

3.2.11. Beaked Whales:

Northern Bottlenose Whale *Hyperoodon ampullatus* (Forster, 1770)

Cuvier's Beaked Whale *Ziphius cavirostris* G. Cuvier, 1823

Blainville's Beaked Whale *Mesoplodon densirostris* (Blainville, 1817)

Gervais' Beaked Whale *Mesoplodon europaeus* (Gervais, 1855)

Sowerby's Beaked Whale *Mesoplodon bidens* (Sowerby, 1804)

True's Beaked Whale *Mesoplodon mirus* True, 1913

Ziphiidae constitutes the second most speciose family of Cetacea, with 6 genera and 21 species (most in *Mesoplodon*) now recognized, second only to Delphinidae (Mead, 2002). Some species are still known only from stranded specimens and have never been seen alive (or even as a completely intact carcass). Ziphiids are collectively known as beaked whales. They all occur in deep water, far offshore. Six species are known from the North Atlantic, and all six have occurred in the Rhode Island study area. Many beaked whale species are difficult to differentiate with intact specimens at hand and nearly impossible to identify at sea, and sightings identified to species were extremely rare before the late 20th Century. All six species are considered together here.

Description

Except for a few larger species, including only *Hyperoodon ampullatus* in the North Atlantic, all of the beaked whales are medium-sized animals (adult lengths of 4–7 m) that share a number of distinctive characters (Mead, 1989a, 1989b, 2002; Heyning, 1989, 2002; Gowans, 2002; Pitman, 2002). They have tail flukes that lack a central notch and small triangular dorsal fins located in the rear third of the body. The flippers are relatively small, with relatively long arm bones and short digits. On the ventral surface of the lower jaw there are two so-called throat grooves, which likely are involved in expansion of the oral cavity for suction feeding. The head has a pronounced, elongated rostrum that is continuous with the forehead without a distinct break or crease. In most species there is only one more or less tusk-like tooth in each mandible, which erupts only in adult males.

Northern bottlenose whales are the largest of the Atlantic beaked whales, with males reaching a maximum length of 9.8 m and females reaching 8.7 m (Mead, 1989b; Jefferson et al., 1993; Wynne and Schwartz, 1999; Gowans, 2002). The body is robust with a relatively wide back. The head is rounded and bulbous, which becomes increasingly pronounced in older, larger animals and nearly square with a flattened, vertical forehead in adult males. The blowhole is located in a shallow depression on top of the head, and the blow is short and bushy, and may be angled slightly forward. There is a pronounced, elongate, dolphin-like beak. They are tan to dark chocolate brown in color, with a lighter belly and often with lighter blotches, scratches, and scars. The head and neck are whitish on large adults. The dorsal fin is prominent, falcate, darker in color than the body, and located about two-thirds of the way back along the body.

Adult Cuvier's beaked whales reach 7–7.5 m long (Heyning, 1989, 2002; Jefferson et al., 1993; Wynne and Schwartz, 1999). They have relatively robust, cigar-shaped bodies with small conical heads and short, tapered flippers. There is often a visible concavity or depression at the top of the forehead. There is little or no distinct beak, and the line of the mouth is relatively short and curved upward toward the rear. The teeth of adult males may be visible at the tip of the lower jaw, and are sometimes covered by a clump of stalked barnacles. The body is tan to reddish brown to dark gray, often mottled and covered with circular white scars and parallel pairs of scratches. The head and neck are often white, especially in adults, with a dark patch around the eye. Much of the back may be whitish in older males.

Beaked whales in the genus *Mesoplodon* are much smaller than northern bottlenose whales and smaller than Cuvier's beaked whales. In addition, they have elongate, tapered beaks which differ from both the very short conical head of Cuvier's beaked whales and the bulbous head with a dolphin-like beak of bottlenose whales. Identifying individuals to species becomes much more difficult. All species are about the same size and have the same general shape, show indistinct blows, have relatively small triangular to falcate dorsal fins located about 2/3 back on the body, and have flippers that fit into shallow depressions on the side of the body (Mead, 1989a).

Blainville's beaked whales may be the easiest of the four North Atlantic *Mesoplodon* species to differentiate, assuming a close look under optimum conditions (Mead, 1989a; Jefferson et al., 1993; Wynne and Schwartz, 1999; Pitman, 2002). They are up to 4.7 m long. The body is relative robust and spindle-shaped, with a relatively thick beak. The forehead

appears flattened in front of the blowhole, and there is little or no obvious indentation at the blowhole. The rear half of the lower jaw has an obvious upward arch, which enlarges and extends higher than the top of the upper jaw in adult males. Adult males have two massive, flattened, triangular, forward-tilting teeth growing from the top of the arch in the lower jaw that are clearly visible when the mouth is closed; they may have attached clusters of stalked barnacles. The color is dark gray to black on the back with lighter sides and a white belly. There may be a dark circular patch around the eye, and large oval scars and scratches are common.

Female Gervais' beaked whales are up to 5.2 m long, while males only reach 4.6 m (Mead, 1989a; Jefferson et al., 1993; Wynne and Schwartz, 1999; Norman and Mead, 2001; Pitman, 2002). The body is slender and laterally compressed, with an elongate, tapered beak and a prominent melon with a small indentation behind it at the blowhole. Gervais' and True's beaked whales are very similar, with the beak in the former having relatively flattened sides. The flippers are set very low on the body. The color is dark gray on the back and sides with irregular white patches and a lighter belly.

Sowerby's beaked whales are up to 5 m long (Mead, 1989a; Jefferson et al., 1993; Wynne and Schwartz, 1999; Pitman, 2002). The body is slender and spindle-shaped, with an elongate, tapered beak and a very prominent melon with a pronounced indentation behind it at the blowhole. The color is dark gray to brown on the back with somewhat lighter sides and an even lighter belly.

True's beaked whales are up to 5.2 m long (Mead, 1989a; Jefferson et al., 1993; Wynne and Schwartz, 1999; Pitman, 2002). The body is relatively robust and tapers noticeably toward the tail. There is an elongate, tapered, somewhat dolphin-like beak with rounded sides and a prominent melon with a small indentation behind it at the blowhole. There is a sharp ridge from dorsal fin to the flukes. The color is gray to brown, gradually paling from a dark back to lighter sides to a whitish belly, with a darker band down the center of the back. The dorsal fin, lips, and a circular eye patch are black.

Status

None of the North Atlantic beaked whales are listed under the U.S. Endangered Species Act and none are included on the Rhode Island state list. Northern bottlenose whales and all four

Mesoplodon species are classified as Data Deficient on the IUCN Red List, but Cuvier's beaked whale is classified as Least Concern. Under the Species at Risk Act in Canada, the Scotian Shelf population of *Hyperoodon* is classified as Endangered and Sowerby's beaked whale is classified as Special Concern (CWS, 2006).

The original population of northern bottlenose whales prior to whaling may have been as many as 90,000, and the current number may be 40–50,000 (Mead, 1989b; Gowans, 2002; IUCN, 2008). The most recent estimate of the northern bottlenose whale population in the Gully, based on photoidentification of individual whales, is 163 animals (Whitehead and Wimmer, 2005). Genetic studies show that the populations in the Gully, Davis Strait, and Iceland are distinct, suggesting little interchange between the areas (Dalebout et al., 2006). There is no abundance estimate for U.S. waters in the SAR because they occur so rarely. There are no North Atlantic ocean-wide estimates of abundance for any of the other beaked whales, although the global abundance of *Ziphius* is believed to be over 100,000 animals. They are pooled in abundance estimates in U.S. Atlantic waters because of species identification issues; the most recent pooled abundance estimate for all five species combined is 3,513 whales from Florida to Georges Bank in summer 2004 (Waring et al., 2008). For the Gulf of Mexico, there are separate abundance estimates for *Ziphius*—95 in 1996–2001 and 65 in 2003–2004, *Mesoplodon* spp.—106 in 1996–2001 and 57 in 2003–2004, and unidentified beaked whales—146 in 1996–2001 and 337 in 2003–2004. None of those estimates are corrected for diving and beaked whales tend to be long divers, therefore the actual numbers are likely to be substantially greater. It is possible that some beaked whales are rather abundant and that their apparent rarity is due more to their offshore distribution, low detectability, and tendency to avoid ships.

Commercial whaling for northern bottlenose whales began in the second half of the 19th Century and lasted until 1973 (Mead, 1989b; Gowans, 2002). At least 80,000 were killed over that time, with peak catches in the 1890s. During 1962–1967, 87 were killed in the Gully by whalers from Nova Scotia (Mitchell, 1974). They are occasionally killed by small-scale whalers in the Faroe Islands, two in 2001 and six in 2002 (IWC, 2005, 2006). *Ziphius* was taken opportunistically in the Japanese fishery for North Pacific bottlenose whales, up to 35 in a single year (Heyning, 1989), and was occasionally taken by traditional whalers in the West Indies (Caldwell and Caldwell, 1971). There have been no directed hunts for *Mesoplodon* spp. (Mead,

1989a), although there have been occasional opportunistic takes in small cetacean fisheries, e.g. *M. bidens* in Newfoundland (Sergeant and Fisher, 1957).

Before it was shut down due to excessive marine mammal bycatch rates, the pelagic driftnet fishery for swordfish off the northeastern U.S. had a relatively high rate of beaked whale bycatch. Forty-six mortalities were recorded by NMFS fishery observers from 1989 to 1998, including 24 Sowerby's, 4 True's, and 1 Cuvier's, with 17 not identified to species (Waring et al., 2008). The extrapolated total annual average mortality from that fishery was 23 beaked whales killed per year. More recently, an average of 1.0 beaked whale per year strands along the U.S. Atlantic coast from human-caused mortality (ship collisions or entanglement in fishing gear), which is not thought to represent a serious impact on any of the species present.

There has been concern in recent years that very loud mid-frequency sounds, most notably naval active sonar and seismic exploration for oil and gas, could have serious impacts on beaked whales (Frantzis, 1998; Balcomb and Claridge, 2001; Evans and England, 2001). There have been several mass stranding events that have coincided with naval exercises—in the Bahamas, Canary Islands, and Mediterranean. Cuvier's beaked whales are most often affected, but some events have included Blainville's or Gervais' beaked whales. One hypothesis is that the loud sounds cause the whales to panic and surface very rapidly from depth, releasing nitrogen bubbles and causing the equivalent of the "bends" (Jepsen et al., 2003). The debilitated whales then strand, and eventually die from the physiological stresses associated with stranding (Cox et al., 2006). There may be other, more subtle impacts of anthropogenic sound. Aguilar Soto et al. (2006) suggested from their tagging study that intense ship noise might impact foraging behavior. On one of the dives by the tagged *Ziphius*, the animal made significantly fewer "buzzes" when the tag was receiving a high level of ship noise.

Ecology and life history

Northern bottlenose whales are usually encountered in small groups of up to four whales (Mead, 1989b). Short-lived aggregations of up to 20 animals are observed (Gowans, 2002). Associations between adult females tend to be short-lived, but some male associations persist for years, suggesting a fission-fusion social structure with male coalitions, similar to that of bottlenose dolphins (Gowans et al., 2001; Gowans, 2002). They typically spend 10 minutes or

more on the surface before dives that may last 1–2 hours. The median dive depth is 1000 m, and they are likely diving to the bottom for foraging (Hooker and Baird, 1999).

Northern bottlenose whales specialize mostly on one genus of deep-water squid, *Gonatus* sp., especially *G. fabricii* (Mead, 1989b; Hooker et al., 2001), although they feed on other species of squid and deep-water fishes. Whitehead et al. (2003) concluded that northern bottlenose whales have a much narrower feeding niche (measured as number of genera of squid eaten) than either sperm whales or *Ziphius*. Their dietary specialization is probably related to their restricted distribution and movement patterns, foraging primarily along the 1000-m isobath.

Reproduction in *Hyperoodon* is the best known of the North Atlantic ziphiids from data collected during 20th Century commercial whaling (Mead, 1989b). Sexual maturity in females occurs at a minimum length of 6.0 m and average length and age of 6.9 m and 11 years. In males the minimum length at maturity is 7.3 m, and the averages are 7.5 m and 7–11 years. Gestation lasts about 12 months, and lactation lasts at least 1 year and is possibly prolonged. Calves average 3.5 m at birth. The mean calving interval is 2 years, although some females have been observed accompanied by newborns and yearlings simultaneously.

Given that observations of living animals are rare and that most species are believed to actively avoid close approaches by vessels, the behavior of most beaked whale species is very poorly known (Heyning, 1989, Mead, 1989a). Adult male beaked whales often bear multiple scars that match the spacing of the tusks in that species, indicating that the scars are inflicted during aggressive encounters between males (Mead, 1989a). Heyning (1984) concluded from the scarring that the blows were struck with the mouth closed, and that the dense, fused bones of the rostrum in adult males were adapted for intraspecific aggression. Cuvier's beaked whales are typically observed in groups of 1–7 animals, with most groups of four or fewer (Heyning, 1989, 2002). *Mesoplodon* spp. tend to occur in small groups (1–6 whales, usually 2 or 3) of mixed large and small animals and probably have a social system like many other toothed whales (Mead, 1989a; Pitman, 2002). Groups at the surface tend to stay tightly clustered, no more than a body length or two apart (Pitman, 2002).

All beaked whales are probably capable of long and deep dives. *Ziphius* dive durations are generally 20–40 minutes (Heyning, 1989). *Mesoplodon* spp. dives are typically 20 to over 45 minutes, with groups of animals generally surfacing and diving simultaneously (Pitman, 2002).

Recent telemetry tagging studies on *Ziphius cavirostris* and *Mesoplodon densirostris* show their use of echolocation during foraging dives is similar to that in sperm whales, with regular clicks produced continuously at depth and short series of closely spaced clicks (“buzzes”) when closing in on targeted prey items (Johnson et al., 2004; Madsen et al., 2005; Zimmer et al., 2005).

All species of beaked whales are squid specialists (Heyning, 1989, 2002; Mead, 1989a, 1989b; Gowans, 2002; Pitman, 2002). Data on stomach contents of *Mesoplodon* spp. are very sparse, but also show a predominance of deep-water squid and occasionally fish (Mead, 1989a), with some of the fish remains probably introduced secondarily in the stomach contents of squids consumed by the whale.

Data from Japanese whaling indicated mean lengths at maturity for *Ziphius* as 5.8 m in females and 5.5 m in males (Heyning, 1989). The data for females may have been biased, since a 5.1-m pregnant female stranded in Florida. Calves average 2.7 m at birth. Reproductive data for *Mesoplodon* spp. are extremely sparse (Mead, 1989a; Pitman, 2002). One stranded female *M. densirostris* was observed with 9 growth layers in the teeth and one corpus albicans in an ovary, indicating recent sexual maturity. *M. europaeus* is the only species with enough data to estimate mean size at maturity—4.5 m in females.

General distribution

Northern bottlenose whales occur only in the North Atlantic, from Nova Scotia and the British Isles in the south to Baffin Island, Greenland, Iceland, Jan Mayen, and Svalbard in the subarctic north (Mead, 1989b; Gowans, 2002). There are six known areas of aggregation—two near Norway, west of Svalbard, north of Iceland, in Davis Strait west of Greenland, and in the Gully, a large submarine canyon east of Sable Island off Nova Scotia. They occasionally occur south to the edge of Georges Bank, where sightings were recorded near the shelf break in 1980, 1993, and 1996, all in late spring or summer (CETAP, 1982; Waring et al., 2008). Seasonality is poorly known, however the known strandings in eastern Canada and New England are scattered throughout the year (Reeves et al., 1993). Bottlenose whales occur in the Gully year-round, and some individuals have been sighted in other canyons along the edge of the Nova Scotian shelf (Gowans et al., 2000; Hooker et al., 2002; Wimmer and Whitehead, 2004).

Cuvier's beaked whale is the most cosmopolitan of all beaked whales, occurring in cold temperate to tropical waters world-wide (Heyning, 1989, 2002). There were six identified sightings in 1979 and 1980 off the northeast U.S. (CETAP, 1982), and a number of additional sightings in more recent surveys off the northeast and in the Gulf of Mexico (Waring et al., 2008). Sightings have been in spring and summer, and concentrated in deeper waters from the shelf break to further offshore. They are also known from strandings along the east coast from Nova Scotia to Florida to the West Indies.

Blainville's beaked whale has the widest distribution of any *Mesoplodon* species, occurring world-wide in warm temperate to tropical waters (Moore, 1966; Mead, 1989a). In the North Atlantic, they are more common in North America than in Europe. Strandings in the western North Atlantic are known from Nova Scotia south to Florida, the Gulf of Mexico, the Bahamas, and the Caribbean.

Gervais's beaked whales were once thought to occur only in the North Atlantic, but there were three strandings on Ascension Island in the tropical South Atlantic in 1980. They are the most common beaked whale in the stranding record from the east coast of the U.S. (Moore, 1966; Mead, 1989a; Norman and Mead, 2001). Fisher's Island, New York is the northernmost occurrence. Strandings occur south to Florida, the Gulf of Mexico, the West Indies, and the Caribbean. Occurrences on the eastern side of the North Atlantic are rare and scattered, occurring in France, Spain, the Canary Islands, Mauritania, and Guinea-Bissau.

Sowerby's beaked whales are known from cold temperate waters on both sides of the North Atlantic, but are much more common on the European side than on the North American side (Moore, 1966; Mead, 1989a). In the western North Atlantic, strandings are known from southern New England north to Newfoundland and Labrador. There is one stranding record from the Gulf of Mexico coast of Florida, however that is believed to be a stray far outside the normal range of the species.

As with Gervais' beaked whale, True's beaked whales were believed to occur only in temperate North Atlantic waters, but recently specimens have been identified from strandings on the Indian Ocean coasts of South Africa and Australia. Strandings are known from the northeast Atlantic (Scotland, Ireland, and France) and in the western North Atlantic from Nova Scotia south to Florida and the Bahamas (Moore, 1966; Mead, 1989a).

Historical occurrence

The only documented historical records of northern bottlenose whale in southern New England were in Rhode Island in 1867—an 8.2-m animal was killed off Newport in February and a second was seen but escaped, and two 7.5-m animals stranded near the Stone Bridge in Tiverton on an unknown date. These were the southernmost known occurrences for the species in the western North Atlantic (Mead, 1989b) until a sighting of two animals near the shelf break east of Cape May, New Jersey in June 1981 (CETAP, 1982). Connor (1971) concluded that all earlier published reports for Long Island were in error. For example, Goodwin (1935) wrote “Linsley (1842) reported a whale of this species at Stonington, Conn.” He clearly mistook Linsley’s account of a minke whale (“*Rorqualus costatus* [sic] Dekay, Beaked Whale”) for *Balaena rostrata*, a once-commonly used junior synonym for bottlenose whale. Waters and Rivard (1962) perpetuated the error, saying that bottlenose whales had been “recorded from the Gulf of Maine to Long Island Sound,” but they included no specific occurrence records from Massachusetts.

There are two historical stranding records for Cuvier’s beaked whale in Rhode Island, both described in Cronan and Brooks (1968). A 564-cm animal stranded in Newport in October 1901. A 580-cm, 2,535-kg animal stranded alive in Newport on 13 March 1961 and died the next day. The photo in Cronan and Brooks shows visible teeth, so it was an adult male. There were no stranding records in the study area in New York, although there were several farther west in Long Island and others in New Jersey. Waters and Rivard (1962) stated that there had been many strandings over the years in Massachusetts, mainly in spring, and reported three recent records—two in Falmouth in March 1958 and one on Nauset Beach in August 1961, killed by a ship collision.

There are no historical stranding records for any of the *Mesoplodon* species in Rhode Island, and few in the study area. There is one record of Blainville’s beaked whale in eastern Long Island, on 12 May 1925 in Southampton. There was one stranding of True’s beaked whale on Mason’s Island in Mystic, Connecticut on 19 November 1937, the only Connecticut occurrence for any beaked whale. There are multiple historical records of Blainville’s, Gervais’, and True’s beaked whales in western Long Island and New Jersey. Goodwin (1935) suggested that a stranding at Southampton, New York was probably a Sowerby’s but gave no evidence or

even a date. Waters and Rivard (1962) reported that Blainville's, Sowerby's, and True's beaked whales were all known from strandings in Massachusetts.

Recent occurrence

The general pattern for beaked whales in the Rhode Island study area is strandings on the beaches and sightings at the shelf break and farther offshore, with a few scattered occurrences in between (Fig. 23). Most records that are identified to species are strandings; conversely, very few sightings are identified to species. There were two identified Cuvier's beaked whale sightings in the study area—one animal from a whale-watching boat in August 1986 in relatively shallow water near the 60-m isobath southeast of Montauk Point and a pair from a NOAA ship in deep water over the slope about 175 km offshore in August 1995. There were also two identified sightings of Sowerby's beaked whales in deep slope waters from a NOAA ship in 2004—three animals on 11 July and two animals on 2 August. Sowerby's was the most common beaked whale species taken incidentally by the swordfish driftnet fishery (see Status, above), which operated on the southern edge of Georges Bank just to the east. There are no identified sightings of Blainville's, Gervais', or True's beaked whales in the Rhode Island study area. There are few data for any species on migration or seasonality; sightings have tended to be mostly in the summer, but that may reflect more on patterns of survey effort and good weather than presence of whales (Table 3). Blainville's beaked whale is the only species that does not occur most often in summer, with two spring records and one in winter.

A stranding on Fishers Island (part of New York, but physically closer to Connecticut than to Long Island) on 17 July 1999 was originally identified as Sowerby's beaked whale and reported as such to the stranding network. It would have been the first documented occurrence of the species in the Rhode Island study area and the only record for New York. Subsequently, the skull was cleaned and photographs were sent to J. G. Mead at the Smithsonian, who identified it as Gervais' beaked whale (R. Nawochik, Mystic Aquarium, pers. comm.), the sole record of that species in the Rhode Island study area. To balance the ledger, there was a stranding on Block Island on 22 February 2007 (it occurred after obtaining the stranding database, so is not included on Fig. 23). It was identified at first by a local volunteer as a "dolphin," but photos were sent to Mystic Aquarium and then eventually forwarded to the Smithsonian. Dee Allen at the

Smithsonian identified it as definitely a *Mesoplodon* and most likely Sowerby's beaked whale (*M. bidens*), but in the interim a storm washed the carcass back out to sea so no specimen could be collected to document the identification.

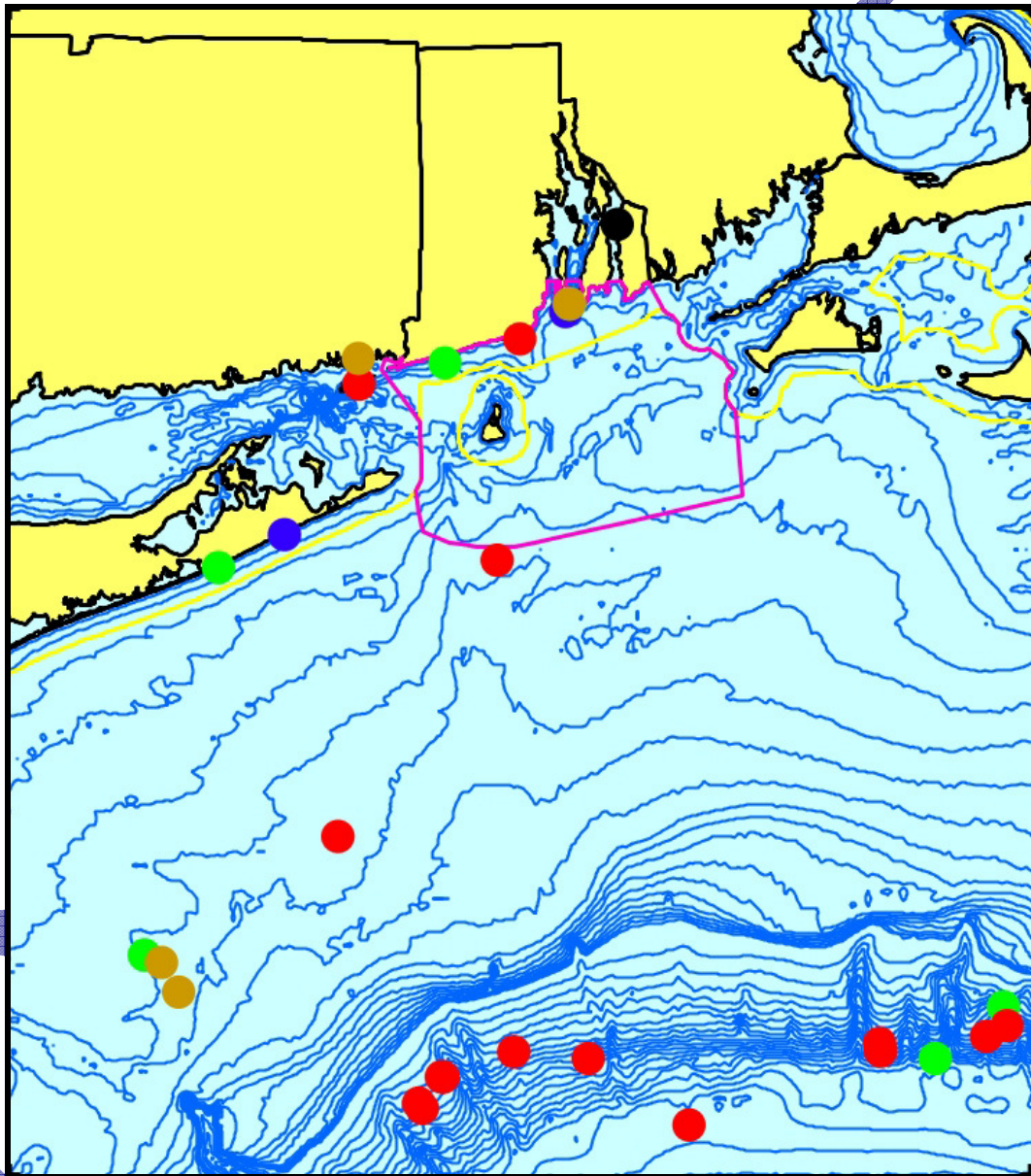


Figure 23. Aggregated sighting, stranding, and bycatch records of northern bottlenose whales, Cuvier's beaked whales, Blainville's beaked whales, Gervais' beaked whales, Sowerby's beaked whales, True's beaked whales, unidentified *Mesoplodon* sp., and unidentified beaked whales in the Rhode Island study area, 1867–2005 (n = 29: winter = 2, spring = 6, summer = 16, fall = 4, unknown = 1).

Table 3. Seasonal frequencies of all beaked whale records in the database (except for one 1857 northern bottlenose whale stranding where the date was not known).

Species	Winter	Spring	Summer	Fall
Northern bottlenose whale	1	0	0	0
Cuvier's beaked whale	0	1	2	1
Blainville's beaked whale	1	2	0	0
Gervais' beaked whale	0	0	1	0
Sowerby's beaked whale	0	0	2	0
True's beaked whale	0	0	1	1
<i>Mesoplodon</i> sp.	0	0	4	0
Unidentified beaked whale	0	3	6	2
Total	2	6	16	4

A 420-cm, 781-kg Blainville's live-stranded at East Hampton, New York on 14 February 1986. It died soon after stranding. On 21 March 1991, a 404-cm female Blainville's beaked whale stranded just west of the Quonochontaug Breachway in Charlestown, Rhode Island. It was lactating, but there was no sign of the calf.

There was only one recent stranding of a True's beaked whale in the Rhode Island study area. A badly decomposed 463-cm carcass washed up on 2 August 1983 at Sand Hill Cove in Narragansett.

