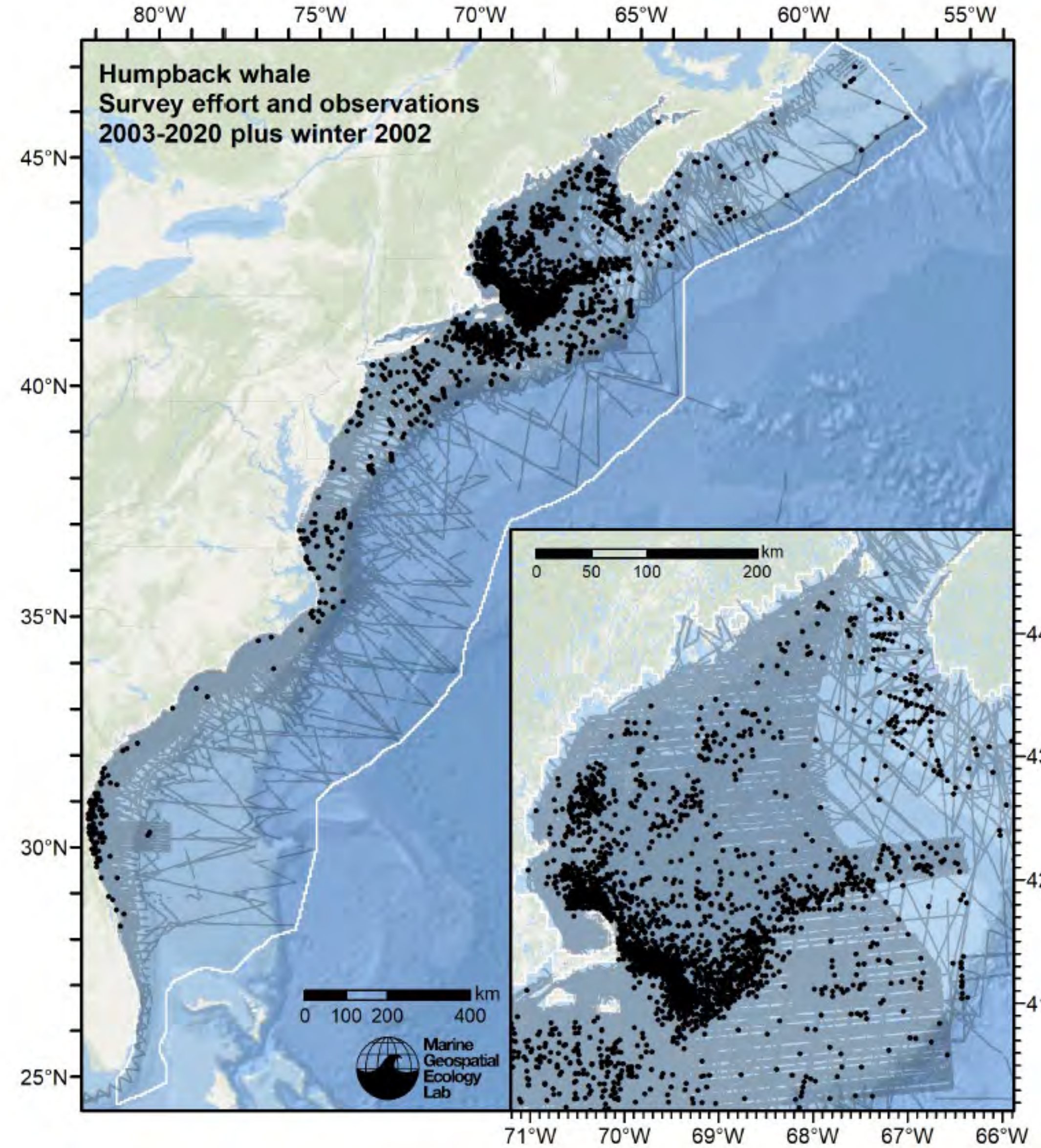


**Figure 4**. Survey effort and humpback whale observations available for density modeling, after detection functions were applied, and excluded segments and truncated observations were removed (Roberts et al. 2022).

## III. New York Rarity *(provide map, numbers, and percent of state occupied)*

### Details of historic and current occurrence:

Humpback whale occurrence in New York has changed drastically in the last two decades. Historically, a few humpback whales were probably killed off Long Island by early shore-based whalers hunting North Atlantic right whales, and undoubtedly more humpbacks were pursued by whalers following the significant decline of North Atlantic right whales (Connor 1971). A favorite whaling ground for humpback whales was on Nantucket Shoals, about 100 miles east of Montauk Point, where they were frequently killed during the 18th and 19th centuries (Allen 1916). Simon (1966) stated that humpback whales were "formerly common" but were "badly depleted and now considered to be rare in the North Atlantic", though increasing sightings were reported. Connor

(1971) reported that humpback whales are highly migratory along well-defined routes, that in spring “northbound humpbacks pass our region, and large herds have been seen in April moving north some 200 miles east of the coast”. Allen (1916) also noted that “the larger schools are usually fairly well offshore at all times”. In addition, Connor (1971) stated that humpbacks can be seen close to shore in the northeast during spring, and a few might also be seen in summer and fall, but that the southward migration “appears to be farther offshore”. The first comprehensive surveys suggested that the Great South Channel is a major exit and entry point between Gulf of Maine feeding areas and migration routes in deep water (CETAP 1982). A precise U.S. East Coast migratory route has yet to be identified but the theme of differing notions on migration (i.e., a distinct, nearshore route versus broadly offshore) continues, possibly reflecting seasonal differences and/or changes through time.

McKenzie and Nicolas (1988) experienced humpback whales slightly differently, with sightings reported to be “relatively constant each year over the shelf waters from spring through fall”. This shift was identified in a study investigating historic newspaper records of large whales where both sighting and stranding records for humpback whales were near zero until the early 1980s then began increasing (Brown and Wiedenmann 2024). Southern New England between April and October was described as a major feeding area, and more specifically feeding humpbacks used the 100-meter contour from the mid-Atlantic northward. The area just east of Montauk was also highlighted as an important humpback whale feeding area and it’s likely that opportunistic feeding was occurring all along the continental shelf in the mid-Atlantic (CETAP 1982, McKenzie and Nicolas 1988). For the Gulf of Maine stock of humpback whales in the western North Atlantic, sand lance was recognized early on as an important prey item (Payne et al. 1986). Though other identified prey included herring and mackerel, it was hypothesized that “behavior and bottom topography are critical factors in the foraging strategies of humpback whales” and therefore the humpback whales’ distribution (Payne et al. 1986).

Other historical sources recognize humpback whale presence in all seasons with a peak in spring and summer (Kenney and Vigness-Raposa 2010). Surveys done by Okeanos Foundation documented humpbacks regularly in New York waters in surveys from the 1970s – early 1990s (Sadove and Cardinale 1993). Humpbacks were commonly seen in the greatest abundance from June through September and again in December and January. Summer sightings included all age classes and many mother/calf pairs. Juvenile humpback whales occurred in December and January, usually feeding and often amongst groups of fin whales, indicating that this area could be an important wintering area for juvenile whales. The actual abundance of whales over the years was highly variable; in some years, humpbacks were a rare visitor to the New York Bight, while in other years they were common and found in groups of 20 or more. While no population estimates could be developed, the authors stated that probably no more than 50 – 100 humpbacks used the New York Bight at one time during the study period (Sadove and Cardinale 1993). Importantly, Sadove and Cardinale (1993) reported that humpback whales are regularly seen in very shallow water and that they spend extended periods of time in Long Island Sound, Gardiner’s Bay, and Block Island Sound. Humpbacks were also documented moving in and out of inlets, like Shinnecock and Fire Island, and were frequently sighted in New York Harbor. Fine-scale occurrence of humpback whales in New York appears food dependent, as they are seen feeding at all times of year on schooling fish, especially sand lance (Sadove and Cardinale 1993).

During the 2008 to 2009 deployment of passive acoustic recorders in the New York Harbor area and offshore of Long Island, humpbacks were opportunistically detected on 70 of 258 recording days. Most detections were in the spring and winter; only one day during fall had humpback acoustic presence and there was no recording effort during summer (BRP 2010). From October 2018 to October 2020, passive acoustic monitoring (PAM) was conducted by the Wildlife Conservation Society in Lower and Upper New York Bay (WCS 2021). Humpback whales were detected during winter, spring, and fall at all locations but interestingly, during the summer, there were many visual sightings yet relatively few acoustic detections. Other PAM efforts have revealed similar, near-continuous acoustic presence in New York, with a peak in winter and spring and a minimum beginning in July and continuing for the rest of the year (Davis et al. 2020, PACM 2025).

Brown et al. (2017) reported 46 sightings of humpbacks in the New York-New Jersey Harbor Estuary between 2011 and 2016. Over that time period, sightings increased in frequency, from zero documented humpback whale sightings in 2011 to 31 sightings in 2016. Most were documented between October and December, and all individuals observed were deemed likely juveniles. Half of the documented sightings included lunge feeding and in almost one-quarter of the lunge feeding sightings menhaden was the confirmed prey species. Interestingly, no sightings were reported during winter months.

By 2017, humpback whales in the coastal waters of New York and New Jersey were essentially common, as shown in the results of multiple monitoring efforts occurring simultaneously from 2017-2020. The NYSERDA digital aerial survey documented 20 humpback whale sightings from 2016-2019. Sightings were recorded during all seasons but mostly during spring (n=12), and most of the spring sightings were farther offshore (NYSERDA 2021). DEC's whale monitoring program effort from 2017-2020 documented extensive humpback whale presence in the New York Bight (Tetra Tech and LGL 2020, Estabrook et al. 2021). PAM showed that humpbacks were detected on 79% of days, during all months but variable by season (Estabrook et al. 2025). All recording sites detected humpback whale vocalizations, with the fewest detections at the site just outside of New York Harbor and the highest detections at the second to farthest offshore site. Peak acoustic presence near the harbor was from November to March and offshore near the shelf edge July to September. For this study, survey year influenced detection rates, where each year was found to be statistically significantly different (Estabrook et al. 2025). DEC aerial survey results showed that sighting rates were highest for humpback whales of all large whale species documented (Zoidis et al. 2021). A total of 111 sightings of an estimated 279 individuals were recorded during the three years of aerial effort. Sightings occurred during all four seasons and all calendar months. Humpback whales were most frequently recorded during summer (151 whales) and fall (55 whales); winter and spring totals were similar with 39 and 34 whales sighted, respectively. Sightings rates for humpbacks were highest during summer (4.40), followed by fall (1.45), winter (1.16), and spring (0.98). The most frequently recorded behavior was foraging behavior (40% of sightings totaling 111 whales in 14 groups), followed by rest/slow travel. All foraging events occurred during May, June, and July and occurred in group sizes ranging from one individual to a group of 52 spread out in 12 subgroups (Lomac-MacNair et al. 2022). Most foraging took place on the continental shelf, but humpbacks had the highest nearshore zone foraging rates as well. Ten of the 14 foraging humpback whale groups were observed bubble net feeding and the rest exhibited lunge feeding behavior. Bubble net feeding events occurred further offshore and in deep water than lunge feeding and also appeared to be seasonally separated; bubble net feeding in May and June and lunge feeding in June and July. Mixed species aggregations which included humpback, fin, and minke whales and common dolphins joined in multiple times. Interannual variation was high, with Year 2 having the highest sighting rate (3.91 whales/1,000 km effort), followed by Year 3 (1.45/1,000 km effort) and Year 1 (0.73 whales/1,000 km effort). The month of June 2018 shows a significant increase in sightings, which were associated with overall sightings increase across whale species, all of which were feeding. These documented sightings establish the NYB as at least a seasonal foraging ground for large whale species, especially humpback whales (Lomac-MacNair et al. 2022). Cetacean Biologically Important Areas (BIAs) are in the process of being updated for the U.S. East Coast; a humpback whale feeding BIA in New York is being considered (LaBrecque et al. 2015).

Summer sightings of humpback whales at the shelf break in the New York Bight have been increasing since about 2004 (Palka 2020). Davis et al. (2020) hypothesized that there may be more offshore movement by humpbacks in the mid-Atlantic due to an apparent decrease in fall acoustic detections. Multiple sources have identified adults and/or larger groups of humpback whales, particularly those engaged in cooperative feeding behaviors, are more frequent farther offshore (Lomac-MacNair et al. 2022, Stepanuk et al. 2021). This separation of juvenile humpback whales feeding close to shore while a mix of juveniles and adult individuals feed offshore demonstrates an age-specific difference in New York distribution, highlighted by the fact that most vessel struck humpback whales were juveniles (Stepanuk et al. 2021).

The occurrence of humpback whales in the nearshore NYB is likely influenced by their increased use of waters south of primary feeding grounds (e.g., the Gulf of Maine; Swingle et al. 1993; Barco et al. 2002, Aschettino et al. 2020; Hayes et al. 2020, Palka 2020). The latest density model highlights that substantial sightings have been recorded in nearshore New York and New Jersey but were not usable in the model due to their opportunistic collection (Roberts et al. 2022, King et al. 2021, Chou et al. 2022). It has been suggested that this phenomenon may be due to an increase in the West Indies Distinct Population Segment (Bettridge et al. 2015), and a subsequent return to previously occupied areas. Humpback whales have had more time to recover from commercial whaling than some other species, as humpback whaling was banned in the North Atlantic in 1955 (Rocha et al., 2014). However, the growth of the West Indies Distinct Population Segment was estimated to be slow when humpback whale sightings began increasing in New York (Stevick et al. 2003; Bettridge et al. 2015). Some studies show that humpback whales likely did not inhabit the New York Bight consistently and were relatively “rare” until the last couple decades (Brown and Wiedenmann 2024, CETAP 1982). Importantly, this includes all areas of New York, as the most recent density model for humpback whales predicted lower but non-zero density in Long Island Sound, where humpbacks have been sighted opportunistically over the years (Roberts et al. 2022). This would suggest that humpback whales are not, in fact, repopulating the New York Bight but expanding their habitat. There is some evidence of this in the very recent apparent re-occurrence of cow/calf pairs. Though previously stated by Sadove and Cardinale (1993) to be “many”, humpback whale cow/calf pairs appeared in New York waters in higher numbers for the first time in 2024. Between 2012 and 2023, only 2 cow/calf pairs were confirmed in the apex of the New York Bight. In 2024, an influx of adult humpbacks from the Gulf of Maine stock appeared and 7 cow/calf pairs were confirmed by New York City-based whale watching group Gotham Whale and an additional six confirmed pairs (three of which were also documented by Gotham Whale) seen by Montauk-based whale watching and research group the Coastal Research and Education Society of Long Island (CRESLI). In all, there were 10 confirmed mother-calf pairs documented in the New York Bight in 2024 (D. Brown personal communication, A. Kopelman personal communication). While some mother-calf pairs have been sighted off of Montauk in previous years – one pair in 2023, and four pairs in 2022 – the influx of 2024 was apparently Bight-wide given the equivalent increase, and some unique pairs, on the western edge near New Jersey. Importantly, two of the 2024 mother-calf pairs seen by Gotham Whale were the two previously documented moms with calves, indicating that some adult female humpback whales have come to the New York Bight with more than one calf, which likely happens more than we know (D. Brown pers. comm.).

Brown et al. (2022) found that many humpback whales sighted in the apex of the New York Bight belong to the Gulf of Maine feeding population. Juveniles were the most common humpback age group in the apex of the New York Bight, which is a different age structure then the Gulf of Maine primary feeding ground, suggesting that there is preferential exchange by younger whales (Robbins 2007, Brown et al. 2022). The greater frequency of short-distance movement and a higher rate of exchange with nearby areas rather than distant ones have previously been identified as typical of North Atlantic humpback whales (Stevick et al. 2006, Heide-Jørgensen and Laidre, 2007, Dalla Rosa et al. 2008, Kennedy et al. 2014). Additional insights from Brown et al. (2022) on humpback whale occupancy include that 42% of individuals were seen only once during the 2012-2018 study period, 58% were seen multiple times (either in the same year or in multiple years), and 31% individuals returned the following year. Examples include 3 humpback whales that were seen in 3 separate years and 2 individuals that were seen in 5 separate years. Occupancy ranged from 2 to 141 days with an average of 37 days. For the humpback whales identified and compared to other regions, almost half were documented in other parts of the New York Bight (such as off

Montauk) or off Virginia, and 36% were seen in more than one other location. Six whales were seen in both the Gulf of Maine and the New York Bight in the same year, and one whale was seen in both regions in two different years. Interestingly, two whales had sighting history in Newfoundland. However, this means that the larger feeding subpopulation is unknown for many humpback whales documented in NY.

Ultimately, it's unknown whether the increased number of humpback whale sightings in New York are due to shifts in distribution, an increase in sighting effort, or an increase in the population (Hayes et al. 2020). Factors unrelated to population growth that could be influencing the influx of humpback whales in New York's coastal waters are changes in prey availability and climate change (Pershing 2021). Humpback whales are opportunistic predators that have been shown to increase in nearshore areas when there is a higher availability of prey fish (Askin et al. 2017). Changes in prey availability are a common cause of changes in the distribution of humpback whales at high latitudes (Payne et al. 1986, 1990, Piatt et al. 1989, Stevick et al. 2006). A number of recent studies describe visual observations of humpback whales feeding on Atlantic menhaden, especially nearshore, (Brown et al. 2018, King et al. 2021, Stepanuk et al. 2021, Lomac-MacNair et al. 2022). Aschettino et al. (2020) also found that increasing numbers of humpback whales wintering off coastal Virginia appeared to be feeding on Atlantic menhaden. Large schools of Atlantic menhaden have been documented since 2014 and 2015 and Roberts et al. (2020) found that the geographic centroid of Atlantic menhaden distribution has shifted northward into the NYB over the last 4 decades (Lucca and Warren 2019), suggesting that an increase in menhaden, in number and/or availability, may be driving the increase in humpback whales in the New York Bight, especially nearshore and in the apex. It's important to note that interspecific competition may also be driving an increase in (feeding) humpback whales, specifically nearshore, since most humpback whales feeding nearshore are juveniles while both juveniles and adults feed offshore (Stepanuk et al. 2021).

Humpback whale sightings through 2024 were pulled from OBIS-SEAMAP. Inside of the New York State Offshore Planning Area there were 1,749 sightings, only 213 of which were recorded prior to 2015. Throughout the New York Bight, especially nearshore New York, New Jersey, and Southern New England, 2,452 out of 4,166 sightings were recorded from 2015 through 2024. It's important to note that these records and their representation do not take effort into account.

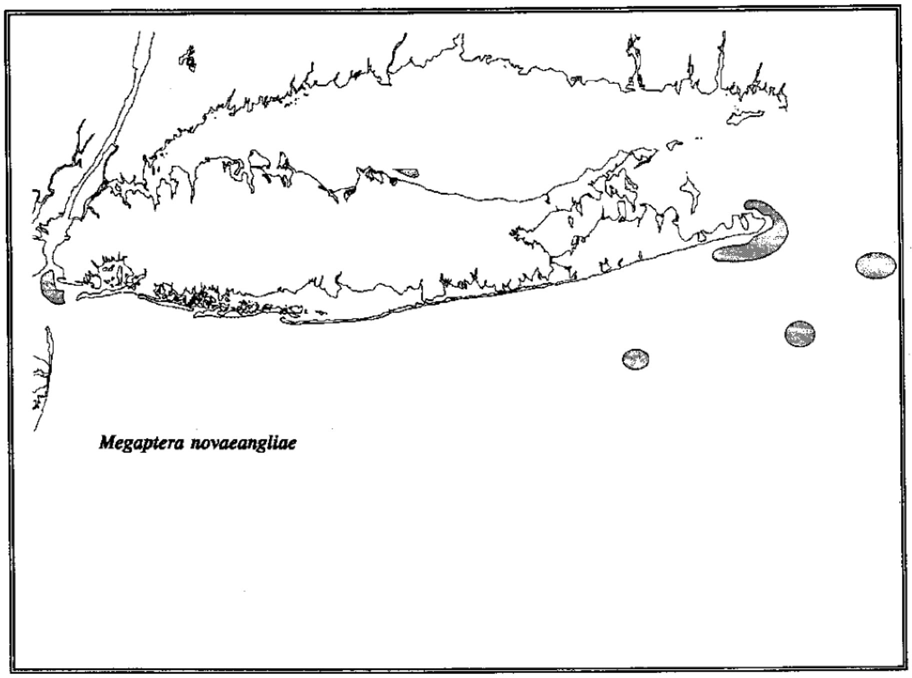


**Figure 5**. Locations of sightings of humpback whales by surveys conducted by the Okeanos Ocean Research Foundation from the 1970s to early 1990s (Sadove and Cardinale 1993).