There have been no recent strandings of northern bottlenose whale, Cuvier's beaked whale, or Sowerby's beaked whale (except for possibly the 2007 Block Island stranding discussed above) in the Rhode Island study area. Taking into account all of the historical and recent information, the general conclusion would be that the study area is situated well beyond the normal range of northern bottlenosed whales, near the southwestern edge of the range of Sowerby's beaked whale, near the northeastern edge of the range of Gervais' beaked whale, and well within the range of the other three species.

Conclusions

At least three species of beaked whales probably occur regularly within the Rhode Island study area, and two others may occur. Beaked whales normally occur far offshore at the shelf break and beyond, and so would not be expected within the SAMP area.

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3.2.18. Beluga Whale *Delphinapterus leucas* (Pallas, 1776)

Monodontidae includes two species of Arctic endemics, the narwhal (*Monodon monoceros*) and the beluga. The two living species are relicts of a family that was formerly more widespread in Northern Hemisphere temperate latitudes (Barnes, 2002b). Belugas are also known as white whales; the word “beluga” or “belukha” is the Russian word for “white.”

Description

Beluga whales may be the easiest cetaceans to identify (Brodie, 1989; Jefferson et al., 1993; O’Corry-Crowe, 2002). Adult females are up to 4 m long. The maximum recorded size for a male was 6 m, but they usually do not reach more than about 4.5 m. Belugas have stocky bodies with no dorsal fin, instead there is a low dorsal ridge about 50 cm long but only 1–3 cm high along the mid-back. There may be thick folds of blubber, especially along the ventral surface. There is an obvious neck, which is much more flexible and mobile than in other cetaceans. The head is rounded and tapered in calves, with only the slightest indication of a beak. The melon expands with age, creating a bulbous forehead and a more obvious short, broad beak. The flippers are broad, blunt, and flat, but develop a distinct upward curve on the lateral edge in adult males that can be used to differentiate sexes in the field. The flukes have convex trailing edges. Belugas’ most conspicuous character is their color—adults are completely snow-white. Calves are born dark slaty gray and gradually become lighter with age, becoming all white at the time of sexual maturity. Adults sometimes appear yellow, however that seems to be associated with molt.

Status

Belugas are not listed under the U.S. Endangered Species Act or on the Rhode Island state list, and are classified as Near Threatened on the IUCN Red List. The St. Lawrence Estuary stock is listed as Threatened under the Species At Risk Act in Canada (CWS, 2006). It had been classified as Endangered by COSEWIC (Committee on the Status of Endangered Wildlife in Canada), but their role is advisory only, with the SARA listing made by the federal government.

The total abundance of beluga whales worldwide is estimated to be at least 150,000, spread across 29 separate identified regional populations (IUCN, 2008). The St. Lawrence Estuary stock was estimated at 1,221 whales in 1997, with the number of calves observed suggesting a slow recovery (CWS, 2006). There is no estimate of the number in U.S. Atlantic waters (Waring et al., 2008).

Belugas are taken by subsistence hunters in many parts of the species' range. Statistics collated by the International Whaling Commission's Scientific Committee summarize the 2000–2004 annual subsistence takes in Greenland (610, 398, 399, 430, 196), Russia (22, 7, 20, 66, unknown), and Alaska (240, 463, 394, 271, 262) (IWC, 2005, 2006). Canada reported a subsistence take of 375 in 2001, but takes in other years are not known (IWC, 2006; Canada is not an IWC member). In the St. Lawrence estuary, they were hunted for over 400 years until the hunt was prohibited in 1979 (CWS, 2006). The peak years of the St. Lawrence beluga hunt were 1880–1950, when as many as 15,000 whales were killed. Béland (1996) estimated that the St. Lawrence beluga population was about 5,000–10,000 at the beginning of the 20th Century, declining to only about 350 individuals in the 1970s.

A serious concern with St. Lawrence estuary beluga whales is the issue of toxic contamination and associated health effects (Béland et al., 1993; Martineau et al., 1994, 1999; De Guise et al., 1994, 1998; Measures et al., 1995; Béland, 1996; Mathieu et al., 1997; Gauthier et al., 1999; Hickie et al., 2000). The St. Lawrence River is the outlet from the Great Lakes and a substantial watershed in the industrial center of North America. There are contaminants in the water and sediments, accumulating up the food chain to the belugas at the top. St. Lawrence belugas have much higher loads of contaminants than Arctic belugas, including lead, mercury, selenium, PCB's, DDT, dioxins, furans, Mirex, and PAH's. The effects of these contaminants include direct toxicity, suppression of the immune system, effects on the reproductive system, mutation, and cancer. There is evidence for higher rates of disease and parasitism in St. Lawrence beluga whales. One beluga with both testes and ovaries was recorded in 1994, and many females appear to cease reproduction after reaching about age 21, which is not known from other beluga populations. Finally, over a third of all known tumors recorded from cetaceans have been in St. Lawrence River belugas.

Ecology and life history

Beluga whales are highly social and gregarious (Brodie, 1989; O’Corry-Crowe, 2002). They generally are seen in small groups of 2–10 animals, however they often occur in aggregations of over 1,000 animals in their summer habitats. Sightings off the northeastern U.S. are usually single individuals, although there was one group of six animals seen for two months in the vicinity of Portland, Maine in August–September 1927 (Reeves and Katona, 1980). Reeves and Katona reviewed hypotheses for why belugas have not expanded their range south of the St. Lawrence while at the same time there were so many extralimital records. The possible explanations were temperature, avoidance of predators, competition, and prey abundance including the effects of commercial fishing, of which they considered competition the most likely. It is more likely that matrilineal habitat fidelity plays an important role, but that research was not available in 1980.

Belugas follow a distinct annual movement pattern (Brodie, 1989; O’Corry-Crowe, 2002). After the spring break-up of the sea ice, they move into summering areas in near-shore waters and in river mouths and estuaries. They frequently occur in extremely shallow water, sometimes barely deep enough to swim. They are apparently capable of swimming backwards, which may help them avoid being stranded by the out-going tide. At times they have been observed getting stuck on an out-going tide and simply waiting for the next high tide to re-float them. One hypothesis for using shallow waters in summer is that water temperatures may warm more quickly, providing a thermoregulatory benefit to young calves. In addition, belugas are the only cetacean known to undergo an annual molt in summer (St. Aubin et al., 1990). The entire outer layer of the skin turns yellow and is sloughed off. During the molt, belugas are known to rub themselves on gravel bottoms in shallow water to help scrape off the old skin (Smith et al., 1992). In winter, belugas are thought to mainly move offshore with the ice edge, however satellite tracked radio-tagging has shown them traveling long distances to as far as 1100 km offshore and as much as 700 km deep in the ice pack (Suydam et al., 2001).

Beluga whales are capable of diving to the sea floor in much of their habitat (Martin and Smith, 1992; Martin et al., 1998; Suydam et al., 2001). Satellite-linked time-depth-recorder tags show that they routinely dive to 300–600 m and are capable of dives to more than 1000 m with durations up to 25 minutes.

The diet of beluga whales is extremely broad, although little is known for the winter season (Brodie, 1989; Stewart and Stewart, 1989; Measures et al., 1995; Béland, 1996; O’Corry-Crowe, 2002). Prey species include benthic and demersal fishes such as flounders, gadids, and sand lance; pelagic fish such as capelin, herring, and smelt; migratory fishes like salmonids and eels; squid; octopus; shrimp; and benthic worms, clams, and crabs. Evidence for bottom feeding includes occasional seaweed, sand, and gravel in stomach contents.

Calving takes place in a relatively short period in the summer, with the timing differing slightly between different stocks (Brodie, 1989; Stewart and Stewart, 1989; O’Corry-Crowe, 2002). Calving peaks in July in the St. Lawrence population. Calves average 1.6 m at birth. Mating takes place in the spring, and the gestation period is 14–14.5 months. Males attain sexual maturity at about age 8, and females around 5–6. Lactation lasts 20–24 months, with the calf beginning to feed on easily captured prey like crabs, worms, and mollusks during its second year. The inter-birth interval for most females is 3 years.

General distribution

The beluga is primarily an Arctic species, occurring in high latitudes around the Northern Hemisphere (Brodie, 1989; Stewart and Stewart, 1989; Nowak, 1999; O’Corry-Crowe, 2002). They are found along Alaska (south into the Bering Sea), Arctic Canada (south to Labrador and Hudson Bay), east and west Greenland, Svalbard, northern Norway, and Arctic Russia (south into the Sea of Okhotsk in the northwest Pacific). Stock divisions are maintained by very strong matrilineal fidelity to summering sites, even where there are few barriers between sites. Genetic studies have been used to elucidate stock structuring in belugas. Nuclear DNA markers show that North American belugas partition into two groups, eastern and western, suggestive that they occupied two separate refugia during the Pleistocene Ice Age (Brown Gladden et al., 1999b). Mitochondrial DNA shows the finer structure indicative of matrilineal habitat fidelity (Brennin et al., 1997; Brown Gladden et al., 1997). There are isolated relict populations in Cook Inlet in southern Alaska and in the Gulf of St. Lawrence and adjacent bays and rivers in eastern Canada. There have been occasional occurrences of belugas along the Atlantic coast from Nova Scotia to New Jersey (Reeves and Katona, 1980), which are believed to be individuals from the St.

Lawrence population. Brown Gladden et al. (1999a) confirmed via genetic sampling that a beluga stranded in Nova Scotia did come from the St. Lawrence population.

Historical occurrence

Cronan and Brooks (1968) knew of no occurrences of belugas in Rhode Island, but stated that “there are records from New Hampshire; Cape Cod, Massachusetts; and Atlantic City, New Jersey; it therefore seems likely that the white whale may someday be seen off Rhode Island.” The occurrence of belugas at Atlantic City is one of those errors that get passed down through the literature based a previous misinterpretation and then a series of repeated citations. Reeves and Katona (1980) concluded that the error traced back to someone’s mis-reading of True (1910), who reported behavioral observations of two captive belugas that were held in a tank in Atlantic City in 1908. Reeves examined the skull of one of those animals in the Smithsonian collection (USNM238104), and it did have a tag labeled “from Atlantic City,” but the curatorial records show that it was captured in the St. Lawrence River. Connor (1971) knew of no confirmed records of belugas in or near Long Island. He said that Roy Latham had reported a 3–4-m white cetacean that he concluded was a beluga in Long Island Sound between Orient Point and Mattituck for four days in June 1942. Connor judged the report to be reliable, and there is a record in the Smithsonian database based on Connor’s publication, the only mid-Atlantic beluga record in the Smithsonian database older than 1978. Reeves and Katona (1980) also accepted Latham’s report as likely in their review of extralimital beluga occurrences off the northeastern U.S.

Recent occurrence

Belugas are rare in the Rhode Island study area, with only four records (Fig. 24; note that the numbers of sightings can be misleading, because an animal seen repeatedly for up to several months is typically represented in the data by only one or two records). Somewhat surprisingly, they occur more frequently in western Long Island and New Jersey (including one seen in Delaware Bay and the Delaware River in April 2005, as far upstream as Trenton). Individuals that do occur south of Cape Cod commonly stay for extended periods, usually very near the coast

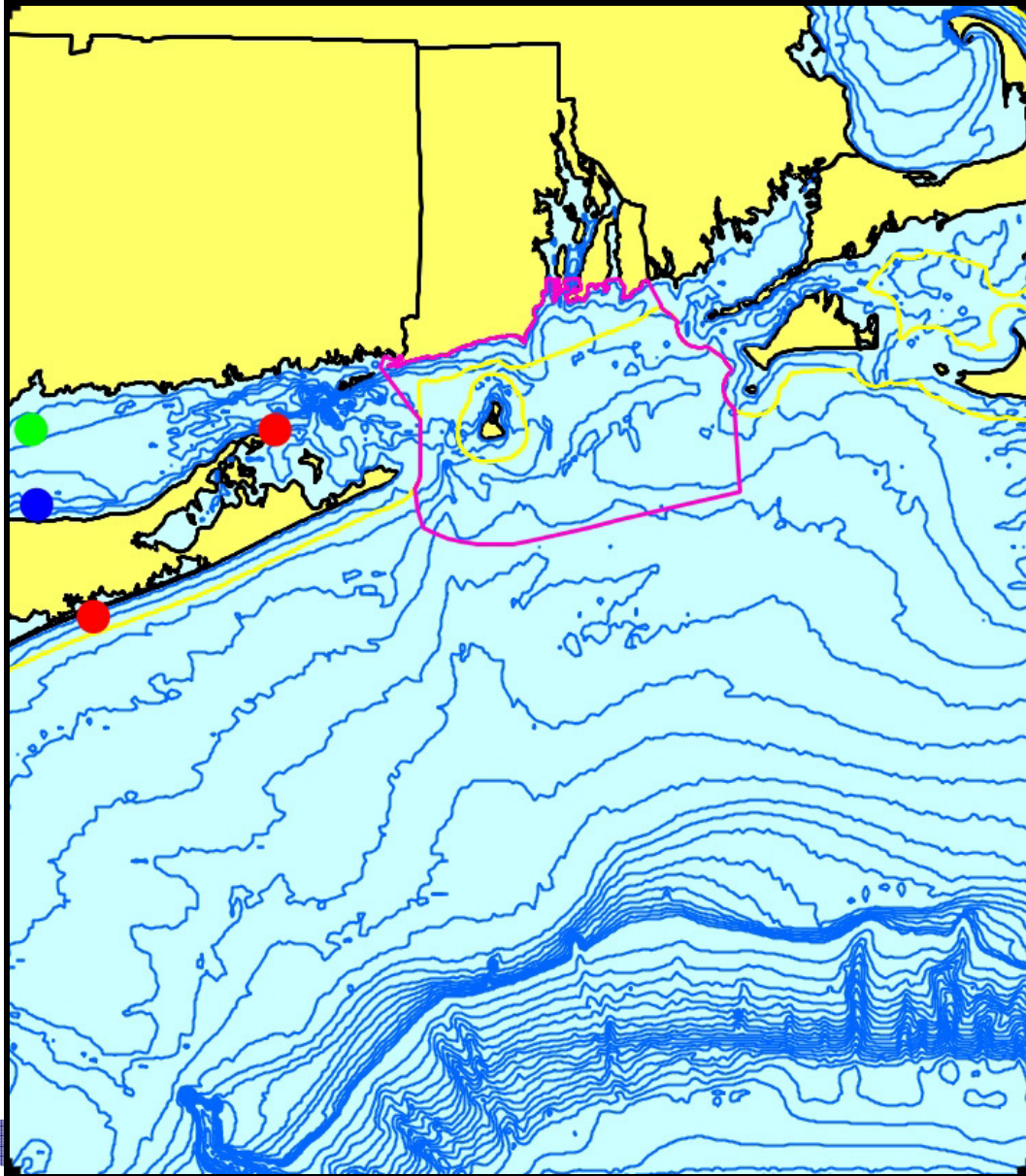


Figure 24. Aggregated sighting, stranding, and bycatch records of beluga whales in the Rhode Island study area, 1942–1986 ($n = 4$: winter = 1, spring = 1, summer = 2, fall = 0).

(Reeves and Katona, 1980). The study area records include the June 1942 sighting off Orient Point reported in Connor (1971). A single beluga was seen off Moriches Inlet on the south shore of Long Island on 22 June 1980. In February 1985, a beluga was seen in the harbor at New Haven, Connecticut. It was sighted repeatedly over the succeeding months. On 13 May 1986 it

was found dead and entangled in fishing gear in Long Island Sound south of New Haven, however the cause of death was determined at necropsy to be from a gunshot wound.

Conclusions

Belugas clearly occur only accidentally on rare occasions in the Rhode Island study area and are not expected in the SAMP area.

DRAFT

DRAFT

3.2.19. Harbor Porpoise *Phocoena phocoena* (Linnaeus 1758):

Phocoenidae includes three genera and six species of small toothed whales known as the porpoises, which are the smallest of the living cetaceans (Read, 2002). They are sometimes referred to as the “true” porpoises, most likely because the term “porpoise” has frequently been used in the U.S. as equivalent to “dolphin.” Porpoises are closely related to the dolphins, and were long included in the Delphinidae. They are now recognized as a separate family, but are included with Delphinidae and Monodontidae in the superfamily Delphinoidea (Rice, 1998).

Porpoises are easily differentiated from dolphins by having spatulate rather than conical teeth (Read, 2002). The exposed portion of a porpoise tooth is flattened, somewhat wider than the base diameter, and slightly curved. A porpoise has a conical head without a beak. Their skulls resemble the skulls of very young dolphins, with delayed fusion of cranial sutures. The rostrum of the skull is much shorter than in small dolphins, and there are paired rounded protuberances on the premaxillae just in front of the braincase, which is relatively large and rounded. Porpoises have small but robust bodies, with relatively small flippers and dorsal fins (the dorsal fin is absent in the finless porpoise), which is likely related to conservation of heat for a relatively small animal living in cold water. Most species have epidermal tubercles on the leading edge of the dorsal fin. Porpoise life histories are more like those of mysticetes than like other odontocetes, with early maturation, rapid growth, short inter-birth intervals, and a low degree of sociality (Read and Hohn, 1995).

Description

Harbor porpoises are the smallest cetaceans occurring in the North Atlantic, reaching only 1.4–1.9 meters. They exhibit reverse sexual dimorphism; an average female is 160 cm and 60 kg, an average male is 145 cm and 50 kg, and the largest individual known was a 200-cm, 70-kg female (Bjørge and Tolley, 2002). The size ranges of mature porpoises from the Bay of Fundy were: females—131–168 cm (mean = 157, n = 32), 42–76 kg (mean = 62); males—129–157 cm (mean = 144, n = 62), 36–61 kg (mean = 49) (Read, 1999). The body is stocky, dark gray to black on the back and white on the belly with little or no distinctive patterning (Gaskin et al., 1974; Jefferson et al., 1993; Read, 1999; Wynne and Schwartz, 1999; Bjørge and Tolley, 2002).

The sides may be mottled or simply transition gradually from dark to light. There are often one or more dark stripes from the corner of the mouth to the flipper. Individuals may show darker eye, chin, and lip patches. The head is bluntly conical with no distinct beak. The flippers are small and pointed, and the dorsal fin is small, triangular (sometimes slightly falcate), and located slightly behind the middle of the back.

Status

Harbor porpoises are not listed under the U.S. Endangered Species Act. A proposal made in 1993 to list the Gulf of Maine/Bay of Fundy stock as Threatened because of excessive bycatch mortality in the sink gillnet fishery was withdrawn in 1999 after an extensive review (NMFS, 1999) and the species was removed from the Candidate list in 2001 (NMFS, 2001). Harbor porpoises are not included on the Rhode Island state list and are classified as Least Concern on the IUCN Red List. Northwest Atlantic harbor porpoises are listed as Special Concern under the Species at Risk Act in Canada (CWS, 2006). The total number of harbor porpoises in the North Atlantic is likely to be over 500,000 (IUCN, 2008). The current estimate for the Gulf of Maine/Bay of Fundy stock is 89,054 (Waring et al., 2008).

Harbor porpoises were the subject of an organized hunt in Denmark for oil and meat from at least the 14th Century until World War II, and had probably been hunted in that area since the Stone Age (Kinze, 1995). Average annual catches probably exceeded 1,000 animals. Inuit subsistence hunters in Greenland took 1,607 porpoises in 2000, 1,946 in 2001, 1,373 in 2002, 2,320 in 2003, and 2,238 in 2004 (IWC, 2005, 2006). Micmac and Passamaquoddy Indians in the Bay of Fundy and along the coast of Maine hunted porpoises for both meat and oil in the 19th and 20th Centuries (reviewed by Reeves and Read, 2003). They hunted from canoes using shotguns, but there is no archeological evidence that hunting occurred before the introduction of firearms. The blubber was rendered down to 2–3 gallons of oil that was used for lighting and lubrication. Much more valuable was the “jaw oil” from the mandibular fat, which was used for lubricating clocks, watches, and other precision instruments. Jaw oil was obtained by hanging the lower jaw over a can and allowing the oil to drip out, producing about a half-pint per animal. Total takes were likely several hundred per year.

Mortality of harbor porpoises and other phocoenids as bycatch in commercial fisheries is

a global concern (Perrin et al., 1994b; D'Agrosa et al., 1995; Read and Wade, 2000). The most significant fishery bycatch occurs in sink gillnet fisheries. As pointedly noted by Reeves and Read (2003), the first U.S. government fisheries report in 1886 detailing the efficiency of gillnet fishing for cod also reported incidental captures of harbor porpoises. The most recent stock assessment for Gulf of Maine/Bay of Fundy harbor porpoise stock (Waring et al., 2008) reported annual average mortality of 725 porpoises in gillnet fisheries during 2001–2005—475 in the northeastern U.S., 177 in the mid-Atlantic, and 73 in Canada. There are also lower levels of mortality in other fisheries. A Take Reduction Plan is in effect in U.S. Atlantic waters, involving fishery closures in specific areas at times when the probability of porpoise bycatch is high, plus a requirement for the use of acoustic alarms (“pingers”) to alert porpoises to the presence of gear. Bycatch mortality did decline for a time, however then began to increase, perhaps due to declining compliance with the Take Reduction Plan.

Harbor porpoises are the most common stranded cetacean in the Rhode Island study area (Table 2). Fishery-related mortality is likely to be a significant component of the stranding record. Of those strandings where a cause of death could be determined, over a quarter showed evidence of fishery interactions (Waring et al., 2006b). In another 18%, the animals were judged to be emaciated and most likely were newly weaned calves that were unsuccessful at feeding independently.

Given that harbor porpoises live in coastal waters adjacent to areas with high human population densities and industrial development, the potential effects of toxic pollution are of concern. In some areas harbor porpoises do have high levels of organochlorines and heavy metals in their body tissues, but no correlations have been shown with adverse health effects or body condition (Read, 1999).

Ecology and life history

The most common harbor porpoise sighting off the northeastern U.S. is a single individual, with pairs and trios common (CETAP, 1982). This is consistent with observations in other areas (Read, 1999; Bjørge and Tolley, 2002). Groups of 6–10 are often observed, or even larger groups on rare occasions, however these are not stable social groupings as in many other toothed whales. Harbor porpoise groupings are fluid, short-term associations in a “fission-

fusion” social structure (Reeves and Read, 2003). The largest reported groups are most likely aggregations of un-associated animals in areas of abundant prey.

Harbor porpoises exhibit a clear seasonal pattern of distribution and movement, however there is little evidence for a coordinated annual migration (Reeves and Reed, 2003). Off the northeastern U.S., porpoise abundance declines in the Gulf of Maine in winter, coincident with the peak occurrence in the mid-Atlantic region. However, evidence from genetic sampling of stranded and bycaught individuals shows that some proportion of the animals in the mid-Atlantic region do not come from the Gulf of Maine/Bay of Fundy stock (Rosel et al., 1999). In addition, the majority of stranded and bycaught porpoises in the mid-Atlantic are juveniles. Although juvenile mortality rates can be expected to be higher, there also may be age differences in seasonal movements, perhaps with younger animals wintering in more inshore areas than older animals.

Most dives by harbor porpoises are just about a minute or a little longer, but they are capable of diving for 5 minutes to depths exceeding 200 m (Westgate et al. 1995). Their surfacings are very brief. Read and Westgate (1997) studied movements of Gulf of Maine harbor porpoises using satellite-tracked radio tags. Average daily movements were 14–58 km. Tagged animals commonly remained resident in small, localized areas for extended periods, then made relatively rapid, directed movements lasting hours or days to different areas. Tagged porpoises ranged over the entire Bay of Fundy and Gulf of Maine area.

Harbor porpoises primarily feed on fish and secondarily on squid and crustaceans (Gaskin et al., 1974; Read, 1999; Bjørge and Tolley, 2002; Reeves and Read, 2003). They preferentially feed on non-spiny fishes with relatively high fat content that are less than 40 cm long (usually 10–30 cm). Clupeids and gadoids dominate. Their primary prey species in the Bay of Fundy are herring and silver hake. Other commonly eaten species include anchovies, sprat, sardines, and capelin, and calves apparently begin feeding on small crustaceans. Stomach contents of stranded porpoises in the Rhode Island study area frequently include herring and squid (Sadove and Cardinale, 1993). Harbor porpoises do not forage cooperatively, and often feed near the bottom (Read, 1999). Their daily ration ranges from 5% to 14% of body weight, and is highest in immatures and in pregnant and lactating females.

Harbor porpoise reproduction is strongly seasonal, with the timing varying between regions (Read, 1999; Reeves and Read, 2003). In the Gulf of Maine/Bay of Fundy population,

ovulation occurs within a few weeks in late spring and early summer (Read, 1990a). Only the left ovary matures. There is also marked reproductive seasonality in the males, with testis mass and sperm production varying on an annual cycle and peaking at the same time as ovulation (Reeves and Read, 2003). At the peak of the breeding season, the testes in an adult male comprise about 4% of total body mass. The mating system is probably promiscuous with sperm competition occurring. Gestation is 10–11 months, with most calves born in May in the Gulf of Maine, and June-July in Europe.

Calves are about 75 cm long and weigh about 6 kg at birth, and triple their weight in about 3 months (Read, 1999; Reeves and Read, 2003). Lactation lasts at least 8 months and possibly as long as a year, but weaning is gradual and calves begin feeding independently well before being completely weaned. Post-partum estrus and mating is common in harbor porpoise females, resulting in simultaneous pregnancy and lactation and 1-year intervals between calves. Most females give birth annually in the Gulf of Maine and European populations, but every other year in the California population (Read, 1990b; Read and Hohn, 1995).

Harbor porpoises typically reach sexual maturity in their third or fourth years, but are not physically mature until about age 5 in males and 7 in females (Read, 1999). The mean age at sexual maturity for Gulf of Maine/Bay of Fundy females is 3.44 years, at an average length of 143 cm (Read, 1990b).

Some harbor porpoises from the Bay of Fundy have tested positive for antibodies to morbillivirus (Duignan et al., 1995). A few porpoises died during the 1988 PDV epizootic in the North Sea harbor seals. Van Bressem et al. (2001) reported 16.7% morbillivirus seropositives in mature porpoises from the British Isles, but no positive tests in immatures from the British Isles or in either immatures or adults from the North Sea.

General distribution

Harbor porpoises are known from cool temperate to subpolar waters around both the North Atlantic and North Pacific (Gaskin et al., 1974; Read, 1999; Bjørge and Tolley, 2002; Reeves and Read, 2003). They occur most often in relatively shallow continental shelf and coastal waters. The sightings from the 1978–1981 CETAP surveys showed porpoises in spring most concentrated in the southwestern Gulf of Maine around Nantucket Shoals and western

Georges Bank but also occurring throughout the Gulf of Maine and southern New England shelf, followed by a marked concentration into the northern Gulf of Maine and Bay of Fundy in the summer (CETAP, 1982). Sightings were much less frequent and extremely scattered in fall and winter, and it was hypothesized that many individuals migrated to the mid-Atlantic or offshore waters. Strandings are widespread from Maine to North Carolina. There are two stranding records for Florida in the 1980s and one in 2003 (Waring et al., 2008), however they are considered to be extralimital, since there are no other records south of North Carolina.

Historical occurrence

Cronan and Brooks (1968) knew of no records of harbor porpoises in Rhode Island, but did mention occurrences nearby in Mount Hope Bay in July 1931 and September 1934 that “would have to go through Rhode Island waters to arrive in or leave Mount Hope Bay.” In the Smithsonian database there is a record of a stranding at Brenton’s Point in Newport on 5 July 1901, collected by E. A. Mearns, plus another undated specimen record from Newport, also collected by Major Mearns. There are also records of a 119-cm, 26-kg porpoise stranded at Narragansett Pier in February 1972, and 139-cm animal stranded on First Beach in Newport in March 1976.