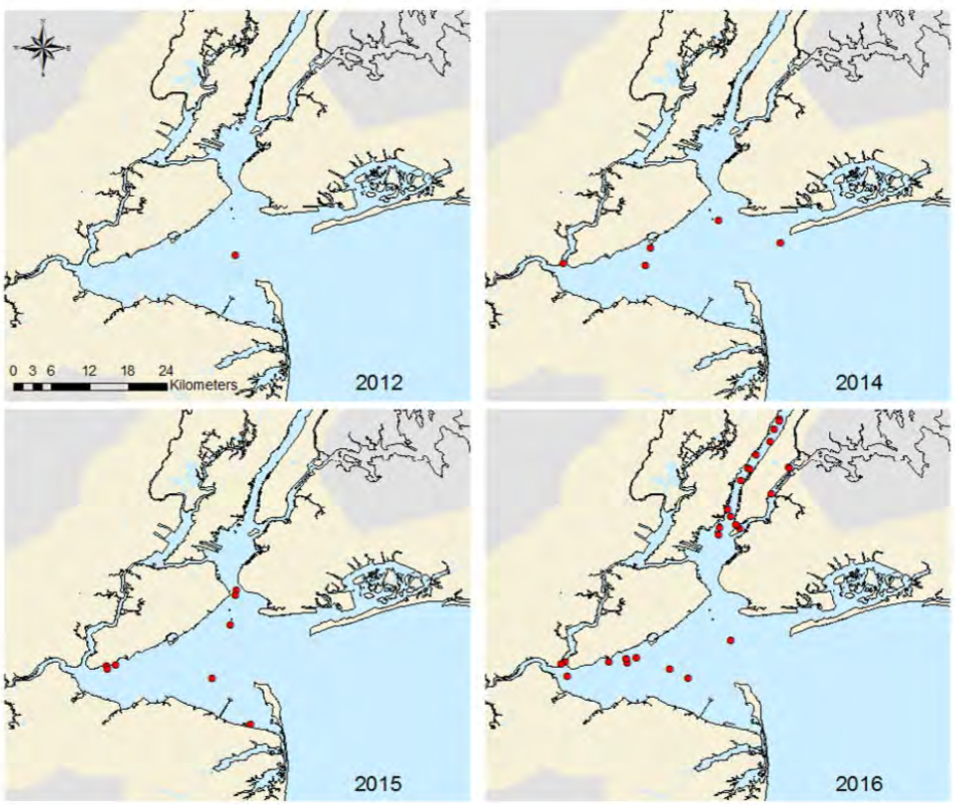


**Figure 6.** Humpback whale sightings locations by year. There were no sightings in 2011 or 2013 (Brown et al. 2017).

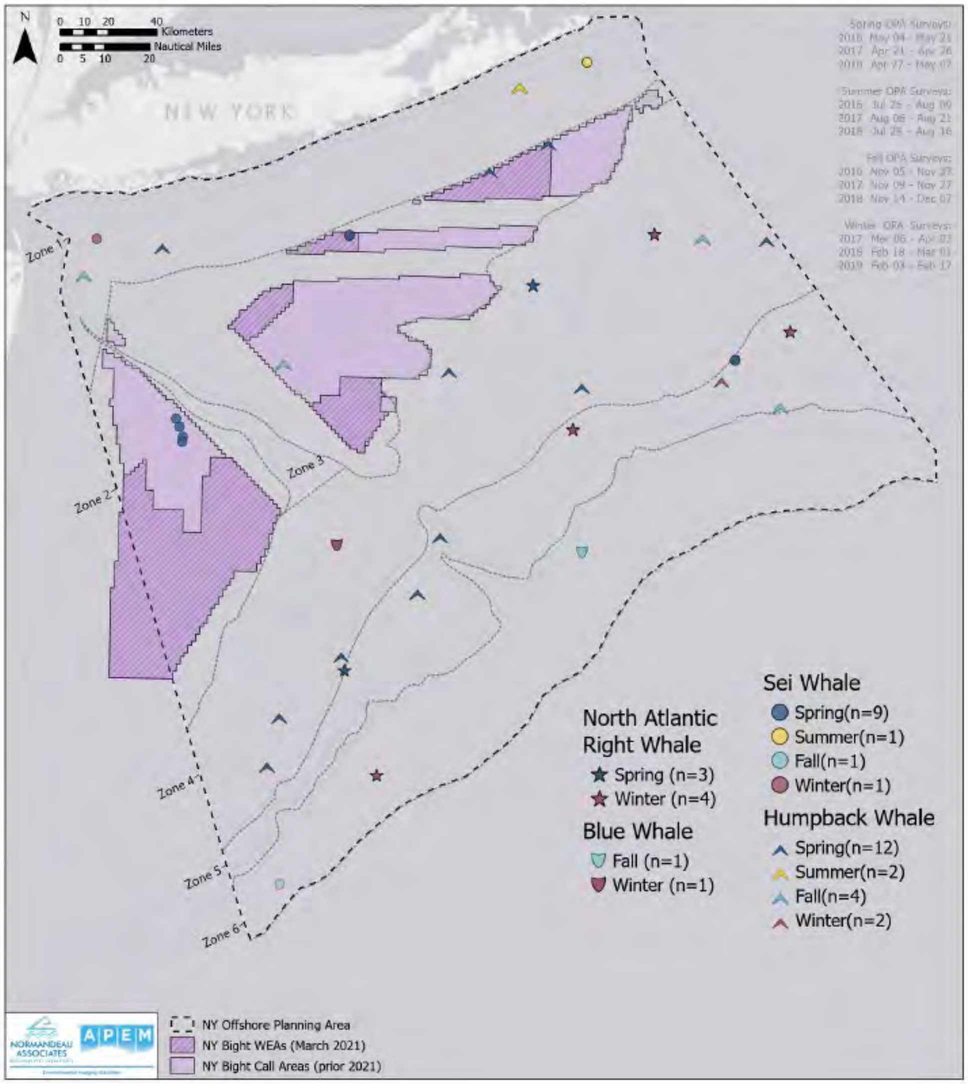


**Figure 7.** Spatial distribution of low-frequency cetacean species with fewer than 30 occurrences across all digital aerial surveys, 2016-2019 (NYSERDA 2021).

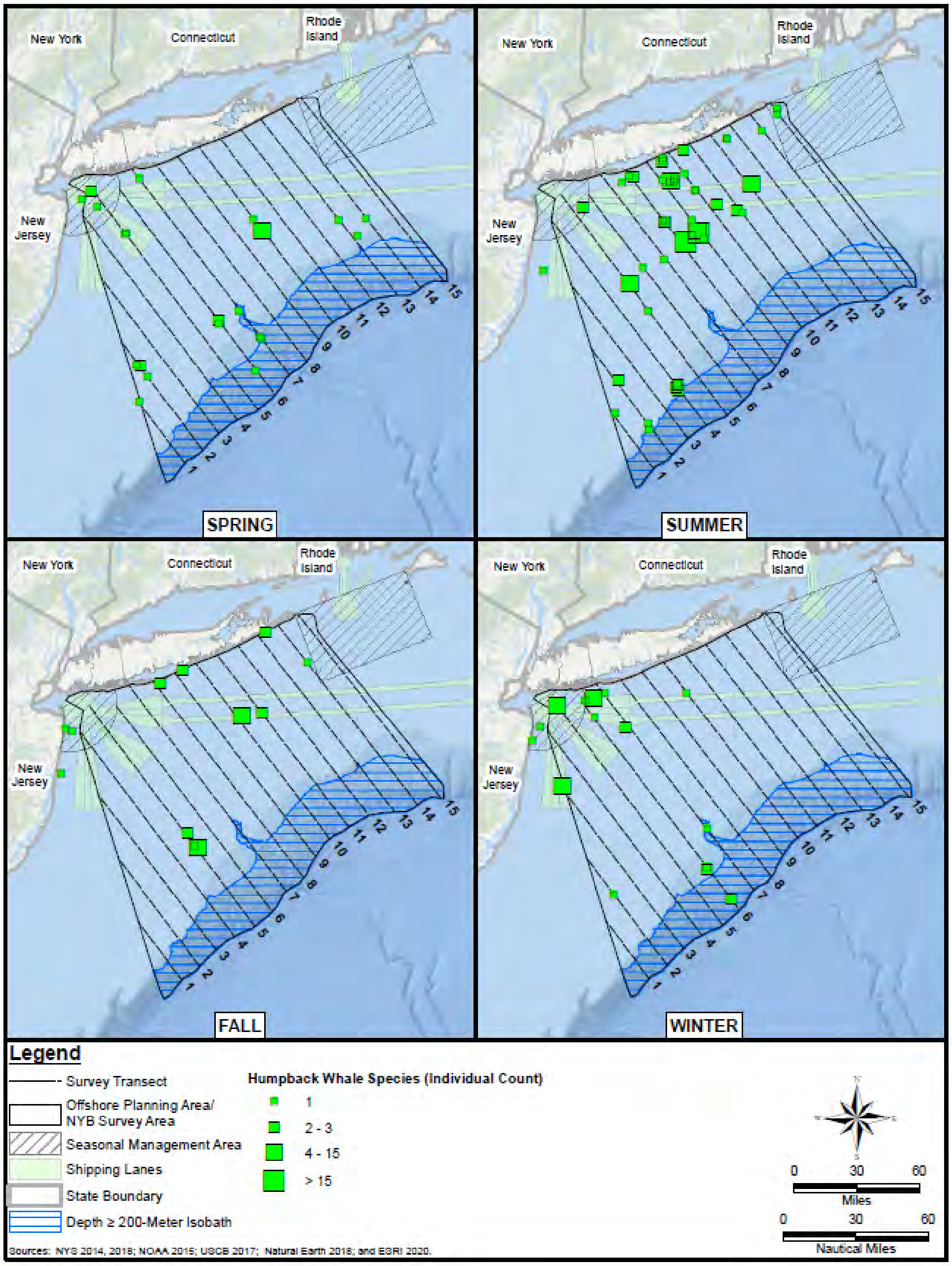


**Figure 8.** Locations of all aerial humpback whale sightings by count and season, 2017-2020 (Tetra Tech and LGL 2020).

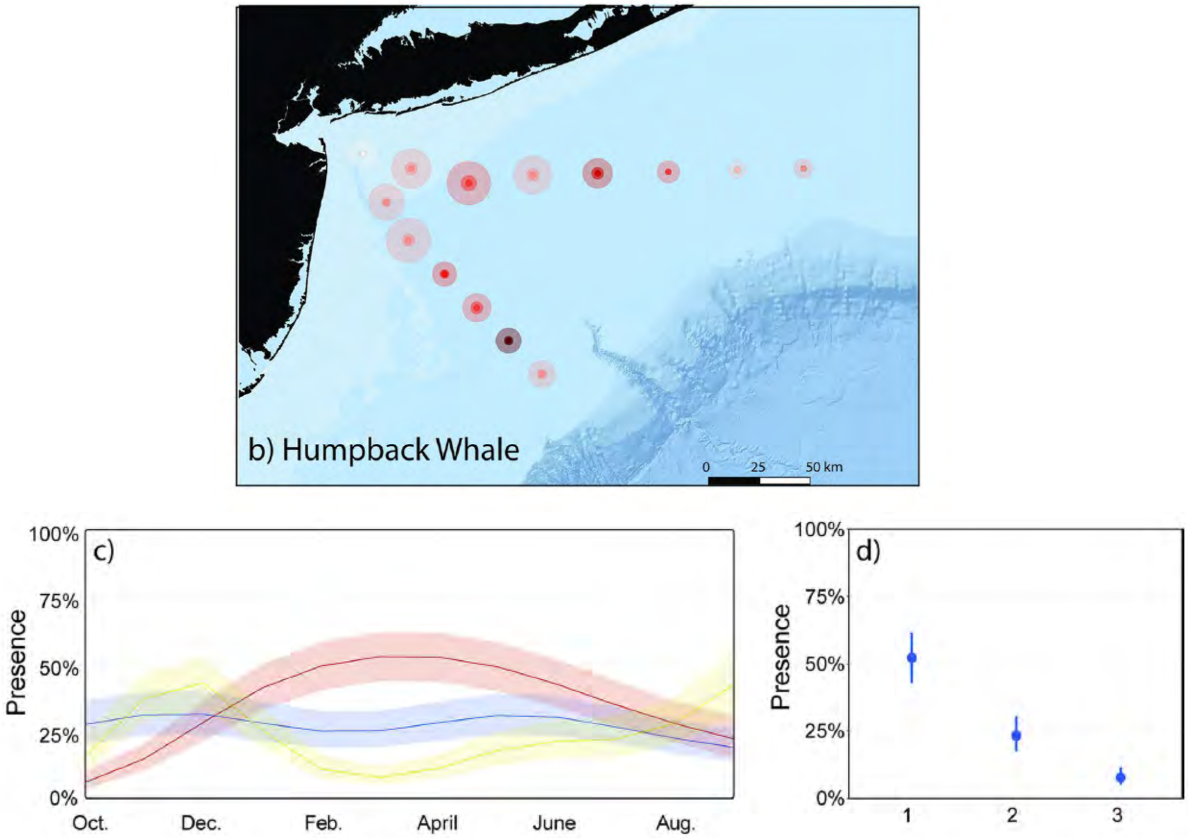


**Figure 9.** Humpback whale passive acoustic detections in space (b) and time (c and d), 2017-2020. In (b), the size of the circle around each site represents the estimated detection area and the colormap is scaled to the proportion of days with detections over total days recorded, where white is 0 presence and deep red is the highest presence for the species (47-53). In (c), the x-axis is calendar year and red is Year 1 (October 2017-2017), blue is Year 2 (October 2018-2019), and yellow is Year 3 (October 2019-2020). In (d), the x-axis is survey year (Estabrook et al. 2025).

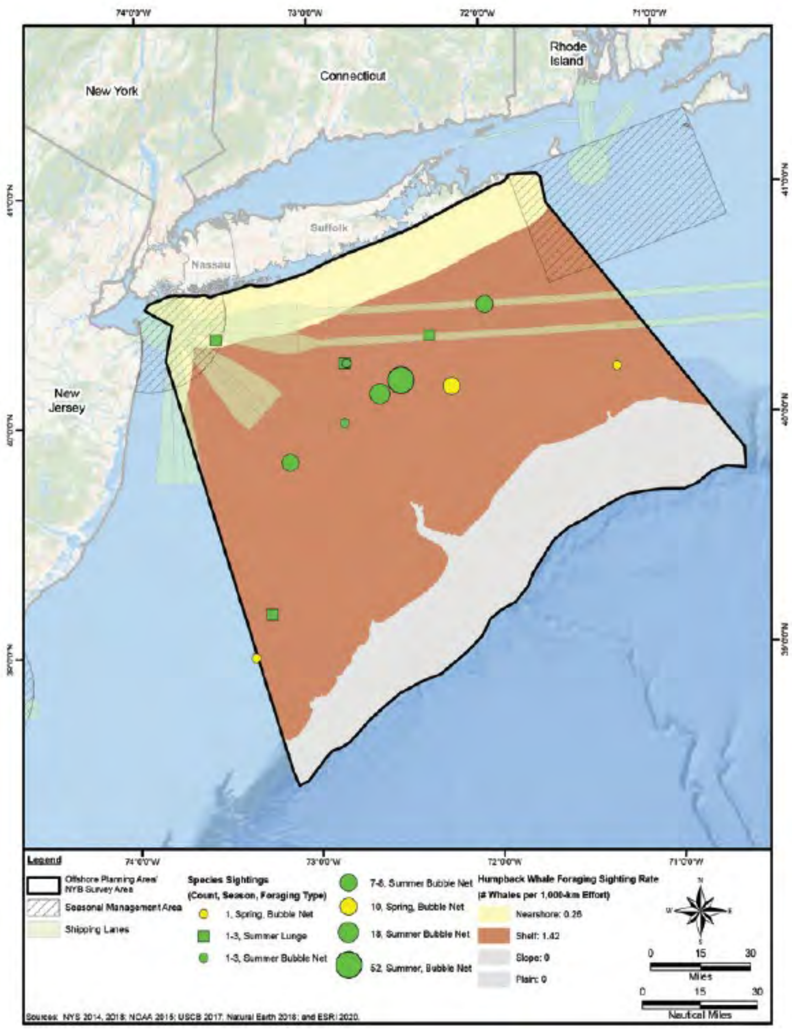


**Figure 10.** Foraging humpback whales by count, season, and distribution zone (Nearshore: 0 to 25 km from shore, Shelf: >25 km from shore to 200 m water depth, Slope: >200 to 1,000 m water depth, and Plain: >1,000 m water depth; Lomac-MacNair et al. 2022).

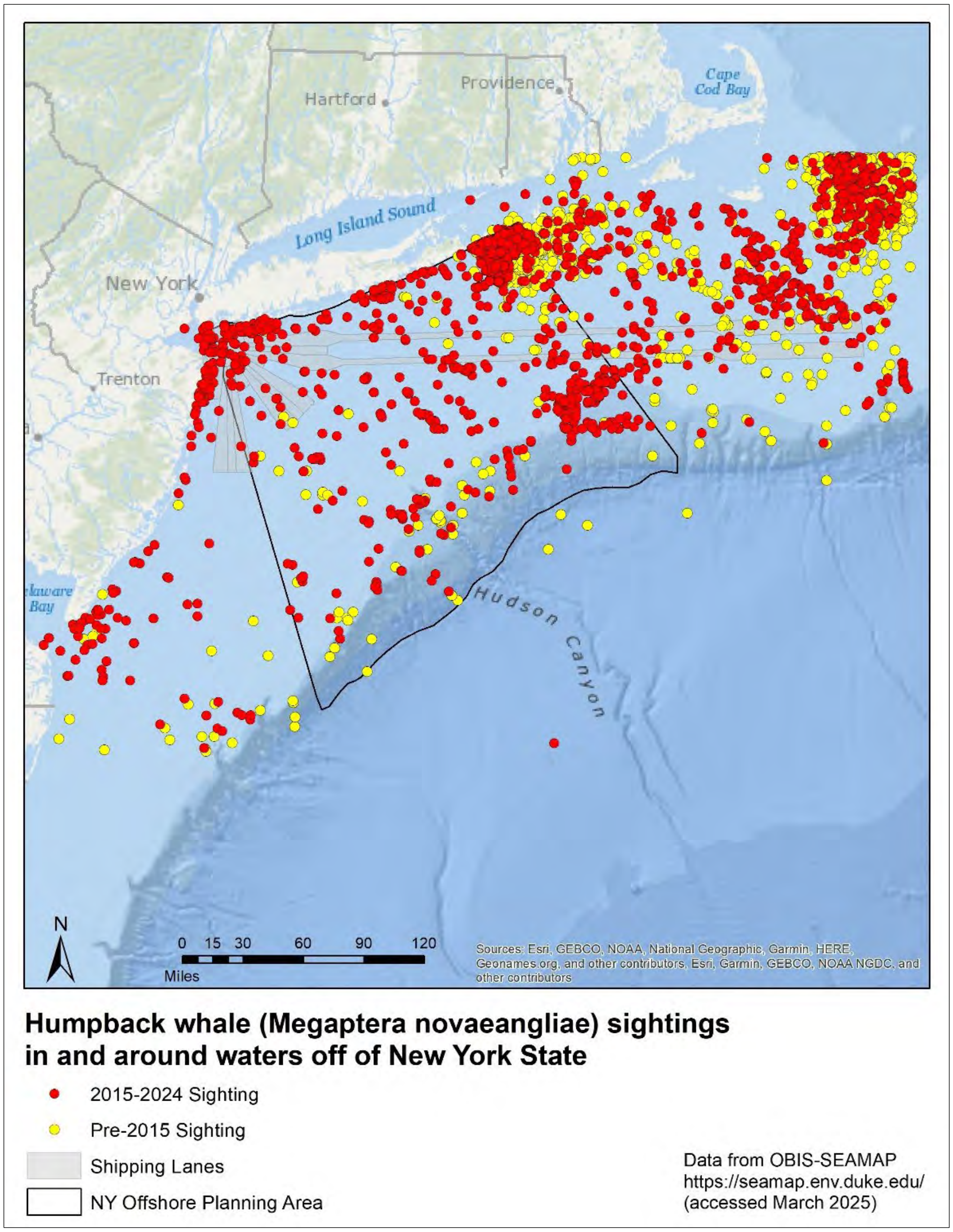


**Figure 11.** Humpback whale sightings from OBIS-SEAMAP.

## New York's Contribution to Species North American Range:

| Percent of North American Range in NY | Classification of NY Range | Distance to core population, if not in NY |
|---|---|---|
| 1-25% | Core | |

*Column options*
**Percent of North American Range in NY**: 100% (endemic); 76-99%; 51-75%; 26-50%; 1-25%; 0%; Choose an item
**Classification of NY Range**: Core; Peripheral; Disjunct; (blank) or Choose an item

## IV. Primary Habitat or Community Type *(from NY crosswalk of NE Aquatic, Marine, or Terrestrial Habitat Classification Systems):*

**a.** Pelagic

**b.** Marine, Deep Subtidal

**c.** Estuarine, Deep Subtidal

### Habitat or Community Type Trend in New York

| Habitat Specialist? | Indicator Species? | Habitat/ Community Trend | Time frame of Decline/Increase |
|---|---|---|---|
| No | Yes | Increasing | 2011 to present |

*Column options*
**Habitat Specialist and Indicator Species**: Yes; No; Unknown; (blank) or Choose an item
**Habitat/Community Trend**: Declining; Stable; Increasing; Unknown; (blank) or Choose an item

### Habitat Discussion:

Humpback whales are found in all ocean basins though are less common in Arctic waters. In the western North Atlantic, humpbacks occur from the West Indies to Greenland. Humpback whales undertake long migrations between winter breeding grounds in tropical waters and summer feeding grounds in the cold waters of the mid- to high latitudes (Clapham 2018). They also display within-season movement to find or follow prey (NMFS 1991). Little is known about the actual migratory path for the West Indies DPS but it's likely that humpback whales migrate offshore, corroborated by recent studies that show a decrease in detections nearshore during the time of migration (NMFS 1991, Davis et al. 2020). However, there may still be something to the argument that humpback whales follow very specific migration routes. Horton et al. (2011) analyzed satellite tag tracks and found that the whales could maintain a constant directed movement, often with precision better than 1 degree. Furthermore, Horton et al. (2020) expanded on the concept using whaling records and additional satellite tag data to show that humpback whale migration (e.g., migratory corridor, migration path straightness, direction, timing, and velocity) has not significantly changed during a time of oceanographic and geomagnetic changes. In other words, "these whales maintained prolonged migratory fidelity to a limited suite of spatiotemporal trajectories through gravitational coordinates raising the possibility that migratory decisions are relatively insensitive to changing oceanographic and geomagnetic conditions (Horton et al. 2020). This is perhaps counterintuitive in the time of climate change, where the movements of other whale species have shifted along with environmental conditions.

Seasonal migrations from feeding grounds to breeding grounds can be as long as 8,000 km (Stevick et al. 1999, Stone et al. 1990, Rasmussen et al. 2007, Robbins et al. 2008, Darling and Cerchio 1993, Salden et al. 1999). Stone et al. (1987) hypothesized that Bermuda may be a migratory stopover for northwest Atlantic humpback whales. Grove et al. (2023) presented abundance estimates and photo identification trends over a ten-year period, affirming that Bermuda is indeed an important location for migrating humpbacks. In one of the Eastern North Pacific migration routes, humpback whales made a 3,000-mile (4,830 km) trip between Alaska and Hawaii in as little as 36 days (Gabriele et al. 1996). The longest recorded migration between a breeding and feeding area was 5,160 miles (8,300 km); this journey from Costa Rica to Antarctica was completed by seven individuals including a calf (Rasmussen et al. 2007). However, the longest mammalian migration every documented was by a female humpback whale. This individual was originally photographed off of Brazil and was resighted two years later off the coast of Madagascar, a distance of at least 9,800 km (Stevick et al. 2010). It is currently unknown how often such large-scale migrations occur, but the phenomenon is believed to be more common in the Southern Hemisphere, where continents do not restrict movements to as large of an extent as in the Northern Hemisphere (Stevick et al. 2010). Interestingly, Riekkola et al. (2019) showed that traveling further during migration does not always imply an increase in energy use by humpback whales, since they use speed to compensate.

Occasionally, humpback whales even migrate between oceans (Pomilla and Rosenbaum 2005). These movements are almost always made by males, who are willing to travel farther for potential mating opportunities (Darling and Cerchio 1993, Salden et al. 1999, Pomilla and Rosenbaum 2005). Females usually exhibit strict feeding and breeding site fidelity, and most humpback whales exhibit maternally directed site fidelity, returning annually to the feeding grounds they first traveled to with their mothers (NMFS 1991, Stevick et al. 2010).