There are historical stranding and capture records in the Smithsonian data for eastern Long Island, and quite a few more for western Long Island and New Jersey. The earliest harbor porpoise record in those data was a report of a porpoise taken more than 30 km up the Connecticut River in Middletown, Connecticut in 1850. One of the Smithsonian records is a sighting of 25 porpoises off Orient Point on 7 December 1921 extracted from Connor (1971), which might be suspect (see below). There is also a record of a live-stranding of a 120-cm, 20-kg porpoise in Niantic, Connecticut that was collected and survived for a short time at Mystic Aquarium. Waters and Rivard (1962) said that harbor porpoises occurred all along the coasts of New England, but were not very common in Cape Cod Bay. They presented only one recent record—a stranding up a river in Annisquam on Cape Ann in 1955.

Historical accounts of harbor porpoises in southern New England study area must be treated with some level of skepticism because of the common use of the word “porpoise” to also refer to dolphins, as pointed out by Connor (1971) with regard to sighting reports for Long Island

during summers in the 1950s and 1960s. In addition, the recent data show harbor porpoises to be relatively rare in summer (see below). Also somewhat suspect are the accounts of porpoises in large schools, sometimes up to hundreds of animals (e.g., Miller, 1899; Rowley, 1902; Turrell, 1939: as cited by Conner, 1971; Cronan and Brooks, 1968). De Kay (1842) reported that porpoises were “formerly so abundant on the shores of Long Island as to have induced the inhabitants to form establishments for their capture.” His account was derived from a 1792 report by E. L’Hommedieu in *Transactions of the Society in the State of New-York for the Promotion of Agriculture, Arts, and Manufactures*, which described a net fishery in eastern Long Island taking small cetaceans for oil and leather. Mead (1975) concluded that the fishery was not for harbor porpoises, but was most likely for bottlenose dolphins, in part because the average oil yield reported (6 gallons) was too high for *Phocoena* but matched that from the Cape Hatteras *Tursiops* fishery. In addition, the capture method described matched what was used at Cape Hatteras. Linsley’s (1842) report that “Numbers of the common porpoise are taken in this town for the sake of the oil, which is usually from three to seven gallons” suffers from the same weakness.

Recent occurrence

Harbor porpoise occurrence in the Rhode Island study area is strongly seasonal, with 69.5% of all records in spring, followed by winter (19.5%), summer (7.8%), and fall (2.7%) (Fig. 25). Sightings are widespread across the shelf. Strandings have occurred all along the south shore of Long Island and in parts of coastal Rhode Island. There were also strandings along both sides of Long Island Sound and occasional occurrences in bays, estuaries, and rivers. Seasonal stranding frequencies partly mirror the sighting frequencies—highest in winter and second-highest in spring. Harbor porpoises are relatively common in the winter in eastern Long Island Sound, Gardiner’s Bay, and Peconic Bay (Sadove and Cardinale, 1993), however bays and sounds are excluded from survey areas so there are few documented sighting records. They probably also occur in winter in Narragansett Bay, although we have only second- and third-hand anecdotal reports for evidence.

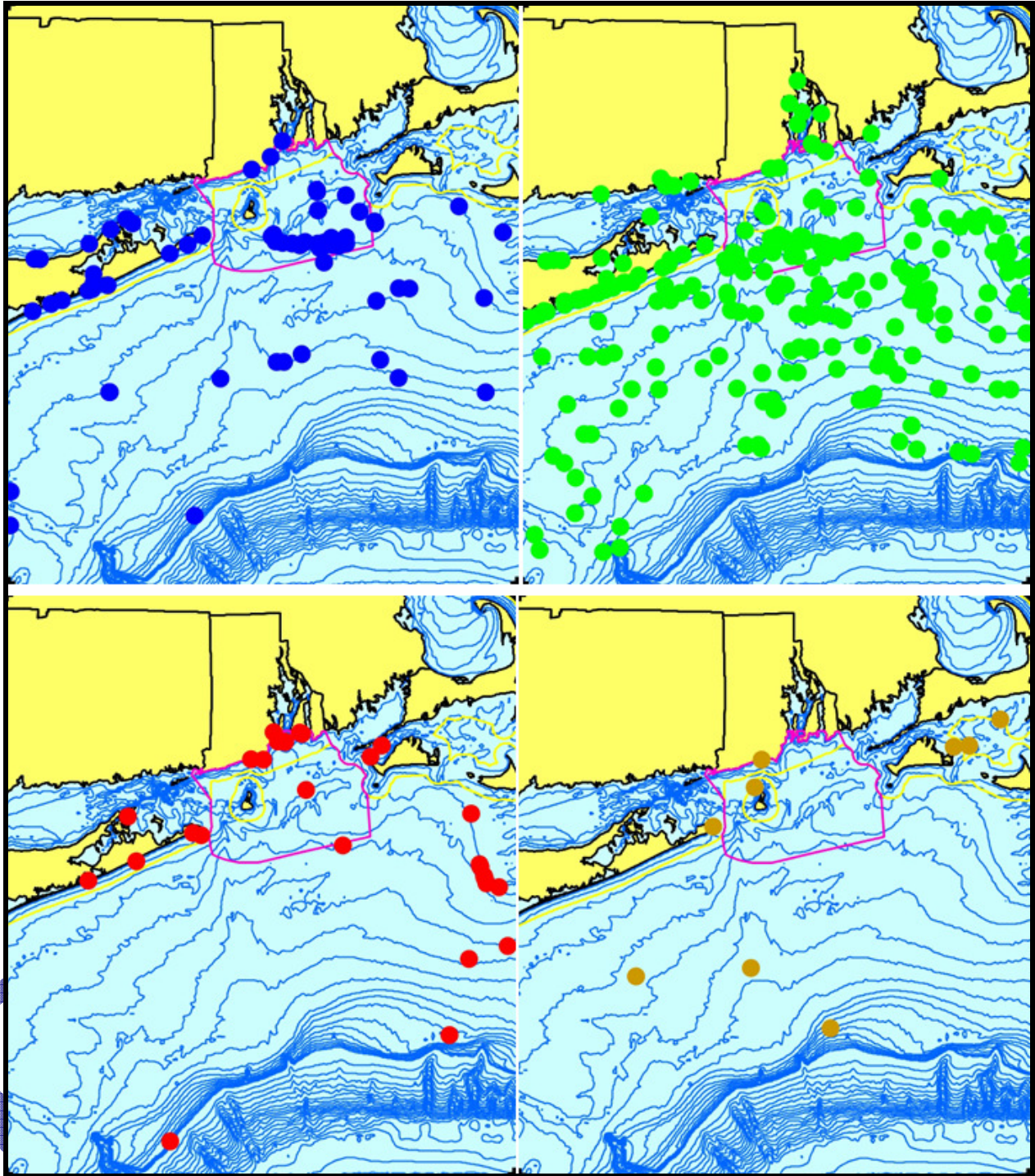


Figure 25. Aggregated sighting, stranding, and bycatch records of harbor porpoises in the Rhode Island study area, 1850–2007 (n = 376: winter = 73, spring = 262, summer = 29, fall = 10, unknown = 2).

The effort-corrected relative abundance patterns show that harbor porpoises occurred within the SAMP area in all four seasons of the year (Fig. 26). The data probably under-represent occurrence, because of their relatively low detectability during surveys. In winter, they were present at low to moderate abundances in the eastern part of the SAMP area, as well as south of Martha's Vineyard and Nantucket and offshore along the entire study area. In spring, porpoises occurred throughout the SAMP area, at relative high abundances in the offshore portion. They also occurred at relatively high abundance throughout much of the study area, and in highest abundance over Nantucket Shoals and eastward. Spring is when harbor porpoises are known to be migrating from wintering areas in the mid-Atlantic and offshore toward their spring and summer feeding grounds in the Gulf of Maine (CETAP, 1982; Read, 1999; Waring et al., 2008). In summer, porpoises were present in lower numbers in the eastern half of the SAMP area, and still in high abundance in the Nantucket Shoals area. Their abundance was lowest in fall—in the western half of the SAMP area around Block Island, plus relatively limited areas offshore, at Nantucket Shoals, and near Cape Cod and Nantucket.

Stranding frequencies show a clear increasing trend beginning in the late 1980s (Fig. 27). One can only speculate about underlying causes. A high proportion of stranded porpoises have thin blubber, with starvation a contributing factor to their deaths (Nawojchik, 2002). Increased strandings could be related to increasing porpoise abundance in the region or to declines in prey availability. Some proportion of stranded porpoises also shows evidence of interaction with fisheries, primarily sink gillnets (Waring et al., 2008). Increasing strandings may reflect changes in fisheries—perhaps expansion of gillnet fishing for monkfish and dogfish. Landings of both increased sharply beginning about 1990.

The current Harbor Porpoise Take Reduction Plan (http://www.nero.noaa.gov/prot_res/porptrp) includes measures that recognize the high levels of mortality of harbor porpoises in gillnet fisheries off Rhode Island. The TRP established a Cape Cod South closure area to protect harbor porpoises. The closure area extends from 71°45' W (approximately the longitude of Weekapaug) east to 70°30' W (eastern Martha's Vineyard), and from the shoreline to 40°40' N. Gillnet fishing is prohibited completely in March. In December–February and April–May, gillnet fishing is allowed only using nets equipped with acoustic alarms (“pingers”) that alert porpoises to the presence of the nets.

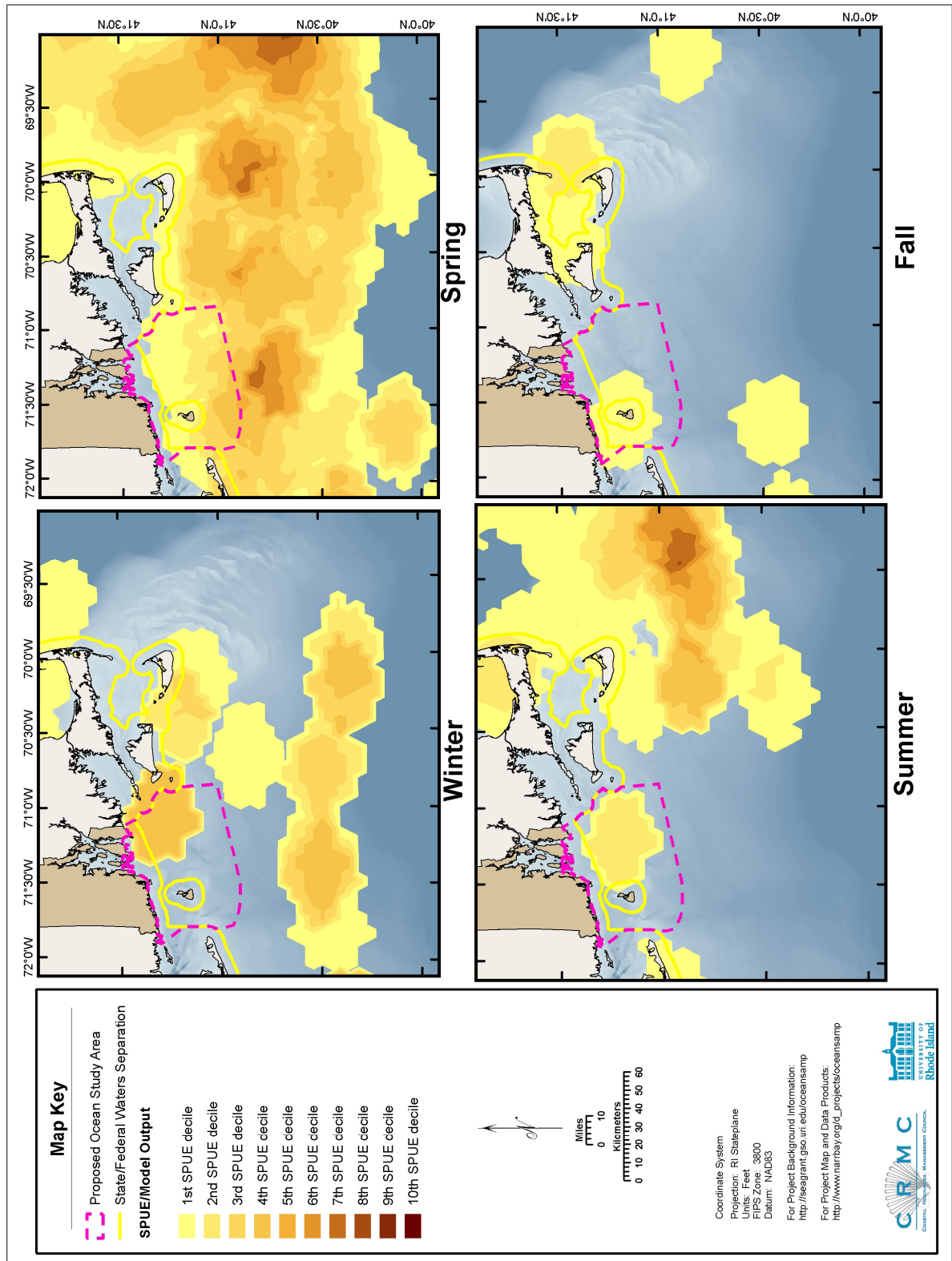


Figure 26. Modeled seasonal relative abundance patterns of harbor porpoises in the Rhode Island study area, corrected for uneven survey effort.

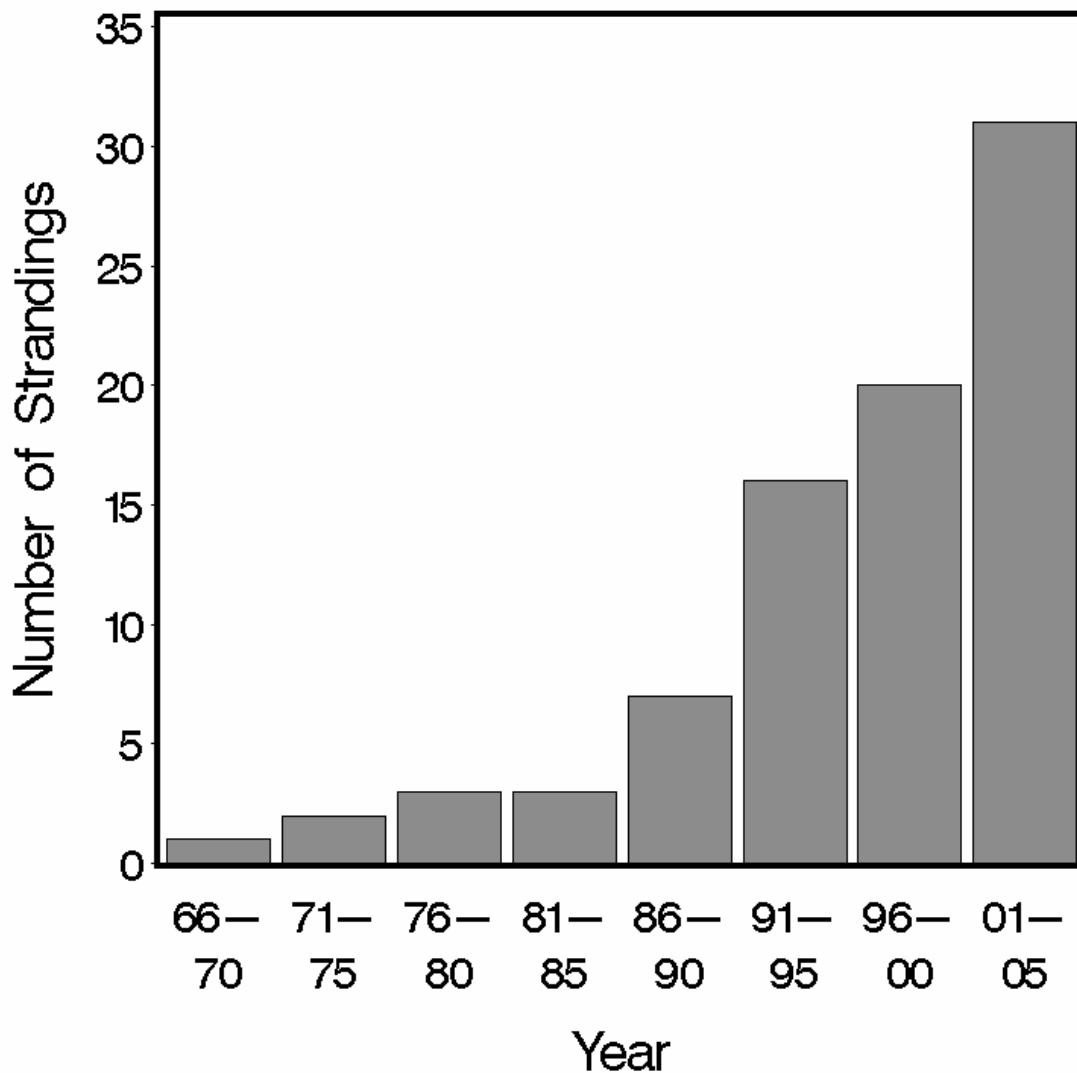


Figure 27. Five-year stranding frequencies for harbor porpoises in the Rhode Island study area, 1966–2005.

Conclusions

Harbor porpoises can occur in the SAMP area at any time of year, but are most abundant in spring, when they are moving inshore and northeastward. They are among the most abundant cetacean species in the SAMP area or the Rhode Island study area. Although they are not listed under the ESA, their abundance increases the likelihood of effects from development. In

addition, seasonal restrictions on activities to mitigate potential impacts on right whales and other endangered species would mean that those activities would occur at times when harbor porpoises were likely to be abundant. This combination of factors suggests that harbor porpoise should be included in the second tier of conservation priorities for the SAMP (see Recommendations).

DRAFT

3.2.20. Long-finned Pilot Whale *Globicephala melas* (Traill, 1809)

Short-finned Pilot Whale *Globicephala macrorhynchus* Gray, 1846

Delphinidae is the most diverse and speciose family of cetaceans, with 17 currently accepted genera. Smaller delphinids are generally called “dolphins” and the larger ones “whales,” perhaps somewhat arbitrarily. In the recent past, the term “porpoise” was often used instead of “dolphin,” especially in the U.S. The latter term could be confusing, because it also refers to tropical game and food fish in the genus *Coryphaena*. “Dolphin” is now used less often to refer to the fish in favor of the Hawaiian or Spanish name (mahi mahi or dorado, respectively).

All of the large, black, blunt-headed delphinids are sometimes collectively referred as blackfish, an old whalers’ and fishermen’s term. Pilot whales are sometimes also called potheads. The two species of pilot whales are well-defined and mostly parapatric, however, their ranges overlap in the waters off the mid-Atlantic coast of the U.S. They are also extremely difficult to differentiate in the field, so much of the information below refers to the two species combined.

Description

Pilot whales are easy to identify, but differentiating the long-finned and short-finned species in the field is exceedingly difficult (Jefferson et al., 1993; Bernard and Reilly, 1999; Wynne and Schwartz, 1999; Olson and Reilly, 2002). Both species are large, robust animals with a distinct “barrel-chested” appearance. Both are sexually dimorphic, with males larger than females. The head is rounded and bulbous with a very prominent melon, a slight beak, and an upturned mouth. The tailstock has prominent dorsal and ventral keels. The flippers are curved, tapered, and pointed. The dorsal fin is low, rounded to somewhat falcate, broad-based, and located well in front of the middle of the body. The color is black, dark gray, or brown overall, except for a whitish “anchor” mark on the chest, lighter gray “eyebrow” streaks from the eyes to the back, and a light gray “saddle” behind the dorsal fin.

Long-finned males may be as long as 7.6 m, while females reach a maximum of only 5.7 m. Their flippers are longer at about one-fifth of body length, with an obvious “elbow,” but the length ranges overlap, making the difference in flipper length nearly useless as a field character for sightings of live animals. Short-finned pilot whales are somewhat smaller, and possibly

slightly more thick-bodied, with males up to 6 m and females up to 5.5 m. The flippers in short-fins are shorter (about one-sixth of body length) and more curved, but the length ranges overlap, making the difference in flipper length nearly useless as a field character for sightings of live animals. In both species, dorsal fin shape changes in older adult males, with a tendency to become more broad-based in long-fins and more broad-based and hooked in short-fins. Additionally, in at least some short-fins, the saddle and lighter streaks on the head may be more distinct, and the overall color more brown than black. Range may be helpful, but should not be relied upon for identification.

Status

Long-finned pilot whales are not listed under the U.S. Endangered Species Act, are classified as Unprotected on the Rhode Island state list, and are classified as Data Deficient on the IUCN Red List. The short-finned pilot whale is not listed under the U.S. Endangered Species Act, is not included on the Rhode Island state list, and is classified as Data Deficient on the IUCN Red List.

The total abundance of either species of pilot whale in the North Atlantic is not well known, although the long-finned species is better known. Early estimates of the total size of the population impacted by directed harvests in eastern Canada concluded that there were 50,000–60,000 long-finned pilot whales in the western North Atlantic (Mitchell, 1974; Mercer, 1975). Hay (1982) estimated the abundance of long-finned pilot whales off Newfoundland and Labrador at 6,731–19,603; Kingsley and Reeves (1998) estimated 1,600 in the Gulf of St. Lawrence in late summer 1995; and Buckland et al. (1993) estimated 778,000 in the eastern and central North Atlantic. Because of the difficulty in identifying pilot whales at sea, off the eastern U.S. the two species currently must be combined for estimating abundance. Based on a 2004 summer survey, the combined stocks of both species between Florida and the Bay of Fundy were estimated at 31,139 animals (Waring et al., 2008). Efforts are underway to use a combination of genetic data from biopsy sampling and spatial modeling to partition the estimates by species. In the Gulf of Mexico only short-finned pilot whales occur; recent abundance estimates for parts of the Gulf are 2,388 in 1996–2001 and 716 in 2003–2004.

Directed pilot whale fisheries on both species have occurred in many places around the world (reviewed in Bernard and Reilly, 1999). A drive fishery in Newfoundland took almost 10,000 pilot whales in 1956 but declined during the 1960s and eventually ended. Small-scale pilot whale fisheries formerly took place in Norway, Greenland, Iceland, Ireland, and Cape Cod, and Inuit subsistence hunters in Greenland took 5 in 2000, 45 in 2001, 24 in 2002, 195 in 2003, and 208 in 2004 (IWC, 2005, 2006). The drive fishery for long-finned pilot whales in the Faroe Islands is the only substantial hunt still continuing in the North Atlantic. It dates back to at least the 16th Century. Catches were about 1,500 per year in the 1970s and 2,500 per year in the 1980s, with little evidence for any negative impacts on overall pilot whale stocks in the northeastern Atlantic. Annual catches in 2000–2003 were 588, 918, 626, and 503 (IWC, 2005, 2006). Short-finned pilot whales were hunted for centuries in Japan, and there are still catches of a few hundred per year (304 in 2000, 389 in 2001, 176 in 2002, 160 in 2003: IWC, 2005, 2006). In the North Atlantic, Yankee whalers left behind traditional fisheries in both the West Indies and the Azores that persisted into the 1980s.

Pilot whales are also impacted by bycatch in commercial fisheries. In U.S. Atlantic waters, average annual fishery-related mortality of both species combined in 2001–2005 was 163 animals. The predominant source of mortality is the pelagic long-line fishery for swordfish (86 per year), and pilot whales are also taken in bottom and mid-water trawl fisheries for squid, groundfish, and herring. Pilot whales were formerly taken in the pelagic swordfish driftnet and tuna pair-trawl fisheries, both now closed.

Ecology and life history

Pilot whales live in permanent social groups of about 10–50 animals, but at times pods join to form aggregations of hundreds of animals (Bernard and Reilly, 1999; Olson and Reilly, 2002). Off the northeastern U.S., group sizes observed ranged from 1 to 500, with a mode of 10 and mean of 20 (CETAP, 1982). In this region they commonly associate with other cetaceans. The most frequently observed mixed-species herds in the shelf-edge habitat off the northeastern U.S. were pilot whales and offshore bottlenose dolphins. They also have been observed associated with Risso's, common, and spotted dolphins and sperm whales, as well as in the same areas as fin and humpback whales in more inshore waters.

Short-finned pilot whales that were trained by the U.S. Navy routinely dived to 300 m and were capable of dives of 15 minutes and to at least 500 m and probably over 600 m (Bernard and Reilly, 1999).

In the North Pacific, there are differences in northern and southern stocks of short-finned pilot whales off Japan in size, markings, and life history (Kasuya and Tai, 1993; Bernard and Reilly, 1999). In the southern stock, mating is mostly in April–May and births are in July–August, but some births occur year round. In the northern stock calving is more strictly seasonal, with breeding in September and calving in December. Calves are about 1.7 m long at birth. The age at weaning is longer than in long-fins at 3.5–5.5 years. An older female might nurse her last calf for as long as 15 years (Marsh and Kasuya, 1991). Females reach sexual maturity at 9 years on average and males at about 16 years. A significant proportion of females become senescent, ceasing reproduction during or after their 30s.

Details of the social structure of long-finned pilot whale herds have been examined by genetic sampling from groups killed in a fishery in the Faroe Islands (located in the northeastern North Atlantic between Scotland and Iceland) (Amos et al., 1993). Entire herds are driven into a fjord or bay and killed, providing a complete picture of the inter-relationships among group members. All of the adults in a pod are related to one another. The calves and juveniles are offspring of the adult females in the pod, but the pod's adult males are not their fathers. Both males and females remain with their mothers for their entire lives, similar to the situation in killer whales. It is believed that mating occurs in large temporary aggregations, when the adult males are able to breed with females in other pods. Pilot whales also are one of the only non-human mammals with evidence of reproductive senescence, with post-reproductive individuals contributing to the survival of the young. In this system, the long-term benefits of group-living, social facilitation, and learning are maximized while still avoiding inbreeding.

Both species of pilot whales are known to strand commonly in large groups (Geraci and Lounsbury, 1993; Bernard and Reilly, 1999; Perrin, 2002f). Mass stranding is a phenomenon that occurs only in social odontocetes, including sperm whales, pilot whales, false killer whales, and some dolphin species. The causes of mass strandings are not well understood, and there are numerous hypotheses, including disease, parasites, geomagnetic anomalies interfering with navigation, social cohesiveness, and others. It is likely that there is no single cause, and that multiple causes interact. A common site for long-finned pilot whale mass strandings is on the

inside of Cape Cod. In fact, a tidal creek in Wellfleet is called Blackfish Creek for the pilot whale strandings that have happened in that area at least since colonial times. Stranding events there tend to happen in winter, after storms when the water is murky and visibility limited. The bottom slope is nearly flat, so that echolocation provides no cue as to which direction is offshore, which also means that very wide mud flats are exposed at low tide. There is a known area of geomagnetic anomalies. It also may be possible that the usual direction to safety offshore for western North Atlantic pilot whales is south and east, which does not hold true inside Cape Cod Bay. In some strandings, rescue attempts are unsuccessful as animals seem to intentionally beach themselves again. Sometimes it appears that one or more individuals may be debilitated by disease or other cause, and the rest of the herd is trying to stay together. The adaptive value of social cohesion may be maladaptive under those circumstances.

On two occasions long-finned pilot whales that stranded in New England were rehabilitated and then released with satellite-tracked radio tags that provided information on movements and diving. Mate et al. (2005) tagged a 3-m, 2-year-old male in a group of three juveniles released after 7 months in captivity. They were released together on 29 June 1987 on the outer edge of Georges Bank about 160 km southeast of Cape Cod. The tagged whale was tracked for 94.5 days and a minimum distance traveled of 3144 km. It spent 10 days on Georges Bank, then moved offshore beyond the shelf edge for 9 days, then traveled 2 days north into the central Gulf of Maine, where it remained for the next 67 days. On day 20 it was observed in a group of pilot whales. The percent of time spent at the surface per day ranged from 5 to 47%. The average dive time was only about 40 seconds, but the average included short respiratory dives between breaths at the surface. The overall range of dive times was 6 seconds to almost 28 minutes, with a higher probability of short dives during the daytime and longer dives at night.