*Feeding Ground*

In their summer distribution in the western North Atlantic, humpbacks can be found in four primary feeding areas: the U.S. East Coast (including the Gulf of Maine), Gulf of St. Lawrence, Newfoundland/Labrador and western Greenland (Payne et al. 1986, Katona and Beard 1990). Feeding areas are often near or over the continental shelf and associated with cooler temperatures and oceanographic or topographic features that serve to aggregate prey (Moore et al. 2002, Zerbini et al. 2006). Within the feeding area, humpback whales are often associated with areas of upwelling, which typically occur in areas where there are changes in underwater topography, such as ledges and seamounts (CETAP 1982, Payne et al. 1986, Robbins 2007). It's known that humpback whales feed opportunistically along the shelf as well (Kenney and Winn 1986).

Humpback whales typically arrive in the Gulf of Maine feeding ground in April and leave in December (Robbins 2007). In these New England waters, feeding is the primary activity and humpback whale distribution within this region is therefore correlated to prey availability and abundance (Payne et al. 1986, 1990). Payne et al. (1986) showed that humpbacks shifted their primary feeding grounds in direct response to shifts in sand lance distribution. Feeding humpback whales were at one time less common south of Cape Cod, though they were commonly found east/southeast of Montauk during the feeding season (CETAP 1982, Kenney and Winn 1986). Important prey in the North Atlantic are herring, sand lance, and caplin; some mackerel, pollock, haddock, and krill are also sometimes prey items in the northern Gulf of Maine (Mitchell 1973, Paquet et al. 1997, NMFS 1991). The prey of choice in the waters off New York is menhaden, which interestingly is not included in the Gulf of Maine humpback whale management documents to date (Brown et al. 2018, King et al. 2021, Lomac-MacNair et al. 2022).

There is some evidence of demographic differences throughout the Gulf of Maine feeding ground (Robbins 2007). Robbins (2007) found that females were more likely to use southern areas, while males were more frequently encountered in northern areas, such as the Bay of Fundy. The study did suggest that adult females appeared to primarily use areas where sand lance was the primary prey (Robbins 2007). In the Gulf of Maine these were nearshore areas where sandy shoals were found, including Stellwagen Bank (Payne et al. 1986). However, it was found that humpbacks sometimes switched to herring (and sometimes mackerel) when prey availability shifted (Payne et al. 1986, Fogarty et al. 1991). When this occurs, humpbacks are found further offshore (Weinrich et al. 1997).

Sadove and Cardinale (1993) documented humpback whales in New York feeding primarily on sand lance. During the study, humpback whales used relatively shallow, near-shore areas and were observed for a week or more in Long Island Sound, Block Island Sound, Gardiner's Bay, and inlets (e.g., Shinnecock, Fire Island, and New York Harbor) along the south shore of Long Island (Sadove and Cardinale 1993). Like other areas along the coast, year-to-year distribution of humpbacks in New York waters was hypothesized to be driven primarily by the distribution of prey.

*Breeding Grounds*

Most humpback whales (approximately 90%) in the western North Atlantic feeding grounds migrate to the West Indies breeding ground where they spend the winter months (Clapham et al. 1993, Mattila et al. 2001). The largest aggregations of humpback whales in the West Indies are found in the Dominican Republic, notably Silver Bank and Navidad Bank, from late December through early April (Winn et al 1975, Balcomb and Nichols 1982, Whitehead and Moore 1982, Mattila et al. 1989, 1994). On the breeding grounds, North Atlantic humpback whales mate and calve (Mattila et al. 1989). Some humpback whales from the Iceland and Norway feeding ground also go to the West Indies, where spatial and genetic mixing among feeding groups occurs (Katona and Beard 1990, Clapham et al. 1993, Palsbøll et al. 1997, Stevick et al. 1998, Kennedy et al. 2014). Though we know there is some interchange of individuals between the eastern and western Atlantic wintering grounds, our knowledge of breeding season distribution is still incomplete (Smith and Pike 2009, Stevick et al. 2016).

During the winter breeding season, humpback whales engage in little to no foraging and subsist on stored fat. They prefer locations with protection against prevailing winds, have flat bottoms in water from 15 to 60 meters deep, and with high water temperatures (24 to 28 degrees Celsius), which is among the highest water temperature experienced by baleen whales (Whitehead and Moore 1982).

*Wintering at High Latitudes*

Migration to the mating and calving grounds in the Caribbean is not completed by every humpback whale every winter season, as many individuals are seen in mid- and high-latitude regions throughout the year or stay for the winter (CETAP 1982, Williamson 1961, Clapham et al. 1993, Swingle et al. 1993, Robbins 2007, Kennedy et al. 2014*,* Kowarski et al. 2018). Aschettino et al. (2020) also found that increasing numbers of humpback whales wintering off coastal Virginia. photographic records from Newfoundland have shown several adult humpbacks remain there year-round, particularly on the island's north coast. In addition, some individuals have been sighted repeatedly in the same winter season (Clapham et al. 1993, Robbins 2007).

Acoustic recordings made within the Massachusetts Bay area detected some level of humpback song and non-song sounds in almost all months, with two prominent periods: March through May and September through December (Clark and Clapham 2004, Vu et al. 2012, Murray et al. 2014). This pattern of acoustic occurrence, especially for song, confirms the presence of male humpback whales in the area. A complementary pattern of humpback singer occurrence was observed during the January–May period in deep-ocean regions north and west of the Caribbean and to the east of Bermuda during April (Clark and Gagnon 2002). These acoustic observations from both coastal and deep-ocean regions support the conclusion that at least male humpbacks are seasonally distributed throughout broad regions of the western North Atlantic.

## V. Species Demographics and Life History

| Breeder in NY? | Non-breeder in NY? | Migratory Only? | Summer Resident? | Winter Resident? | Anadromous/ Catadromous? |
|---|---|---|---|---|---|
| Choose an item. | Yes | Choose an item. | Yes | Yes | Choose an item. |

*Column options*
**First 5 fields**: Yes; No; Unknown; (blank) or Choose an item
**Anadromous/Catadromous**: Anadromous; Catadromous; (blank) or Choose an item

**Species Demographics and Life History Discussion** *(include information about species life span, reproductive longevity, reproductive capacity, age to maturity, and ability to disperse and colonize):*

The expected life span of humpback whales is about 80 to 90 years (NMFS 2024). Generation length was calculated to be 25.5 years (Cooke 2018). Humpbacks can grow up to 60 feet in length and weigh up to about 40 tons (NMFS 2024). They are generally the easiest baleen whale species to identify based on morphology (Jefferson et al. 1993, Winn and Schwartz 1999). There are differences in size and coloration between the hemispheres but all humpback whales have extremely long pectoral flippers, measuring one third of their body length, usually about 15 feet long, with bumps on the trailing edge. On the top of the rostrum, humpback whales have bumps or knobs that have a hair in the center. In addition, humpbacks often have barnacles attached to them, especially on their chin. Like other baleen whale species that show sexual dimorphism, females may be slightly larger than males. Typically, humpback whale groups are small and associations between individuals do not last long, except for the mother/calf pairs that stay together for about one year (Clapham and Mead 1999). However, large groups of humpback whales are occasionally seen in New York and the surrounding areas, sometimes numbering over 40, all of which can be engaged in foraging (Lomac-MacNair et al. 2022).

Humpback whales are uniquely identifiable based primarily on unique black and white patterns on the underside of their tails, or flukes, but other features such as dorsal fin shape and scars can also help identify individuals (Katona and Whitehead 1981, Smith et al. 1999). The pigmentation patterns on humpback whale flukes are unique to each animal, ranging from all black to all white, and are as good at identifying individuals as fingerprints are for humans (NMFS 2024). The flukes themselves can be up to 18 feet wide and are serrated on the trailing edge, creating features that are used to confirm individual identification (Katona et al. 1979).

Rorquals (e.g., baleen whales with throat grooves) are “gulpers”: the mouth is opened, taking in a large volume or water and prey which sits within the lower jaw and ventral pouch, then the mouth is closed and the pouch is contracted, pushing water out through the baleen and keeping prey inside (Nemoto 1970, Pivorunas 1979, Lambertsen 1983). The baleen plates of rorquals are shorter and coarser than some other species, like right whales, and the rostrum of the skull is flatter and broader. Humpback whales sometimes forage cooperatively with conspecifics, such as in bubble net feeding (Clapham 1993). They have the most diverse feeding behaviors of any baleen whale species, such as lunge feeding and kick feeding, some of which are spread through populations by cultural transmission (Weinrich et al. 1992, Friedlaender et al. 2006). Dive behavior varies but averages from less than 5 minutes to 10-15 minutes (Clapham and Mead 1999).

Both male and female humpbacks reach sexual maturity between 4 and 10 years of age, though it varies within and among populations (NMFS 2024, Clapham 1992, Robbins 2007). Average length at sexual maturity is 11.6 meters (Clapham and Mead 1999). The humpback whale calving interval ranges from 1 to 5 years; both annual and multi-year intervals have been observed but births every 2 to 3 years is most common (NMFS 1991, Wiley and Clapham 1993). Calves are born 13 to 16 feet long on the winter breeding grounds between January and April after an 11–12-month gestation period (NMFS 1991, NMFS 2024). Lactation typically lasts about 11 months though weaning, which usually occurs during winter months, can be done as early as six months old. Calves are independent by age one (Clapham and Mayo 1990). Mean calving rates have been estimated at .38-.50 per female per year (Wiley and Clapham 1993). For the Gulf of Maine stock, data supplied by Barlow and Clapham (1997) and Clapham et al. (1995) gives values of 0.96 for survival rate, 6 years as mean age at first parturition, 0.5 as the proportion of females, and 0.42 for annual pregnancy rate (Hayes et al. 2020).

Biological functions in humpback whales are closely tied to seasonal change (Winn and Reichley 1985). During summer and fall, humpback whales spend much of their time feeding and building fat stores for winter. Most humpback whales exhibit maternally-directed site fidelity, returning to the same feeding ground year after year. The existence of these matrilineally determined discrete subpopulations is supported by studies on the mitochondrial genome and individual animals movements (Palsbøll et al. 1995, Palsbøll et al. 2001, Stevick et al. 2006). Females with calves are usually the last to arrive on the summer feeding grounds (Dawbin 1997). Demographic segregation during migration has been found in the North Atlantic, where males arrived significantly earlier in the breeding grounds than all females (Stevick et al. 2003b). Stevick et al. (2003b) also found that whales from the western North Atlantic arrived on the breeding grounds significantly earlier than those from eastern North Atlantic feeding grounds, which could affect the amount of genetic mixing between the western and eastern groups. Basran et al. (2023) reported the first documented migration of a mother/calf pair from Iceland to the West Indies breeding ground. It's currently unknown whether these patterns are a result of different selective pressures or not, but new evidence of movement patterns in North Atlantic humpback whales continues to highlight the fact that we still don't know for sure how these groups (e.g., distinct population segments) mix and breed (Jones et al. 2025).

It is widely believed that, while mating might occur on feeding grounds or on migration, most mating and conceptions take place in winter breeding areas (Clapham 1996; Clark and Clapham 2004). Humpback whales are generally polygynous, with groups of males exhibiting competitive behavior to access breeding females (NMFS 1991, Clapham 1996). Breeding grounds have a strong sex bias towards males, amplifying the intense competition that occurs among males (Smith et al. 1999, Herman et al. 2011). Competitive behavior may be aggressive, such as ramming and hitting one another with their pectoral flippers and flukes, surfacing on top of each other, and vocal and bubble displays (Tyack and Whitehead 1983, Baker and Herman 1984). Because of this, most mothers with calves have an escort whale that is a sexually mature adult male (Herman and Antinoja 1977, Clapham et al. 1992). The mother-calf-escort social group is common on breeding grounds (Smith et al. 2008, Clapham et al. 1992). Because females undergo postpartum ovulation, it's thought that an escort is either seeking access to a female or mate-guarding post-copulation (Ransome et al. 2021). Other males may try to displace the escort, creating a dangerous situation for the mother-calf pair. Unintentional calf injuries have been speculated to occur, and the first death of a calf during aggressive escort and mating behavior was reported in 2021 (Ransome et al. 2021). Injuries to the males involved range from minor to severe and a few deaths have been reported (NMFS 1991). The most significant and well-known breeding behavior is the males' use of long, complex songs during courtship (Payne and McVay 1971, Tyack 1981, Tyack and Whitehead 1983, Herman 2017). Songs can last up to 20 minutes and may be heard up to 20 miles away (Clapham and Mattila 1990). A male may sing for hours, repeating the same song numerous times. All males in a population sing the same song but the song evolves over time (Darling and Sousa-Lima 2005). Humpback whale singing has been studied for decades, but its evolution and definitive function remains unclear. In particular, the significance of songs on summer feeding ranges, such as songs detected in the New York Bight, is unknown but it may correspond to hormonal activity and proves that not all humpbacks migrate to wintering/breeding grounds annually (Mattila et al. 1987, McSweeney et al. 1989, Vu et al. 2012, Zeh et al. 2020).

*Natural Mortality*

Little is known about natural mortality in humpback whales. In the Gulf of Maine, the annual adult mortality rate was estimated at .04 (Barlow and Clapham 1997). Robbins (2007) estimated calf survival (e.g., 0–1 years of age) in the Gulf of Maine at 0.664, which is low compared to other areas, but varies annually.

Recorded natural mortality causes to date include ice entrapment, parasites, biotoxins, and predation. Humpback whales may become trapped in pack ice. In Newfoundland, one ice entrapment event involved about 25 humpbacks and some mortality occurred (NMFS 1991).

Parasites are believed to play some role in humpback whale natural mortality. The giant nematode (*Crassicauda boopis*), which humpbacks and other baleen whale species can carry, is known to cause a significant inflammatory response leading to kidney failure, other morbidities, and ultimately mortality (Lambertson 1985, 1986, Lambertsen 1992, Lambertsen et al. 1986). Recent studies have also shown endoparasitic infections in free-living large whales including humpbacks (Kleinertz et al. 2021).

Between November 1987 and January 1988, at least 14 humpback whales died after eating Atlantic mackerel in Cape Cod Bay (Geraci et al. 1989, 1990). The whales died from paralytic shellfish poisoning (PSP), a form of biotoxin, with an additional animal reported dead off New York shortly after, also from PSP. It is believed that the actual number of mortalities is higher than this (NMFS 2011). In addition, trophic transfer of biotoxins from harmful algal blooms (HABs) has been shown to be potentially fatal in baleen whales (Fire et al. 2010). Sub-lethal effects of HABs of may include lower reproductive success and increased susceptibility to other causes of death (Leandro et al. 2010). The intensity and frequency of HABs are expected to increase with ocean warming (Gobler et al. 2017).

Predation on humpback whales by killer whales and sharks varies in frequency by region (Mehta et al. 2007, Wade et al. 2007, Steiger et al. 2008, Ford and Reeves 2008). Humpback whale interactions with killer whales are evident by the presence of rake marks (i.e., parallel lines from killer whale teeth) on their flukes (Shevchenko 1975, Katona et al. 1988). In the western North Atlantic, the presence of rake marks on humpback whales is common. Killer whale scarring rates among whales observed in the West Indies ranged from 12.3% to 15.3% (Wade et al. 2007). McCordic et al. (2013) more recently estimated that the scarring rate in the Gulf of Maine is 9.3%, and almost double that (17.4%) in Canada. A recent study found rake mark scarring rates consistent with these prior studies, including 21.7% of the Atlantic Canada population and 13.5% of the Gulf of Maine population (Koilpillai et al. 2024). Photo-identification data indicate that rake marks are usually acquired in the first year of life, although attacks on adults also occur (Wade et al. 2007, Mehta et al. 2007, Steiger et al. 2008).

There have been at least two documented attacks on humpback whales by killer whales on the Grand Banks in Newfoundland (Whitehead 1987). Whitehead (1987) hypothesized that killer whale attacks are on disabled or young animals. Killer whale attacks have also been reported off of Alaska but there have similarly been instances of killer whales and humpback whales feeding close to each other with no attacks (Dolphin 1987, Jourdain and Vongraven 2017). Dolphin (1987) hypothesized that attacks occur on young animals and probably during migration, when group size and protection is low. Jefferson (1991) reviewed killer whale interactions with other species and determined that humpback whales were the second highest species to be predated. Additional interactions in Eastern Canada and off the coast of Massachusetts have been documented (Katona et al. 1988, Whitehead and Glass 1985). Most observations of humpback whales under attack from killer whales reported vigorous defensive behavior and tight grouping when more than one humpback whale was present (Ford and Reeves 2008). In fact, Pitman et al. (2017) suggest that the increasingly documented killer whale attack interference by humpback whales, which has allowed even some non-humpback whale targets to escape an attack unharmed, is a phenomenon for which interspecific altruism cannot be ruled out.

Shark predation may play a role in natural mortality of young and weak individuals (NMFS 1991). Like killer whales, sharks seem to target young and/or entangled humpback whales (Mazzuca et al. 1998, Glockner-Ferrari et al. 1987). In New York, humpback whale carcasses are increasingly scavenged by sharks, with at least two documented cases involving adult great white sharks. While predation events have not been documented, there is increasing presence of humpback whales, including calves, and great white sharks in the New York Bight, potentially leading to increased predation attempts.

There have been several Unusual Mortality Events (UMEs) declared for humpback whales since 2000. In 2003, a UME was declared when about 12-15 humpbacks died on Georges Bank (NMFS 2011). While the cause has not been officially declared, some of the whales tested positive for low levels of domoic acid (NMFS 2011). Seven humpbacks were part of a UME in New England in 2005, and 21 dead humpbacks were found between July and December in 2006. The causes of the mortalities are currently unknown (NMFS 2011). The current UME, which began in 2016, is discussed in Threats.

## *VI.* **Threats** *(from NY 2015 SWAP or newly described)*

| Threat Level 1 | Threat Level 2 | Threat Level 3 | Spatial Extent* | Severity* | Immediacy* | Trend | Certainty |
|---|---|---|---|---|---|---|---|
| 3. Energy Production & Mining | 3.1 Oil & Gas Drilling | | Small | Moderate | Unknown | Choose an item. | Choose an item. |
| 3. Energy Production & Mining | 3.3 Renewable Energy | 3.3.2 Wind farms | Restricted | Slight | Immediate | Choose an item. | Choose an item. |
| 4. Transportation & Service Corridors | 4.3 Shipping Lanes | 4.3.1 Shipping | Restricted | Moderate | Immediate | Choose an item. | Choose an item. |
| 4. Transportation & Service Corridors | 4.3 Shipping Lanes | 4.3.2 Dredging of shipping lanes | Small | Slight | Immediate | Choose an item. | Choose an item. |
| 5. Biological Resource Use | 5.4 Fishing & Harvesting Aquatic Resources | 5.2.1 Recreation or subsistence harvesting | Large | Slight | Immediate | Choose an item. | Choose an item. |
| 5. Biological Resource Use | 5.4 Fishing & Harvesting Aquatic Resources | 5.4.2 Commercial fishing | Large | Slight | Immediate | Choose an item. | Choose an item. |
| 6. Human Intrusions & Disturbance | 6.1 Recreational Activities | 6.1.4 Recreational boating | Pervasive | Slight | Immediate | Choose an item. | Choose an item. |
| 6. Human Intrusions & Disturbance | 6.2 War, Civil Unrest & Military Exercises | 6.2.3 Military exercises | Restricted | Slight | Immediate | Choose an item. | Choose an item. |
| 8. Invasive & Other Problematic Species | 8.2 Problematic Native Plants & Animals | 8.2.6 Increased predation by large predators | Large | Slight | Immediate | Choose an item. | Choose an item. |
| 8. Invasive & Other Problematic Species | 8.2 Problematic Native Plants & Animals | 8.2.7 Ectoparasites | Large | Slight | Immediate | Choose an item. | Choose an item. |
| 8. Invasive & Other Problematic Species | 8.4 Pathogens | | Large | Slight | Immediate | Choose an item. | Choose an item. |
| 9. Pollution | 9.1 Domestic & Urban Wastewater | | Pervasive | Slight | Immediate | Choose an item. | Choose an item. |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 9. Pollution | 9.2 Industrial & Military Effluents | | Pervasive | Slight | Immediate | Choose an item. | Choose an item. |
| 9. Pollution | 9.4 Garbage & Solid Waste | 9.4.4 Drifting plastic and entanglement rubbis | Pervasive | Slight | Immediate | Choose an item. | Choose an item. |
| 9. Pollution | 9.6 Excess Energy | 9.6.3 Noise pollution | Pervasive | Moderate | Immediate | Choose an item. | Choose an item. |
| 11. Climate Change | 11.1 Habitat Shifting & Alteration | Choose an item. | Pervasive | Moderate | Immediate | Choose an item. | Choose an item. |
| 11. Climate Change | 11.3 Changes in Temperature Regimes | Choose an item. | Pervasive | Moderate | Immediate | Choose an item. | Choose an item. |

**Table 2.** Threats to humpback whale.

According to NOAA's 2015 status review of humpback whales, in the North Atlantic Ocean, the threats of harmful algal blooms (HABs), vessel strikes, and fishing gear entanglements are likely to moderately reduce the population size or the growth rate of the West Indies DPS (Bettridge et al. 2015). All other threats except for climate change, which had uncertain severity at the time of the review, are considered likely to have no impact or minor impact on the West Indies DPS population size or growth rate (Bettridge et al. 2015). The Potential Biological Removal (PBR), or maximum number of annual human-caused mortalities for the population, is 22 for the Gulf of Maine humpback whale stock (Hayes et al. 2020). From 2013-2017, the minimum annual rate of detected human-caused mortality and serious injury was an average 12.15 animals per year and totaled 60.75 for the period (Hayes et al. 2020). Because only roughly 20% of mortalities since 2000 are estimated to have been observed, the minimum fraction of anthropogenic mortality is 0.85. This means that if undetected carcasses are accounted for, the annual human-caused mortality and serious injury would be 53 and significantly exceed PBR (Hayes et al. 2020). The issue of carcass detection, or lack thereof, related to serious injury and mortality from entanglements and vessel strikes that prevents a clear accounting of each threat's pervasiveness.

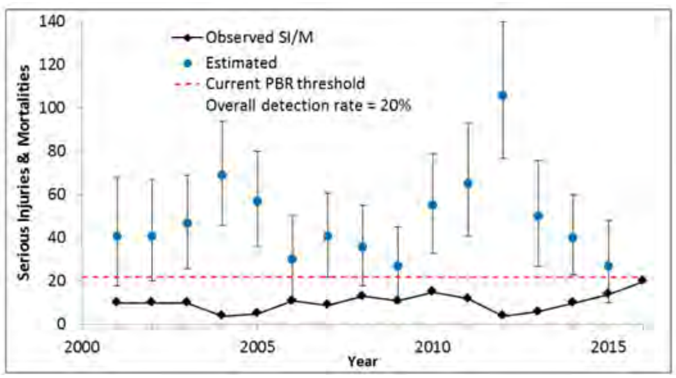


**Figure 12**. Time serious of observed annual total serious injuries and mortalities (SI/M; bottom black line) observed versus total annual estimated mortalities (blue circles with associated error bars). Dashed line indicates current PBR threshold of 22 (Hayes et al. 2020).