Nawojchik et al. (2003) released two juvenile males on 20 October 17 km south of Montauk Point (they had stranded on 28 June). They first headed west along the Long Island shore, then turned east and traveled to Nantucket. At that point they moved offshore to the outer part of Georges Bank and around the eastern end of the bank into the basins to its north in November–December, then made a clockwise loop around the northern Gulf of Maine in January and ended up in the Great South Channel area east of Cape Cod in February. Most dives were less than 2 minutes and shallower than 15 m, but the tags provided binned summary statistics and not individual dive profiles. Both whales made dives exceeding 26 minutes. Their deepest dives

were 312 and 320 m, which is approximately the depth to the bottom in the area where they were at the time.

The preferred prey of both pilot whale species is squid, although at least long-finned pilot whales have been observed to feed on fish in the North Atlantic (Sergeant, 1962; Mercer, 1975; Kenney et al., 1985a; Desportes and Mauritsen, 1993; Bernard and Reilly, 1999; Olson and Reilly, 2002). Pilot whales were commonly taken in foreign fishing activities that were conducted in December–May 1977–1991 along the shelf edge off the northeastern U.S., with 391 taken in the mackerel fishery and 41 taken in the squid fishery (Waring et al., 1990; Fairfield et al., 1993). It is unclear whether mackerel is an important prey item in winter in our region, or whether the whales were simply feeding opportunistically on mackerel scavenged from the trawl nets.

Based on samples from fisheries in Newfoundland and the Faroe Islands, long-finned pilot whale calves in the North Atlantic are born in July–October (Bernard and Reilly, 1999). Calves are about 1.7 m long at birth (Wynne and Schwartz, 1999). Estimates of gestation period range from 12 months to as long as 15–16 months. Calves are weaned at about 22 months, and females that are simultaneously pregnant and lactating are rare. The average inter-birth interval is about 40 months. Females reach sexual maturity at 6–8 years (3.6–3.8 m) and males at about 12–17 years (4.8 m) (Desportes et al., 1993; Martin and Rothery, 1993). The occurrence of reproductive senescence seems to be less common than in short-finned pilot whales; a pregnant 55-year-old was observed in the Faroes, though ovulations appear to be spaced further apart in older females.

General distribution

Long-finned and short-finned pilot whales have mostly parapatric distributions, but they overlap in several areas of the world (Rice, 1998; Bernard and Reilly, 1999; Olson and Reilly, 2002). Long-finned pilot whales occur in the entire Southern Ocean south of 40°S and in the North Atlantic north of about 30°N, overlapping with short-fins from Australia to South America in the South Pacific, on the Atlantic coast of South America, and around South Africa. The broadest overlap is in the North Atlantic, from the east coast of the U.S. across to the eastern North Atlantic from France to northwest Africa. Long-finned pilot whales range from North

Carolina north to Newfoundland, Greenland, and Iceland, with possibly extralimital occurrences represented by strandings in South Carolina and Georgia. Fullard et al. (2000) proposed that there were two stocks of long-finned pilot whale in the North Atlantic—a cold-water population distributed north and west of the Gulf Stream, and a warm-water population associated with the Gulf Stream across the basin from North America to Europe.

Short-fins are found world-wide in warm-temperate to tropical waters on both sides of the equator, primarily in deeper offshore areas. Their southern limit is about 40°S latitude around the entire Southern Ocean, to about 50°N in the North Pacific and 42°N in the North Atlantic. The distributions overlap from Australia to South America in the South Pacific, on the Atlantic coast of South America, and around South Africa. The broadest overlap is in the North Atlantic, from the east coast of the U.S. across to the eastern North Atlantic from France to northwest Africa. In the western North Atlantic, the range of short-finned pilot whales includes the southern U.S., Gulf of Mexico, Caribbean, West Indies, and the coast of South America. The northern limit of the range off the Atlantic coast is not well known, but believed to be between Virginia and New Jersey, probably varying seasonally.

Off the northeastern U.S., pilot whales (both species combined) are found primarily along the shelf edge and around the edges of Georges Bank in all four seasons, most scattered in the winter (CETAP, 1982). Pilot whales occupied the most inshore depth zone of the shelf-edge cetaceans, along with common dolphins and offshore bottlenose dolphins (CETAP, 1982; Kenney, 1990). The patterns of seasonal distributions seen in the CETAP surveys and gaps in those patterns were suggestive of spatial partitioning between the species. In the winter, the densest concentration of sightings was offshore of New Jersey and southern New England, with scattered sightings along the edge of Georges Bank. South of New Jersey there were very few sightings except for a small cluster just off Cape Hatteras, North Carolina. In the spring, pilot whales were widespread from Maryland north to Georges Bank, and into shallower water on the shelf. There was a larger group of sightings off North Carolina than in winter, and still a hiatus in sightings east of Virginia. During the summer, there was a distinct concentration of pilot whales along the outer shelf from North Carolina to Delaware Bay, then a distinct gap south of Long Island and Cape Cod, and then sightings all around Georges Bank and into the central Gulf of Maine. Payne and Heinemann (1993) also noted the tendency for pilot whales to move into the deeper basins north of Georges Bank in late spring and summer. The pattern in fall was similar,

except the gap in the middle was somewhat wider and extended farther south. More recent summer stock assessment surveys in 1998 and 2004 also showed a gap in pilot whale sightings approximately between the longitudes of eastern Long Island and Cape Cod (Waring et al., 2008). Those surveys also resulted in pilot whale sightings much farther offshore, mainly associated with the edge of the Gulf Stream.

Historical occurrence

The earliest pilot whale records for the Rhode Island study area were reported by De Kay (1842), who described a stranding at Fairfield Beach, Connecticut in October 1832 and two animals captured at the eastern end of Long Island in 1834. Cronan and Brooks (1968) reported three records from Rhode Island. One stranded in Middletown on 1 September 1959 and a 197-cm calf was caught in a fish trawl on 19 March 1961 about 50 km south of Narragansett Bay. The third was “the famous ‘Willy the Whale’ that cavorted about in the upper Providence River in July 1962. ‘Willy,’ who was actually a female, was over 18 feet in length.” Connor (1971) mentioned several 20th Century stranding records from New York plus reports of frequent sightings. Waters and Rivard (1962) said that long-finned pilot whales were the most common whale in Cape Cod Bay, usually occurring in herds of up to 300, but that a large group of 1,975 had been seen off Blackfish Creek in Wellfleet in 1895. They also said that pilot whales occurred year-round, but were most abundant in July and August. However, they did not list any recent records.

Recent occurrence

Pilot whales occur in the Rhode Island study area in all four seasons (Fig. 28), with a very strong peak in the spring (70.7%), and roughly equivalent proportions in the other seasons (winter – 8.1%, summer – 13.3%, fall – 7.4%). There are 43 records identified as long-finned pilot whales, only 1 as short-finned pilot whale, and 226 as only *Globicephala* sp. The seasonal proportions are nearly identical for long-finned pilot whales and *Globicephala* sp. There were only 12 sightings from the whale-watching data, 9 in summer and 3 in spring. Sightings were across the entire study area from the inner shelf to the slope, with more in shallow water in the

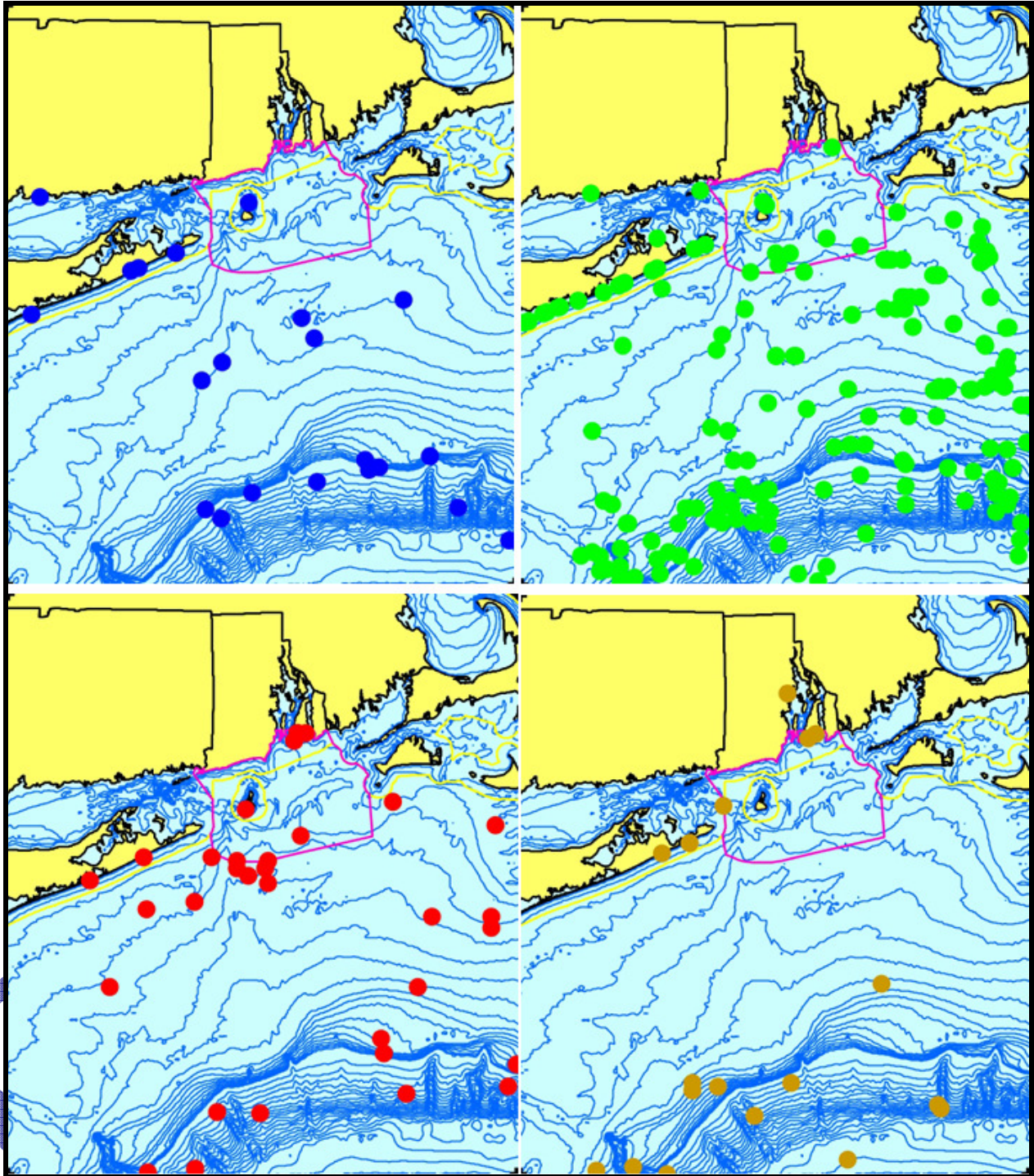


Figure 28. Aggregated sighting, stranding, and bycatch records of long-finned, short-finned, and unidentified pilot whales in the Rhode Island study area, 1834–2006 (n = 270: winter = 22, spring = 191, summer = 36, fall = 20, unknown = 1).

spring, mirroring the pattern seen in CETAP (1982). In the Rhode Island to New Jersey stranding data, the ratio of long-finned to short-finned pilot whale is 9:1, but with the exception of the single Rhode Island record, short-finned pilot whale strandings have occurred only in New Jersey, and mainly in the southern part of that state. While there is a likelihood that some strandings might be misidentified, it is probably justifiable to conclude that pilot whales in the Rhode Island study area are usually the long-finned species, with short-fins occurring relatively rarely. A substantial proportion of the 226 unidentified pilot whale records in the combined data are more likely to have been long-finned pilot whales, consequently they were classified as “common” (Table 2) even though there were far fewer than 100 identified records.

The pattern in the effort-corrected relative abundance data (Fig. 29) is quite similar to that seen in the total occurrence data. Pilot whales occur in the Rhode Island study area year-round, but are most abundant in spring. Spring is also the only season when the relative abundance output predicts that pilot whales might occur in the SAMP area—in the southwestern corner of the area. In winter, there is an area of low abundance just offshore of the SAMP area and somewhat higher abundances farther offshore near the shelf edge. In summer, the abundances are maximum, but mainly east of the study area and offshore. The pattern in fall is similar to summer, however at lower abundance.

There was a mass stranding of 11 long-finned pilot whales in Cow Cove on Block Island, Rhode Island on 22 December 1983. The following day only five remained, all dead, but it is unclear from the Smithsonian data record whether the others were pushed off, left on their own, or died and washed out with the tide and waves. From necropsies of the five carcasses, the 1983 Block Island event was not a typical pilot whale mass stranding with a cross-section of ages and sexes (Nawokchik, 2002). All five were adult females of about the same size (442–457 cm) that all had some sort of medical problems (missing or broken teeth, thin blubber, kidney abnormality, abdominal fluid build-up).

Pilot whale stranding frequencies spiked in the late 1980s, and then declined but to a somewhat higher level than observed prior to 1985 (Figure 30). The years 1987–1991 comprised a period of increased strandings, with two in 1987, five in 1988, four in 1989, two in 1990, and three in 1991. Nearly all were in the spring, except for one in winter 1987, one in fall 1989, and one in winter 1991. Long-finned pilot whale strandings in Rhode Island occurred in Newport on 5 May 1974, in Newport on 28 November 1989 (a 192-cm calf), in Little Compton on 27 April

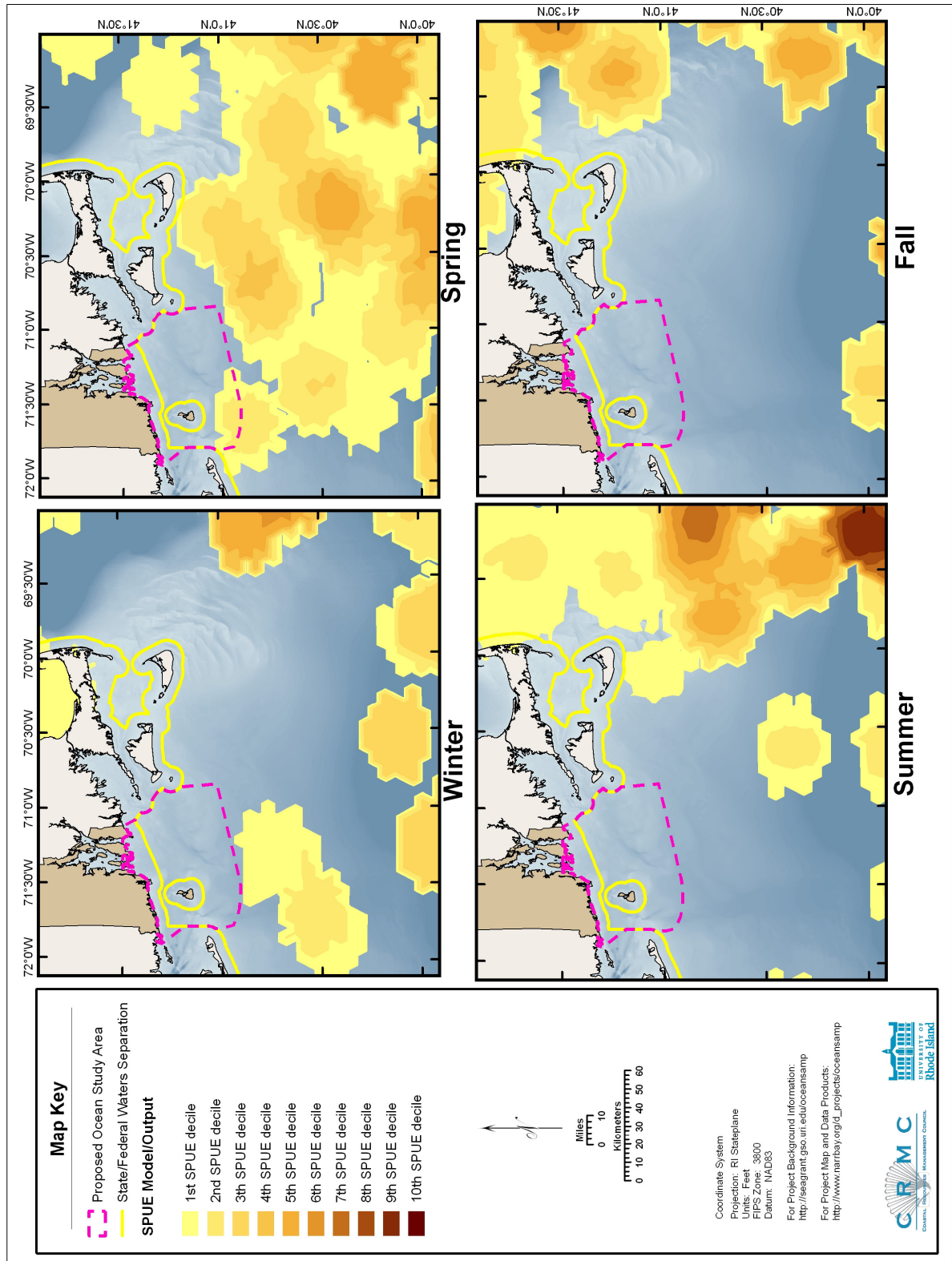


Figure 29. Modeled seasonal relative abundance patterns of pilot whales in the Rhode Island study area, corrected for uneven survey effort.

1990, at Clay Head on Block Island on 19 April 1994, near Goddard Park in Warwick on 8 October 1998, at Third Beach in Middletown on 2 June 2002, at Easton's Beach in Newport on 28 July 2003, and at Sandy Point on Block Island on 18 May 2004. There were also two strandings in Connecticut—in Madison on 5 April 1989 and in Branford on 9 February 1991. The latter animal had been reported alive along the Connecticut shore for five days before it washed up dead.

The only short-finned pilot whale record in the state or in the study area was a single animal stranded on 6 June 2001 at Snake Hole Beach on Block Island.

There were four strandings in the state of unidentified pilot whales: 18 December 1981 at Apponaug Cove in Warwick, 27 December 1985 at Brenton Cove in Newport, 18 February 1987 in Newport, and 17 March 1987 in Newport.

Conclusions

Although pilot whales (most likely long-finned pilot whales) are relatively abundant in the Rhode Island study area, they are not likely to occur within the SAMP area. The highest likelihood of occurrence would be in spring, and intensive whale-watching trips occasionally recorded pilot whale sightings southwest of Block Island. Pilot whales are not a significant concern for the SAMP.

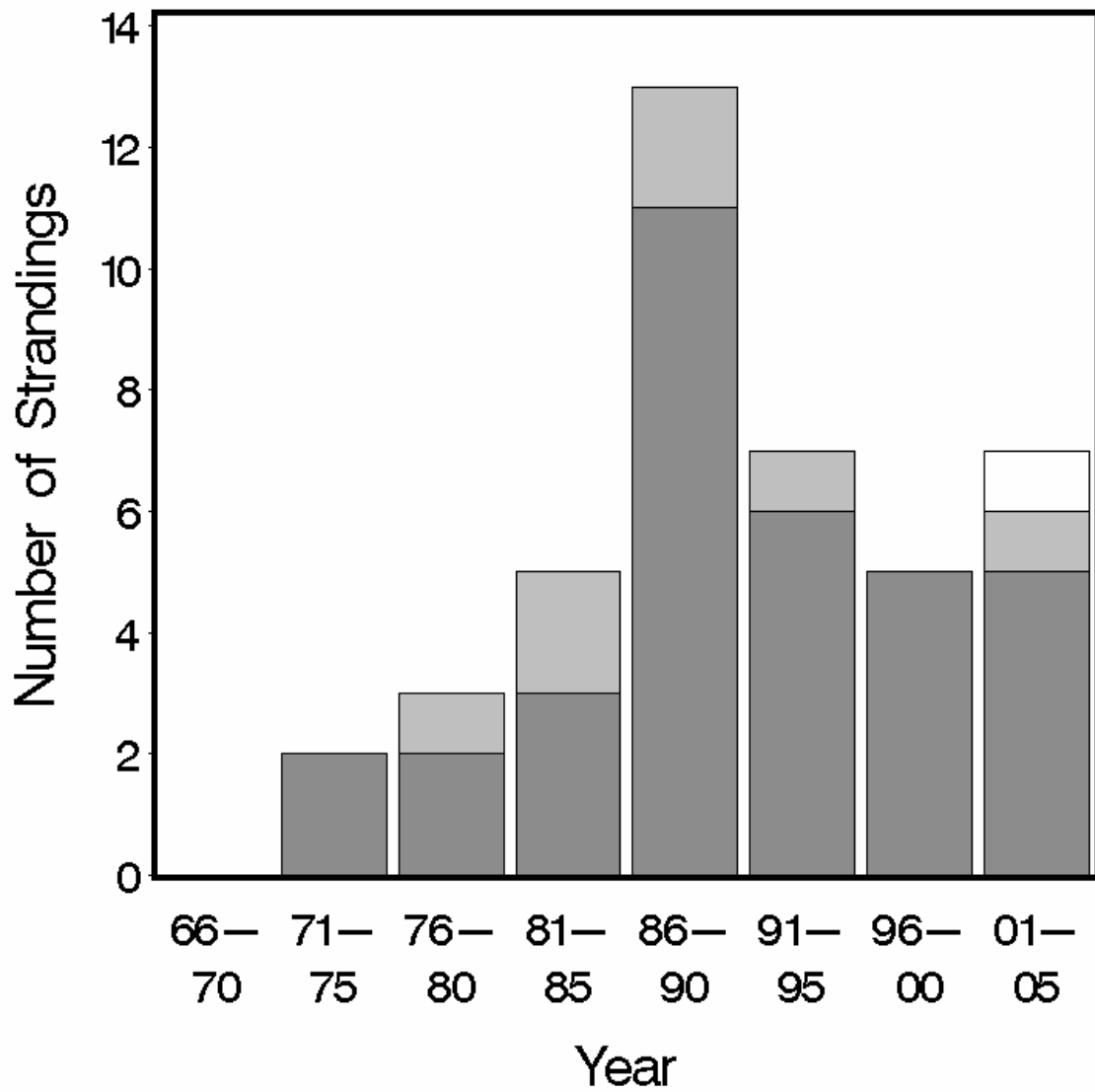


Figure 30. Five-year stranding frequencies for long-finned pilot whales (dark gray bars), short-finned pilot whales (white), and unidentified pilot whales (light gray) in the Rhode Island study area, 1965–2005.

DRAFT

3.2.22. Killer Whale *Orcinus orca* (Linnaeus, 1758)

Description

Killer whales, or orcas, are the largest of all delphinids. They are sexually dimorphic, with males up to 9.8 m and females up to 7–8.5 m (Jefferson et al., 1993; Wynne and Schwartz, 1999). They are very distinctive and easily recognized. The body is robust with a rounded head and very large, rounded flippers. The dorsal fin is about 1 m tall and falcate in females and juveniles, and 2 m high and erect in adult males. The color pattern is strikingly distinct, with a black back, dorsal fin, flukes, and flippers clearly contrasting with white under the belly, chin, and flukes. The white belly extends in a narrow lobe up and back on both sides behind the dorsal fin, and there is an oval white patch behind and above each eye. There is also a gray saddle patch behind the dorsal fin. Killer whales have 10–12 large, slightly curved teeth on each side of both upper and lower jaws.

Status

Killer whales are not listed under the U.S. Endangered Species Act, although the Southern Resident stock in the eastern North Pacific has recently been listed as Endangered (NMFS, 2005). They are not included on the Rhode Island state list, and are classified as Data Deficient on the IUCN Red List. There are no abundance estimates for the entire North Atlantic, although there are estimates based on photoidentification or similar methods for limited areas (Dahlheim and Heyning, 1999), including 500–1500 off Norway and 143 off Iceland. There is also no estimate for U.S. Atlantic waters, and an estimate of 133 for the northern Gulf of Mexico (Waring et al., 2008). Killer whales were formerly taken by small-scale coastal whaling in a number of locations; 13 were killed by subsistence hunters in Greenland in 2002 (IWC, 2006).

Ecology and life history

Killer whales are extensively studied, and are known to live in permanent pods of up to 50 individuals (reviews in Dahlheim and Heyning, 1999 and Ford, 2002). Pods are matrilineal social

groups that are formed of females, their sons and daughters, and the offspring of the daughters. Unlike most mammals, both females and males remain in their natal pods for life. The maximum life span of orcas may be 80 or 90 years, which results in pods containing as many as four generations together.

General distribution

Killer whales are cosmopolitan, and may be the most broadly distributed of all cetaceans (Heyning and Dahlheim, 1988; Dahlheim and Heyning, 1999; Ford, 2002). They occur in all oceans of the world from the tropics to the edge of the polar ice, and from estuaries and shallow coastal waters to deep, offshore waters. They appear to be most common in colder, nearshore waters. In the western North Atlantic, they are known from the Arctic to the tropics, but are not common anywhere. There were only 12 sightings off the northeastern U.S. during the CETAP study (CETAP, 1982) and none during the more recent NMFS assessment surveys (Waring et al., 2008), although over a longer term they appear to be regular visitors to the Gulf of Maine (Gormley, 1990).

Historical occurrence

Cronan and Brooks (1968) said they had one record of a killer whale stranding in Rhode Island, but provided no details, however Waters and Rivard (1962) included in their table a stranding of a 5.5-m animal in Narragansett in December of 1956. Waters and Rivard said that killer whales were fairly common in Massachusetts waters, and also cited records of one killed in Lewis Bay in Hyannis in March 1949, a pod seen off Provincetown in August 1949, and a stranding of a 5.2-m whale on Waquoit Beach in Falmouth in 1956. De Kay (1842) reported several sightings of killer whales off Long Island, and suggested without documentation that they were formerly more numerous. Connor (1971) described a live-stranded 730-cm orca at Orient, Long Island in January 1944 and a large male that followed a fishing boat for more than 30 km on its way back to Montauk in July 1958 (both records were in the Smithsonian data).

Recent occurrence

There are five additional killer whale records in the more recent data (Fig. 31). One or more orcas were reported by fishermen in Long Island Sound off Mattituck in August 1977. A group of 20 was sighted about 16 km southeast of Block Island on 22 September 1981. There were also three sightings in deep water south of Cape Cod—a group of 6 on 25 July 1979, a single animal on 5 October 1981, and a group of 19 on 13 September 1991.

Conclusions

Killer whales are sufficiently rare in the Rhode Island study area as to be ignored relative to development in the SAMP area.

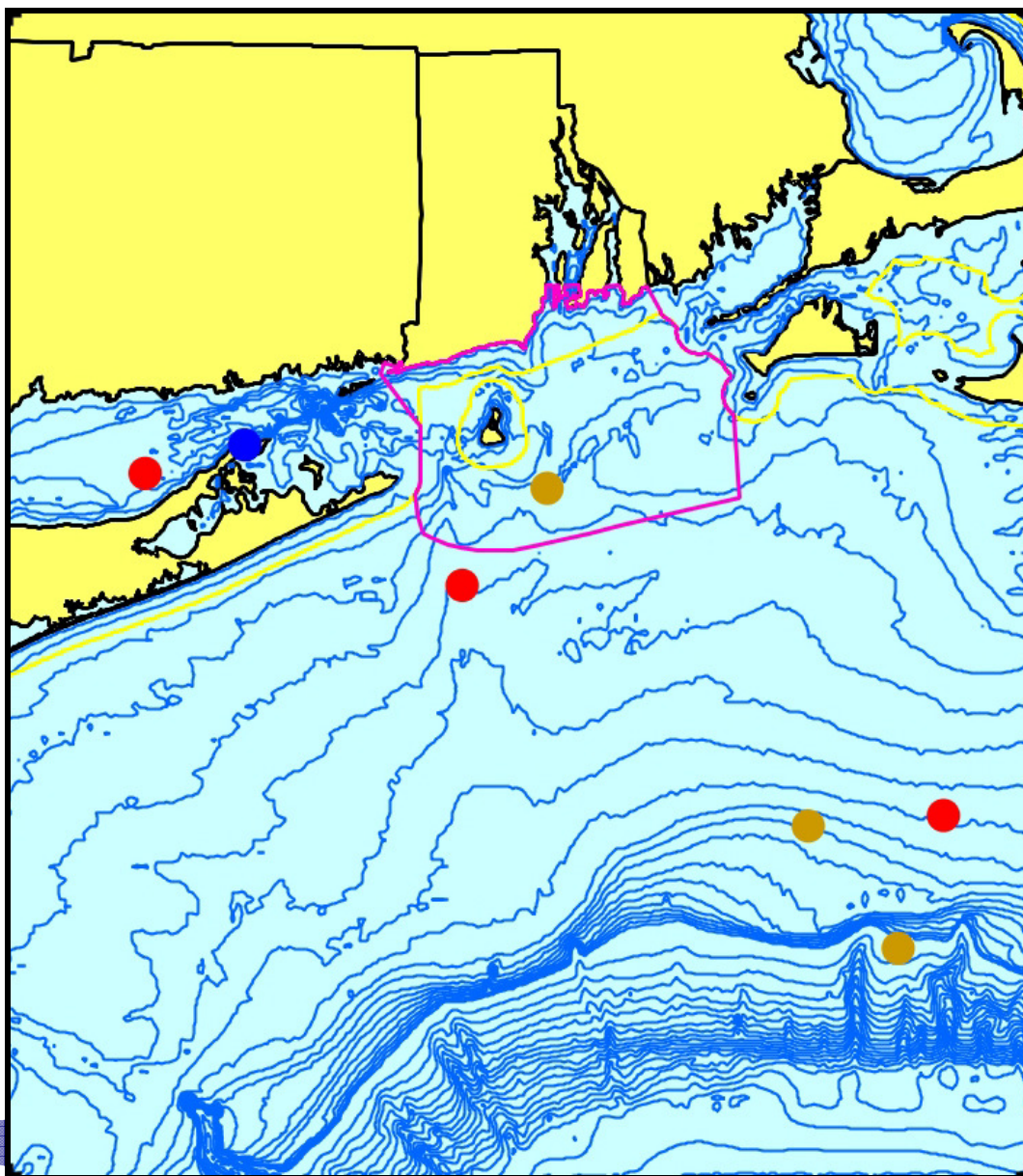


Figure 31. Aggregated sighting, stranding, and bycatch records of killer whales in the Rhode Island study area, 1944–1991 ($n = 7$: winter = 1, spring = 0, summer = 3, fall = 3).

3.2.23. False Killer Whale *Pseudorca crassidens* (Owen, 1846)

Description

False killer whales were so named because of the resemblance of the skull to that of a killer whale, not because of similar appearances (Odell and McClune, 1999). In fact, they look more like slimmed-down pilot whales, with which they are included as the larger “blackfish” (Jefferson et al., 1993; Wynne and Schwartz, 1999). They are long and slender, uniformly black with a pale anchor mark on the chest, no cape, and no white markings visible anywhere on the head or back. Total length is up to 5.5 m in males and 4.8 m in females. The head is narrow and tapered, with no beak and a small, rounded melon that overhangs the lower jaw. The flippers have a distinctive hump on the leading edge, which makes them look permanently bent. The dorsal fin is dolphin-like, narrow-based, located at mid-back, falcate, and often rounded at the tip. There are 7–12 large (up to 1.8 cm in basal diameter) teeth in each side of both jaws.

Status

False killer whales are not listed under the U.S. Endangered Species Act, are not included on the Rhode Island state list, and are classified as Data Deficient on the IUCN Red List. There are no estimates of the total number of false killer whales in the North Atlantic, none have been sighted from any stock assessment surveys off the U.S. Atlantic, and the number in the northern Gulf of Mexico is estimated as 1,038 (Waring et al., 2008). False killer whales are taken in low numbers (5–26 in a year in 2000–2004) in coastal small-cetacean fisheries in Japan (IWC, 2005, 2006).

Ecology and life history

False killer whales are believed to feed primarily on deep-sea squid and fishes, but have been seen to attack smaller dolphins escaping from tuna nets (Odell and McClune, 1999; Baird, 2002a). There was one observation each of an attack on a humpback whale calf and on a group

of sperm whales. They appear to be very gregarious, but their social organization and life history are very poorly known.

General distribution

False killer whales are found in pelagic tropical, subtropical, and warm temperate seas in all oceans of the world (Stacey et al., 1994; Odell and McClune, 1999; Baird, 2002a). In the western Atlantic, they occur from Maryland south to the Gulf of Mexico, Caribbean Sea, West Indies, and off mainland South America to the tip of Tierra del Fuego. Sightings are typically in deep water beyond the shelf break. Little is known of seasonality of occurrence.

Historical occurrence

There are no historical records of false killer whales in the Rhode Island study area, and they were not mentioned by Cronan and Brooks (1968) or any of the other regional sources consulted.

Recent occurrence

There have been no false killer whale strandings in the Rhode Island study area. There were nine sightings in the whale-watching data over a four-year period in 1990–1993, all in the same general vicinity south of Block Island and Montauk Point between the 50- and 70-m isobaths (Fig. 32). The sightings occurred during very short periods each year: 22–29 May 1990, 31 May–13 June 1992, and 3 May 1993. The largest group seen at any one time was five, and on the only day with two sightings (28 May 1990), there were groups of two and three whales seen. One could speculate that a small group of five false killer whales returned to the same vicinity at the same time of year for several years in a row. From other sighting records in the NARWC database, the pattern of occasional occurrences in unusual locations seems to be characteristic of false killer whales. Although most sightings have been off the southeastern U.S., there are records far to the east in the mid-ocean, a sighting in Cape Cod Bay in March 1978, and sightings on Georges Bank in 1980 and 1987.

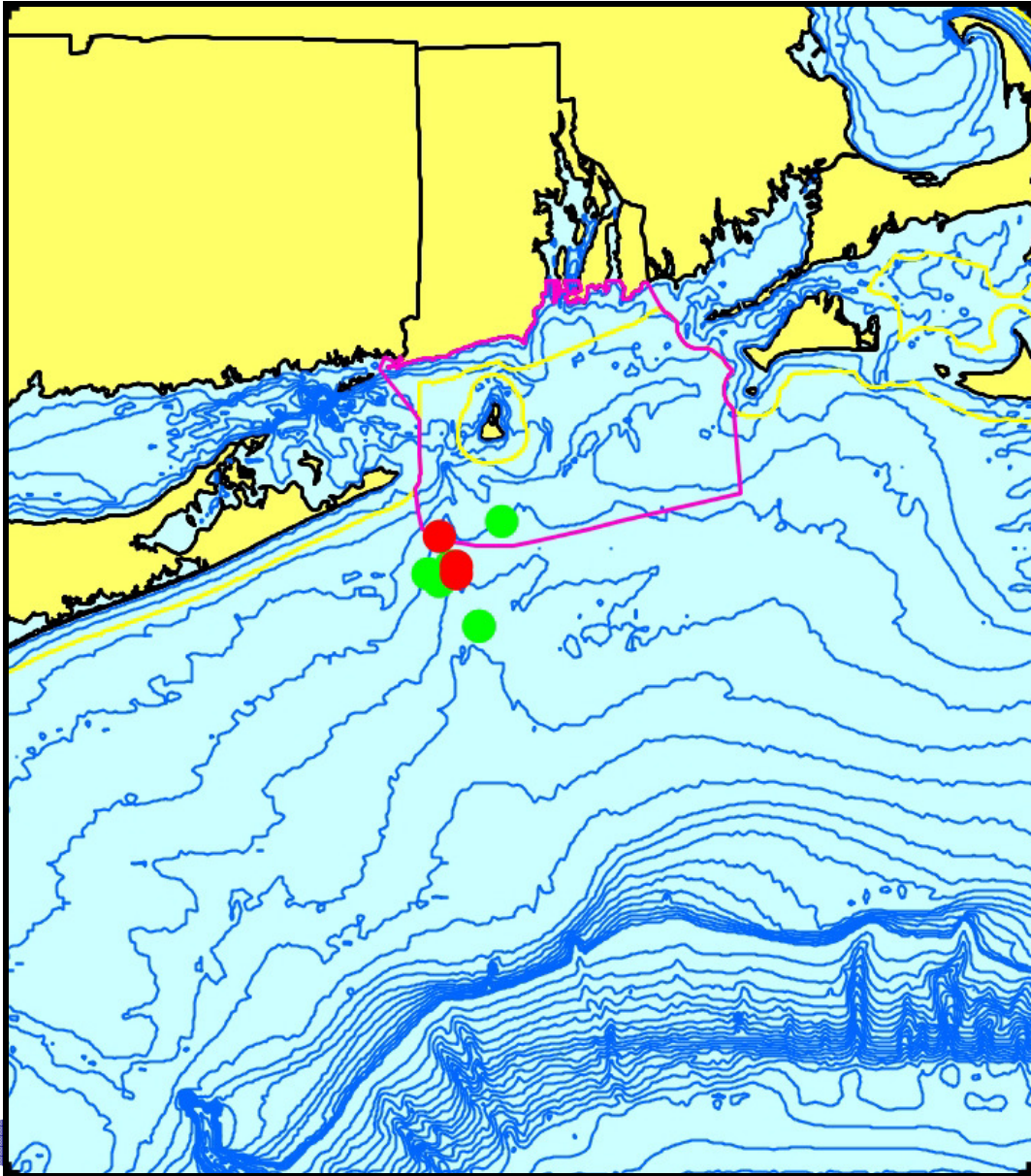


Figure 32. Aggregated sighting, stranding, and bycatch records of false killer whales in the Rhode Island study area, 1990–1993 ($n = 9$: winter = 0, spring = 6, summer = 3, fall = 0).

Conclusions

Although false killer whales may occur on very rare occasions in the SAMP area, they may safely be ignored.

DRAFT

3.2.24. Risso's Dolphin *Grampus griseus* (G. Cuvier, 1812)

Description

Risso's dolphins are large, robust animals, 3–4 m in length, which are relatively easy to identify (Jefferson et al., 1993; Kruse et al., 1999; Wynne and Schwartz, 1999; Baird, 2002b). The body is thick and robust from the dorsal fin forward and relatively slender behind. The impression is that of a shorter, more barrel-chested pilot whale. The head is blunt with a squarish profile and a slight but distinctive vertical crease down the forehead. The mouth curves noticeably upward, and there is no beak. The flippers are very long and pointed but broader than in pilot whales, and the dorsal fin is very tall, slender, and falcate. The color pattern is distinctive and unique. Calves are uniformly light gray, and gradually darken to dark gray or brown with a white belly and white “anchor” mark on the chest as juveniles. Older animals get gradually whiter, mainly from scars and scratches, especially on the head. Old adults may be entirely white except for the dorsal fin, flippers, and flukes.

Status

Risso's dolphins are not listed under the U.S. Endangered Species Act or on the Rhode Island state list, and are classified as Least Concern on the IUCN Red List. There are no estimates of the total number of Risso's dolphins in the North Atlantic, and no information on stock separation. The most recent estimate of abundance of Risso's dolphins along the U.S. Atlantic coast was 20,479, with an additional 1,589 in the northern Gulf of Mexico (Waring et al., 2008). Surveys in 1998 estimated the Atlantic stock at 28,164.

Risso's dolphins have been taken in a number of small-cetacean fisheries around the world, but have never been the focus of a large-scale fishery (Kruse et al., 1999). They have been taken in Europe, Canada, the West Indies, the Azores, Peru, and Japan. Recent takes in Japanese small-cetacean fisheries were 506 in 2000, 474 in 2001, 386 in 2002, 373 in 2003, and 6 in 2004 (IWC, 2005, 2006). They are also subject to incidental take in variety of commercial fisheries (Read, 1996). The average annual fishery-related mortality of Risso's dolphins in U.S. Atlantic fisheries in 2001–2005 was 40 (Waring et al., 2008). Most mortality (37 per year on average)

was in the pelagic swordfish long-line fishery, with the remainder in the sink gillnet fishery. There was formerly mortality in the pelagic swordfish driftnet and tuna pair-trawl fisheries, both of which are now closed.

Ecology and life history

Risso's dolphins generally occur in small groups of 10–50 animals, but may be sighted as single individuals and in herds of several hundred or more (Kruse et al., 1999; Baird, 2002b). Off the northeastern U.S. the mean group size was 17, with a range from 1 to 400 (CETAP, 1982). They frequently perform aerial behaviors such as breaching, spy-hopping, and lob-tailing, but rarely bow-ride. They were sighted at times in association with pilot whales, offshore bottlenose dolphins, and other species (CETAP, 1982). In the North Pacific they associate with many other species in mixed groups (Kruse et al., 1999).

There are almost no data on diving capabilities. They appear to be capable of dives up to 30 minutes (Kruse et al., 1999).

Risso's dolphins are believed to feed exclusively or almost exclusively on squid (Kruse et al., 1999; Baird, 2002b). Reduction in the number of teeth is believed to be an adaptation to the squid-feeding habit (Clarke, 1986). Based on observations of activity patterns off Santa Catalina Island, California, Risso's dolphins are mainly nocturnal feeders (Shane, 1995).

Life history data for Risso's dolphins are sparse (Kruse et al., 1999; Baird, 2002b). Calves are born at 110–150 cm, and calving may peak in the winter. Size at sexual maturity is 2.6–2.8 m in females and 2.6–3.0 m in males. There is no information on gestation or lactation periods or inter-birth intervals.

Amano and Miyazaki (2004) reported on a school of 79 killed in a drive fishery in Japan. There were 49 females and 30 males, for a sex ratio of 1.63:1. Of the females, 2 were pregnant, 9 lactating, 2 both pregnant and lactating, 14 resting, 14 immature, and 8 unknown (66% mature). Their age at maturity was probably 8–10 years, and the oldest was 34.5. Of the males, 23 were immature, 4 were maturing, 1 was mature, and 2 were unknown (18% mature). The estimated age at maturity was 10–12, but the sample size was very small. The oldest male was 16.5. The sex and age structure of the school suggests a life history pattern where males leave their natal groups when mature and remain segregated from schools of females and immatures.

General distribution

Risso's dolphins are found in tropical and temperate waters world-wide (Rice, 1998; Kruse et al., 1999; Baird, 2002b). In the Atlantic, they occur from Newfoundland and the British Isles south to the southern tips of Africa and South America, although the distribution is poorly known along the coasts of east-central South America and western Africa. Their distribution is primarily in deeper pelagic waters, and is poorly known in the central ocean regions. In the western North Atlantic they are found primarily along the shelf break, but are also sighted commonly in shallower waters to about mid-shelf, as well as much farther offshore. Off the northeastern U.S., Risso's dolphins occurred along the entire shelf in spring and summer, with dense concentrations from about Virginia to Cape Cod in spring and from Virginia to Georges Bank in summer (CETAP, 1982). In the fall, the number of sightings declined and the distribution contracted to Virginia–Long Island. There were many fewer sightings in winter, mostly east of Maryland and Virginia. Summer surveys in 1998, 1999, and 2004 extended farther offshore and resulted in numerous sightings, often associated with edges of the Gulf Stream and warm-core rings (Waring et al., 2008). The recent surveys also resulted in sightings offshore of the 100-m isobath off the southeastern U.S.

Historical occurrence

Cronan and Brooks (1968) were aware of no Risso's dolphin occurrences in Rhode Island. Neither De Kay (1842) nor Linsley (1842) mentioned the species. Schevill (1954) reported a sighting of more than 60 Risso's dolphins on 20 August 1952 about 140 km due south of Block Island near the shelf break. That record seemed to be the basis for conjectures about occurrence by Cronan and Brooks (1968), Waters and Rivard (1962), and Connor (1971). In their table of records from the 1940s and 1950s, Waters and Rivard included only Schevill's 1952 sighting (however giving the number of animals as one) and a sighting of three 350 km east of Cape Cod. Of course, none of those authors had the benefit of seeing the results of CETAP and subsequent surveys to know that Risso's dolphins are quite common in the area of Schevill's sighting. There are no historical strandings in the Rhode Island study area, although they are relatively common in New Jersey and less so in western Long Island. The only historical sighting

in the study area was a group of 3 near Hudson Canyon on 29 May 1960 reported by Ulmer (1980) and included in the Smithsonian data.

Recent occurrence

Risso's dolphins are present year-round, but with strong seasonality (Fig. 33). They are most common in summer with 56.3% of the records, followed by 25.0% in fall, 15.9% in spring, and only 2.9% in winter. The sighting distribution is primarily along the shelf break and slope, with a few sightings in waters shallower than 100 m. There was only one spring sighting in the SAMP area, although there were strandings in or nearby in every season. Even with very intensive whale-watching over more than 15 years, they recorded only one sighting of Risso's dolphin, which was on an offshore trip.

The patterns in the relative abundance data (Fig. 34) show the same thing as the total data. Abundance is lowest in winter and spring and highest in summer and fall. In addition, the species' distribution is centered far offshore in all seasons, with no areas of predicted occurrence in or near the SAMP area.

In the recent stranding record for the Rhode Island study area, Risso's dolphins have been relatively scarce. The first known stranding in the area was a 288-cm "old" adult on 17 July 1987 at Schooner Point on Block Island. A 192-cm immature male stranded at Newport on 28 November 1989. On 14 December 1991 a live Risso's dolphin was seen in a cove on the west side of Hog Island, but it was found dead the next day. A 250-cm adult stranded on Cooneymus Beach on Block Island on 3 March 1994. Risso's dolphins stranded in South Kingstown on 1 August 2004 and at Mackerel Cove in Jamestown on 25 August 2005. There were also strandings on the south shore of eastern Long Island in January 1995, March 2002, June and July 2004, and July, August, and September 2005. There is a very clear recent spike in the stranding record—of 13 total strandings during 1987–2005, 7 (53.8%) were in the last two years. To see whether that trend was more widespread and if it continued beyond the end of the stranding database we used, we reviewed the 2007 (Waring et al., 2008), 2008 (Waring et al., 2009), and draft 2009 stock assessments (NMFS, unpublished). The total numbers of Risso's dolphin strandings from Maine to Virginia were: 3 in 2001, 7 in 2002 (5 in Massachusetts), 13 in 2003 (10 in Mass.), 13 in 2004, 25 in 2005, 5 in 2006, and 7 in 2007. The 2004–05 spike seen in

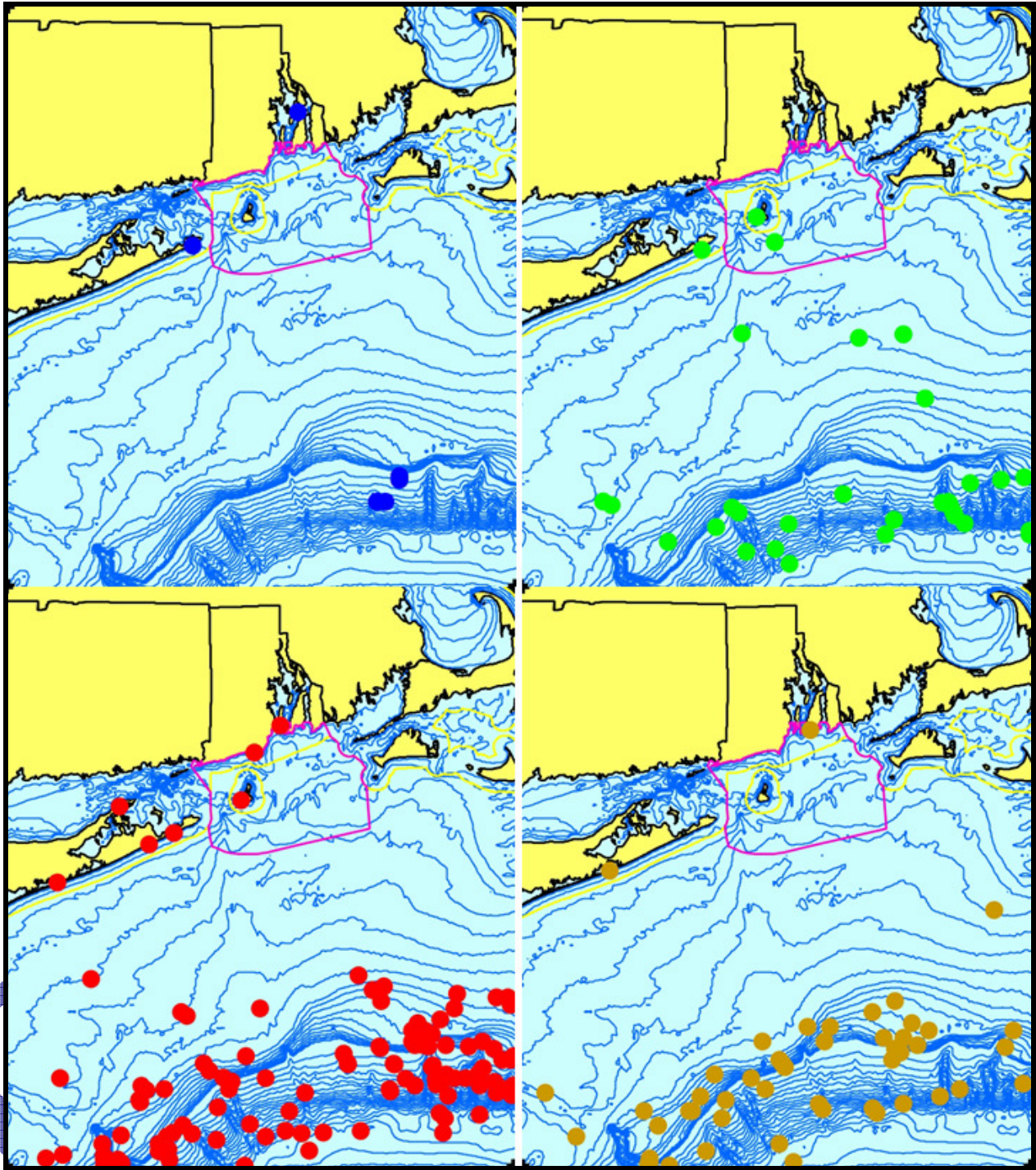


Figure 33. Aggregated sighting, stranding, and bycatch records of Risso's dolphins in the Rhode Island study area, 1960–2005 ($n = 208$: winter = 6, spring = 33, summer = 117, fall = 52).

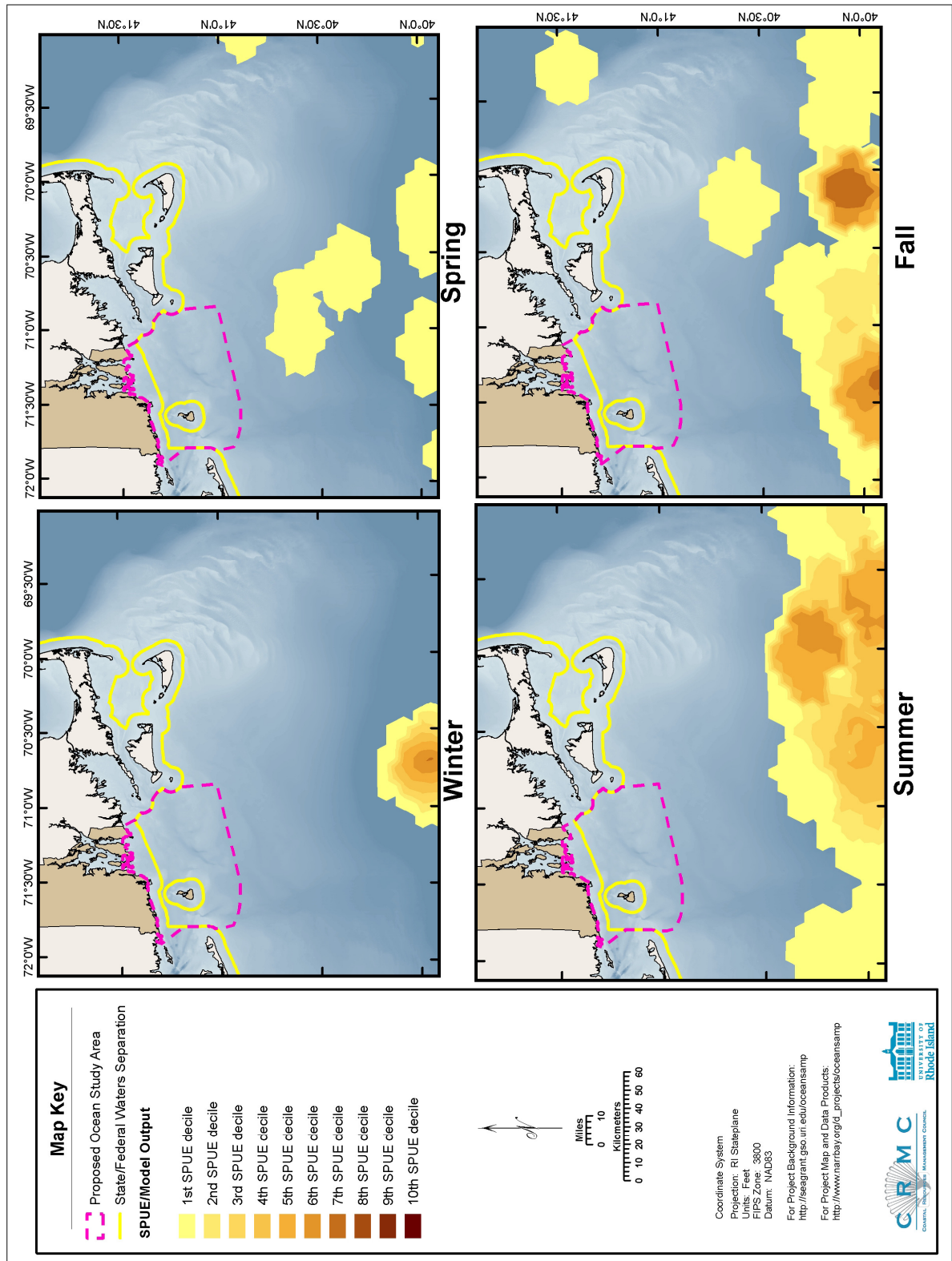


Figure 34. Modeled seasonal relative abundance patterns of Risso's dolphins in the Rhode Island study area, corrected for uneven survey effort.

strandings in the study area was also present in the entire Northeast; it appeared to begin a year earlier in Massachusetts, and it did not continue beyond 2005.

Conclusions

Risso's dolphins are offshore animals and are not expected to occur in the SAMP area. They are clearly much more common in the study area than the previous species, false killer whale, however the respective numbers of sightings from the whale-watching boats were XXX and nine. That confirms just how unlikely Risso's dolphins are to occur in the SAMP area.

DRAFT

3.2.25. Atlantic White-sided Dolphin *Lagenorhynchus (Leucopleurus) acutus* (Gray, 1828)

The six species of dolphins that have been included in the genus *Lagenorhynchus* appear very similar; all have robust bodies with tall falcate dorsal fins, very short beaks, and bold, distinctive color patterns (Jefferson et al., 1993; Folkens et al., 2002). LeDuc et al. (1999) and Cipriano (1997) both showed that the two North Atlantic species are genetically very divergent from the other four species and from each other. *L. albirostris* is the designated type species of the genus, and therefore should maintain the current name. The available generic name would be *Leucopleurus* Gray, 1866 for the Atlantic white-sided dolphin. A detailed genetic analysis by May-Collado and Agnarsson (2006) supported the recognition of Atlantic white-sided dolphin as *Leucopleurus acutus*.