As discussed in the most recent Stock Assessment Report (SAR) for Gulf of Maine humpback whales, there is growing evidence that this population has been well over PBR for years (Hayes et al. 2020). For example, an Unusual Mortality Event (UME) was declared in 2017 for the Gulf of Maine humpback whale population, which started in January 2016 and was found to be due to human causes (i.e., vessel strikes and entanglements) (NMFS 2025a). This further highlights the likelihood that anthropogenic mortality and serious injury, specifically vessel strikes and entanglements, may very well be inhibiting recovery of the population. Overall, the 2019 SAR for the Gulf of Maine humpback whale population points to the prevalence of serious injury and mortality from entanglements rather than from vessel strikes, but this is likely no longer the case (see UME discussion below). Regardless of specific cause, human impacts may be slowing the recovery of the Gulf of Maine humpback whale population (Hayes et al. 2020).

<u>Unusual Mortality Events (UMEs)</u>

Per the Marine Mammal Protection Act (MMPA), an unusual mortality event (UME) is defined as "a stranding that is unexpected; involves a significant die-off of any marine mammal population; and demands immediate response" (NMFS 2025a). These events require increased investigation, as they often signal larger issues in the environment. In addition to the UMEs listed in the table below, there was an event in the first half of 1990 when seven dead juvenile humpback whales stranded between New Jersey and North Carolina. It's unknown what caused the mortalities or what significance they had in the population.

| UME Name | Date Range | Species | Year Declared | Location | Number of Animals | Cause |
|---|---|---|---|---|---|---|
| Gulf of Maine Large Whale | June 17, 2003 – September 1, 2003 | Humpback, fin, minke, and long-finned pilot whale | 2003 | Canada to Massachusetts | 21<br>(16 humpbacks) | Undetermined* |
| Northeast Large Whale | July 1, 2005 – November 7, 2005 | Minke, humpback, fin, and sperm whale | 2005 | Canada to Maryland | 34<br>(7 humpbacks) | Undetermined |
| Northeast Large Whale | January 1, 2006 – December 31, 2007 | Humpback whale | 2006 | Maine to Virginia | 48<br>(21 humpbacks) | Undetermined |
| Atlantic Humpback Whale | January 1, 2016 - present | Humpback whale | 2017 | Atlantic Ocean | 249+ | Human Interaction (vessel strike and entanglement) |

*A few sampled carcasses showed saxitoxin and domoic acid but no definitive conclusions could be drawn.

**Table 3.** All humpback whale unusual mortality events (UMEs) that include the Gulf of Maine population (NMFS 2025d).

*Current UME: 2016-present*

The current UME was declared in April 2017 due to elevated humpback whale mortalities along the Atlantic coast, from Maine through Florida, which began in January 2016. Connor (1971) reported that in New York humpback whales "rarely become stranded" and, as such, there were no state records at the time; this is unfortunately no longer the case. In the current UME, the state of New York has the second highest number of humpback whale cases, a total of 47 as of March 2025, involved in the UME which now totals 252 cases (NMFS 2025a). For the cases in New York where cause of death has been determined, most (n=27) are due to vessel strike while only 5 have been due to entanglement. The highest year, in which 11 humpback whales stranded dead in New York, was in 2023. That year was marked by a steep increase in strandings along the entire U.S. East Coast throughout most of the year and involved many different cetacean species (NMFS 2023).

| | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | Subtotal | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| New York (State) | 4 | 4 | 7 | 3 | 6 | 1 | 2 | 7 | 2 | 0 | 36 | 47 |
| New York (Offshore) | 0 | 1 | 1 | 2 | 3 | 0 | 0 | 4 | 0 | 0 | 11 | |

**Table 4.** 2016-present Unusual Mortality Event (UME) humpback whale cases by year (NMFS 2025a).

While no detailed summary of cases for all states currently exists, most cases with known cause of death follow the same trend of more vessel strikes than entanglements (though there may be some states with more entanglement deaths than vessel strikes). Regardless, the UME has called attention to the fact that humpback whales in New York are found increasingly closer to shore, are mostly juveniles (and therefore inexperienced), and are mostly engaged in erratic (e.g., lunge) feeding behavior. This leads to young whales whose focus is not on their surrounding environment, which in the case of New York, means they are directly exposed to the excessive traffic and speed of recreational vessels and the constant presence of large container ships traveling along three separate shipping lanes to reach the busiest port on the U.S. East Coast. Likewise, they also are exposed to large, lucrative commercial and charter fishing vessels/fleets, as well as a significant number of boats engaged in recreational fishing.

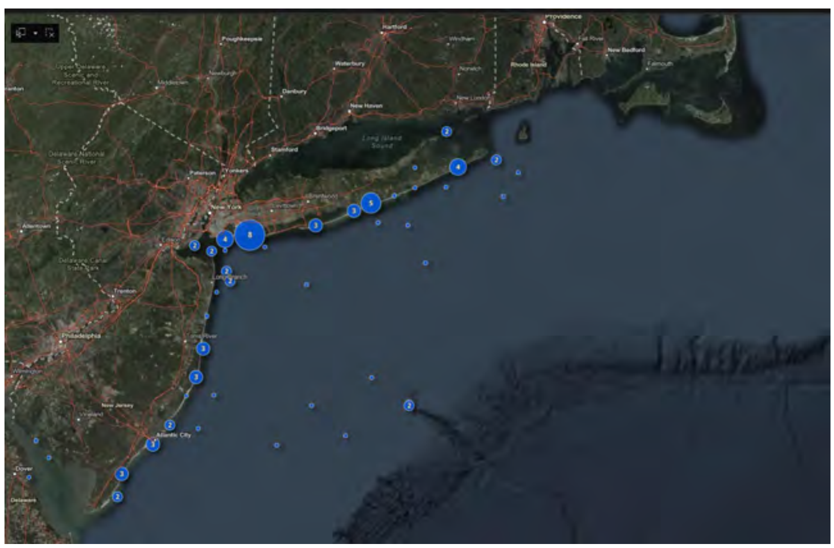

**Figure 13.** All humpback whale Unusual Mortality Event (UME) cases within the New York Bight (NMFS 2025a).

It's important to note that New Jersey has a total of 34, which the stranding response teams from New York have assisted with as needed, and some of which could have been New York strandings due to wind direction and currents. Over the course of the UME there have been multiple instances of two humpback carcasses stranding on the same day but in two different locations within the New York Bight area (e.g., one on Long Island and one in New Jersey).

Vessel Strikes

Because of their coastal distribution humpback whales are at significant risk of being struck by vessels. Jensen and Silber (2004) compiled information on reported U.S. ship strikes from 1975 through 2002 and found that humpback whales were the second most common species to be struck with 44 records. Humpback whales are one of the few species that have been observed with some regularity in the area around New York Harbor, which has high levels of vessel traffic (Sadove and Cardinale 1993). Whether accommodating or ignoring ships while behaviorally active, humpbacks are at increased risk (Beach and Weinrich 1989). Brown et al. (2019) examined humpback whale sightings in the apex of the New York Bight from 2011 to 2016 compared to vessel traffic and found that 95% of the sightings in 2016 were within 100 meters of a vessel. During DEC's 2017-2020 aerial surveys, three groups of humpbacks were recorded foraging in one of the three NY/NJ shipping lanes, including one group of 7 to 8 whales engaged in bubble net feeding (Lomac-MacNair et al. 2022).

Among strandings along the mid and southeast U.S. coastline from 1975 to 1996, 80% of struck whales were less than 3 years old (Laist et al. 2001). The prevalence of juvenile individuals in both nearshore humpback whale sightings and deceased stranded individuals may also be indicative of the kind of vessel strike risk occurring in the New York Bight (Stepanuk et al. 2021). This has become increasingly apparent as the UME and shifting presence of humpbacks has continued over time. Most humpback strandings that have occurred in the NYB have involved juveniles and were caused by vessel strikes (Stepanuk et al. 2021, NMFS 2025a).

The changing distribution and number of humpback whales along the U.S. East Coast has been documented off Virginia, specifically the Chesapeake Bay. Aschettino et al. (2020) found that humpback whales spend most of their time engaged in feeding at the mouth of the Chesapeake Bay and nine of the 106 individually identified humpbacks had propeller scars (e.g., evidence of vessel interaction). Ongoing tagging research in Virginia using digital sound and movement tags (DTAGs) has shown that humpback whales do respond to approaching vessels and may react through horizontal avoidance (e.g., changing direction), changing behavioral states (e.g., foraging to not foraging), and changing dive and surfacing patterns (e.g., more dives and shorter dive duration when ships are near; Shearer et al. 2019, 2024). The presence of vessels during reproductively significant behavior, such as singing behavior documented just off Virginia that includes a passive, head-down orientation between 10- and 14-meters depth, increases the risk of a strike (Adcock et al. 2024). As previously noted, humpback whale singing has also been recorded in the New York Bight (Zeh et al. 2020).

The cryptic nature of vessel strike serious injury and mortality contributes to its undercounting. Blunt force trauma (bone fractures, bruising, etc.) is indicative of a vessel strike but is usually undetectable externally, even when it's lethal (Moore et al. 2013). Sharp force trauma however, such as deep cuts, is undeniable in its presentation on the outside of the whale. Therefore, when assessing the prevalence of injury due to vessel strike, only sharp force trauma (e.g., propeller scars and/or the amputation of fins, flippers, or dorsal fin) can be documented in living animals (Wiley and Asmutis 1995). This is especially relevant given the large number of "offshore" humpback whale carcasses that have been detected during the UME; since they are not able to be brought to shore for a full necropsy to determine cause of death, documentation of these carcasses cannot account for the internal injuries associated with vessel strikes.

Entanglement

Humpbacks may be more likely to become entangled based on morphology (e.g., long pectoral flippers). Cassoff et al. (2011) describe in detail the types of injuries that baleen whales, including humpbacks, suffer because of entanglement in fishing gear. Whales surviving the initial entanglement might take considerable time to shed the gear, heal, and possibly recover. During this time, they can suffer from reduced feeding ability and suppressed immune system function, all leading to higher indirect mortality or reduced fecundity (van der Hoop et al. 2017).

Entanglements have been documented on the east coast of North America since 1976. Disentanglement, or "entrapment assistance", started in Canada by fishermen who accidentally caught whales; an average of 50 humpback whale entanglements was reported annually in Newfoundland between 1979 and 1988 (Lien et al. 1988, Lien et al. 1992). Because such assistance reduced the mortality rates of entangled individuals, disentanglement similarly started occurring in the United States.

The Center for Coastal Studies in Provincetown, MA and other organizations have been studying entanglement in Gulf of Maine humpbacks since 1997. Because the caudal peduncle is often involved in entanglements and is visible when humpback whales dive, photographs of scarring on this area have provided critical information on entanglement rates in the Gulf of Maine (Robbins and Mattila 2001, Robbins 2009, 2011). Inferences made from scar prevalence and modeling indicate that (1) younger animals are more likely to become entangled than adults, (2) less than 10% of humpback entanglements are ever reported, and (3) 3% of the population may be dying annually as the result of entanglements (Robbins and Mattila 2001, Robbins 2009, 2010, 2011, 2012). Both eye-witness reports and scar-based studies suggest that independent juveniles are significantly more likely to become entangled than adults (Robbins 2009). Females with entanglement injuries produced fewer calves than females with no evidence of entanglement; these impacts on reproduction are still being examined (Robbins and Mattila 2001). Mark-recapture studies of the fate of entangled whales in the Gulf of Maine suggest that juveniles are less likely than adults to survive (Robbins et al. 2008). A study of entanglement scarring on 134 humpback whales in the Gulf of Maine suggested that between 48% and 65% had experienced entanglements and that at least 12% encounter gear annually (Robbins and Mattila 2001, Robbins 2012). Between 2003 and 2006, about 65% of new individuals entering the entanglement study had evidence of a prior entanglement on their caudal peduncle (Robbins 2009). There were an estimated 203 entanglement events during this period but only nine of them were well-documented, a reporting rate of only 5.7% despite a strong outreach and response network.

Because of the prevalence of fishing gear and its overlap in whale habitat, entanglements are inevitable. Some mitigation measures, such as time-area closures and limiting the number of vertical lines in the water column, help to reduce this probability. Disentanglement is helpful and has saved many individuals but should not be relied upon; there are still significant health impacts experienced by whales that are entangled and therefore entanglement should be prevented altogether. Advances have been made in the creation of ropeless fishing gear, and iterative testing and development continues. As aquaculture expands in coastal areas, it will be essential to mitigate for entanglements (Storlund et al. 2024). Additionally, as climate change affects regional oceanography, especially in the Gulf of Maine, the location of fishing gear may change and possible increase the risk of entanglements as both whales and humans shift their activities (Schilling et al. 2023). Currently, most humpback whale entanglement cases (70%) are detected in the Gulf of Maine (Robbins and Pace 2018).

Unfortunately, it's become common practice for recreational fishermen in New York to target groups of humpbacks whales under the assumption that target species like tuna are also feeding on menhaden schools. Recreational fishermen purposefully drag their gear, consisting largely of monofilament, around, through, and over groups of humpbacks, including those with calves. This dangerous situation becomes worse when the whales, mostly calves and juveniles, end up severely entangled in gear such as tuna jigs. Recently documented activity of this nature revealed at least three of the summer 2024 calves became entangled with monofilament on their flukes; in one case, a calf's fluke was near amputation on one side when it was last seen. Analysis of entanglement rates in humpbacks commonly seen in New York is needed to better understand if and how these whales are encountering gear while in the Bight.

Stranding and entanglement response in New York is done by the New York Marine Rescue Center (NYMRC) and the Atlantic Marine Conservation Society (AMSEAS). Each group is federally permitted and responsible for a different subset of cases. All large whale events – live and dead –

fall under the purview of AMSEAS, however they are not authorized to disentangle large whales. The nearest group authorized to perform disentanglements is located in Provincetown, Massachusetts.

Climate Change

Climate change has led to temperature and current shifts throughout the North Atlantic Ocean that could lead to shifts in distribution of humpback whales as occupied habitats may become unsuitable and previously unsuitable habitats may become occupied (NMFS 1991, Sadove and Cardinale 1993). The seasonal timing of humpback migrations is already shifting in response to climate change (Ramp et al. 2015, Pendleton et al. 2022). Habitat expansion is likely to occur in the Arctic as sea ice coverage continues to reduce (Zein and Haugum 2018). Already the northernmost documentation of humpback whales has changed, with summer 2016 sightings in the Russian Arctic (Zein and Haugum 2018). Kebke et al. (2022) highlighted the primary consequences of climate change on the health of cetacean populations: impacts on distribution, abundance, phenology and behavior; impacts on reproductive success; and impacts on pollutant burdens. Humpback whale reproductive rates have shifted in some areas as well, tracking with climate anomalies (Cartwright et al. 2019). Kershaw et al. (2021) reported declining rate of reproductive success in Gulf of the St. Lawrence; between 2004 and 2018, 39% of identified pregnancies were unsuccessful. Decreased prey availability and/or quality due to climate change may make it difficult for females to reach the appropriate body condition to support a full-term pregnancy and produce a healthy calf. Current humpback whale breeding grounds are predicted to become unusable by 2100, with sea surface temperatures exceeding the species' tolerance (Derville et al. 2019, von Hammerstein et al. 2022). Establishing a new breeding ground or following prey into novel areas where no protective measures exist, such as the North Atlantic right whale movement following copepods into the Gulf of St. Lawrence in 2017, can result in a significant number of serious injuries and mortalities and population-level impacts (Meyer-Gutbrod et al. 2021).

*Harmful Algal Blooms* (HABs)

In cetaceans in all the world's oceans, there has been an increase in cases of poisoning due to harmful algal blooms (HABs; Harvell et al. 1999). Higher than usual precipitation during the summer may lead to a rise in temperature and a decrease in salinity, creating conditions which favor HABs (Dufour et al., 2010). The algae produce a neurotoxin called saxitoxin which causes neurological issues that may result in death. Cetaceans ingest this neurotoxin through their prey, a case of poisoning through the food chain. Global warming and subsequent changes in the rainfall regime may lead to an increase in the frequency and intensity of algal blooms and expand the impact of this threat. Intensity and frequency of algal blooms are expected to increase with ocean warming (Gobler et al. 2017). Sub-lethal effects may include lower reproductive success and increased susceptibility to other mortality causes (Leandro et al. 2010). Recent analysis of HAB events indicated that there is not as strong a relationship between HAB occurrence and whale injuries and deaths on the east coast as there is on the west coast, but there is still risk of whales being more susceptible to other threats due to HAB effects (Silber and Silber 2024).

Contaminants/Toxins

Overall, the effects of contaminants and toxins in humpback whales are unknown though could have both sub-lethal and chronic impacts. Humpback whales can accumulate lipophilic compounds (e.g., halogenated hydrocarbons) and pesticides (e.g., DDT) in their blubber from feeding on contaminated prey (i.e., bioaccumulation) or inhalation in areas of high contaminant concentrations (Barrie et al. 1992, Wania and Mackay 1993, O'Shea et al. 1999). Elfes et al. (2010) found high concentrations of organic contaminants accumulated in Gulf of Maine humpback whale blubber samples, speculating that levels possibly reflect prey choice. The study also found high levels of PCBs and insecticides. Some contaminants (e.g., DDT) are passed on maternally to young during gestation and lactation (Aguilar and Borrell 1994). Metcalfe et al. (2004) found in biopsy-sampled humpbacks under one year of age in the Gulf of St. Lawrence that PCB levels were similar to that of their mothers and other adult females, indicating that bioaccumulation can be rapid and occur through multiple routes (e.g., transplacental and lactational). The threshold level for negative effects and transfer rates to calves are unknown for humpback whales, but contaminants have been proposed as a factor in low reproductive rates in humpbacks off Southern California (Steiger and Calambokidis 2000).

Baugh et al. (2023) analyzed contaminant burdens in female humpback whales in the Gulf of Maine. They found levels of contaminants more than the threshold for adverse health effects and higher levels in juveniles than adults, indicating maternal offloading does occur across contaminants and is important for evaluating population health and viability. While no exceedingly significant effects of contaminants have yet been documented in humpback whales, it is possible that exposure has long-term effects such as reduced reproductive success and/or long-term survival. It's also true that some toxic contaminants do not accumulate in the tissues after exposure but may still have negative impacts. Perhaps most concerningly, climate change may serve to amplify the effects of contaminants and the presence of certain pathogens in the marine environment (Schiedek et al. 2007, Kebke et al. 2022).

Offshore Development

*Offshore Wind Energy, Oil Spills*

Pre-construction, construction, operation, and decommissioning of offshore development projects encompass a wide range of underwater sound in addition to pile driving noise (Ruppel et al. 2022). Offshore energy development could potentially degrade humpback whale habitat or displace them from common foraging or breeding areas. Studies have found evidence of this in passive acoustic data that showed the Southern New England area, a hot spot of offshore wind energy development, is an important area for humpback whales and other endangered cetacean species (Stone et al. 2017, Van Parijs et al. 2023). Development of offshore wind energy areas will also introduce a significant amount of vessel traffic, compounding impacts (Van Parijs et al. 2023). In addition, baleen whales are at the highest risk of entanglement in the moorings and associated power cables used to anchor offshore renewable energy, including wind, wave, and tidal energy (Benjamins et. al. 2014).

Oil spills that occur while humpback whales are present could result in skin irritation, baleen fouling, ingestion of oil, respiratory distress, ingestion of contaminated prey, and displacement from habitat (Geraci 1990). Actual impacts would depend on the extent and duration of contact and the characteristics of the oil. Most likely, the effects would be irritation to the respiratory system and absorption of toxins into the bloodstream (Geraci 1990).

Anthropogenic Noise

Anthropogenic noise in the marine environment has increased substantially since the 1950s, and this rapid change in the acoustic environment may have profound implications for marine mammals that evolved in a much quieter environment (McDonald et al. 2006, Hildebrand 2009, Clark et al. 2009). The primary sources of anthropogenic noise in the ocean are shipping, oil and gas exploration (e.g., seismic surveys and air guns), military activities, and marine construction (e.g., pile-driving, dredging, etc.) (Nowacek et al. 2007). Marine mammals, and especially cetaceans, rely on sound during all stages of life; they use sound to communicate, navigate, locate prey, and sense their environment. As such, humpback whales rely heavily on sound and increasing levels of anthropogenic noise in the ocean could hamper these abilities in the form of masking (e.g., not hearing conspecifics), displacement, temporary or permanent hearing loss, stress, and other behavioral changes (Gordon et al. 2004, Nowacek et al. 2007, Tyack 2008, Southall et al. 2019). Noise may seriously disrupt marine mammal communication, navigational ability, and social patterns, but noise is also highly variable in its generation and its reception. Noise may be intermittent or continuous, steady or impulsive, and may be generated by stationary or passing sources. Noise exposure can result in a multitude of impacts, ranging from those causing little to no impact to more severe outcomes like serious injury or mortality (Richardson et al. 1995, Foote et al. 2004).

Response to anthropogenic noise exists on a spectrum, from minor physiological changes to death, and the level of response varies due to many factors. The noise source type and characteristics, the surrounding environment (e.g., distance from shore, bathymetry), distance between the source and receptor, receptor characteristics (e.g., behavioral context, age, sex), and the time of day and/or season all affect the impact and response to noise (Richardson et al. 1995, NRC 2003, 2005). Hearing damage is usually categorized as causing either a temporary threshold shift (TTS) or a permanent threshold shift (PTS) (Southall et al. 2007, 2019). Excessive noise exposure may be damaging during early individual development, may cause stress hormone fluctuations, and/or may cause whales to leave an area or change their behavior within it (Weilgart 2007).

There are also short-term and long-term behavioral changes. Long-term changes include displacement from habitat, which may or may not be recolonized, sensitization (i.e., increased behavioral or physiological responsiveness over time) to noise that could exacerbate other effects, and habituation (i.e., decreased behavioral responsiveness over time) to chronic noise that could cause animals to remain close to noise sources. Except for displacement, long-term behavioral changes are subtle and therefore difficult to detect and quantify. The potential effects of chronic noise on baleen whales include stress, acoustic masking, behavioural disturbance, displacement from habitat, temporary hearing loss and, in extreme cases, permanent loss of hearing or other physiological damage (Weilgart 2007). Physical oceanographic factors and submarine topography influence sound propagation and the distance at which sound affects behavior, and the geographic scope of potential impacts is vast as low-frequency sounds can travel great distances under water, (Payne and Webb 1971, Watkins and Wartzok 1985).