Description

Atlantic white-sided dolphins have robust bodies about 2.5–2.8 m in length; prominent sharp keels on the top and bottom of the tailstock; short, thick beaks; and very prominent, tall, falcate, pointed, broad-based dorsal fins (Jefferson et al., 1993; Reeves et al., 1999a; Wynne and Schwartz, 1999; Cipriano, 2002). Females are about 20 cm shorter than males. The basic color pattern is three-banded, with a black cape, a gray band along the side, and a white belly, all with clear, distinct, relatively horizontal margins. On the flank, below and slightly behind the dorsal fin, there is a brilliant white patch or band below the edge of the cape, which extends up and back into the cape as a yellowish-tan band. The cape extends all the way back from the dorsal fin to the tail, though from above and behind it may look like a narrow black stripe along the dorsal keel between the two yellow bands on the sides. On the beak, the upper jaw is black and the lower is white. The eye is surrounded by a round black patch, which is connected by a narrow black stripe to the upper jaw. There may also be a narrow, less distinct gray stripe from the eye to the black flipper, and there is a black patch around the genital slit.

Status

Atlantic white-sided dolphins are not listed under the U.S. Endangered Species Act or on the Rhode Island state list, and are classified as Least Concern on the IUCN Red List. There are no precise estimates of the number of white-sided dolphins inhabiting the North Atlantic, though the number is roughly estimated as a few hundred thousand (Cipriano, 2002). They were one of the two most abundant dolphins observed during the CETAP studies (the other was the common dolphin), with seasonal abundances off the northeast U.S. in spring through fall of 38,000 to 42,000 (CETAP, 1982; Kenney et al., 1997). The most recent estimates for the Gulf of Maine and surrounding area have been extremely variable—51,640 in 1999, 109,141 in 2002, 2,330 in 2004, and 17,594 in 2006 (Waring et al., 2008). Kingsley and Reeves (1998) estimated the number in the Gulf of St. Lawrence in 1995 at 11,740.

A directed fishery for Atlantic white-sided dolphins formerly occurred in Norway, and small numbers are taken by subsistence hunters in Greenland (Reeves et al., 1999a). Large numbers were taken in some years in the former pilot whale drive fishery in Newfoundland (Sergeant and Fisher, 1957). In the Faroe Islands, white-sided dolphins continue to be taken in their pilot whale drive fishery, with total takes of 255 in 2000, 546 in 2001, 714 in 2002, and 186 in 2003 (IWC, 2005, 2006).

White-sided dolphins are also taken as bycatch in commercial fisheries (Addink et al., 1997; Couperus, 1997; Palka et al., 1997; Reeves et al., 1999a). The 2001–2005 average annual mortality from incidental take in U.S. Atlantic commercial fisheries was 357, including 31 in sink gillnet fishery, 221 in bottom trawls, 103 in mid-water trawls, and 2 in herring trawls (Waring et al., 2008). There were earlier takes known in swordfish driftnets (fishery now closed), Canadian sink gillnets, and Spanish deepwater trawlers off the Grand Banks.

Ecology and life history

White-sided dolphins generally occur in groups of a few to 50 or 60 animals, with some differences between areas (Reeves et al., 1999a; Cipriano, 2002). In the Gulf of Maine, they appear to travel in tight groups of 6–10 animals that are sometimes loosely associated in larger herds. In the CETAP (1982) data, group sizes ranged from 1 to 800, with a mean of 54.3, but the

most frequently observed group size was 8 dolphins. White-sided dolphins are very active, fast-swimming animals, and are known to breach and tail-slap, as well as to bow-ride in front of vessels and surf in their wakes. They have been observed swimming directly in front of large whales, which is thought to be the same bow-riding behavior seen in front of vessels.

White-sided dolphins have been observed in mixed-species aggregations with long-finned pilot whales in eastern Canadian waters, with white-beaked dolphins in the North Sea, and with white-beaked, bottlenose, and common dolphins off Ireland (Reeves et al., 1999a). In the Gulf of Maine, white-sided dolphins are frequently (i.e., at about a quarter of all sightings) sighted in association with other species known to feed on sand lance and other small fishes, including fin, humpback, and minke whales (CETAP, 1982). This was the most commonly observed multi-species association during the CETAP surveys. The association in this case is fundamentally different from the mixed schools of pilot whales, bottlenose dolphins, and other delphinids seen in offshore waters. In mixed schools of shelf-edge delphinids, they clearly are swimming together in a coordinated group, and the group sizes of each species were not significantly different between associated and non-associated sightings (i.e., a mixed school of, e.g., *Globicephala* and *Tursiops* is simply a typical school of each that have joined together). In the baleen whale/white-sided dolphin associations, group sizes for each species are significantly larger when associated with other species than when not associated, suggested that the multi-species sightings are adventitious groups of animals that occur when each species individually aggregates to feed on the same patchy prey resource, but there is no true interaction.

Mass strandings of white-sided dolphins are relatively common. Such strandings have been known since antiquity, and are probably a naturally occurring phenomenon (Gaskin, 1992). Such occurrences show a clear spatial pattern, with about 85–90% of all stranded white-sided dolphins between North Carolina and Nova Scotia occurring in Massachusetts.

White-sided dolphins do not appear to be deep divers. A satellite-tracked tagged animal made no dive longer than 4 minutes and most of its dives were less than 1 minute (Mate et al., 1994).

White-sided dolphins feed on a wide variety of small fishes and squid, with differences in the species consumed between areas and seasons (reviewed by Reeves et al., 1999a). Sand lance is an important prey in the spring in the Gulf of Maine. Other fish prey include herring, smelt, mackerel, silver hake, and a variety of other gadoids.

Sergeant et al. (1980) and Perrin and Reilly (1994) summarized the available information on life history in white-sided dolphins. Calves are born at around 110 cm long in May to early August, peaking in June–July, however the calving period may be more prolonged in the northeastern Atlantic. The gestation period is 10–12 months. Lactation lasts about 18 months, and about a quarter of mature females are simultaneously pregnant and lactating. The resulting average inter-birth interval is 2–3 years. Sexual maturity in males is at 230–240 cm and 8–9 years of age; females mature at 201–222 cm and 6–8 years old.

General distribution

Atlantic white-sided dolphins and white-beaked dolphins are both found only in the North Atlantic, with broadly overlapping distributions (Rice, 1998; Reeves et al. 1999a, 1999b; Cipriano, 2002; Kinze, 2002). White-sided dolphins are found in temperate to subarctic waters on both sides of the basin, with the northern limits of the range not very clear, but probably very similar to the white-beaked dolphin's—to Newfoundland, Greenland, Iceland, Svalbard, and the North Cape of Norway. The southern distributional limit of white-sided dolphins is further south, at least on the western side of the North Atlantic, where they occur to the mid-Atlantic. Both species occur south to the Bay of Biscay on the eastern side of the basin. In the western North Atlantic, their range extends from the U.S. mid-Atlantic to Greenland. They are common in the Gulf of Maine and Gulf of St. Lawrence, but seem to be relatively rare along the Atlantic coast of Nova Scotia. Palka et al. (1997) suggested that there were separate stocks in the Gulf of Maine, Gulf of St. Lawrence, and Labrador Sea.

Off the northeastern U.S., white-sided dolphins occur regularly from Hudson Canyon east to Georges Bank and north to the Bay of Fundy (CETAP, 1982; Selzer and Payne, 1988; Waring et al., 2008). They are the most common and abundant dolphin in the Gulf of Maine. They occur throughout the Gulf, but are most concentrated in the western portions from the Great South Channel east of Cape Cod to the Maine coast. During the CETAP surveys in 1979–1981, the annual pattern showed strong aggregation between Cape Cod and Georges Bank in the spring, dispersal throughout the Gulf of Maine in summer, a weaker aggregation in the central Gulf in fall, and a near-absence in the winter. The distribution in those years may have been driven by the distribution of sand lance, which were extremely abundant at that time. Strandings in the

mid-Atlantic were mainly in the winter, leading to an hypothesis for a winter migration offshore and to the south.

Prior to the 1970s, however, white-sided dolphins were very rarely seen within the Gulf of Maine. A sighting of a small group of about 12 east of Cape Cod was worthy of publication in the *Journal of Mammalogy* (Schevill, 1956), and their range was believed to be centered along the outer edge of the shelf, as is apparently the case off Newfoundland and Europe (Reeves et al., 1999a; Northridge et al., 1997). During the 1970s, white-beaked dolphins were more commonly observed in the Gulf of Maine. Kenney et al. (1996) hypothesized that white-sided and white-beaked dolphins in the Gulf of Maine shifted distributions after drastic changes in the stocks of small pelagic forage fishes caused by commercial fisheries. Intense fishing by foreign fleets in the 1960s and early 1970s caused a major decline in herring stocks, which were replaced by an explosion of sand lance (Sherman et al., 1981). The hypothesis was that white-beaked dolphins preferred herring, and moved east on the Nova Scotian shelf, and white-beaked dolphins shifted from an offshore to inshore habitat to fill the vacated niche. White-sided dolphins appeared in the stranding record in the mid-Atlantic during the 1970s and gradually expanded to the south, which seems to fit that same pattern of an offshore-to-inshore habitat shift, perhaps accompanied by growth of the population.

Historical occurrence

Cronan and Brooks (1968) reported only one known occurrence of white-sided dolphin in Rhode Island—a stranding at Monahan's Dock in Narragansett Pier on 22 July 1967. Neither De Kay (1842) nor Linsley (1842) included white-sided dolphin as a species occurring in New York or Connecticut. Goodwin (1935) stated that the nearest record to Connecticut was from Cape Cod, Massachusetts. The nearest record Connor (1971) knew of was the stranding reported by Cronan and Brooks. Waters and Rivard (1962) reported that the species “may range south to Cape Cod, but it does so rarely. There are only a few recorded sightings in the area of Cape Cod.” They reported strandings in Wellfleet in March 1949 and May 1960, and a mass stranding of 12 animals on Monomoy Island in September 1954. There were no other records in the Rhode Island study area prior to 1973.

Recent occurrence

The first recent record of Atlantic white-sided dolphin in the Rhode Island study area was a stranding at Bellport, Long Island in December 1973. The first Rhode Island stranding after the 1967 event was a 202-cm dolphin on First Beach in Newport on 1 May 1976. Later that same year, on 17 August, came the first live sighting record—a group of 200 dolphins seen in the southwestern end of Buzzard's Bay. Since then, the species has become common in the study area, and is the third most frequently recorded small cetacean (Table 1). There are occasional unconfirmed opportunistic reports of white-sided dolphins in Narragansett Bay, typically in fall and winter. Atlantic white-sided dolphins in the Rhode Island study area are inhabitants of the continental shelf, with a slight tendency to occur in shallower water in the spring (Fig. 35). They are most common in spring, with 61.4% of all records, evident in both sightings and strandings, followed by summer (21.0%), winter (10.0%), and fall (7.6%). There is an obvious aggregation of sightings southeast of Montauk Point, in that area where deeper water comes closest to shore—in spring and secondarily in summer. In the data from the whale-watching boats, there were 16 spring sightings and 7 summer sightings; their removal has almost no effect on the pattern of seasonality and little effect on the spatial pattern. The spring-summer concentration southeast of Montauk is not caused by bias from the whale-watch sightings. It is likely that the same prey resources that draw fin whales to that area also attract white-sided dolphins. There was one stranding in the spring on the Connecticut shore of Long Island Sound; there was one more in Connecticut and one in Long Island west of the study area boundary.

The effort-corrected patterns of relative abundance show that Atlantic white-sided dolphins occur in the Ocean SAMP area in all four seasons (Fig. 36). In winter, they occur at low abundance in the offshore half of the SAMP area, but more abundantly in deeper water on the outer part of the shelf. In spring they occur throughout the SAMP area in low numbers. The area of highest abundance is offshore of the southeastern corner of the SAMP area, and the distribution is in somewhat shallower water than in winter. There is also an area of relatively high abundance in the Great South Channel region east of Cape Cod. In summer, there is an area of moderate abundance in the eastern half of the SAMP area, the zone of abundance south of the SAMP has moved a little farther offshore, and the highest abundance is in the Great South Channel. The pattern in fall is similar to spring, but at lower abundances.

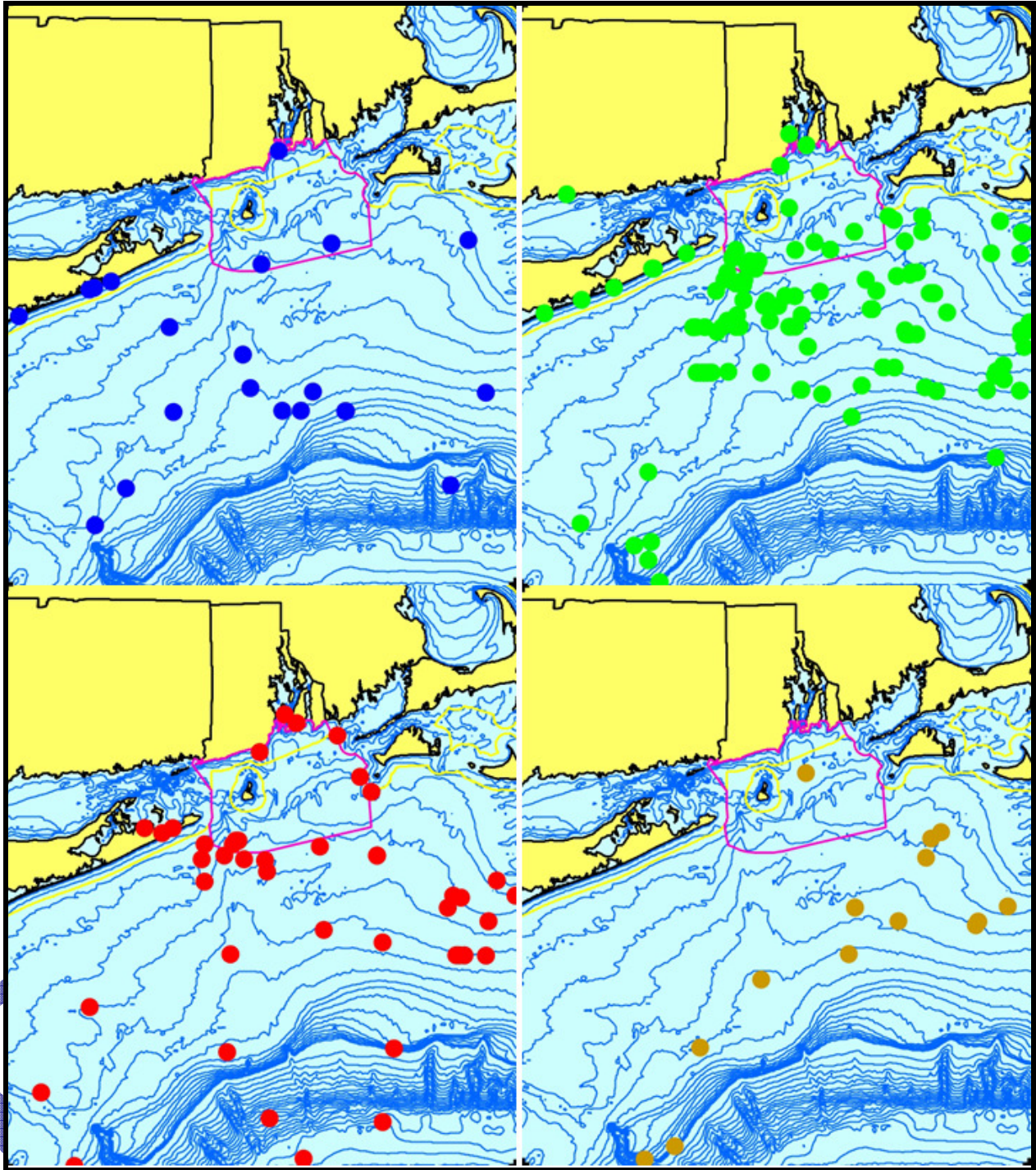


Figure 35. Aggregated sighting, stranding, and bycatch records of Atlantic white-sided dolphins in the Rhode Island study area, 1973–2006 ($n = 210$: winter = 21, spring = 129, summer = 44, fall = 16).

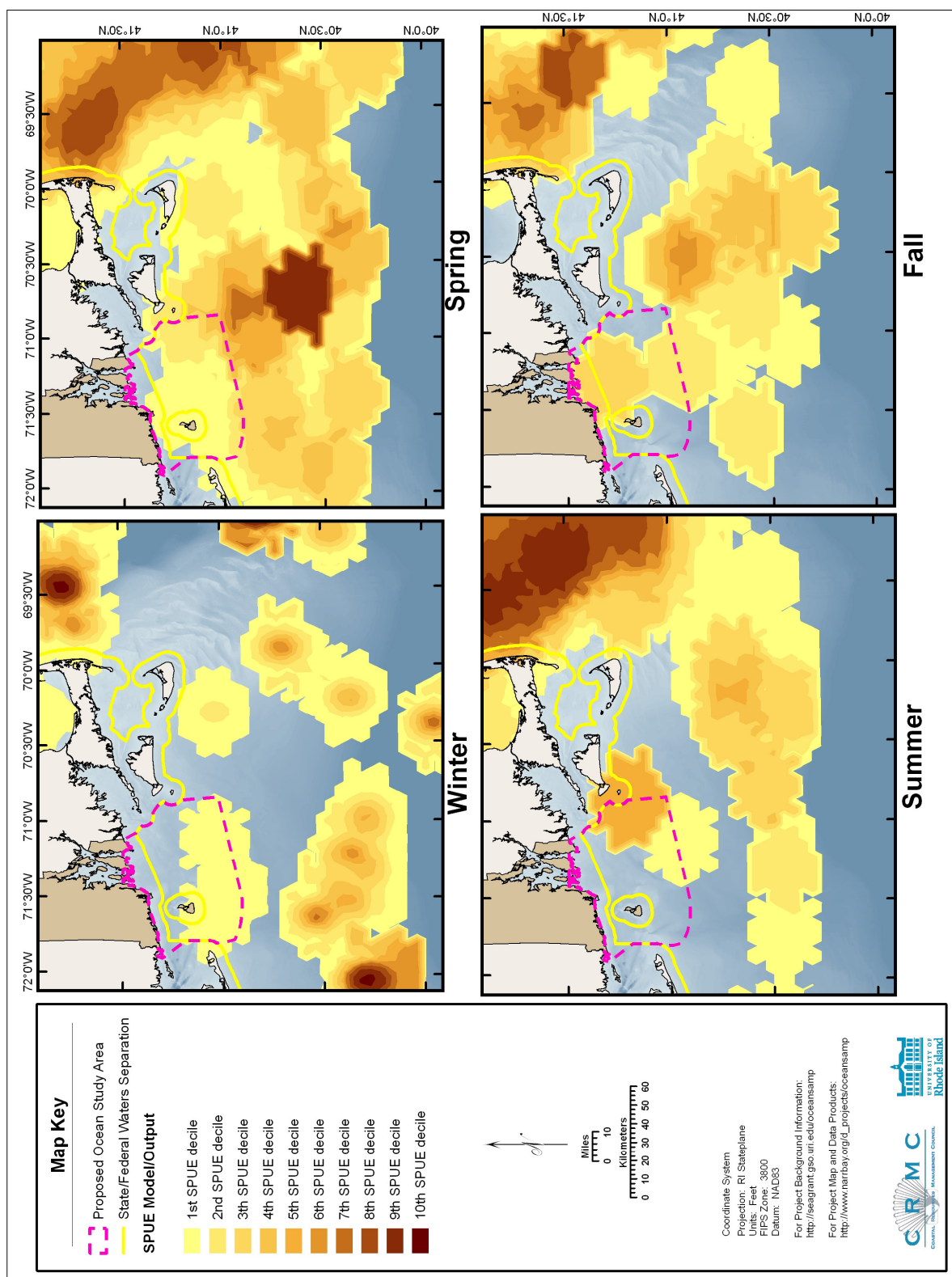


Figure 36. Modeled seasonal relative abundance patterns of Atlantic white-sided dolphins in the Rhode Island study area, corrected for uneven survey effort.

Atlantic white-sided dolphin strandings in the Rhode Island study area have been relatively rare (Fig. 37). There was a spike in 2001–2005, but the annual average was still low at only 1.2 per year. Four of the six strandings in that 5-year period were in Rhode Island—two in 2002 and 2 in 2005 (Waring et al., 2008), but the stranding rate is minimal in comparison with Massachusetts. Of 285 white-sided dolphins stranded from North Carolina to Nova Scotia in 2001–2005, 222 (78%) were in Massachusetts, mostly in mass strandings. Strandings in the study area were less strongly seasonal than sightings, with six in winter (29%), ten in spring (48%), and five in summer (24%).

After the first two Rhode Island strandings in 1967 and 1976, the next was on 21 February 1997 at Snug Harbor, when a 140-cm, 50-kg juvenile that was disoriented in Point Judith Pond was live-captured, then released alive after blood samples tested normal. Two dolphins stranded on Scarborough Beach in Narragansett on 31 March 2002, one stranded on First Beach in Newport on 8 June 2002, one stranded at Plum Point in North Kingstown on 6 March 2005, and one stranded on the eastern side of Jamestown on 7 July 2005. There was one stranding in Connecticut—at Branford in May 2003. The other 14 white-sided dolphin strandings in the study area were all in eastern Long Island, in 1973 (mentioned above), 1974, 1978, 1979, 1981, 1985, 1987, 1988, 1991, 1995 (two), 1996, 1997, and 2004. The strandings are rare and localized: 1997, 2002, and 2005 were the only years with two strandings, and only in 1997 were there strandings in more than one state.

Conclusions

Atlantic white-sided dolphins are not ESA-listed, but they are probably the cetacean species that occurs seasonally in the highest numbers in the SAMP area. As such, they would be in the second tier of species that need to be considered carefully relative to the SAMP (see section 4, Recommendations).

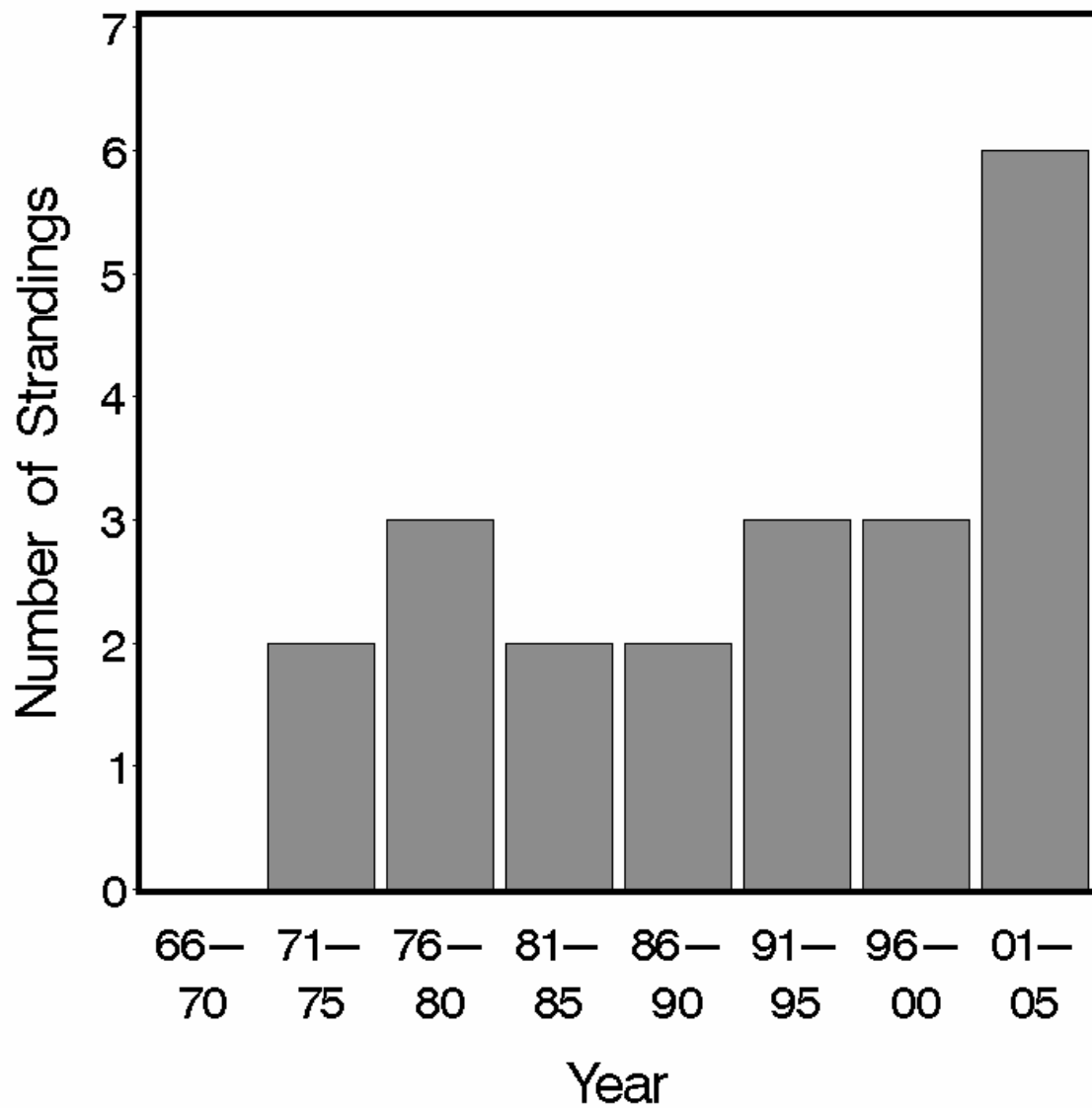


Figure 37. Five-year stranding frequencies for Atlantic white-sided dolphins in the Rhode Island study area, 1966–2005.

3.2.26. White-beaked Dolphin *Lagenorhynchus albirostris* (Gray, 1846)

Description

White-beaked dolphins are very similar in overall body form to Atlantic white-sided dolphins, with robust bodies; prominent keels on the top and bottom of the tailstock; short, thick beaks; and very prominent, tall, falcate dorsal fins (Jefferson et al., 1993; Reeves et al., 1999b; Wynne and Schwartz, 1999; Kinze, 2002). White-beaked dolphins are slightly larger, reaching 3–3.2 m in length. Both species are counter-shaded with black backs and white bellies, but remaining details of their color patterns are distinctively different. In white-beaks, as their common name indicates, the white belly area includes both the upper and lower jaws and a little of the melon, though a close look is necessary to see this well in free-swimming animals. In front of the dorsal fin, there is a black cape, a white or pale gray patch below, and a dark gray to black patch below that. The cape and the darker patch on the side blend together at the head. Behind the dorsal fin, most of the animal is medium to very pale gray to nearly white, without distinct edges between different colors.

Status

White-beaked dolphins are not listed under the U.S. Endangered Species Act or on the Rhode Island state list, and are classified as Least Concern on the IUCN Red List. There are no synoptic estimates of the number of white-beaked dolphins across the Atlantic, though from estimates in separate smaller areas it is possible that the number is in the high tens to low hundreds of thousands (Reeves et al., 1999b). Individual estimates from eastern Canadian waters range up to several thousand. None were sighted during the CETAP census surveys, although a single estimate of 573 was calculated from a special right whale survey east of Cape Cod in May 1980 (CETAP, 1982). An aerial survey in the Gulf of Maine in August 2006 resulted in the first available estimate from any of the NMFS stock assessment surveys—2003 white-beaked dolphins (Waring et al., 2008).

White-beaked dolphins were at times the subject of small-scale opportunistic hunting in Norway, Iceland, Greenland, Newfoundland, and Nova Scotia. Some of the dolphins taken in the

Faroe Islands pilot whale fishery may be white-beaked rather than white-sided dolphins. They were formerly hunted for food in Newfoundland and Labrador, with up to several hundred killed per year (Alling and Whitehead, 1987). Present takes in that region are apparently limited to only the most remote regions of Labrador (Lien et al., 2001). There are no records of human-related mortality in U.S. waters (Waring et al., 2008), although they are known to be killed by entanglement in fixed fishing gear in eastern Canadian waters (Alling and Whitehead, 1987; Read, 1994; Hai et al., 1996) and also in Europe (Kinze et al., 1997).