Short-term changes include stopping a behavior such as feeding, resting, or socializing. Behavioral reactions can vary not only among individuals but also for a given individual between one specific set of variables and another, depending on previous experience. Behavioral changes can include more calls, longer calls, or different frequency of calls (Di Iorio & Clark 2010). Several species of large whales have been found to increase the amplitude of their calls in response to large levels of noise, which could lead to increased energy consumption (Holt et al. 2008, Parks et al. 2011). In contrast, above a certain level of noise, some whale species are known to stop vocalizing, and there is also the potential for masking of calls if background noise occurs within the frequencies used by calling whales (Melcón 2010).

An animal's auditory threshold may be masked by noise at frequencies similar to or louder than biologically important sounds. Above a certain level of noise, some whale species are known to stop vocalizing (Melcón 2010), and there is also the potential for masking of calls if background noise occurs within the frequencies used by calling whales (BRP 2010). In a large, solitary species, this could lead to difficulty finding other whales, including potential mates. Masking these acoustic signals can disturb the behavior of individual animals, groups of animals, or entire populations (Richardson et al. 1995). Individuals may try to minimize masking by changing their behavior, such as producing more calls, producing longer calls, or shifting the frequency of the calls (Parks et al. 2007, Parks et al. 2009). Interruption of normal vocalizing behavior could have significant energetic consequences, particularly if these shifts in vocalizing impact foraging efficiency. The acoustic monitoring in the New York Bight in 2008-2009 and 2017-2020 recorded elevated levels of ambient noise, sometimes over the NOAA-established limit for harassment and behavioral impacts (BRP 2010, Estabrook et al. 2021).

*Military Activity*

Acute, intermittent noise from military activity, especially from mid-frequency sonar and explosions, is likely to result in significant behavioral disruption and responses, and, at sufficiently high levels, may result in mortality from acoustic trauma for some baleen whale species (Weilgart 2007).

Controlled experiments have shown clear behavioral responses to simulated military sonar and sounds by baleen whale species, including cessation of feeding, increased swimming speed, and travel away from the sound source (Goldbogen et al. 2013, Southall et al. 2014). Military training exercises and active sonar could adversely affect humpback whales, since the low frequency transmissions overlap with humpback whale hearing range, thereby masking communications between individuals and negatively affecting social ecology and interactions of humpback whale groups (NMFS 1991). Humpback whale songs were found to lengthen during low-frequency active (LFA) sonar activities (Miller et al. 2000). This altered song length persisted two hours after the sonar activities stopped (Fristrup et al. 2003). Researchers have also observed diminished song vocalizations in humpback whales during remote sensing experiments 200 kilometers away from the whales' location in the Stellwagen Banks National Marine Sanctuary (Risch et al. 2012). Studies on the impact of naval sonar indicate that this activity "near humpback whale feeding grounds may lead to reduced foraging and negative impacts on energy balance" as lunge feeding dropped at least 65% during active sonar periods (Sivle et al. 2016).

*Oil and Gas Exploration*

As with military activity, the acute, intermittent noise from seismic mineral exploration is likely to cause significant behavioral change and, for some baleen whale species at high enough levels, result in mortality (Gailey et al. 2007, Dunlop et al. 2017, Harris et al. 2018). Baleen whales are known to detect the low-frequency sound pulses emitted from air guns used during seismic surveys and have been observed changing their behavior due to the presence of seismic survey vessels (McCauley et al. 2000, Stone 2006). Stone et al. (2003) found that baleen whales were sighted less frequently and exhibited avoidance behavior when air guns were active. In addition, whales tended to dive less at these times, possibly because noise levels are lower near the surface than at depth (Richardson et al. 1995).

Seismic operations have also been linked to extended area avoidance and louder vocalization levels by baleen whales (Castellote et al. 2012a, Nieukirk et al. 2012). The continuous compensation in high-activity areas, such as the east coast of Canada which has been subject to much oil and gas exploration, may have lingering impacts on a humpback whale's overall fitness. Studies have highlighted concerns about the long-term effects of prolonged exposure to air guns (Delarue et al. 2018).

Risch et al. (2012) examined the occurrence of humpback whale song on Stellwagen Bank National Marine Sanctuary in the Gulf of Maine during an acoustic experiment 200 kilometers away. Results showed a significant difference in the amount of song detected when the experiment was active. In addition, the study's findings represent "the greatest published distance over which anthropogenic sound has been shown to affect vocalizing baleen whales". The study was also the first to show that active acoustic fisheries technology could affect whales in such a way.

In response to an active seismic array, migrating humpback whales changed their behavior and respiration rates and, significantly, their progression migrating was slowed to below normal speeds (Dunlop et al. 2017). This is particularly relevant to the West Indies humpback whale DPS as, previously noted, timing of arrival on the breeding or feeding grounds may impact the availability of resources in terms of mates or prey, respectively. Dunlop et al. (2020) showed further impacts of seismic arrays and vessel noise, reporting the reduction of social interactions when vessels were present, even if the seismic array was inactive. Importantly, the distance at which this impact occurred is much greater than that considered for mitigation measures currently.

*Shipping Noise*

Shipping is the main source of low-frequency noise in the oceans (Ruppel et al. 2022). Over the past few decades, the contribution of shipping activities to ambient noise has increased by 12 dB (Hildebrand 2009). As highly migratory species, humpback whales, like all baleen whales, depend on long-range communication to maintain individual and population health (Payne and Webb 1971). Cholewiak et al. (2018) determined that vessel noise near shipping lanes, which includes most of the New York Bight, significantly decreases the communication space of multiple baleen whale species. Additionally, Clark et al. (2009) found that baleen whales showed diminished call rates in the presence of passing vessels. In fact, shipping was predicted to reduce communication space of singing humpback whales in the northeast U.S. by 8% (Clark et al. 2009). Fournet et al. (2018) reported evidence that for every 1 dB increase in ambient sound the probability of humpback whale calls decreased by 9% and when vessel noise contributed, the probability decreased by up to 45%.

Blair et al. (2016) examined impacts of ship noise on the behavior of foraging humpback whales in the Gulf of Maine. The authors found that whales decrease the number of bottom-feeding events per dive and reduce their feeding dive descent rate as ship noise increased. In other words, there were statistically significant alterations in humpback whale feeding behavior due to shipping noise exposure. Dunlop (2016) found lower vocal levels in humpback whales while vessel noise was present, suggesting possible masking and an inability to cope with increasing anthropogenic noise compared to natural noise sources like wind. Though some researchers have argued that habituation to sound may occur, this can easily be confused with hearing loss or individual differences in tolerance levels (Bejder et al. 2006).

Noise pollution may make a previously occupied area unsuitable for this species. Passive acoustic monitoring in the New York Harbor region and offshore of Long Island to the continental shelf edge found that there was the potential for acoustic masking of humpback calls due to high levels of anthropogenic noise (BRP 2010, Estabrook et al. 2021). It is possible that humpback whales may avoid these areas when noise levels are elevated. Further research is needed to identify whether these factors are altering habitat availability in New York waters.

Whale Watching/Harassment

Whale-watch tourism is a global industry with major economic value for many coastal communities (O'Connor et al. 2009). The industry has been expanding rapidly since the 1980s, at an estimated 3.7% global increase in whale watchers per year from 1998 to 2008 (O'Connor et al. 2009; Kessler and Harcourt 2012). Whale-watching operations have been documented in 119 countries worldwide as of 2008, including on many humpback whale feeding grounds, breeding grounds and migratory corridors (O'Connor et al. 2009).

Humpback whales are the main target of whale-watching activities in New York and other areas, so there is the potential that some of these negative effects may be seen. Scheidat et al. (2004) found that humpback whales in Ecuador increased dive time in the presence of whale-watching vessels and increased their path directness when vessels left. In the 1980s in Alaska and Hawaii, the impact of whale watching on humpback whales was investigated. Responses included moving away, changing patterns of breathing and diving (including increased dive time), and sometimes displaying agonistic behavior (Bauer and Herman 1986, Baker et al. 1984). Schuler et al. (2019) investigated humpback whale response to whale-watching vessels in Alaska, finding that whales in the presence of vessel showed an estimated 39% higher change in linear movement, a 6% increase in swimming speed, and a 7% decrease in breathing intervals at the surface. Additional vessels further increased or decreased response, and importantly, humpbacks were likely to maintain feeding behavior even if vessels were nearby. This last point highlights the trend for humpbacks to engage in feeding behaviors in high-risk environments, such as the juveniles that lung feed close to shore in New York (Smith et al. 2022).

Amrein et al. (2020) showed that humpback whales in an area of high boat density exhibited signs of disturbance such as frequent changes in direction. This is significant because many laws and regulations, including the U.S. Marine Mammal Protection Act (MMPA), prohibits the disturbance of whales. Other stress responses have included trumpeting, breaching, vertical or horizontal avoidance, lobtailing, and flipper slapping (though sometimes these behaviors may only be an indication of “excitability”; Watkins 1967, Whitehead 1985).

There are significant potential changes in behavior and fitness due to whale-watching disturbance. This is especially problematic when nursing mothers and their calves are disturbed. As reported by Sprogis et al. (2020), mothers' resting time decreased, their respiration rate doubled, and their swim speed increased when vessels were nearby. However, humpbacks may likewise approach whale watching boats, adding to the complexity of the threat (Watkins 1986). Teerlink et al. (2018) compared cortisol levels between different Alaska whale watch areas and found significant differences in the measured levels. They hypothesize that there could be regional differences at play, including differences in anthropogenic threat levels and nutritional stressors. This theory is particularly relevant to the humpback whales in the New York Bight, which are in poorer body condition than other feeding populations within the West Indies DPS (Napoli et al. 2024).

Research is lacking in determining how these many short-term behavioral changes may impact whales long-term (Parsons 2012). Whale watching is a good example of cumulative impacts, in that the responses of whales may translate to declines in overall health, making them more susceptible to other threats, especially acute threats such as vessel strike (Parsons 2012). Wright et al. (2011) suggested that the cumulative effects experienced by large whale populations subject to whale watching could decrease reproductive and/or survival rates. Our understanding of the overall impacts of anthropogenic activities like whale watching and recreational boating has grown over the years but additional research is needed. Work done in the southern Gulf of Maine has so far found no negative long-term effects such as decreased calving rate and calf survival as a result of whale-watching activities (Weinrich and Corbelli 2009).

Marine Debris

According to the United Nations Global Compact, more than 8 million tons of plastic ends up in the ocean every year, and the amount of plastic in the ocean is expected to quadruple by 2040 (United Nations Global Impact 2025). Plastic ingestion has been well documented in cetaceans including several species of baleen whales. Ingestion of marine debris by cetaceans may include internal injuries or cause complete blockage to the digestive tract leading to malnutrition, starvation, and mortality (Simmonds 2012, Baulch and Perry 2014). Most cetacean ingestion of marine debris is discovered through necropsies of stranded animals and has been documented in more than half of extant cetacean species, including nine baleen whale species, with ingestion rates as high as 31% in certain populations (Baulch and Perry 2014).

As filter feeders, baleen whales like humpback whales are exposed to microplastic on a greater scale. Besseling et al. (2015) presented the first documentation of microplastics present in the intestines of a humpback whale. Kahane-Rapport et al. (2022) found that fish-feeding baleen whales ingested less microplastics than krill-feeding baleen whales but overall, there is a high risk of cumulative physiological and toxicological impacts across baleen whale species. It's likely that daily microplastic ingestion is underestimated by orders of magnitude and more monitoring and assessment is needed. Alexiadou et al. (2019) highlighted the impact on mobility that ingesting marine debris can have on whales, noting that half of ship-struck cetaceans had ingested plastic. Roman et al. (2020) explored the types of debris ingested by marine taxa and how lethal each type is, and determined that rubber, while less commonly ingested by cetaceans, is most likely to be lethal when ingested. More research is still needed to see how prevalent marine debris ingestion and entanglement are in the Gulf of Maine humpback whale population.

### Are there regulatory mechanisms that protect the species or its habitat in New York?

**Yes:** _X__ **No:**_____ **Unknown:**_____

**If yes, describe mechanism and whether adequate to protect species/habitat:**

The humpback whale receives federal protection under the Marine Mammal Protection Act of 1972 (MMPA). The humpback whale is protected internationally from commercial hunting under the International Whaling Commission's (IWC) global moratorium on whaling.

Humpback whales are also protected under the Environmental Conservation Law (ECL) of New York. The humpback whale is listed as a state endangered species in New York. Section 11 – 0535 protects all state-listed endangered and threatened species and makes it illegal to take, import, transport, possess or sell any listed species or part of a listed species. In addition, Article 17 of the ECL works to limit water pollution, and Article 14 presents the New York Ocean and Great Lakes Ecosystem Conservation Act, which helps to protect the habitat of the humpback whale.

The Atlantic Large Whale Take Reduction Plan is still active and being modified to address the ongoing entanglement threat. NMFS has created new laws based on recommendations to the plan but risk is still high. For example, sinking groundline was required by law to be implemented in 2008. To encourage compliance by fishermen, DEC's Marine Endangered Species and Crustacean Unit partnered with the Cornell Cooperative Extension of Suffolk County and initiated gear buyback programs, which removed 16.9 tons of floating rope from New York's commercial lobster fishery. Unfortunately, these existing mechanisms have not adequately addressed the threats to humpbacks in New York and significantly more regulatory mechanisms are needed in order to protect the species.

### Describe knowledge of management/conservation actions that are needed for recovery/conservation, or to eliminate, minimize, or compensate for the identified threats:

Long-term surveys and monitoring strategies should be developed by the state with annual dedicated funding. If it is known where and when humpback whales are occurring in New York waters, more effective management and conservation strategies can be deployed. Seasonal speed restrictions on vessels in high use areas could be put into effect. In addition, seasonal and/or area closures on certain fisheries where the gear poses the largest threat to large whales may help minimize entanglement in gear. Near real-time acoustic monitoring of large whales is a dependable tool to establish presence. If coupled with the appropriate level of restrictions on vessel speed, for example, it could help reduce the risk of vessel strike within the major shipping lanes. Risk assessment for recreational vessels is still needed and mitigation measures should be put in place to protect humpback whales in nearshore waters.

Little is known about the humpback whale population, fine-scale movement and behavior, and threat level while in the New York Bight. The humpback whale would benefit greatly from further research utilizing a variety of methods including satellite tags. Further research into threats such as climate change at a state and regional level is warranted. In addition, public outreach and education on this species and the importance of reporting ship strikes and entanglements is encouraged.

***Complete Conservation Actions table using IUCN conservation actions taxonomy at link below. Use headings 1-6 for Action Category (e.g., Land/Water Protection) and associated subcategories for Action (e.g., Site/Area Protection):***
***[https://www.iucnredlist.org/resources/conservation-actions-classification-scheme](https://www.iucnredlist.org/resources/conservation-actions-classification-scheme)***

| Action Category | Action | Description |
|---|---|---|
| A.2 Direct Species Management | A.2.1.5.0 Prevent mortality or injury from humans | Implement seasonal speed restrictions on vessels in high-use and/or high-risk areas |
| B.3 Outreach | B.3.1.4 Public outreach and information | Encourage responsible human behavior |

| Action Category | Action | Description |
|---|---|---|
| C.7 Legislative and regulatory framework or tools | C.7.1 Create, amend, or influence legislation, regulation, or codes<br>C.7.2 Create or amend policies, guidelines, or best practices | Create state legislation, regulation, policies, and/or guidelines; identify best practices for boating |
| C.8 Research and Monitoring | C.8.1.1.0 Field Research | Conduct research on humpback whales in the New York Bight |

**Table 5.** Recommended conservation actions for humpback whale.

## VII. References


Adcock, D.L., Shearer, J.M., Foley, H.J., Swaim, Z.T. and Read, A.J., 2024. Song fragments recorded on a tagged juvenile humpback whale (Megaptera novaeangliae) on a winter feeding ground at the mouth of the Chesapeake Bay, Virginia, USA.

Aguilar, A. and Borrell, A., 1994. Reproductive transfer and variation of body load of organochlorine pollutants with age in fin whales (Balaenoptera physalus). Archives of environmental contamination and toxicology, 27(4), pp.546-554.

Alexiadou, P., Foskolos, I. and Frantzis, A., 2019. Ingestion of macroplastics by odontocetes of the Greek Seas, Eastern Mediterranean: Often deadly!. Marine Pollution Bulletin, 146, pp.67-75.

Allen, G.M., 1916. The whalebone whales of New England (Vol. 8, No. 2). Boston Society of Natural History Saltonstall fund.

Amrein, A.M., Guzman, H.M., Surrey, K.C., Polidoro, B. and Gerber, L.R., 2020. Impacts of whale watching on the behavior of humpback whales (Megaptera novaeangliae) in the coast of Panama. Frontiers in Marine Science, 7, p.601277.

Aschettino JM, Engelhaupt DT, Engelhaupt AG, DiMatteo A, Pusser T, Richlen MF, Bell JT (2020). Satellite Telemetry Reveals Spatial Overlap Between Vessel High-Traffic Areas and Humpback Whales (Megaptera novaeangliae) Near the Mouth of the Chesapeake Bay. Front Mar Sci 7:121. doi: 10.3389/fmars.2020.00121

Askin, N., Belanger, M. and Wittnich, C., 2017. Humpback whale expansion and climate-change evidence of foraging into new habitats. Journal of Marine Animals and Their Ecology, 9(1), pp.13-17.

Baker, C.S. and Herman, L.M., 1984. Aggressive behavior between humpback whales (Megaptera novaeangliae) wintering in Hawaiian waters. Canadian journal of zoology, 62(10), pp.1922-1937.

Balcomb, K. C. and G. Nichols. 1982. Humpback whale censuses in the West Indies. Reports to the International Whaling Commission 32: 401 - 406.

Barco, S.G., W.A. McLellan, J.M. Allen, R.A. Asmutis-Silvia, R. Mallon-Day, E.M. Meagher, D.A. Pabst, J. Robbins, R.E. Seton, W.M. Swingle, M.T. Weinrich and P.J. Clapham. 2002. Population identity of humpback whales (Megaptera novaeangliae) in the waters of the U.S. mid-Atlantic states. J. Cetacean Res. Manage. 4(2): 135-141.

Barlow, J. and P. J. Clapham. 1997. A new birth-interval approach to estimating demographic parameters of humpback whales. Ecology 78: 535 - 546.

Barrie, L. A., D. Gregor, B. Hargrave, R. Lake, D. Muir, R. Shearer, B. Tracy, and T. Bidleman. 1992. Arctic contaminants: sources, occurrence and pathways. Science of the Total Environment. 122:1-74.

Basran, C.J., Bertulli, C.G., Cecchetti, A., Rasmussen, M.H., Whittaker, M. and Robbins, J., 2019. First estimates of entanglement rate of humpback whales Megaptera novaeangliae observed in coastal Icelandic waters. Endangered species research, 38, pp.67-77.

Basran, C., Chosson, V., Williams, A., Simpson, N., Long, S.A., Dodds, F., Rasmussen, M.H. and Horrocks, J.A., 2023. First documented migration of an Icelandic humpback whale mother and calf pair from the West Indies breeding grounds. J. Cetacean Res. Manage., 24, pp.205-208.

Bauer, G.B. and Herman, L.M., 1986. Effects of vessel traffic on the behavior of humpback whales in Hawaii. National Marine Fisheries Service.

Baugh, K.A., Robbins, J., Schultz, I.R. and Ylitalo, G.M., 2023. Persistent organic pollutants in female humpback whales Megaptera novaeangliae from the Gulf of Maine. Environmental Pollution, 316, p.120616.

Baulch, S. and Perry, C., 2014. Evaluating the impacts of marine debris on cetaceans. Marine pollution bulletin, 80(1-2), pp.210-221.

Beach, D.W. and M.T. Weinrich. 1989. Watching the whales: Is an educational adventure for humans turning out to be another threat for endangered species? Oceanus 32(l):84–88.

Bejder, L., A. Samuels, H. Whitehead, and N. Gales. 2006. Interpreting short-term behavioural responses to disturbance within a longitudinal perspective. Animal Behaviour. 72(5):1149-1158.

Benjamins, S., Harnois, V., Smith, H.C.M., Johanning, L., Greenhill, L., Carter, C. and Wilson, B. 2014. Understanding the potential for marine megafauna entanglement risk from renewable marine energy developments. Scottish Natural Heritage Commissioned Report No. 791.

Besseling, E., Foekema, E.M., Van Franeker, J.A., Leopold, M.F., Kühn, S., Rebolledo, E.B., Heße, E., Mielke, L.J.I.J., IJzer, J., Kamminga, P. and Koelmans, A.A., 2015. Microplastic in a macro filter feeder: humpback whale Megaptera novaeangliae. Marine pollution bulletin, 95(1), pp.248-252.

Best, P. B. 1987. Estimates of the landed catch of right (and other whalebone) whales in the American fishery, 1805 - 1909. Fisheries Bulletin 85(3): 403 - 418.

Bettridge, S., C.S. Baker, J. Barlow, P.J. Clapham, M. Ford, D. Gouveia, D.K. Mattila, R.M. Pace III, P.E. Rosel, G.K. Silber and P.R.Wade. 2015. Status review of the humpback whale

(Megaptera novaeangliae) under the Endangered Species Act. NOAA Tech. Memo. NMFS-SWFSC-540. 263 pp.

Bioacoustics Research Program [BRP]. 2010. Determining the seasonal occurrence of cetaceans in New York coastal waters using passive acoustic monitoring. Cornell Lab of Ornithology: Bioacoustics Research Program. TR 09-07. 60 pp.

Blair, H.B., Merchant, N.D., Friedlaender, A.S., Wiley, D.N. and Parks, S.E., 2016. Evidence for ship noise impacts on humpback whale foraging behaviour. Biology letters, 12(8), p.20160005.

Braham, H. W. 1984. The status of endangered whales: an overview. Marine Fisheries Review 46(4): 2 - 6.

Breiwick, J.M., Mitchell, E. and R.R. Reeves. 1983. Simulated population trajectories for Northwest Atlantic humpback whales, 1865-1980.Fifth Biennial Conf. on Biol. of Marine Mammals, Boston. Abstract. p. 14.

Brown, D.M., Robbins, J., Sieswerda, P.L., Schoelkopf, R., & Parsons, E.C.M. (2017). Humpback whale (Megaptera novaeangliae) sightings in the New York-New Jersey Harbor Estuary. Marine Mammal Science, 34(1), 250-257. https://doi.org/10.1111/mms.12450

Brown DM, Robbins J, Sieswerda PL, Ackerman C, Aschettino JM, Barco S, Boye T, DiGiovanni RA, Durham K, Engelhaupt A, Hill A, Howes L, Johnson KF, Jones L, King CD, Kopelman AH, Laurino M, Lonergan S, Mallette SD, Pepe M, Ramp C, Rayfield K, Rekdahl M, Rosenbaum HC, Schoelkopf R, Schulte D, Sears R, Stepanuk JEF, Tackaberry JE, Weinrich M, Parsons ECM, Wiedenmann J. 2022. Site fidelity, population identity and demographic characteristics of humpback whales in the New York Bight apex. J Mar Biol Ass 102:157–165. doi: 10.1017/S0025315422000388

Brown, D.M. and Wiedenmann, J., 2024. Newspapers describe long-term trends in whale occurrence in the nearshore New York Bight. Ocean & Coastal Management, 255, p.107224.

Cartwright, R., Venema, A., Hernandez, V., Wyels, C., Cesere, J. and Cesere, D., 2019. Fluctuating reproductive rates in Hawaii's humpback whales, Megaptera novaeangliae, reflect recent climate anomalies in the North Pacific. Royal Society open science, 6(3), p.181463.

Cassoff, R.M., Moore, K.M., McLellan, W.A., Barco, S.G., Rotstein, D.S. and Moore, M.J., 2011. Lethal entanglement in baleen whales. Diseases of Aquatic Organisms, 96(3), pp.175-185.

Cetacean and Turtle Assessment Program [CETAP]. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf, final report, Cetacean and Turtle Assessment Program, University of Rhode Island. Washington, DC, Bureau of Land Management. #AA551-CT8-48: 576.

Cholewiak, D., Clark, C.W., Ponirakis, D., Frankel, A., Hatch, L.T., Risch, D., Stanistreet, J.E., Thompson, M., Vu, E. and Van Parijs, S.M., 2018. Communicating amidst the noise: modeling the aggregate influence of ambient and vessel noise on baleen whale communication space in a national marine sanctuary. Endangered Species Research, 36, pp.59-75.

Chou, E., Rekdahl, M.L., Kopelman, A.H., Brown, D.M., Sieswerda, P.L., DiGiovanni Jr, R.A. and Rosenbaum, H.C., 2022. Occurrence of baleen whales in the New York Bight, 1998–2017: insights from opportunistic data. Journal of the Marine Biological Association of the United Kingdom, 102(6), pp.438-444.

Clapham, P. J., Palsbøll, P. J., Mattila, D. K., & Vasquez, O. (1992). Composition and dynamics of humpback whale competitive groups in the West Indies. Behaviour, 122(3–4), 182–194. https://doi.org/10.1163/156853992X00507

Clapham, P.J. 1992. Age at attainment of sexual maturity in humpback whales, Megaptera novaeangliae. Canadian Journal of Zoology 70(7): 1470–72.

Clapham, P. J. 1993. Social organization of humpback whales on a North Atlantic feeding ground. Symposium of the Zoological Society of London. 66:131-145.

Clapham, P.J., L.S. Baraff, C.A. Carlson, M.A. Christian, D.K. Mattila, C.A. Mayo, M.A. Murphy and S. Pittman. 1993. Seasonal occurrence and annual return of humpback whales, Megaptera novaeangliae, in the southern Gulf of Maine. Can. J. Zool. 71:440–443.

Clapham, P. J. 1996. The social and reproductive biology of humpback whales: An ecological perspective. Mammal Review. 26(1):27-49.

Clapham P.J. 2018. Humpback whale Megaptera novaeangliae. In: B. Wursig, J.G.M. Thewissen, K.M. Kovacs (ed.), Encyclopedian of Marine Mammals, Academic Press.

Clapham, P.J., M.C. Bérubé and D.K. Mattila. 1995. Sex ratio of the Gulf of Maine humpback whale population. Mar. Mamm. Sci. 11:227–231.

Clapham, P. J., and D. K. Mattila. 1990. Humpback whale songs as indicators of migration routes. Marine Mammal Science. 6(2):155-160.

Clapham, P.J. and Mayo, C.A., 1990. Reproduction of humpback whales (Megaptera novaeangliae) observed in the Gulf of Maine. Reports of the International Whaling Commission (Special Issue), 12, pp.171-175.

Clapham, P. J. and Mead, J. G. 1999. Megaptera novaeangliae. Mammalian Species 604: 1-9.

Clapham, P.J., J. Barlow, M. Bessinger, T. Cole, D. Mattila, R. Pace, D. Palka, J. Robbins and R. Seton. 2003. Abundance and demographic parameters of humpback whales from the Gulf of Maine, and stock definition relative to the Scotian Shelf. Journal of Cetacean Research and Management 5(1): 13-22.

Clark, C. W., and P. J. Clapham. 2004. Acoustic monitoring on a humpback whale (Megaptera novaeangliae) feeding ground shows continual singing into late spring. Proceedings of the Royal Society of London. 271:1051-1057.

Clark, C.W. and G.C. Gagnon. 2002. Low-frequency vocal behaviors of baleen whales in the North Atlantic: Insights from IUSS detections, locations and tracking from 1992 to 1996. J. Underwater Acoust. (USN) 52:609–640.

Clark, C.W., W.T. Ellison, B.L. Southall, L. Hatch, S.M. Van Parijs, A. Frankel, and D. Ponirakis. 2009. Acoustic masking in marine ecosystems: intuitions, analysis, and implication. Marine Ecology Progress Series 395:201–222.

Committee on Taxonomy. 2024. List of marine mammal species and subspecies. Society for Marine Mammalogy. https://marinemammalscience.org/science-and-publications/list-marine-mammal-species-subspecies/ Accessed March 2025.

Connor, P. F. 1971. The Mammals of Long Island, New York. Bulletin 146. New York State Museum & Science Service, Albany, NY. v + 78 pp.

Cooke, J.G. 2018. Megaptera novaeangliae. The IUCN Red List of Threatened Species 2018: e.T13006A50362794. http://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T13006A50362794.en

Dalla Rosa L, Secchi ER, Maia YG, Zerbini AN and Heide-Jørgensen MP (2008) Movements of satellite-monitored humpback whales on their feeding ground along the Antarctic Peninsula. Polar Biology 31, 771–781.

Darling, J. D. and S. Cerchio. 1993. Movement of a humpback whale (Megaptera novaeangliae) between Japan and Hawaii. Marine Mammal Science 9: 84 - 89.

Darling, J. D., and R. S. Sousa-Lima. 2005. Songs indicate interaction between humpback whale (Megaptera novaeangliae) populations in the western and eastern South Atlantic Ocean. Marine Mammal Science. 21(3):557-566.

Davis, G. E., Baumgartner, M. F., Corkeron, P. J., Bell, J., Berchok, C., Bonnell, J. M., Bort Thornton, J., Brault, S., Buchanan, G. A., Cholewiak, D. M., Clark, C. W., Delarue, J., Hatch, L. T., Klinck, H., Kraus, S. D., Martin, B., Mellinger, D. K., Moors-Murphy, H., Nieukirk, S., Nowacek, D. P., … Van Parijs, S. M. (2020). Exploring movement patterns and changing distributions of baleen whales in the western North Atlantic using a decade of passive acoustic data. Global Change Biology, 26(9), 4812–4840. https://doi.org/10.1111/gcb.15191

Dawbin, W. H. 1997. Temporal segregation of humpback whales during migration in southern hemisphere waters. Memoirs of the Queensland Museum 42: 105 - 238.

Derville, S., Torres, L.G., Albertson, R., Andrews, O., Baker, C.S., Carzon, P., Constantine, R., Donoghue, M., Dutheil, C., Gannier, A. and Oremus, M., 2019. Whales in warming water: Assessing breeding habitat diversity and adaptability in Oceania's changing climate. Global Change Biology, 25(4), pp.1466-1481.

Di Iorio, L. and Clark, C.W., 2010. Exposure to seismic survey alters blue whale acoustic communication. Biology letters, 6(1), pp.51-54.

Dolphin, W. F. 1987. Prey densities and foraging of humpback whales, Megaptera novaeangliae. Experientia. 43:468-471.

Dufour, R., Benoît, H., Castonguay, M., Chassé, J., Devine, L., Galbraith, P., Harvey, M., Larouche, P., Lessard, S., Petrie, B. and Savard, L., 2010. Ecosystem status and trends report: Estuary and Gulf of St. Lawrence ecozone. DFO Can. Sci. Advis. Sec. Res. Doc, 30, p.193.

Dunlop, R.A., Noad, M.J., McCauley, R.D., Kniest, E., Slade, R., Paton, D. and Cato, D.H., 2017. The behavioural response of migrating humpback whales to a full seismic airgun array. Proceedings of the Royal Society B: Biological Sciences, 284(1869), p.20171901.

Dunlop, R.A., McCauley, R.D. and Noad, M.J., 2020. Ships and air guns reduce social interactions in humpback whales at greater ranges than other behavioral impacts. Marine Pollution Bulletin, 154, p.111072.

Elfes, C. T., G. R. VanBlaricom, D. Boyd, J. Calambokidis, P. J. Clapham, R. W. Pearce, J. Robbins, J. C. Salinas, J. Straley, P. R. Wade, and M. M. Krahn. 2010. Geographic variation of persistent organic pollutant levels in humpback whale (Megaptera novaeangliae) feeding areas of the North Pacific and North Atlantic. Environmental Toxicology and Chemistry. 29(4):824-834.

Estabrook, B.J., Hodge, K.B., Salisbury, D.P., Rahaman, A. Ponirakis, D., Harris, D.V., Zeh, J.M., Parks, S.E., & Rice, A.N. (2021). Final report for New York Bight Whale Monitoring Passive Acoustic Surveys October 2017-October 2020. New York State Department of Environmental Conservation.

Estabrook, B.J., Bonacci-Sullivan, L.A., Harris, D.V., Hodge, K.B., Rahaman, A., Rickard, M.E., Salisbury, D.P., Schlesinger, M.D., Zeh, J.M., Parks, S.E. and Rice, A.N., 2025. Passive acoustic monitoring of baleen whale seasonal presence across the New York Bight. PloS one, 20(2), p.e0314857.

Fire, S.E., Wang, Z., Berman, M., Langlois, G.W., Morton, S.L., Sekula-Wood, E. and Benitez-Nelson, C.R., 2010. Trophic Transfer of the Harmful Algal Toxin Domoic Acid as a Cause of Death in a Minke Whale (Balaenoptera acutorostrata) Stranding in Southern California. Aquatic Mammals, 36(4).

Fisheries and Oceans Canada [DFO]. 2024. Humpback Whale (Megaptera novaeangliae), Western North Atlantic population. Government of Canada. Last updated 2024-12-23. Accessed March 2025. https://species-registry.canada.ca/index-en.html#/species/160-531

Fogarty, M.J., E.B. Cohen, W.L. Michaels and W.W. Morse 1991. Predation and the regulation of sand lance populations: An exploratory analysis. ICES Mar. Sci. Symp. 193: 120-124.

Foote, A.D., Osborne, R.W. and Hoelzel, A.R., 2004. Whale-call response to masking boat noise. Nature, 428(6986), pp.910-910.

Ford J.K.B. and Reeves R.R. 2008. Fight or flight: antipredator strategies of baleen whales. Mammal Review 38(1): 50–86.

Fournet, M.E., Matthews, L.P., Gabriele, C.M., Haver, S., Mellinger, D.K. and Klinck, H., 2018. Humpback whales Megaptera novaeangliae alter calling behavior in response to natural sounds and vessel noise. Marine Ecology Progress Series, 607, pp.251-268.

Friedlaender, A. S., P. N. Halpin, S. S. Qian, G. L. W. Lawson, P. H., D. Thiele, and A. J. Read. 2006. Whale distribution in relation to prey abundance and oceanographic processes in shelf water of the western Antarctic Peninsula. Marine Ecology Progress Series. 317:297-310.

Fristrup, K.M., Hatch, L.T. and Clark, C.W., 2003. Variation in humpback whale (Megaptera novaeangliae) song length in relation to low-frequency sound broadcasts. The Journal of the Acoustical Society of America, 113(6), pp.3411-3424.

Gabriele, C.M., Straley, J.M., Herman, L.M. and Coleman, R.J., 1996. Fastest documented migration of a North Pacific humpback whale. Marine Mammal Science, 12(3), pp.457-464.

Gailey, G., Würsig, B. and McDonald, T.L., 2007. Abundance, behavior, and movement patterns of western gray whales in relation to a 3-D seismic survey, Northeast Sakhalin Island, Russia. Environmental Monitoring and Assessment, 134, pp.75-91.

Geo-Marine Inc. [GMI]. 2010. Volume III: Marine mammal and sea turtle studies. Ocean/wind power ecological baseline studies, January 2008 – December 2009. Final report. New Jersey Department of Environmental Protection, Office of Science, Trenton, NJ.

Geraci, J.R., Anderson, D.M., Timperi, R.J., St. Aubin, D.J., Early, G.A., Prescott, J.H. and Mayo, C.A., 1989. Humpback whales (Megaptera novaeangliae) fatally poisoned by dinoflagellate toxin. *Canadian Journal of Fisheries and Aquatic Sciences*, *46*(11), pp.1895-1898.

Geraci, J. R. et al. 1990. Humpback whales (Megaptear novaeangliae) fatally poisoned by dinoflagellate toxin. Canadian Journal of Fisheries and Aquatic Science 46(11): 1895 - 1898.

Geraci, J.R. 1990. Physiologic and toxic effects on cetaceans, pp. 167–192. In: Sea mammals and oil: confronting the risks J.R. Geraci and D.J. St. Aubin, Editors. First ed., Academic Press, Inc. San Diego, California: 239 p.

Glockner-Ferrari, D.A., Ferrari, M.J., and McSweeney, D. 1987. Occurrence of abnormalities, injuries, and strandings of humpback whales in Hawaiian waters. Seventh Biennial Conference on the Biology of Marine Mammals, Miami. Abstract.

Gobler, C.J., Doherty, O.M., Hattenrath-Lehmann, T.K., Griffith, A.W., Kang, Y. and Litaker, R.W., 2017. Ocean warming since 1982 has expanded the niche of toxic algal blooms in the North Atlantic and North Pacific oceans. Proceedings of the National Academy of Sciences, 114(19), pp.4975-4980.

Goldbogen, J.A., Southall, B.L., DeRuiter, S.L., Calambokidis, J., Friedlaender, A.S., Hazen, E.L., Falcone, E.A., Schorr, G.S., Douglas, A., Moretti, D.J. and Kyburg, C., 2013. Blue whales respond to simulated mid-frequency military sonar. Proceedings of the Royal Society B: Biological Sciences, 280(1765), p.20130657.

Gonçalves Neto, A., Langan, J.A. and Palter, J.B., 2021. Changes in the Gulf Stream preceded rapid warming of the Northwest Atlantic Shelf. Communications Earth & Environment, 2(1), p.74.

Gordon, J., Gillespie, D., Potter, J., Frantzis, A., Simmonds, M.P., Swift, R. and Thompson, D. (2004). A review of the effects of seismic surveys on marine mammals. Marine Technology Society Journal, 37: 16–34.

Grove, T., King, R., Stevenson, A. and Henry, L.A., 2023. A decade of humpback whale abundance estimates at Bermuda, an oceanic migratory stopover site. Frontiers in Marine Science, 9, p.971801.

Harris, C.M., Thomas, L., Falcone, E.A., Hildebrand, J., Houser, D., Kvadsheim, P.H., Lam, F.P.A., Miller, P.J., Moretti, D.J., Read, A.J. and Slabbekoorn, H., 2018. Marine mammals and sonar: Dose-response studies, the risk-disturbance hypothesis and the role of exposure context. Journal of Applied Ecology, 55(1), pp.396-404.

Harvell, C.D., Kim, K., Burkholder, J.M., Colwell, R.R., Epstein, P.R., Grimes, D.J., Hofmann, E.E., Lipp, E.K., Osterhaus, A.D.M.E., Overstreet, R.M. and Porter, J.W., 1999. Emerging marine diseases--climate links and anthropogenic factors. Science, 285(5433), pp.1505-1510.

Hayes, S.A., Josephson, E., Maze-Foley, K., & Rosel, P.E. (2020). Humpback whale (Megaptera novaeangliae): Gulf of Maine Stock. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2019. NOAA Tech Memo NMFS-NE-264.

Heide-Jørgensen MP and Laidre KL. (2007). Autumn space-use patterns of humpback whales (Megaptera novaeangliae) in West Greenland. Journal of Cetacean Research Management 9, 121–126.

Herman, L.M., Pack, A.A., Rose, K., Craig, A., Herman, E.Y., Hakala, S. and Milette, A., 2011. Resightings of humpback whales in Hawaiian waters over spans of 10–32 years: Site fidelity, sex ratios, calving rates, female demographics, and the dynamics of social and behavioral roles of individuals. Marine Mammal Science, 27(4), pp.736-768.

Herman, L.M., 2017. The multiple functions of male song within the humpback whale (Megaptera novaeangliae) mating system: review, evaluation, and synthesis. Biological Reviews, 92(3), pp.1795-1818.

Herman, L. M. and Antinoja, R. C. (1977). Humpback whales in the Hawaiian breeding waters: Population and pod characteristics. Scientific Reports of the Whales Research Institute, 29, 59-85.

Hildebrand, J. A. 2009. Anthropogenic and natural sources of ambient noise in the ocean. Marine Ecology Progress Series 395:5-20.

Holt, M. M., D. P. Noren, V. Veirs, C. K. Emmons and S. Veirs. 2008. Speaking up: killer whales (Orcinus orca) increase their call amplitude in response to vessel noise. Journal of the Acoustical Society of America 125(1): EL27 - EL32.

Horton, T.W., Holdaway, R.N., Zerbini, A.N., Hauser, N., Garrigue, C., Andriolo, A. and Clapham, P.J., 2011. Straight as an arrow: humpback whales swim constant course tracks during long-distance migration. Biology letters, 7(5), pp.674-679.

Horton, T.W., Zerbini, A.N., Andriolo, A., Danilewicz, D. and Sucunza, F., 2020. Multi-decadal humpback whale migratory route fidelity despite oceanographic and geomagnetic change. Frontiers in Marine Science, 7, p.414.

International Whaling Commission [IWC]. 2002. Report of the Scientific Committee. Annex H: Report of the Sub-committee on the Comprehensive Assessment of North Atlantic humpback whales. J. Cetacean Res. Manage. 4 (supplement): 230-260.

Jensen, A. S., and G. K. Silber. 2004. Large Whale Ship Strike Database. U.S. Department of Commerce, NMFS-OPR-25 37.

Jefferson, T. A., P. J. Stacey, and R. W. Baird. 1991. A review of killer whale interactions with other marine mammals: predation to co-existence. Mammal Review. 21(4):151-180.

Jefferson, T.A., S. Leatherwood, and M.A. Webber. 1993. FAO species identification guide: Marine Mammals of the World. United Nations Food and Agriculture Organization, Rome.

International Whaling Commission [IWC]. 2025a. "Humpback whale". Accessed March 2025. https://iwc.int/about-whales/whale-species/humpback-whale

International Whaling Commission [IWC]. 2025b. "Aboriginal subsistence whaling". Accessed March 2025. https://iwc.int/management-and-conservation/whaling/aboriginal

Johnson H, Morrison D, Taggart C. 2021. WhaleMap: a tool to collate and display whale survey results in near real-time. Journal of Open Source Software, 6(62), 3094, https://joss.theoj.org/papers/10.21105/joss.03094

Johnson, A., G. Salvador, J. Kenney, J. Robbins, S. Kraus, S. Landry and P. Clapham. 2005. Fishing gear involved in entanglements of right and humpback whales. Marine Mammal Science 21(4): 635 - 645.

Jones, L., Allen, J., Basran, C., Berrow, S., Betancourt, L., Bouveret, L., Boye, T., Broms, F., Chosson, V., Clapham, P. and Fernald, T., 2025. Ocean basin-wide movement patterns of North Atlantic humpback whales. J. Cetacean Res. Manage., 26, pp.1-19.

Jonsgård, Å. 1977. Tables showing the catch of small whales (including minke whales) caught by Norwegians in the period 1938-75, and large whales caught in different North Atlantic waters in the period 1868-1975. Rep. int. Whal. Commn 27:413-26

Jourdain, E. and Vongraven, D., 2017. Humpback whale (Megaptera novaeangliae) and killer whale (Orcinus orca) feeding aggregations for foraging on herring (Clupea harengus) in Northern Norway. Mammalian Biology, 86(1), pp.27-32.

Kahane-Rapport, S.R., Czapanskiy, M.F., Fahlbusch, J.A., Friedlaender, A.S., Calambokidis, J., Hazen, E.L., Goldbogen, J.A. and Savoca, M.S., 2022. Field measurements reveal exposure risk to microplastic ingestion by filter-feeding megafauna. Nature communications, 13(1), p.6327.

Kapel, F.O. 1979. Exploitation of large whales in west Greenland in the 20th century. Rep. Int. Whal. Comn. 29: 197-214.

Katona, S., Baxter, B., Brazier, O., Kraus, S., Perkins, J. and Whitehead, H., 1979. Identification of humpback whales by fluke photographs. Behavior of marine animals: Current perspectives in research, pp.33-44.

Katona, S.K. and Whitehead, H.P., 1981. Identifying humpback whales using their natural markings. Polar Record, 20(128), pp.439-444.

Katona, S.K. and Beard, J.A., 1990. Population size, migrations and feeding aggregations of the humpback whale (Megaptera novaeangliae) in the western North Atlantic Ocean. Report of the international whaling commission (Special Issue 12), pp.295-306.

Katona, S. K., J. A. Beard, P. E. Girton and F. Wenzel. 1988. Killer whales (Orcinus orca) from the Bay of Fundy to the Equator, including the Gulf of Mexico. Rit. Fiskideldar 11: 205 - 224.

Kebke, A., Samarra, F. and Derous, D., 2022. Climate change and cetacean health: impacts and future directions. Philosophical Transactions of the Royal Society B, 377(1854), p.20210249.

Kennedy, A.S., A.N Zerbini, O.V. Vasquez, N. Gandilhon, P.J. Clapham, O. Adam. 2014. Local and migratory movements of humpback whales (Megaptera novaeangliae) satellite-tracked in the North Atlantic Ocean. Ca, J. Zool. 92:9–18.

Kenney, R.D. and K. J. Vigness-Raposa. 2010. Marine Mammals and Sea Turtles of Narragansett Bay, Block Island Sound, Rhode Island Sound, and Nearby Waters: An Analysis of Existing Data for the Rhode Island Special Area Management Plan. University of Rhode Island, Technical Report #10. 337 p. https://seagrant.gso.uri.edu/oceansamp/pdf/appendix/10-Kenney-MM&T_reduced.pdf

Kenney, R.D. and H.E. Winn. 1986. Cetacean high-use habitats of the northeast United States continental shelf. Fish. Bull. 84:345–357.