Ecology and life history

White-beaked dolphins typically are sighted in groups a few to 50 animals, most commonly in small groups of fewer than 10, but may at time aggregate in herds of hundreds (Reeves et al., 1999b; Kinze, 2002). There is a suggestion that juveniles segregate into separate groups from adults and calves, but the data are very sparse. They are very active, and are known to leap and breach, as well as bow-ride in front of vessels. They are very fast swimmers, and may create a rooster-tail of spray when surfacing.

White-beaked dolphins appear to feed primarily on fish and secondarily on squid, and also on octopus and benthic crustaceans (Reeves et al., 1999b; Kinze, 2002). The major types of fish eaten are herring and other clupeids, cod and other gadids, hake, capelin, mackerel, flounders, and sand lance.

There are very few available life-history data for white-beaked dolphins (Reeves et al., 1999b; Kinze, 2002). Calves are born at 110–120 cm over an extended period, probably from May to August or September. The gestation period is 10–11 months, but the length of lactation is not known. Information on maturity is based on very small samples. The smallest mature male known was 251 cm, and the largest immature male was 257 cm. In females the range is much wider—the smallest known mature individual was 174 cm and the largest immature was 246 cm. Physical maturity appears to be at an average length and age of 281 cm and 13 in males and 261 cm and 16 in females.

General distribution

Atlantic white-sided dolphins and white-beaked dolphins are both found only in the North Atlantic, with broadly overlapping distributions (Rice, 1998; Reeves et al. 1999a, 1999b; Cipriano, 2002; Kinze, 2002). White-beaked dolphins are found in temperate to subarctic waters on both sides of the basin, with the northern limits around Newfoundland, Greenland, Iceland, Svalbard, the North Cape of Norway, and the White Sea. The southern distributional limit is about the same as white-sided dolphins on the European side of the ocean, to about the Bay of Biscay, but on the North American side they are common only to the Nova Scotian shelf currently, and formerly to the Gulf of Maine, with occasional occurrences as far south as North Carolina and Portugal. In the northeastern Atlantic, white-sided dolphins typically occur farther offshore than white-beaked dolphins. In the western North Atlantic, their range extends from southeastern New England and Nova Scotia to Greenland, although there was one sighting of 15 “probable” white-beaked dolphins on the outer shelf east of northern North Carolina border in May 1979 (CETAP, 1982). Prior to the 1970s, they were the most common species of dolphin occurring within the Gulf of Maine, with sightings concentrated around Massachusetts in April through June or July. Since then, however, they have been very rare in the Gulf of Maine (Waring et al., 2008), though still common off Nova Scotia and farther north (see discussion under white-sided dolphin).

Historical occurrence

There are no historical records of white-beaked dolphins in the Rhode Island study area. They were not mentioned at all by Cronan and Brooks (1968), nor by De Kay (1842), Linsley (1842), Goodwin (1935), or Connor (1971). Waters and Rivard (1962) wrote that the species “very rarely enters New England coastal waters. A sighting on 27 April 1961, thirty miles north of Cape Cod, is said to be the first specimen record from New England.” They also reported a stranding on Nauset Beach on the outer Cape on 29 April 1961. The first known occurrence in the study area was the sighting in February 1975 (see below).

Recent occurrence

There were only 11 scattered occurrences of white-beaked dolphins in the Rhode Island study area (Fig. 38), all but one in spring or summer. The first was a sighting of six dolphins at the shelf break near Hudson Canyon on 15 February 1975. The sightings are concentrated in a few years. There were sightings in Vineyard Sound in August 1977 and March 1979, a sighting south of Martha's Vineyard in June 1979, one over the slope east of Hudson Canyon in August 1979, one animal seen from a whale-watching boat about 2 km off Montauk Point on 4 July 1981, and another sighting of one dolphin just south of Block Island on 5 August 1981. Then there were no sightings for 17 years. There were two strandings, quite possibly related, in Connecticut in May 1986—in West Haven (the westernmost) on the 22nd and in Niantic on the 25th. The last two sightings were from an aerial survey south of Nantucket on 22 May 1998—one group of 40 dolphins and another group of 2.

Conclusions

White-beaked dolphins occur in the study area only rarely, and are probably less likely now than they may have been 40 years ago. Despite the intensive whale-watching, only one sighting was recorded in 1981. White-beaked dolphins can reliably be assigned to the lowest priority group of species relative to the SAMP.

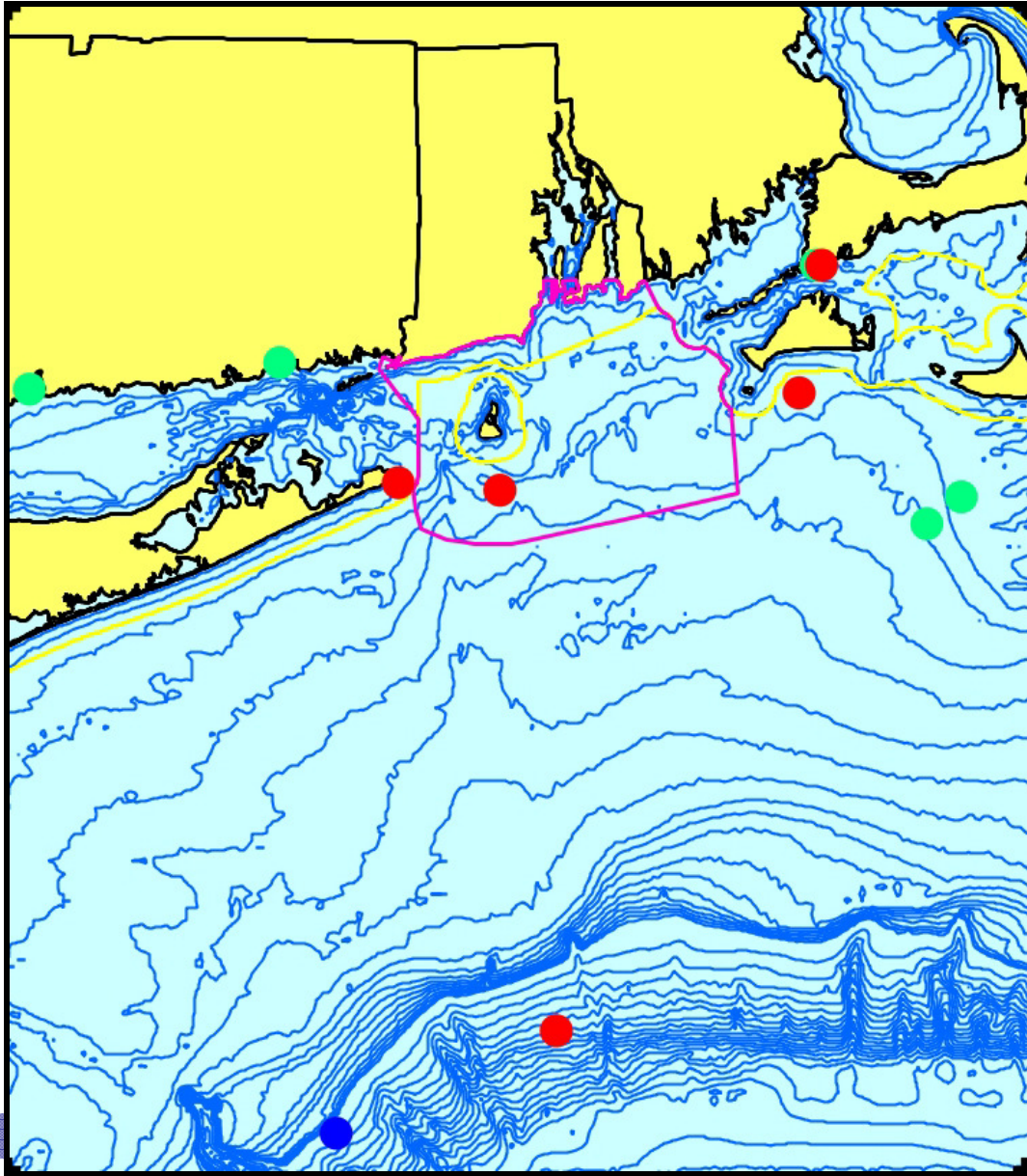


Figure 38. Aggregated sighting, stranding, and bycatch records of white-beaked dolphins in the Rhode Island study area, 1975–1998 ($n = 11$: winter = 1, spring = 5, summer = 5, fall = 0).

DRAFT

3.2.27. Common Bottlenose Dolphin *Tursiops truncatus* (Montagu, 1821)

At least one other species of bottlenose dolphin is recognized—the Indian Ocean bottlenose dolphin, *Tursiops aduncus*, and other species are likely to be (Rice, 1998). In addition, in many areas of the world including the western North Atlantic, there are diagnosable inshore and offshore populations (Mead and Potter, 1990, 1995; Rice, 1998). Off the eastern U.S. the inshore and offshore populations are currently considered to be “ecotypes” or “morphotypes” of a single species for management purposes (Waring et al., 2008). Recent genetic results, however, show them to be sufficiently distinct to be considered separate species (Kingston and Rosel, 2004). The type specimen of *T. truncatus* matches the characteristics of the offshore population; available names for a separate inshore species include *T. erebennus* (Cope, 1865) and *T. subridens* (Flower, 1884) (Mead and Potter, 1995).

Description

Bottlenose dolphins are the “plainest” and least distinctively marked of all of the beaked dolphins in the North Atlantic (Jefferson et al., 1993; Wells and Scott, 1999, 2002; Wynne and Schwartz, 2002). Body size is extremely variable between populations; adults may be 2–3.8 m long. Offshore animals average about 15% larger than inshore animals along the U.S. Atlantic coast (Mead and Potter, 1995). The body is relatively thick and robust (especially in offshore animals), with a tall, falcate dorsal fin. The beak is well-defined and prominent, of moderate length (shorter than in *Stenella* and *Delphinus*, but significantly longer than in *Lagenorhynchus*), and stout. The body is basically gray to brownish, darkest on the back and lightest on the belly. There may be a clearly visible darker cape, or the color may simply fade gradually from the back to the belly. There may be indistinct stripes on the head or spots, and some animals may have a faint version of the spinal blaze that is seen prominently in striped and Atlantic spotted dolphins. In addition to consistent genetic and biochemical differences, inshore bottlenose dolphins in the western North Atlantic are significantly smaller than offshore animals, are usually lighter-colored, have flippers and beaks that are larger relative to body length, as well as narrower skulls and rostrums, feed on different types of prey, and carry different types of parasites (Hersh and Duffield, 1990; Mead and Potter, 1990, 1995; Hoelzel et al., 1998).

Status

Common bottlenose dolphins are not listed under the U.S. Endangered Species Act or on the Rhode Island state list, and are classified as Least Concern on the IUCN Red List. Coastal bottlenose dolphins along the U.S. Atlantic coast were designated as Depleted under the Marine Mammal Protection Act in 1993 (NMFS, 1993) because of high mortality in a 1987 epizootic (Scott et al., 1988). However, the impact of that event was seriously overestimated because the mortality occurred from Florida to New Jersey, but the only available estimate of abundance was for Cape Hatteras to New Jersey. In addition, no subsequent surveys have been able to detect a decrease in the abundance of coastal dolphins. A review of the depleted designation that is presently applied to all coastal management units is needed (Waring et al., 2008). There are no reliable estimates of the total abundance of bottlenose dolphins in the North Atlantic. The existence of inshore and offshore populations (or species) and multiple stocks within populations makes it difficult to synoptically survey the entire region or to estimate the abundance of individual components. Mitchell (1975a) estimated the size of the stock subject to the North Carolina dolphin fishery in the 1880s at around 14,000. The CETAP data suggested that there were 11,000–13,000 bottlenose dolphins north of Cape Hatteras in spring and summer, with probably only 1,000 or fewer in the inshore stock (CETAP, 1982; Kenney, 1990). Subsequent surveys have been conducted in both inshore and offshore waters along the entire east coast (Waring et al., 2008). The Atlantic offshore population was estimated at 81,588 dolphins in 2002–2004 from Florida to Georges Bank. The total of all coastal stocks along the Atlantic coast was estimated at about 44,000 animals, including 17,466 in northern migratory stock—the only one that occurs in the mid-Atlantic. Additional bottlenose dolphin stocks occur in the Gulf of Mexico.

Bottlenose dolphins have been the targets of directed fisheries in several areas of the world (Wells and Scott, 1999, 2002; Reeves and Read, 2003). A fishery once existed in several countries around the Black Sea that took both bottlenose dolphins and harbor porpoises for oil, meat, and leather. Dolphin fisheries also exist in Peru, Sri Lanka, and Japan, taking dolphins for food, for bait in other fisheries, and to eliminate perceived competition for declining fish stocks. Recent takes of bottlenose dolphins in coastal small-cetacean fisheries in Japan have been 1,426 in 2000, 247 in 2001, 729 in 2002, 164 in 2003, and 16 in 2004 (IWC, 2005, 2006). There was a

bottlenose dolphin fishery in operation at Cape Hatteras, North Carolina at least sporadically from 1797 to 1929 (Mead, 1975). A similar fishery was prosecuted at Cape May, New Jersey in 1884–1885, and one may have operated in the 18th Century or earlier in Long Island, depending on what De Kay (1842) and earlier writers were referring to regarding “porpoise” fisheries. Reeves and Read (2003) provide a good review of the fishery methods. Catches at Cape Hatteras were mostly in spring and fall, with very few in summer; so they were apparently targeting migrating animals moving north or south and not residents.

Another directed effort has been the live-capture dolphin fishery for public display and other purposes (including research and military use) (Reeves and Leatherwood, 1984; Reeves and Mead, 1999; Wells and Scott, 1999, 2002). Over 1,500 were captured between the late 1930s and early 1980s, mostly in the southeastern U.S. A May 2000 inventory by NMFS showed 392 captive bottlenose dolphins in 35 facilities in the U.S. alone, with at least several hundred more in at least 16 other countries.

Bottlenose dolphins are taken incidentally as bycatch in a number of different commercial fisheries around the world (Northridge, 1991; Perrin et al., 1994b; Wells and Scott, 2002). The average annual mortalities in 2001–2005 in U.S. Atlantic waters are summarized in Waring et al. (2008). One observed take of an offshore dolphin in 1991 in the New England sink gillnet fishery extrapolated to an annual average of 26. Previous takes included an annual average in the swordfish driftnet fishery in 1989–1998 of 31.7 (that fishery is now closed), an average of 38.4 in the pelagic tuna pair-trawl fishery in 1991–1995 (also now closed), and one animal taken in a bottom trawl in 1991 (extrapolated to a total estimated take that year of 91). There was one take in the mid-Atlantic coastal gillnet fishery in 1998 that was probably an offshore animal, and one take in 2001 in the coastal-offshore overlap zone that was not included in the extrapolated estimate for the fishery due to uncertainty as to the stock identity. Annual average takes of coastal bottlenose in the mid-Atlantic coastal gillnet fishery were 233 per year in 1996–2000 and 61 per year in 2001–2005, with all takes in North Carolina and north and most in North Carolina in the winter. Bottlenose dolphins are probably also killed or injured by recreational fishing gear, but it is not well quantified (Gorzelany, 1998; Wells et al, 1998). Bottlenose dolphins are the most frequently stranded cetacean on the U.S. Atlantic coast—292 in 2003, 359 in 2004, and 284 in 2005 (Waring et al., 2008), occasionally in mass strandings and primarily from New Jersey south. Some proportion of stranded animals bear marks of netting or

ropes and were probably killed by entanglement in fishing gear.

Ecology and life history

Bottlenose dolphins are gregarious, usually occurring in small groups of around 2–15 animals, but groups larger than 1000 have been reported (Wells et al., 1999; Wells and Scott, 1999, 2002). They generally are seen in smaller groups in bays and sounds than offshore, but group size is not a linear function of distance from shore. Off the northeastern U.S., the average group size was 14.8, with a mode of 2 and a range of 1–350 (CETAP, 1982), but that combined inshore and offshore sightings.

Group membership is dynamic, with sex, age, reproductive status, kinship, and affiliation history all involved (Wells et al., 1987; Scott et al., 1990; Wells and Scott, 1999, 2002; Connor et al., 2000; Reeves and Read, 2003). The social structure has been called a “fission-fusion” society. Some subgroups are stable for long terms, some may be repeated over periods of years, and others are more ephemeral. The basic social units are nursery schools of adult females and their calves, mixed-sex juvenile schools, and adult males, either solitary or in strongly bonded pairs and trios. Male-male bonds may last for decades, probably to enhance mating success and predator defense (Wells et al., 1987, 1990; Connor et al., 1992). There is no evidence for male coalitions in Moray Firth, Scotland, although those animals would be the same as the U.S. Atlantic offshore stock where there is very little information. Dominance hierarchies are observed in captivity—maintained by aggressive behaviors, including posturing, loud jaw claps, and physical contact.

Bottlenose dolphins commonly occur in mixed-species schools with other cetaceans. Scott and Chivers (1990) reported that bottlenose in the offshore eastern tropical Pacific were seen 16% of the time with one other species and 4% with two or more other species. They associated mostly with short-finned pilot whales, and pantropical spotted dolphins, and also with Risso's, rough-toothed, and spinner dolphins, sperm whales, and others. Norris and Prescott (1961) and Norris and Dohl (1980) similarly reported a common association of bottlenose dolphins and pilot whales in the North Pacific. Offshore bottlenose dolphins off the northeastern U.S. occur in mixed herds at 10% of all sightings, mostly with pilot whales, and also with

Risso's, common, and striped dolphins (CETAP, 1982). Mixed delphinid schools often included calves and juveniles of one or both species.

There are many reports on the prey of bottlenose dolphins, including observational studies and analyses of stomach contents, mostly dealing with inshore animals (Leatherwood, 1975; Leatherwood et al., 1978; Barros and Odell, 1990; Shane, 1990; Mead and Potter 1990, 1995; Barros and Wells, 1998; Walker et al., 1999; Wells and Scott, 1999, 2002; Reeves and Read, 2003). The dominant prey are fishes, primarily from three families—sciaenids (weakfish, croaker, spot, etc.), scombrids (mackerels), and mugilids (mulletts). Mead and Potter (1990) reported 40 different families of bony fishes, plus skates, rays, sharks, squid, shrimp, and isopods in the stomachs of *Tursiops* from the U.S. Atlantic coast. The four principal prey species were all sciaenids, including weakfish (also known as spotted sea trout), Atlantic croaker, spot, and silver perch. Stomachs of offshore animals were dominated by myctophids and squid.

Female bottlenose dolphins give birth after a 1-year gestation to a single calf that is 84–140 cm at birth, with substantial differences between populations (Wells and Scott, 1999, 2002; Reeves and Read, 2003). In Gulf of Mexico coastal dolphins, calves average 110 cm at birth (Fernandez and Hohn, 1998). Calving seasonality varies between populations (Scott et al., 1990; Urian et al., 1996; Fernandez and Hohn, 1998; Connor et al., 2000). In the long-term stranding data, Mead and Potter (1990) recorded neonates of 106–132 cm, and estimated a mean size at birth of 117 cm and 20.4 kg. They reported a mode in neonate strandings in March, and suggested a prolonged calving season with a peak in spring, with no evidence of a fall peak. During the CETAP (1982) study off the northeastern U.S., bottlenose calves were seen all year, recorded at 12% of sightings in spring, 12% in summer, 16% in fall, and 5% in winter. Thayer et al. (2003) reported that neonate strandings in North Carolina peaked in April–May and were lowest in fall and winter, but that births to known females were in May–June with one in fall. They speculated that the differences could be because of the presence of multiple stocks, or due to bias because out of season births may be more likely to lead to neonate mortality.

Mothers and calves rarely separate during the first few months (Mann and Smuts, 1998). A calf may nurse for several years, but begins foraging independently during its first or second year, maybe as young as four months (Wells et al., 1987; Wells and Scott, 2002). A calf is generally weaned completely at around the time the mother gives birth to the next calf, with overall duration a function of the age, nutritional condition, and social status of the mother

(Wells et al., 1987; Mann et al., 2000; Whitehead and Mann, 2000; Wells and Scott, 2002). The typical inter-birth interval is 3–6 years (Scott et al., 1990; Wells and Scott, 2002).

The mating system in both species of bottlenose dolphins appears to be promiscuous with “roving” males (Wells et al., 1987, 1999; Scott et al., 1990; Connor et al., 1992; 2000; Wells and Scott, 1999, 2002). Associations between males and females are extremely short-term. Coalitions of males travel more widely than any other groups, fighting for access to receptive females. Older males tend to be heavily scarred from fighting. In Australia, *T. aduncus* male coalitions aggressively separate receptive females from their bands and herd them away, which has not been observed in other populations.

In 1987–1988, there was a mass mortality of bottlenose dolphins along the U.S. Atlantic coast between New Jersey and Florida, which killed at least 740 animals (Scott et al., 1988). It was estimated at the time that the event killed 50% of the coastal migratory stock of *Tursiops*, however the only available abundance estimate (from CETAP, 1982) was for a much smaller area than that impacted by the epizootic. The dolphins died acutely from a wide variety of opportunistic viral and bacterial infections, but the underlying cause was first attributed to immune suppression caused by ingestion of prey containing a “red tide” toxin—brevitoxin produced by the dinoflagellate *Karenia* (formerly *Ptychodiscus*) *brevis* (Geraci, 1989). That finding was never widely accepted, particularly since there was no published literature showing a chronic immuno-suppressive effect of brevetoxin. In addition, bottlenose dolphins feed high on the food chain and could be subject to bioaccumulation of toxic contaminants. Animals in U.S. Atlantic waters have high concentrations of PCB’s and PBB’s (Kuehl et al., 1991; Lahvis et al., 1995). Organochlorines, even at relatively low levels, have the potential to affect immune response and may play a part in the apparent increase in disease outbreaks (O’Shea et al., 1999; Wells and Scott, 2002). Males tend to accumulate higher loads than females, who reduce their own levels by transfer in milk lipids to their calves. In South African bottlenose dolphins, it was estimated that first-born calves received 80% of the mother’s body burden of PCB’s and dieldrin (Cockcroft et al., 1989). Subsequent reanalysis of archived tissue samples has suggested that morbillivirus may have played a role in the 1987–88 epizootic (Lipscomb et al., 1994). Morbillivirus has also been implicated in other bottlenose dolphin epizootics in the Gulf of Mexico (Duignan et al., 1996; Lipscomb et al., 1996).

General distribution

Bottlenose dolphins occur in temperate and tropical waters of all oceans of the world, as well as in the Mediterranean, Black, and Red Seas (Rice, 1998; Wells and Scott, 1999, 2002; Reeves and Read, 2003). The limit of the distribution in the Southern Hemisphere is around 40°S. The distribution in the North Pacific extends north to the Sea of Okhotsk and Kuril Islands in the west and to central California in the east. Because of very extensive surveys undertaken to assess the stocks of dolphins impacted by the tuna purse-seine fishery, there are substantial numbers of sightings of bottlenose dolphins across an immense area of the eastern tropical Pacific—as far as 3,000 km and more offshore (Scott and Chivers, 1990). In the North Atlantic their range extends north to southern Greenland, Iceland, and northern Norway. In the western North Atlantic, bottlenose dolphins occur from the equator north to at least Nova Scotia, with some records to Newfoundland.

Within that overall distribution, the picture is complicated by the existence of multiple species, populations, and/or stocks. Surveys in 1979–1981 showed clearly separated inshore and offshore bottlenose dolphins off the northeastern U.S. (CETAP, 1982; Kenney, 1990). There was one band of sightings very close to shore from Cape Hatteras to Delaware Bay and southern New Jersey, and a second band along the shelf break from Cape Hatteras to the Nova Scotian shelf, with scattered sightings far offshore in deep water. In the vicinity of Cape Hatteras, where the continental shelf becomes quite narrow, the two areas of sightings overlapped. South of Cape Hatteras the presence of coastal bottlenose dolphins was well known, but the continuous distribution of the offshore stock was not clear until NMFS conducted marine mammal stock assessment surveys beginning in the 1990s (Waring et al., 2008). The inshore and offshore dolphins are distinct, and possibly represent two different species (reviewed above). Kenney (1990) suggested that inshore and offshore dolphins could be split spatially by partitioning sightings into classes in waters deeper or shallower than 25 m, however no simple scheme has been successful. Torres et al. (2003) analyzed *Tursiops* skin biopsies collected both inshore and offshore from Florida to Georges Bank by incorporating the genetic results into a spatial model. Within 7.5 km from shore, only inshore animals were sampled. In areas more than 34 km offshore and in water deeper than 34 m, only offshore animals were sampled. In between was the

“gray zone” where both types can occur, and there were three locations where both types were biopsied within the same school.

On top of the inshore-offshore pattern there is also a definite seasonal pattern to bottlenose distribution off the northeastern U.S. (CETAP, 1982; Kenney, 1990). Offshore dolphins occurred on the outer shelf along the entire study area from Hatteras to southern Nova Scotia in spring and summer. In the fall the distribution became sparser in the northern half of that range. In winter, sightings of offshore dolphins were very sparse, but still scattered along the entire shelf break. The seasonality was much more dramatic in the inshore distribution, which extended to Delaware Bay in spring and summer, contracted to Virginia and south in fall, and contracted completely to south of Hatteras in winter.

Historical occurrence

Cronan and Brooks (1968) reported two bottlenose dolphin records from Rhode Island, a 315-cm male stranded at Sand Hill Cove in Narragansett on 17 September 1967 and one previously at Newport on an unknown date. That is likely to refer to the specimen from Newport in the Smithsonian, collected by Major E. A. Mearns on 13 December 1899—the oldest bottlenose record in the Rhode Island study area. The species was not included by De Kay (1842) as part of New York’s marine mammal fauna, unless it had been confused or inadvertently combined with the “common porpoise.” Neither Linsley (1842) nor Goodwin (1935) knew of occurrences in Connecticut. Connor (1971) summarized a number of published and anecdotal records of bottlenose dolphins along the shores of Long Island and nearby, indicating that the species was rather common. The Smithsonian data include stranding and sighting records around eastern Long Island between 1921 and 1960, plus several non-dated sightings, all extracted from Connor’s review. There were two other relevant records—a sighting in 1936 “off Block Island” but with no more specifics, reported by Remington Kellogg in a 1940 *National Geographic* article; and a specimen collected during the Atlantis Expedition in May 1939 “100 miles south of Montauk” (beyond the study area). Waters and Rivard (1962) said that bottlenose dolphins were uncommon migrants in Massachusetts waters, and cited only one specific record, a stranding in Plymouth in December 1947.

Recent occurrence

The spatial and temporal distribution of bottlenose dolphins in the Rhode Island study area essentially mirrors what was described above from the CETAP data (Fig. 39). Sightings of offshore dolphins occurred year-round in waters of the outer shelf, shelf break, and upper slope. Summer was the peak season (45.6%), followed by spring (31.3%), fall (18.1%), and winter (4.4%). There were a number of more inshore sightings in summer, but they were in waters deeper than 40–50 m, so there is no clear sighting or distributional evidence for the occurrence of coastal bottlenose dolphins in the study area. (Note, however, that detailed analyses of skull morphometrics, blood profiles, genetics, etc. of stranded specimens would be necessary to say anything about the population origins of individual stranded animals). Fourteen sightings came from the whale-watching boats, about equally in summer and fall, however the fall sightings were all on offshore trips. There were no sightings within the SAMP area, although there were several close by in summer.