Kershaw, J.L., Ramp, C.A., Sears, R., Plourde, S., Brosset, P., Miller, P.J. and Hall, A.J., 2021. Declining reproductive success in the Gulf of St. Lawrence's humpback whales (Megaptera novaeangliae) reflects ecosystem shifts on their feeding grounds. Global Change Biology, 27(5), pp.1027-1041.

King, C.D., Chou, E., Rekdahl, M.L., Trabue, S.G. and Rosenbaum, H.C., 2021. Baleen whale distribution, behaviour and overlap with anthropogenic activity in coastal regions of the New York Bight. Marine Biology Research, 17(4), pp.380-400.

Kleinertz, S., Silva, L.M.R., Köpper, S., Hermosilla, C. and Ramp, C., 2021. Endoparasitic Insights of Free-Living Fin (Balaenoptera physalus), Humpback (Megaptera novaeangliae) and North Atlantic Right Whales (Eubalaena glacialis) from Eastern Canadian Waters. Acta Parasitologica, 66, pp.682-686.

Koilpillai, H.A., Basran, C.J., Berrow, S., Broms, F., Chosson, V., Gowans, S., Jones, L.S., Kempen, R., López-Suárez, P., Magnúsdóttir, E. and Massett, N., 2024. Geographic Distribution of North Atlantic Humpback Whales (Megaptera novaeangliae) with Fluke Scars Caused by Killer Whales (Orcinus orca). Aquatic Mammals, 50(4).

Kowarski, K., Evers, C., Moors-Murphy, H., Martin, B. and Denes, S.L., 2018. Singing through winter nights: Seasonal and diel occurrence of humpback whale (Megaptera novaeangliae) calls in and around the Gully MPA, offshore eastern Canada. Marine Mammal Science, 34(1), pp.169-189.

LaBrecque, E., Curtice, C., Harrison, J., Van Parijs, S. M., & Halpin, P. N. (2015). 2. Biologically Important Areas for cetaceans within US waters-East coast region. Aquatic Mammals, 41(1), 17.

Laist, D.W., A.R. Knowlton, J.G. Mead A.S. Collet, M. Podesta. 2001. Collisions between ships and whales. Mar. Mamm. Sci. 17(1): 35–75.

Lambertsen, R.H., 1983. Internal mechanism of rorqual feeding. Journal of Mammalogy, 64(1), pp.76-88.

Lambertsen, R. H. 1985. Taxonomy and distribution of a Crassicauda spp. infecting the kidney of the common fin whale, Balaenoptera physalus (Linne 1758). Journal of parasitology 71: 485 - 488.

Lambertsen, R. H., B. Birnir, and J. E. Bauer. 1986. Serum chemistry and evidence of renal failure in the North Atlantic fin whale population. Journal of Wildlife Disease 22: 389 - 396.

Lambertsen, R.H. 1986. Disease of the common fin whale (Balaenoptera physalus) crassicaudiosis of the urinary system. Journal of Mammalogy 67(2):353–366.

Leandro, L.F., Rolland, R.M., Roth, P.B., Lundholm, N., Wang, Z. and Doucette, G.J., 2010. Exposure of the North Atlantic right whale Eubalaena glacialis to the marine algal biotoxin, domoic acid. Marine Ecology Progress Series, 398, pp.287-303.

Lien, J., W. Ledwell, and J. Naven. 1988. Incidental entrapment in inshore fishing gear during 1988: A preliminary report to the Newfoundland and Labrador Department of Fisheries and Oceans 15.

Lien, J., D. Nelson, S. Todd, and R. Seton. 1992. Incidental catches of large whales in Newfoundland and Labrador: a program to minimize whale mortality, and damage to fishing gear. Proceedings of the World Fisheries Congress.

Lomac-MacNair, K. S., Zoidis, A. M., Ireland, D. S., Rickard, M. E., & McKown, K. A. (2022). Fin, Humpback, and Minke Whale Foraging Events in the New York Bight as Observed from Aerial Surveys, 2017-2020. Aquatic Mammals, 48(2), 142-158.

Lucca, B.M. and Warren, J.D., 2019. Fishery-independent observations of Atlantic menhaden abundance in the coastal waters south of New York. Fisheries Research, 218, pp.229-236.

MacKay, M., 2015. Occurrence patterns and social behaviors of humpback whales (Megaptera novaeangliae) wintering off Puerto Rico, USA (Doctoral dissertation). Texas A&M University.

Mattila, D. K., P. J. Clapham, O. Vasquez and R. Bowman. 1994. Occurrence, population composition and habitat use of humpback whales in Samana Bay, Dominican Republic. Canadian Journal of Zoology 72: 1898 - 1907.

Mattila, D.K., Guinee, L.N. and Mayo, C.A., 1987. Humpback whale songs on a North Atlantic feeding ground. Journal of Mammalogy, 68(4), pp.880-883.

Mattila, D. K., P. J. Clapham, S. K. Katona and G. S. Stone. 1989. Population composition of humpback whales on Silver Bank. Canadian Journal of Zoology 67: 281 - 285.

Mattila, D. K., M. Bérubé, R. Bowman, C. Carlson, P. J. Clapham, A. Mignucci-Giannoni, P. J. Palsbøll, J. Robbins, P. T. Stevick, and O. Vasquez. 2001. Humpback whale habitat use on the West Indes breeding grounds. Paper SC/53/NAH3 presented to the IWC Scientific Committee, May 2001 (unpublished). 13pp.

Mazzuca, L., S. Atkinson, and E. Nitta. 1998. Deaths and entanglements of humpback whales, (Megaptera novaeangliae), in the main Hawaiian Islands, 1972-1996. Pacific Science. 52(1):1-13.

McCauley, R.D., Fewtrell, J., Duncan, A.J., Jenner, C., Jenner, M.N., Penrose, J.D., Prince, R.I.T., Adhitya, A., Murdoch, J. and McCabe, K., 2000. Marine seismic surveys—a study of environmental implications. The APPEA Journal, 40(1), pp.692-708.

McCordic, J.A., Todd, S.K. and Stevick, P.T., 2014. Differential rates of killer whale attacks on humpback whales in the North Atlantic as determined by scarification. Journal of the Marine Biological Association of the United Kingdom, 94(6), pp.1311-1315.

McDonald, M. A., J. A. Hildebrand, and S. M. Wiggins. 2006. Increases in deep ocean ambient noise in the Northeast Pacific west of San Nicolas Island, California. Journal of the Acoustical Society of America 120:711–718.

McKenzie, T.P. and Nicolas, J.R., 1988. Cetaceans, sea turtles, and pinnipeds of the Mid-Atlantic Water Management Unit. Characterization of the Middle Atlantic Water Management Unit of the Northeast Regional Action Plan. NOAA [Nat. Ocean. Atmos. Admin.] Tech. Mem. NMFS [Nat. Mar. Fish. Serv.]-F/NEC-56, pp.263-304.

McSweeney, D.J., Chu, K.C., Dolphin, W.F. and Guinee, L.N., 1989. North Pacific humpback whale songs: A comparison of southeast Alaskan feeding ground songs with Hawaiian wintering ground songs. Marine Mammal Science, 5(2), pp.139-148.

Mehta, A.V., Allen, J.M., Constantine, R., Garrigue, C., Jann, B., Jenner, C., Marx, M.K., Matkin, C.O., Mattila, D.K., Minton, G. and Mizroch, S.A., 2007. Baleen whales are not important as prey for killer whales Orcinus orca in high-latitude regions. Marine Ecology Progress Series, 348, pp.297-307.

Melcón, M. L., A. J. Cummins, S. M. Kerosky, L. K. Roche, S. M Wiggins, and J. A. Hildebrand. 2010. Blue whales respond to anthropogenic noise. PLoS ONE 7(2): e32681. doi:10.1371/journal.pone.0032681

Metcalfe, C., Koenig, B., Metcalfe, T., Paterson, G. and Sears, R., 2004. Intra-and inter-species differences in persistent organic contaminants in the blubber of blue whales and humpback whales fro

Meyer-Gutbrod, E.L., Greene, C.H., Davies, K.T. and Johns, D.G., 2021. Ocean regime shift is driving collapse of the North Atlantic right whale population. Oceanography, 34(3), pp.22-31.

Miller, P.J., Biassoni, N., Samuels, A. and Tyack, P.L., 2000. Whale songs lengthen in response to sonar. Nature, 405(6789), pp.903-903.

Mitchell, E. 1973. Draft report on humpback whales taken under special scientific permit by eastern Canadian land stations, 1969-1971. Reports of the International Whaling Commission 23: 138-154.

Mitchell, E. and Reeves, R.R. 1983. Catch history, abundance, and present status of northwest Atlantic humpback whales. Rep. int. Whal. Commn (special issue) 5:153-212.

Moore, S. E., J. M. Waite, N. A. Friday, and T. Honkalehto. 2002. Cetacean distribution and relative abundance on the central-eastern and the southeastern Bering Sea shelf with reference to oceanographic domains. Progress in Oceanography. 55(1-2):249-261.

Moore, M., J. van der Hoop, S. Barco, A. Costidis, F. Gulland, P. Jepson, K. Moore, S. Raverty and W. McLellan. 2013. Criteria and case definitions for serious injury and death of pinnipeds and cetaceans caused by anthropogenic trauma. Dis. Aquat. Org. 103:229–264.

Muirhead, C. A., Warde, A. M., Biedron, I. S., Nicole Mihnovets, A., Clark, C. W., & Rice, A. N. (2018). Seasonal acoustic occurrence of blue, fin, and North Atlantic right whales in the New York Bight. Aquatic Conservation: Marine and Freshwater Ecosystems, 28(3), 744-753.

Murray, A., A. Rice and C. Clark. 2014. Extended seasonal occurrence of humpback whales in Massachusetts Bay. J. Mar. Biol. Assoc. U.K. 94:1117–1125.

Napoli, C., Hirtle, N., Stepanuk, J., Christiansen, F., Heywood, E.I., Grove, T.J., Stoller, A., Dodds, F., Glarou, M., Rasmussen, M.H. and Lonati, G.L., 2024. Drone-based photogrammetry reveals differences in humpback whale body condition and mass across North Atlantic foraging grounds. Frontiers in Marine Science, 11, p.1336455.

National Marine Fisheries Service (NMFS). 1991. Recovery Plan for the Humpback Whale (Megaptera novaeangliae). Prepared by the Humpback Whale Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. 105 pp.

National Marine Fisheries Service (NMFS). 2013. Humpback whale (Megaptera novaeangliae): Gulf of Maine stock. NOAA Fisheries Marine Mammal Stock Assessment Reports. National Marine Fisheries Service, Silver Spring, MD. 11 pp.

NatureServe. 2024. NatureServe Explorer. Page last published 11/1/2024. https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.105599/Megaptera_novaeangliae. Accessed November 14, 2024.

National Marine Fisheries Service [NMFS]. 2023. "NOAA Fisheries to discuss East Coast whale strandings". Accessed March 2025. https://www.noaa.gov/media-advisory/noaa-fisheries-to-discuss-east-coast-whale-strandings

National Marine Fisheries Service [NMFS]. 2024. "Humpback whale". Accessed March 2025. https://www.fisheries.noaa.gov/species/humpback-whale

National Marine Fisheries Service [NMFS]. 2025a. 2016-2025 Humpback Whale Unusual Mortality Event Along the Atlantic Coast. Last updated 4/4/25. Accessed April 2025. https://www.fisheries.noaa.gov/national/marine-life-distress/2016-2025-humpback-whale-unusual-mortality-event-along-atlantic-coast

National Marine Fisheries Service [NMFS]. 2025b. Celebrating 15 Years of Surveying Protected Species in the Northwest Atlantic. Last updated March 21, 2025. Accessed March 2025. https://www.fisheries.noaa.gov/feature-story/celebrating-15-years-surveying-protected-species-northwest-atlantic

National Marine Fisheries Service [NMFS]. 2025c. "Atlantic Marine Assessment Program for Protected Species". Accessed March 2025. https://www.fisheries.noaa.gov/new-england-mid-atlantic/population-assessments/atlantic-marine-assessment-program-protected

National Marine Fisheries Service [NMFS]. 2025d. Active and Closed Unusual Mortality Events. Last updated 3/27/25. Accessed April 2025. https://www.fisheries.noaa.gov/national/marine-life-distress/active-and-closed-unusual-mortality-events

National Research Council [NRC]. 2003. Ocean Noise and Marine Mammals. National Academic Press, Washington, D.C.

National Research Council [NRC]. 2005. Marine Mammal Populations and Ocean Noise: Determining When Noise Causes Biologically Significant Effects. Washington, D.C.: National Academy Press. .

Nemoto, T. 1970. Feeding pattern of baleen whales in the oceans, pp. 241–252 in Marine food chains, ed. J.H. Steele. Univ. of California Press, Berkeley.

New York State Energy Research and Development Authority [NYSERDA]. 2021. “Digital Aerial Baseline Survey of Marine Wildlife in Support of Offshore Wind Energy: Spatial and Temporal Marine Wildlife Distributions in the New York Offshore Planning Area, Summer 2016–Spring 2019,” NYSERDA Report Number 21-07d. Prepared by Normandeau Associates, Inc., Gainesville, FL, and APEM, Ltd., Stockport, UK. nyserda.ny.gov/publications.

Nowacek, D.P., Thorne, L.H., Johnston, D.W. and Tyack, P.L. (2007). Responses of cetaceans to anthropogenic noise. Mammal Review, 37: 81–115.

O'Connor, S., R. Campbell, H. Cortez, and T. Knowles. 2009. Whale watching Worldwide: Tourism numbers, expenditures and expanding economic benefits. A special report from the International Fund for Animal Welfare prepared by Economists At Large, Yarmouth, MA, USA. 295.

O'Shea, T.J., Reeves, R.R. and Long, A.K. (eds) 1999. Marine mammals and persistent ocean contaminants. Proceedings of the Marine Mammal Commission workshop, Keystone, Colorado, 12–15 October 1998

Palka D. 2012. Cetacean abundance estimates in US northwestern Atlantic Ocean waters from summer 2011 line transect survey. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 12-29; 37 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://www.nefsc.noaa.gov/ nefsc/publications/

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.

Palsbøll, P.J., J. Allen, M. Berube, P. Clapham, T. Feddersen, P. Hammond, R. Hudson, H. Jorgensen, S. Katona, A.H. Larsen, F. Larsen, J. Lien, D. Mattila, J. Sigurjonsson, R. Sears, T. Smith, R. Sponer, P. Stevick and N. Oien. 1997. Genetic tagging of humpback whales. Nature 388:767–769.

Palsbøll, P.J., P.J. Clapham, D.K. Mattila, F. Larsen, R. Sears, H.R. Siegismund, J. Sigurjónsson, O. Vásquez and P. Arctander. 1995. Distribution of mtDNA haplotypes in North Atlantic humpback whales: the influence of behavior on population structure. Mar. Ecol. Prog. Ser. 116:1–10.

Palsbøll, P.J., J. Allen, T.H. Anderson, M. Bérubé, P.J. Clapham, T.P. Feddersen, N. Friday, P. Hammond, H. Jørgensen, S.K. Katona, A.H. Larsen, F. Larsen, J. Lien, D.K. Mattila, F.B. Nygaard, J. Robbins, R. Sponer, R. Sears, J. Sigurjónsson, T.D. Smith, P.T. Stevick, G. Vikingsson and N. Øien. 2001. Stock structure and composition of the North Atlantic humpback whale, Megaptera novaeangliae. Scientific Committee meeting document SC/53/NAH11. International Whaling Commission, Cambridge, UK.

Paquet, D., C. Haycock and H. Whitehead. 1997. Numbers and seasonal occurrence of humpback whales (Megaptera novaeangliae) off Brier Island, Nova Scotia. Can. Field-Nat. 111:548–552.

Parks, S. E., M. Johnson, D. Nowacek and P. L. Tyack. 2011. Individual right whales call louder in increased environmental noise. Biology Letters 7(1): 33 - 35.

Parks, S.E., Clark, C.W. and Tyack, P.. (2007). Short- and long-term changes in right whale calling behavior: The potential effects of noise on acoustic communication. Journal of the Acoustical Society of America, 122: 3725–3731.

Parks, S.E., Urazghildiiev, I. and Clark, C.W., 2009. Variability in ambient noise levels and call parameters of North Atlantic right whales in three habitat areas. The Journal of the Acoustical Society of America, 125(2), pp.1230-1239.

Parsons, E.C.M., 2012. The negative impacts of whale-watching. Journal of Marine Sciences, 2012(1), p.807294.

Passive Acoustic Cetacean Map [PACM]. 2025. Passive acoustic cetacean map, v1.1.10, accessed 17 Feb 2025. NOAA Northeast Fisheries Science Center, Woods Hole, MA. https://apps-nefsc.fisheries.noaa.gov/pacm/#/fin

Payne, R., and S. McVay. 1971. Songs of humpback whales. Science. 173:585-597.

Payne, R. and Webb, D., 1971. Orientation by means of long range acoustic signaling in baleen whales. Annals of the New York Academy of Sciences, 188(1), pp.110-141.

Payne, P. M., J. R. Nicholas, L. O'Briend and K. D. Powers. 1986. The distribution of the humpback whale, Megaptera novaeangliae, on Georges Bank and in the Gulf of Maine in relation to densities of the sand eel, Ammodytes americanus. Fisheries Bulletin 84: 271 - 277.

Payne, P.M., D.N. Wiley, S.B. Young, S. Pittman, P.J. Clapham, and J.W. Jossi. 1990. Recent fluctuations in the abundance of baleen whales in the southern Gulf of Maine in relation to changes in selected prey. Fish. Bull., U.S. 88:687–696

Pendleton, D.E., Tingley, M.W., Ganley, L.C., Friedland, K.D., Mayo, C., Brown, M.W., McKenna, B.E., Jordaan, A., and M.D. Staudinger. 2022. Decadal-scale Phenology and Seasonal Climate Drivers of Migratory Baleen Whales in a Rapidly Warming Marine Ecosystem. Global Change Biology 28, no. 16: 4989–5005. https://doi.org/10.1111/gcb.16225

Pershing, A.J., Alexander, M.A., Brady, D.C., Brickman, D., Curchitser, E.N., Diamond, A.W., McClenachan, L., Mills, K.E., Nichols, O.C., Pendleton, D.E. and Record, N.R., 2021. Climate impacts on the Gulf of Maine ecosystem: a review of observed and expected changes in 2050 from rising temperatures. Elem Sci Anth, 9(1), p.00076.

Piatt, J.F., Methven, D.A., Burger, A.E., McLagan, R.L., Mercer, V. and Creelman, E., 1989. Baleen whales and their prey in a coastal environment. Canadian Journal of Zoology, 67(6), pp.1523-1530.

Pitman, R.L., Deecke, V.B., Gabriele, C.M., Srinivasan, M., Black, N., Denkinger, J., Durban, J.W., Mathews, E.A., Matkin, D.R., Neilson, J.L. and Schulman-Janiger, A., 2017. Humpback whales interfering when mammal-eating killer whales attack other species: Mobbing behavior and interspecific altruism?. Marine Mammal Science, 33(1), pp.7-58.

Pivorunas, A., 1979. The Feeding Mechanisms of Baleen Whales. American Scientist, 67(4), pp.432-440.

Pomilla, C. and H. C. Rosenbaum. 2005. Against the current: an inter-oceanic whale migration event. Biology Letters 1: 476 - 479.

Punt, A.E., Friday, N.A. and Smith, T.D., 2006. Reconciling data on the trends and abundance of North Atlantic humpback whales within a population modelling framework. J. Cetacean Res. Manage., 8(2), pp.145-159.

Ramp, C., Delarue, J., Palsbøll, P.J., Sears, R., Hammond, P.S. (2015) Adapting to a Warmer Ocean—Seasonal Shift of Baleen Whale Movements over Three Decades. PLOS ONE 10:e0121374. https://doi.org/10.1371/journal.pone.0121374

Ransome, N., Bejder, L., Jenner, M., Penfold, G., Brosig, V. J., Kitson, C., Skjothaug, R., Neilson, E., Loneragan, N. R., & Smith, J. N. (2021). Observations of parturition in humpback whales (Megaptera novaeangliae) and occurrence of escorting and competitive behavior around birthing females. Marine Mammal Science, 38(2), 408-432. https://doi.org/10.1111/mms.12864

Ransome, N., Bejder, L., Jenner, M., Penfold, G., Brosig, V.J., Kitson, C., Skjothaug, R., Neilson, E., Loneragan, N.R. and Smith, J.N., 2022. Observations of parturition in humpback whales (Megaptera novaeangliae) and occurrence of escorting and competitive behavior around birthing females. Marine Mammal Science, 38(2), pp.408-432.

Ransome, N., Kew, A., Duque, E., Morais, M., Wright, W. and Smith, J.N., 2022. Escorting of a mother humpback whale (Megaptera novaeangliae) and the death of her calf during aggressive mating behavior. Marine Mammal Science, 38(4).

Rasmussen, K., D. M. Palacios, J. Calambokidis, M. T. Saborio, L. Dalla Rosa, E. R. Secchi, G. H. Steiger, J. M. Allen and G. S. Stone. 2007. Southern Hemisphere humpback whales wintering off Central America: insights from water temperature into the longest mammalian migration. Biology Letters 3: 302 - 305.

Reeves, R.R., Swartz, S.L., Wetmore, S.E. and Clapham, P.J., 2001. Historical occurrence and distribution of humpback whales in the eastern and southern Caribbean Sea, based on data from American whaling logbooks. J. Cetacean Res. Manage., 3(2), pp.117-129.

Reeves, R.R., Smith, T.D., Josephson, E.A., Clapham, P.J. and Woolmer, G., 2004. Historical observations of humpback and blue whales in the North Atlantic Ocean: clues to migratory routes and possibly additional feeding grounds. Marine mammal science, 20(4), pp.774-786.

Richardson, W. J., C. R. Greene, Jr., C. I. Malme and D. H. Thomson. 1995. Marine Mammals and Noise. Academic Press, San Diego, California.

Riekkola, L., Andrews-Goff, V., Friedlaender, A., Constantine, R. and Zerbini, A.N., 2019. Environmental drivers of humpback whale foraging behavior in the remote Southern Ocean. Journal of Experimental Marine Biology and Ecology, 517, pp.1-12.

Risch, D., Corkeron, P.J., Ellison, W.T. and Van Parijs, S.M., 2012. Changes in humpback whale song occurrence in response to an acoustic source 200 km away. PloS one, 7(1), p.e29741.

Robbins, J. and D.K. Mattila. 2001. Monitoring entanglements of humpback whales (Megaptera novaeangliae) in the Gulf of Maine on the basis of caudal peduncle scarring. Scientific Committee meeting document SC/53/NAH25.International Whaling Commission, Cambridge, UK.

Robbins, J. 2007. Structure and dynamics of the Gulf of Maine humpback whale population. PhD dissertation. Universitiy of St. Andrews, St. Andrews, Scotland.

Robbins, J. 2009. Scar-Based inference into Gulf of Maine humpback whale entanglement: 2003- 2006, Report to the National Marine Fisheries Service. Order Number EA133F04SE0998.

Robbins, J. 2010. Scar-based inference into Gulf of Maine Humpback whale entanglement: 2008. Report to the Northeast Fisheries Science Center, National Marine Fisheries Service, Woods Hole, Massachusetts, USA.

Robbins, J. 2011. Scar-based inference into Gulf of Maine humpback whale entanglement: 2009, Report to the National Marine Fisheries Service. Order number EA133F09CN0253.

Robbins, J. 2012. Scar-based inference into Gulf of Maine Humpback whale entanglement: 2010. Report to the Northeast Fisheries Science Center, National Marine Fisheries Service, Woods Hole, Massachusetts, USA.

Robbins, J. and R.M. Pace, III. 2018. Trends in abundance of North Atlantic humpback whales in the Gulf of Maine. EE133F-17-SE-1320 Task I Contract Report. Northeast Fisheries Science Center, Woods Hole, MA.

Robbins, J., L. Dalla Rosa, J. M. Allen, D. K. Mattila and E. R. Secchi. 2008. Humpback whale photo-identification reveals exchange between American Samoa and the Antarctic Peninsula, and a new mammalian distance record. IWC Scientific Committee Document SC/60/SH5.

Robbins, J., Bérubé, M., Clapham, P.J., Mattila, D.K., Palsbøll, P.J., Asmutis-Silvia, R., Hill, A., Howes, L.J., Landry, S., Lonergan, S. and Schulte, D., 2024. Before and after delisting: population dynamics of North Atlantic humpback whales over two decades in the Gulf of Maine. bioRxiv, pp.2024-02.

Roberts, S.M., Boustany, A.M., Halpin, P.N., 2020. Substrate-dependent fish have shifted less in distribution under climate change. Commun. Biol. 3 https://doi.org/10.1038/ s42003-020-01325-1.

Roberts JJ, Yack TM, Cañadas A, Fujioka E, Halpin PN, Barco SG, Boisseau O, Chavez-Rosales S, Cole TVN, Cotter MP, Cummings EW, Davis GE, DiGiovanni Jr. RA, Garrison LP, Gowan TA, Jackson KA, Kenney RD, Khan CB, Lockhart GG, Lomac-MacNair KS, McAlarney RJ, McLellan WA, Mullin KD, Nowacek DP, O'Brien O, Pabst DA, Palka DL, Quintana-Rizzo E, Redfern JV, Rickard ME, White M, Whitt AD, Zoidis AM. 2022. Density Model for Humpback Whale (Megaptera novaeangliae) for the U.S. East Coast, Version 11.1, 2023-05-27, and Supplementary Report. Marine Geospatial Ecology Laboratory, Duke University, Durham, North Carolina.

Rocha, R.C., Clapham, P.J. and Ivashchenko, Y.V., 2014. Emptying the oceans: a summary of industrial whaling catches in the 20th century. Marine Fisheries Review, 76(4).

Roman, L., Hardesty, B. D., Leonard, G. H., Pragnell-Raasch, H., Mallos, N., Campbell, I., & Wilcox, C. (2020). A global assessment of the relationship between anthropogenic debris on land and the seafloor. Environmental Pollution, 264, 114663. https://doi.org/10.1016/j.envpol.2020.114663

Ruppel, C.D., Weber, T.C., Staaterman, E.R., Labak, S.J. and Hart, P.E., 2022. Categorizing active marine acoustic sources based on their potential to affect marine animals. Journal of Marine Science and Engineering, 10(9), p.1278.

Sadove, S. S. and P. Cardinale. 1993. Species composition and distribution of marine mammals and sea turtles in the New York Bight. Final Report to U.S. Dept. of the Interior, Fish and Wildlife Service Southern New England-New York Bight Coastal Fisheries Project. Charlestown, RI.

Salden, D. R., L. M. Herman, M. Yamaguchi, and F. Sato. 1999. Multiple visits of individual humpback whales (Megaptera novaeangliae) between the Hawaiian and Japanese winter grounds. Canadian Journal of Zoology 77: 504 - 508.

Scheidat, M. C. Castro, J. Gonzalez and R. Williams. 2004. Behavioural responses of humpback whales (Megaptera novaeangliae) to whale watching boats near Isla de la Plata, Machalilla National Park, Ecuador. Journal of Cetacean Research and Management 6(1): 63 - 68.

Schiedek, D., Sundelin, B., Readman, J.W. and Macdonald, R.W., 2007. Interactions between climate change and contaminants. Marine pollution bulletin, 54(12), pp.1845-1856.

Schilling, H.T., Dedden, A.V., Crocetti, S., Liggins, G., Lorigan, S., Marshall, A., Rogers, T.L., Schaeffer, A., Suthers, I.M. and Johnson, D.D., 2023. Regional oceanography affects humpback whale entanglements in set fishing gear. Conservation Science and Practice, 5(11), p.e13034.

Schuler, A.R., Piwetz, S., Di Clemente, J., Steckler, D., Mueter, F. and Pearson, H.C., 2019. Humpback whale movements and behavior in response to whale-watching vessels in Juneau, AK. Frontiers in Marine Science, 6, p.710.

Shearer, J, Nowacek, D, Swaim, Z, Foley, H, Janik, V, Read, A. 2019. Behavioral responses of humpback whales (Megaptera novaeangliae) to approaching ships in Virginia Beach, Virginia, USA. World Marine Mammal Conference, Barcelona, Spain 2019. Abstract.

Shearer, J.M., Foley, H.J., Swaim, Z.T., Janik, V.M. and Read, A.J., 2024. Overwintering humpback whales adapt foraging strategies to shallow water environments at the mouth of the Chesapeake Bay, Virginia, USA. Marine Mammal Science, p.e13184.

Shevchenko, V. I. 1975. The nature of the interrelationships between killer whales and other cetaceans. Morsk Mlekopitayushchie Chast. 2:173-174.

Silber, G.K. and Silber, K.M., 2024. Co-occurrence of harmful algal blooms and whale deaths. Frontiers in Marine Science, 11, p.1454656.

Simmonds, M.P., 2012. Cetaceans and marine debris: the great unknown. Journal of Marine Sciences, 2012(1), p.684279.

Simon, N. 1966. Red data book. Volume I-Mammalia. International Union for Conservation of Nature and Natural Resources. Morges, Switzerland.

Sivle, L.D., Wensveen, P.J., Kvadsheim, P.H., Lam, F.P.A., Visser, F., Curé, C., Harris, C.M., Tyack, P.L. and Miller, P.J., 2016. Naval sonar disrupts foraging in humpback whales. Marine Ecology Progress Series, 562, pp.211-220.

Smith, T. D. and R. R. Reeves. 2003. Estimating historic humpback removals from the North Atlantic: an update. Journal of Cetacean Research and Management 5.

Smith, T.D. and Reeves, R.R., 2010. Historical catches of humpback whales, Megaptera novaeangliae, in the North Atlantic Ocean: Estimates of landings and removals. Marine Fisheries Review, 72(3), p.1.

Smith, T. D., and D. G. Pike. 2009. The enigmatic whale: the North Atlantic humpback. NAMMCO Scientific Publications. 7:161-178.

Smith, T. D., J. Allen, P. J. Clapham, P. S. Hammond, S. Katona, F. Larsen, J. Lien, D. Mattila, P. J. Palsbøll, J. Sigurjonsson, P. T. Stevick, and N. Øien. 1999. An ocean-basin-wide mark-recapture study of the North Atlantic humpback whale (Megaptera novaeangliae). Marine Mammal Science. 15(1):1-32.

Smith, S.E., Brown, D.M., Oliveras, J.R., Sieswerda, P.L., Ahearn, S. and Reiss, D., 2022. A preliminary study on humpback whales lunge feeding in the New York Bight, United States. Frontiers in Marine Science, 9, p.798250.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene, Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, and P.L. Tyack. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals 33(4):411–521.

Southall, B.L., Finneran, J.J., Reichmuth, C., Nachtigall, P.E., Ketten, D.R., Bowles, A.E., Ellison, W.T., Nowacek, D.P. and Tyack, P.L., 2019. Marine mammal noise exposure criteria: Updated scientific recommendations for residual hearing effects. Aquatic Mammals, 45(2), pp.125-232.

Sprogis, K.R., Videsen, S. and Madsen, P.T., 2020. Vessel noise levels drive behavioural responses of humpback whales with implications for whale-watching. Elife, 9, p.e56760.

Steiger, G.H. and Calambokidis, J., 2000. Reproductive rates of humpback whales off California. Marine Mammal Science, 16(1), pp.220-239.

Steiger, G. H., J. Calambokidis, J. M. Straley, L. M. Herman, S. Cerchio, D. R. Salden, J. Urban-R, J. K. Jacobsen, O. Von Ziegesar, K. C. Balcomb, C. M. Gabriele, M. E. Dahlheim, S. Uchida, J. K. B. Ford, P. Ladrón de Guevara-P, M. Yamaguchi, and J. Barlow. 2008. Geographic variation in killer whale attacks on humpback whales in the North Pacific: implications for predation pressure. Endangered Species Research. 4:247-256.

Stepanuk, J.E., Heywood, E.I., Lopez, J.F., DiGiovanni Jr, R.A. and Thorne, L.H., 2021. Age-specific behavior and habitat use in humpback whales: implications for vessel strike. Marine Ecology Progress Series, 663, pp.209-222.

Stevick, P., N. Øien and D.K. Mattila. 1998. Migration of a humpback whale between Norway and the West Indies. Mar. Mamm. Sci. 14:162–166.

Stevick, P. T., N. Oien and D. K. Mattila. 1999. Migratory destinations of humpback whales from Norwegian and adjacent waters: evidence for stock identity. Journal of Cetacean Research and Management 1: 147 - 152.

Stevick, P.T., J. Allen, P.J. Clapham, N. Friday, S.K. Katona, F. Larsen, J. Lien, D.K. Mattila, P.J. Palsbøll, J. Sigurjónsson, T.D. Smith, N. Øien and P.S. Hammond. 2003a. North Atlantic humpback whale abundance and rate of increase four decades after protection from whaling. Marine Ecology Progress Series 258: 263-273.

Stevick, P.T., J. Allen, M. Berube, P. J. Clapham, S. K. Katona, F. Larsen, J. Lien, D. K. Mattila, P. J. Palsbøll, J. Robbins, J. Sigurjonsson, T. D. Smith, N. Øien and P. S. Hammond. 2003b. Segregation of migration by feeding ground origin in North Atlantic humpback whales (Megaptera novaeangliae). Publications, Agencies and Staff of the U.S. Department of Commerce. Paper 164. 9 pp.

Stevick, P.T., J. Allen, P.J. Clapham, S.K. Katona, F. Larsen, J. Lien, D.K. Mattila, P.J. Palsbøll, R. Sears, J. Sigurjónsson, T.D. Smith, G. Vikingsson, N. Øien and P.S. Hammond. 2006. Population spatial structuring on the feeding grounds in North Atlantic humpback whales (Megaptera novaeangliae). J. Zool. 270:244– 255.

Stevick, P. T., M. C. Neves, F. Johansen, M. H. Engel, J. Allen, M. C. C. Marcondes and C. Carlson. 2010. A quarter of a world away: female humpback whale moves 10000 km between breeding areas. Biology Leters 7: 299 - 302.

Stevick, P.T., S.D. Berrow, M. Bérubé, L. Bouveret, F. Broms, B. Jann, A. Kennedy, P. López Suárez, M. Meunier, C.Ryan and F. Wenzel. 2016. There and back again: multiple and return exchange of humpback whales between breeding habitats separated by an ocean basin. J. Mar. Biol. Assoc. U.K., special issue 4:885–890. doi:10.1017/S0025315416000321

Stone, G. S., S. K. Katona, and E. B. Tucker. 1987. History, migration and present status of humpback whales (Megaptera novaeangliae) at Bermuda. Biological Conservation. 42(1):133-145.

Stone, G. S., L. Florez-Gonzalez and S. Katona. 1990. Whale migration record. Nature (London) 346: 705.

Stone, C.J. 2003. The effects of seismic activity on marine mammals in UK waters, 1998–2000. JNCC Report No. 323.

Stone, C.J. and Tasker, M.L., 2006. The effects of seismic airguns on cetaceans in UK waters. J. Cetacean Res. Manage., 8(3), pp.255-263.

Stone KM, Leiter SM, Kenney RD, Wikgren BC, Thompson JL, Taylor JKD, Kraus SD (2017) Distribution and abundance of cetaceans in a wind energy development area offshore of Massachusetts and Rhode Island. J Coast Conserv 21:527–543. doi: 10.1007/s11852-017-0526-4

Storlund, R.L., Cottrell, P.E., Cottrell, B., Roth, M., Lehnhart, T., Snyman, H., Trites, A.W. and Raverty, S.A., 2024. Aquaculture related humpback whale entanglements in coastal waters of British Columbia from 2008–2021. Plos one, 19(3), p.e0297768.

Surrey-Marsden, C., K. Howe, M. White, C. George, T. Gowan, P. Hamilton, K. Jackson, J. Jakush, T. Pitchford, C. Taylor, L. Ward, and B. Zoodsma. 2018. North Atlantic Right Whale Calving Area Surveys: 2015/2016 Results. NOAA Tech. Memo. NMFS-SER-6. 18 pp.

Swingle, W.M., S.G. Barco, T.D. Pitchford, W.A. McLellan and D.A. Pabst. 1993. Appearance of juvenile humpback whales feeding in the nearshore waters of Virginia. Mar. Mamm. Sci. 9:309–315.

Teerlink, S., Horstmann, L. and Witteveen, B., 2018. Humpback whale (Megaptera novaeangliae) blubber steroid hormone concentration to evaluate chronic stress response from whale-watching vessels. Aquatic Mammals, 44(4), pp.411-425.

Tetra Tech and LGL. 2020. Final Comprehensive Report for New York Bight Whale Monitoring Aerial Surveys, March 2017 – February 2020. Technical report prepared by Tetra Tech, Inc. and LGL Ecological Research Associates, Inc. 211 pp. + appendices. Prepared for New York State Department of Environmental Conservation, Division of Marine Resources, East Setauket, NY. May 18, 2020.

Thorne, L.H., Heywood, E.I. and Hirtle, N.O., 2022. Rapid restructuring of the odontocete community in an ocean warming hotspot. Global Change Biology, 28(22), pp.6524-6540.

Tyack, P. L. 1981. Interactions between singing Hawaiian humpback whales and conspecifics nearby. Behavioral Ecology and Sociobiology. 8:105-116.

Tyack, P.L. (2008). Implications for marine mammals of large-scale changes in the marine acoustic environment. Journal of Mammalogy, 89: 549–558.

Tyack, P. and H. Whitehead. 1983. Male competition in large groups of wintering humpback whales. Behavior 83: 123-154.

United Nations Global Impact. 2025. "End Waste Entering the Ocean". Accessed March 2025. https://unglobalcompact.org/take-action/ocean/communication/end-waste-entering-the-ocean

US Navy. 2024. Atlantic Marine Assessment Program for Protected Species (AMAPPS). US Navy Marine Species Monitoring. https://www.navymarinespeciesmonitoring.us/reading-room/project-profiles/atlantic-marine-assessment-program-protected-species-amapps/. Accessed March 2025.

van Der Hoop, J.M., M.J. Moore, S.G. Barco, T.V.N. Cole, P.-Y. Daoust, A.G. Henry, D.F. McAlpine, W.A. McLellan, T. Wimmer and A.R. Solow. 2013. Assessment of management to mitigate anthropogenic effects on large whales. Conserv. Biol. 27:121–133.

van der Hoop, J., Corkeron, P. and Moore, M., 2017. Entanglementwi is a costly life‐history stage in large whales. Ecology and evolution, 7(1), pp.92-106.

Van Parijs, S.M., DeAngelis, A.I., Aldrich, T., Gordon, R., Holdman, A., McCordic, J.A., Mouy, X., Rowell, T.J., Tennant, S., Westell, A. and Davis, G.E., 2023. Establishing baselines for predicting change in ambient sound metrics, marine mammal, and vessel occurrence within a US offshore wind energy area. ICES Journal of Marine Science, p.fsad148.

Volgenau, L., Kraus, S.D. and Lien, J., 1995. The impact of entanglements on two substocks of the western North Atlantic humpback whale, Megaptera novaeangliae. Canadian Journal of Zoology, 73(9), pp.1689-1698.

von Hammerstein, H., Setter, R.O., van Aswegen, M., Currie, J.J. and Stack, S.H., 2022. High-resolution projections of global sea surface temperatures reveal critical warming in humpback whale breeding grounds. Frontiers in Marine Science, 9, p.837772.

Vu, E. T. et al. 2012. Humpback whale song occurs extensively on feeding grounds in the western North Atlantic Ocean. Aquatic Biology 14: 175 - 183.

Wade, P. R., V. N. Burkanov, M. E. Dahlheim, N. A. Friday, L. W. Fritz, T. R. Loughlin, S. A. Mizroch, M. M. Muto, D. W. Rice, L. G. Barrett-Lennard, N. A. Black, A. M. Burdin, J. Calambokidis, S. Cerchio, J. K. B. Ford, J. K. Jacobsen, C. O. Matkin, D. R. Matkin, A. V. Mehta, R. J. Small, J. M. Straley, S. M. McCluskey, and G. R. VanBlaricom. 2007. Killer whales and marine mammal trends in the North Pacific: a re-examination of evidence for sequential megafauna collapse and the prey-switching hypothesis. Marine Mammal Science. 23(4):766-802.

Wania, F., and D. Mackay. 1993. Global fractionation and cold condensation of low volatility organochlorine compounds in polar regions. Ambio. 22:10-18.

Whitehead, H., 1985. Why whales leap. Scientific American, 252(3), pp.84-93.

Whitehead, H. 1987. Updated status of the humpback whale, Megaptera novaeangliae, in Canada. Canadian Field-Naturalist 101(2): 284 - 294.

Whitehead, H. and Glass, C., 1985. Orcas (killer whales) attack humpback whales. Journal of Mammalogy, 66(1), pp.183-185.

Whitehead, H. and M. J. Moore. 1982. Distribution and movements of West Indian humpback whales in the winter. Canadian Journal of Zoology 60: 2203 - 2211.

Whitt, A.D., Powell, J.A., Richardson, A.G. and Bosyk, J.R., 2015. Abundance and distribution of marine mammals in nearshore waters off New Jersey, USA. J. Cetacean Res. Manage., 15, pp.45-59.

Wildlife Conservation Society [WCS]. 2021. Assessing Cetacean Presence in the New York Harbor Using Passive Acoustic Monitoring. Final report to the Hudson River Foundation. January 2021.

Wiley, D. N., and R. A. Asmutis. 1995. Stranding and mortality of humpback whales, (Megaptera novaeangliae), in the mid-Atlantic and southeast United States, 1985-1992. Fishery Bulletin. 93(1):196-205.

Wiley, D. N., and P. J. Clapham. 1993. Does maternal condition affect the sex ratio of offspring in humpback whales? Animal Behavior. 46(2):321-324.

Wiley, D. N., R. A. Asmutis, T. D. Pitchford and D. P. Gannon. 1995. Stranding and mortality of humpback whales, Megaptera novaeangliae, in the mid-Atlantic and southeast United States, 1985 - 1992. Fisheries Bulletin 93(1): 196 - 205.

Williamson, G. R. 1961. Winter sighting of a humpback whale suckling its calf on the Grand Bank of Newfoundland. Norsk Hvalfangst-Tidende 50:335-336, 339-341.

Wynne, K. and M. Schwartz. 1999. Guide to Marine Mammals & Turtles of the U.S. Atlantic & Gulf of Mexico. Rhode Island Sea Grant.

Winn H.E. and Reichley N.E., 1985. Humpback whales, Megaptera novaeangliae (Borrowski, 1781). In: Handbook of Marine Mammals. Volume 3: The Sirenian and Baleen Whales. Pp 241-273 Ridgway S.H. and Harrison R.J. (eds). Academic Press: 362 pp

Winn, H.E., Edel, R.K. and Taruski, A.G., 1975. Population estimate of the humpback whale (Megaptera novaeangliae) in the West Indies by visual and acoustic techniques. Journal of the Fisheries Board of Canada, 32(4), pp.499-506.

Woods Hole Oceanographic Institute [WHOI]. 2025. Robots4Whales. https://robots4whales.whoi.edu/

Wright, A.J., Deak, T. and Parsons, E.C.M., 2011. Size matters: management of stress responses and chronic stress in beaked whales and other marine mammals may require larger exclusion zones. Marine Pollution Bulletin, 63(1-4), pp.5-9.

Zeh, J.M., Rekdahl, M.L., Rice, A.N., Clark, C.W. and Rosenbaum, H.C., 2021. Detections of humpback whale (Megaptera novaeangliae) vocalizations on an acoustic sensor in the New York Bight. Marine Mammal Science, 37(2).

Zein, B. and Haugum, S.V., 2018. The northernmost sightings of humpback whales. J. Mar. Anim & Ecol, 10(1), pp.5-8.

Zerbini, A. N., A. Andriolo, M. P. Heide-Jorgensen, J. L. Pizzorno, Y. G. Maia, G. R. VanBlaricom, D. P. Demaster, P. C. Simoes-Lopes, S. Moreira, and C. Behtlem. 2006. Satellite-monitored movements of humpback whales Megaptera novaeangliae in the southwest Atlantic Ocean. Marine Ecology Progress Series. 313:295-304.

Zerbini, A.N., P.J. Clapham and P.R. Wade. 2010. Assessing plausible rates of population growth in humpback whales from life-history data. Mar. Biol. 157:1225–1236.

Zoidis, A.M., Lomac-MacNair, K.S., Ireland, D.S., Rickard, M.E., McKown, K.A., & Schlesinger, M.D. (2021). Large whale distribution and density in the New York Bight from monthly aerial surveys 2017-2020. Continental Shelf Research, 230, 104572. https://doi.org/10.1016/j.csr.2021.104572

Zoodsma, B., K. Howe, M.White, J. Jakush, C. George, T. Gowan, P. Hamilton, K. Jackson, T. Pitchford, C. Taylor, and L. Ward. 2016. North Atlantic right whale calving area surveys: 2014/2015 results. NOAA Tech. Memo. NMFS-SER-4. 16 pp.