The first true offshore bottlenose dolphin sightings in the study area were in the 1970s. On 16 May 1974, a group of fifty dolphins was sighted from a U.S. Coast Guard cutter near the shelf break about 150 km south of Montauk Point. On 8 October 1978 a group of thirty was seen in the vicinity of Block Canyon. That sighting was extracted as an opportunistic sighting record in the early phase of CETAP from the Smithsonian's Scientific Event Alert Network bulletin, so it is also included in the Smithsonian data (among the many duplicates across datasets that needed to be identified and removed). The dolphins were originally seen by Paul Connor and the sighting published by Ulmer (1980).

The effort-corrected relative abundance patterns (Fig. 40) reinforce the suggestion that bottlenose dolphins in the Rhode Island study area are from the offshore population. There were no areas of predicted occurrence in the nearshore zone in the study area. There are areas of predicted bottlenose dolphin occurrence in all four seasons—always offshore. Overall relative abundance is lowest in the winter and highest in the summer, and the areas of highest abundance are outside the study area. Summer was the only season when the analysis showed that bottlenose might be expected within the SAMP area—in the most offshore portion and at the lowest level of abundance.

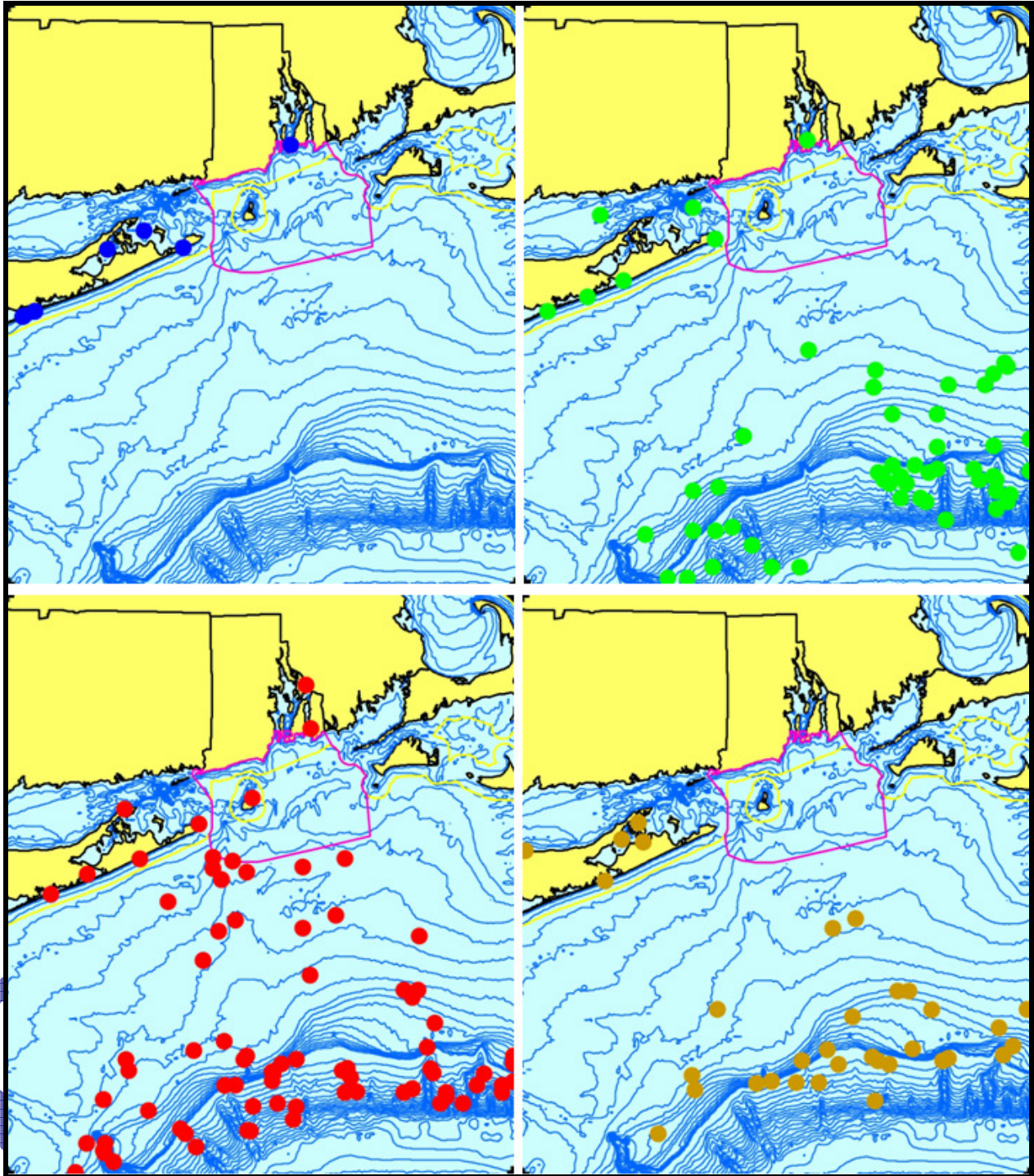


Figure 39. Aggregated sighting, stranding, and bycatch records of bottlenose dolphins in the Rhode Island study area, 1899–2006 ($n = 182$: winter = 8, spring = 57, summer = 83, fall = 33, unknown = 1).

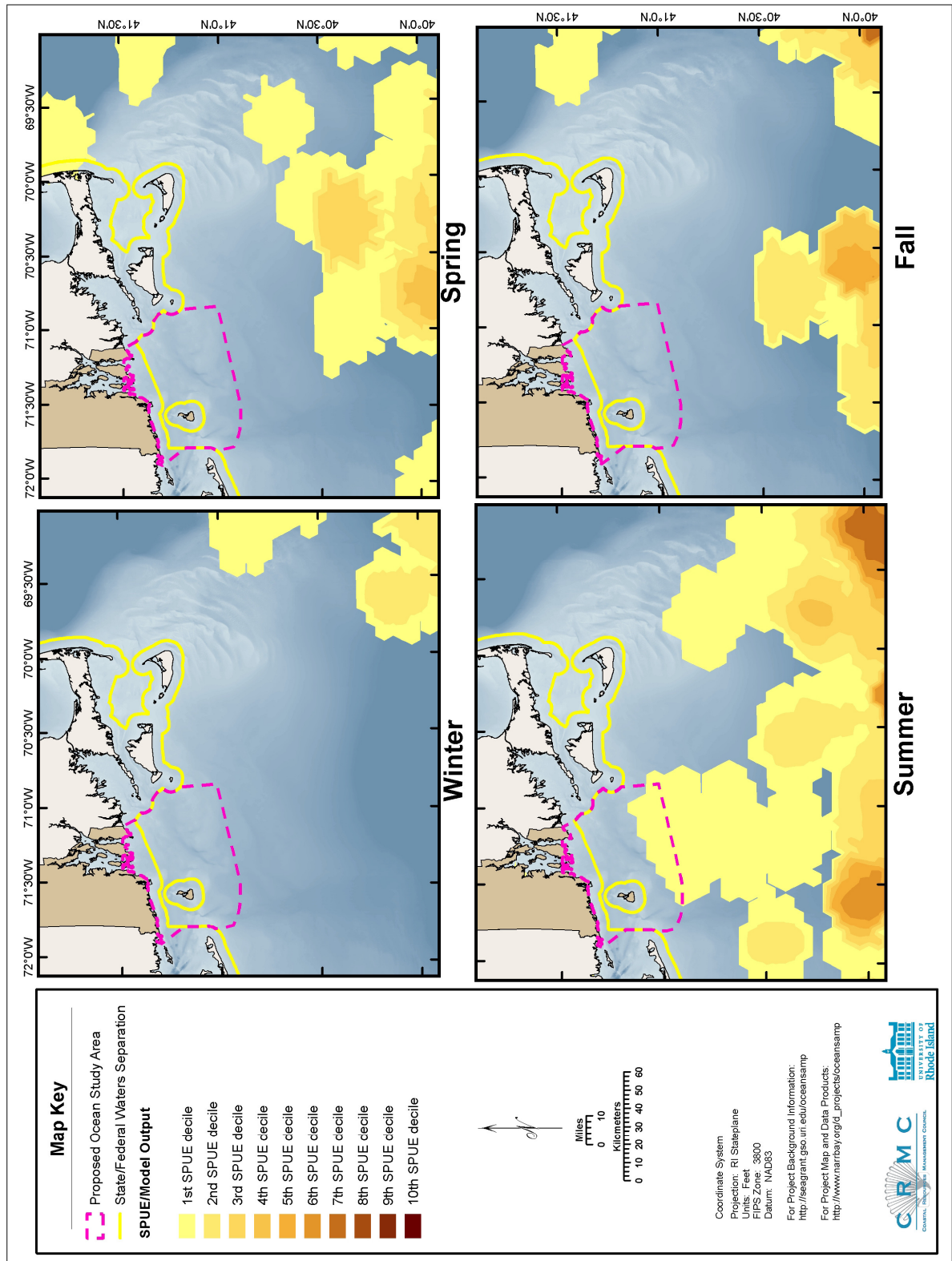


Figure 40. Modeled seasonal relative abundance patterns of common bottlenose dolphins in the Rhode Island study area, corrected for uneven survey effort.

Bottlenose dolphins are the eighth most frequently stranded cetaceans in the Rhode Island study area (Table 2), which is much lower than the ranking in New York (third) or in New Jersey and states to the south (first). This is certainly due to the northern extent of the range of the inshore population. The seasonality in the strandings is different than seen in the total records, with about equal numbers in winter through summer (6, 6, and 7, respectively) and lower in the fall (3), which is more like the known temporal pattern of the offshore stock off southern New England than the inshore stock. There was a long gap in the stranding record for the study area between 1960 and 1983. Beginning in 1983, there have been four bottlenose strandings in Rhode Island, one on Fisher's Island, and thirteen in eastern Long Island (Fig. 41). There are two spikes in the time series. Of the five strandings in 1986–1990, four were in 1988, and may have been related to the epizootic. The second spike was six during 1996–2000, but those were more spread out, with three in 2000 and one each in 1996, 1998, and 1999.

On 16 August 1983, a 265-cm bottlenose dolphin live-stranded on the shore of Mount Hope Bay in Warren. It was taken to New England Aquarium in Boston, but its fate was not noted in the data record. On 31 August 1992, a 310-cm dolphin stranded on the east side of the Sakonnet River in Little Compton, which was noted as most likely from the offshore population. The last two Rhode Island strandings were both in 2004. One was on the Navy base in Newport on 7 March and the other was on Block Island on 12 July. The Fisher's Island stranding was in August 1984. It was a very large male, 310 cm long and weighing 496 kg. A stranding on Montauk December 1988 was also a large animal at 311 cm; the record notes that analysis of a blood sample showed it to be an offshore bottlenose.

Conclusions

The sparse data suggest that bottlenose dolphins in the Rhode Island study area are more likely to come from the offshore population than from the coastal stock complex, which still is designated as “depleted” under the MMPA. Therefore the level of management concern is somewhat lower. Bottlenose dolphins are relatively abundant in the Rhode Island study area, but not in the SAMP area.

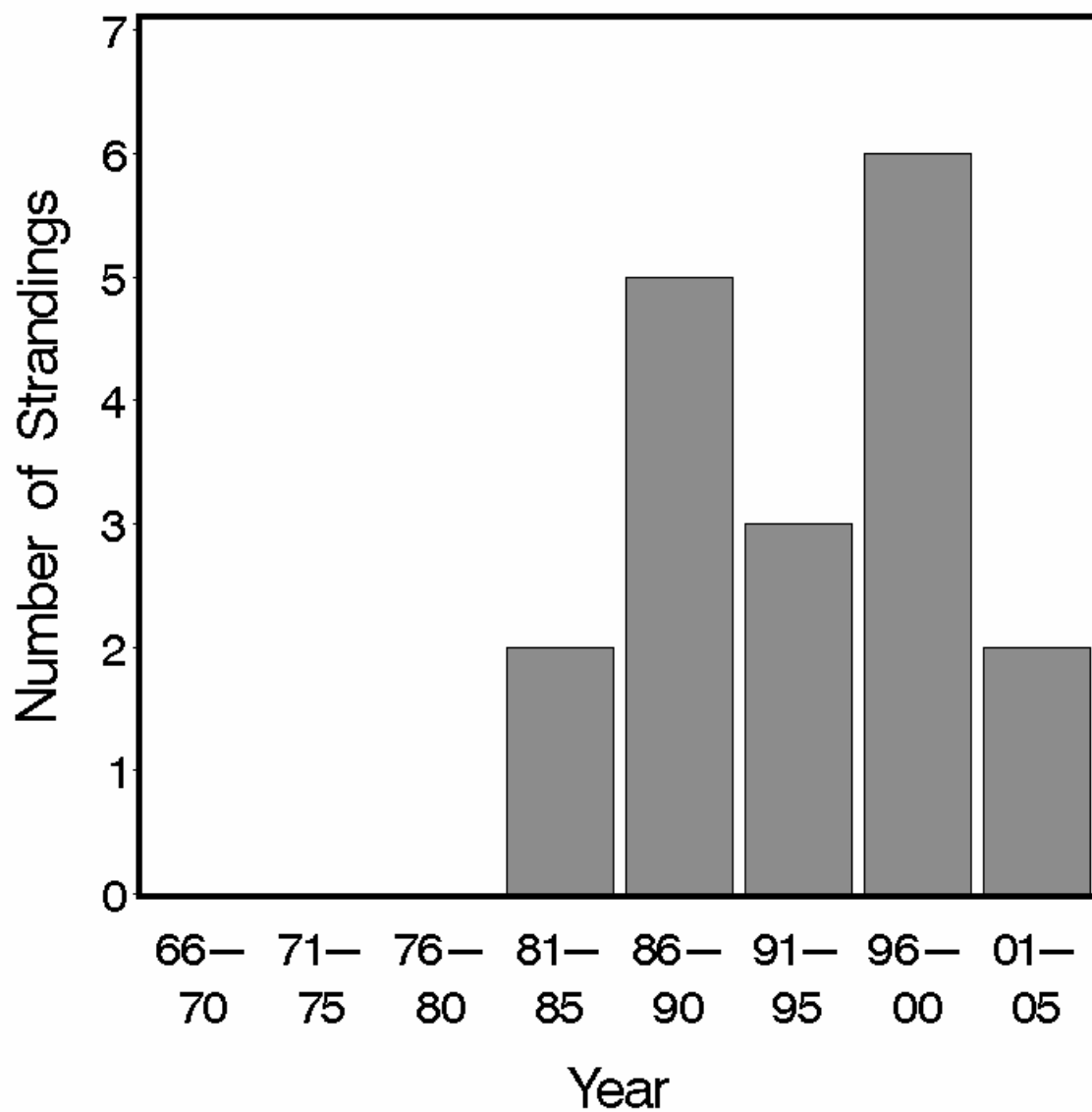


Figure 41. Five-year stranding frequencies for common bottlenose dolphins in the Rhode Island study area, 1966–2005.

DRAFT

3.2.28. Short-beaked Common Dolphin *Delphinus delphis* Linnaeus 1758

Rice (1998) recognized three different species of *Delphinus*—the short-beaked common dolphin (*D. delphis*), the long-beaked common dolphin (*D. capensis*), and the Indian Ocean common dolphin (*D. tropicalis*), which may actually be a longer-beaked subspecies of *D. capensis* endemic to the Indian Ocean (Heyning and Perrin, 1994; Jefferson and Van Waerebeek, 2002). Only *D. delphis* is known from the North Atlantic (Heyning and Perrin 1994; Perrin 2002c).

Description

Common dolphins have the typical form of oceanic dolphins, with a streamlined fusiform body, a distinct beak that is separated from the melon by a crease, and a prominent dorsal fin (Jefferson et al., 1993; Evans, 1994; Wynne and Schwartz, 1999; Perrin, 2002c). Short-beaked common dolphins are slender, and range up to 2.3–2.6 m in length, with males slightly larger than females. Their color pattern is striking and distinctive. William Perrin developed a scheme for systematically classifying the pigmentation patterns of small cetaceans (summarized in Perrin, 2002b). There are two areas of dorsal pigmentation—the “cape,” which is generally smaller and more anterior, and the “dorsal overlay,” which is larger and extends farther posteriorly. The overlap of the two results in the typical pattern for a particular species. In common dolphins the cape is yellowish-tan, with a lower margin that runs back from the forehead crease, just below the eye, slightly downward to a lowest point between the flippers and the dorsal fin, then curves up to the back midway between the dorsal fin and the tail. The dorsal overlay is light gray; its lower margin starts on the forehead, curves upward over the eye to its highest point in front of the dorsal fin, then curves back downward to the belly in the area of the genital slit. Where the two areas overlap, the color is dark gray to black, resulting in a dorsal field that is a rather narrow band from the head back that widens to a sharp point directly below the dorsal fin (the “saddle,” where the margins of the cape and the dorsal overlay cross), then narrows to a point on the mid-back behind the dorsal fin. Anterior to the saddle the color on the side is yellowish tan (the cape alone), posterior to it and onto the back near the tail the color is gray (dorsal overlay alone). The belly is white. There is a prominent black blaze extending

upward and forward from the genital slit to near the point of the saddle, which is thinner and paler in females. The complex pattern on the side of the animal gives rise to the alternative common names saddleback, hourglass, and criss-cross dolphin. The dorsal fin is tall, falcate, in the middle of the back, and black, often with a paler gray center. The lips, flippers, flukes, and a small circle around the eye are black. There are thin black stripes from the upper beak to the eye, and from chin to the flipper.

Status

Short-beaked common dolphins are not listed under the U.S. Endangered Species Act or on the Rhode Island state list, and are classified as Least Concern on the IUCN Red List. There is no estimate for the total abundance of short-beaked common dolphins in the North Atlantic. The CETAP (1982) survey results showed that common dolphins were one of the most abundant cetaceans off the northeastern U.S., with about 45,000 present in winter. More recent surveys (all in the summer) estimated a smaller population, until a summer shipboard survey from Florida to the Bay of Fundy in 2004 resulted in an estimate of 120,743 common dolphins (Waring et al., 2008).

There was a directed fishery (for human consumption) on common dolphins, bottlenose dolphins, and harbor porpoises in the Black Sea (Evans, 1994). The fishery began in the late 19th Century, and was conducted by Turkey, the Soviet Union, Romania, and Bulgaria. Tens of thousands of animals were taken annually, with peak kills perhaps as high as 200,000. The fishery ended in 1966, except in Turkey where it continued to 1983.

Common dolphins are taken incidentally in a number of commercial fisheries worldwide, in particular in gillnets (Perrin et al., 1994b) and in the eastern tropical Pacific tuna purse-seine fishery (Allen, 1985; NRC, 1992; Gosliner, 1999; Gerrodette, 2002). In the western North Atlantic, common dolphin bycatch mortalities occur in a number of different fisheries (Waring et al., 2008). The pelagic swordfish driftnet fishery killed an average of 303 annually in 1989–1998, but has since been shut down. An experimental mid-water pair-trawl fishery for tuna killed 16 per year in 1991–1995, but it has also been closed. The most recent five-year average fishery-related mortality of common dolphins for U.S. Atlantic waters was 151 per year for 2001–2005, primarily in trawl fisheries, with a few in sink gillnets.

Ecology and life history

Common dolphins are known to aggregate into extremely large herds at times, however those schools are composed of smaller groups of 20–30 related individuals (Evans, 1994; Perrin, 2002c). Large herds chased during tuna fishing operations would break up into successively smaller groups, but the smallest groups of 20–30 animals remained tightly aggregated and never separated. Offshore fishermen tell of seeing herds of common dolphins on Georges Bank that take hours to pass by. Off the northeastern U.S. in 1979–1981, the average group size sighted was 54.8 dolphins, but the average was skewed by a few sightings of groups as large as 2000 individuals (CETAP, 1982). The modal group size was 8 animals. Off the northeastern U.S. they were sighted in mixed groups less often than a number of other species (CETAP, 1982). Other cetaceans with which they were associated on four or five occasions included fin whales, pilot whales, striped dolphins, and Risso's dolphins.

Common dolphins do not appear to be deep divers. Tagging studies show that most dives are to less than 50 m, with a few dives to as deep as 200 m.

Common dolphins feed on small fishes and squids, including species that school in near-surface waters and mesopelagic species that occur near the surface at night (Evans, 1994; Perrin, 2002c). Tagging studies in the North Pacific showed that foraging dives commenced at dusk and continued all night long. They were apparently feeding on deep-scattering layer fishes (dominated by myctophids or “lanternfishes”) that migrate upwards at dusk and return to mid-depths at dawn, as well as on the squid that were also feeding on the small fishes. Hassani et al. (1997) looked at the stomach contents of common and striped dolphins taken as bycatch in a pelagic driftnet fishery in the northeastern Atlantic. Both species fed primarily on squid (50% or more of the prey items). Secondary prey in common dolphins, about equal in occurrence, were crustaceans (shrimp and krill) and fish (especially myctophids). Major (1986) reported a school of common dolphins on the southern edge of Georges Bank attacking and feeding on squid that had been lured near a research vessel at night by bright lights.

Most information about reproduction and life history comes from populations where large numbers were taken in directed fisheries, as in the Black Sea, or as bycatch in commercial fisheries, as in the eastern tropical Pacific (Evans, 1994; Perrin, 2002c). Sexual maturity occurs at 6–7 years and 195–208 cm in females, and 7–12 years and about 200 cm in males. Ages at

maturity appear to be significantly lower in the Black Sea, possibly a density-dependent response to high exploitation rates. Gestation is 10–11 months. Calves are born at about 80–90 cm in length, and wean in about 5 or 6 months, but begin feeding on solid food as young as 2–3 months. In the Pacific, there are two peaks in calving, in the spring and fall. At any one time, about 10% of adult females off California are “resting” (i.e., neither pregnant nor lactating); in the eastern tropical Pacific the proportion of resting females is about 17% in fall and winter and 30% in spring and summer.

General distribution

Common dolphins occur in tropical to temperate waters around the world, although understanding of distributional details is somewhat muddled by questions of species identity in the older data (Evans, 1994; Rice, 1998; Perrin, 2002c). Evans (1994) shows the Atlantic distribution as continuous from Norway to equatorial west Africa on the east and in Iceland, Greenland, Labrador, and Newfoundland, then continuous to Argentina in the west, but that includes both *D. delphis* and *D. capensis*. In the western North Atlantic, common dolphins occur from Iceland south, but the southern limit of the distribution is unclear and appears to vary between years. Older reports of common dolphins off Florida or in the Gulf of Mexico and Caribbean are likely to be misidentifications of Clymene dolphins (Jefferson et al., 1992; Jefferson, 1997; Jefferson and Curry, 2003). Off the northeast U.S., common dolphin sightings occur over the outer half of the continental shelf and continental slope from North Carolina to Nova Scotia, with occasional sightings in shallower waters in the Gulf of Maine (CETAP, 1982; Waring et al., 2008). Of all of the shelf-edge odontocetes of the region, common dolphins occurred in the zone closest to shore, a habitat they shared with pilot whales and offshore bottlenose dolphins (CETAP, 1982; Kenney, 1990). In the overall record for the broader mid-Atlantic, common dolphins are the most frequently stranded delphinid in Rhode Island and New York; while in New Jersey and south bottlenose dolphins are much more common.

Common dolphins have an atypical seasonal pattern off the northeastern U.S., very different from all other dolphin species (CETAP, 1982; Selzer and Payne, 1988). In spring during 1979–1981, intermediate densities of common dolphins occurred along the entire outer shelf from Virginia to Georges Bank. Sightings were widely scattered in summer, with very low

densities. The animals were thought to move north and east along the Nova Scotian shelf, however recent surveys did not observe substantial numbers of common dolphins there (Waring et al., 2008). Perhaps they move even farther north and east, or more offshore. In the fall, they were concentrated on Georges Bank in very high densities, extending west to about the longitude of Montauk Point. They reached their peak abundance in the winter, when they were again distributed all along the outer shelf from Virginia north.

Historical occurrence

Cronan and Brooks (1968) reported two historical records of common dolphins in Rhode Island—a specimen from Block Island with no date given and one captured alive in Point Judith Pond on 12 August 1966. The former most likely refers to the oldest known record in the study area in the Smithsonian dataset—a 203-cm dolphin captured “off Block Island” on 7 August 1882. Waters and Rivard (1962) said that common dolphins were relatively common in Cape Cod Bay, but made the counter-intuitive (and incorrect) conclusion that “even though most strandings take place in the winter, it is probably more abundant there in the warmer months.” They reported two specific Massachusetts records—a mass stranding of eleven in Wellfleet in February 1949 and a stranding in Dennis in January 1950. De Kay (1842) listed common dolphins as part of the New York fauna, but said they rarely came into shallow water. Linsley (1842) reported that they occurred in Long Island Sound, which Goodwin (1935) extrapolated to “it is probably not an uncommon visitor to the shores of this state [i.e., Connecticut].” Connor (1971) summarized a number of sighting, stranding, and capture records for New York from a variety of sources. Of note was the occurrence of a herd of 30–40 common dolphins seen in the Hudson River in October 1936, almost as far upriver as Albany (Stoner, 1938). There are seven stranding records in the Smithsonian dataset from eastern Long Island between 1923 and 1951, all taken from Connor (1971), but none in Rhode Island.

Recent occurrence

Common dolphins occur in the Rhode Island study area year-round, across much of the shelf but most commonly in waters deeper than about 60 m (Fig. 42). Seasonality is not

particularly strong, with 33.6% of records in spring, 26.2% in summer, 18.2% in fall, and 21.8% in winter. Sightings are somewhat more common in the spring. Strandings also occur year-round. A concentration of sightings in summer southeast of Montauk Point is evident, in the area where the 60-m isobath comes closer to shore. Without the sightings from the whale-watching boats (2 in spring, 39 in summer, and 5 in fall), the spring peak is slightly stronger, but the seasonality during the rest of the year flattens out even more (24.4% winter, 37.0% spring, 19.3% summer, and 19.0% fall).

There are no recent records of common dolphins far up rivers, however such occurrences would only show up in the stranding database if the stranding network responded, and there is no centralized clearinghouse for opportunistic sightings of that type. In Rhode Island, there are occasional opportunistic reports of common dolphins in Narragansett Bay up as far as the Providence River, usually in winter.

The patterns of relative abundance show that short-beaked common dolphins are present in the Rhode Island study area in all four seasons (Fig. 43). They are consistently found on the outer half of the shelf, but do occur within the SAMP area in all seasons. Peak abundance in the study area is in the winter; peak abundance in the SAMP area is in the fall.

In the stranding record for the Rhode Island study area, common dolphins are the second most frequently stranded cetacean (exceeded only by harbor porpoises) and the most common delphinid (Table 2). There were 68 strandings in the study area between 1972 and 2005, including 23 in Rhode Island alone (Table 4). The rest were all in New York, including three on Fisher's Island—one in May 1981 and two in August 1995, six days apart. The first 1995 Fisher's Island animal was a 115-cm, 24-kg juvenile that was live-stranded, collected, and rehabilitated at Mystic Aquarium. The second was a dead 192-cm female, which may have been the juvenile's mother. There was one stranding in Connecticut during the period, but it was west of the study area in Fairfield. Strandings are even more frequent in Massachusetts, with 148 in 2001–2005 (Waring et al., 2008), but those are almost all on Cape Cod and include several mass strandings (e.g., 41 dolphins in four events in 2005). Stranding frequency spiked in 1996–2000, and was somewhat lower but still elevated in 2001–2005 (Fig. 44). The underlying reason for the increase is not known. There is also a clear seasonal pattern in the strandings, with a peak in the winter, a minimum in spring, and a smaller peak in summer (Fig. 45). Seasonal percentages were 40% in winter, 13% in spring, and 24% in both summer and fall.

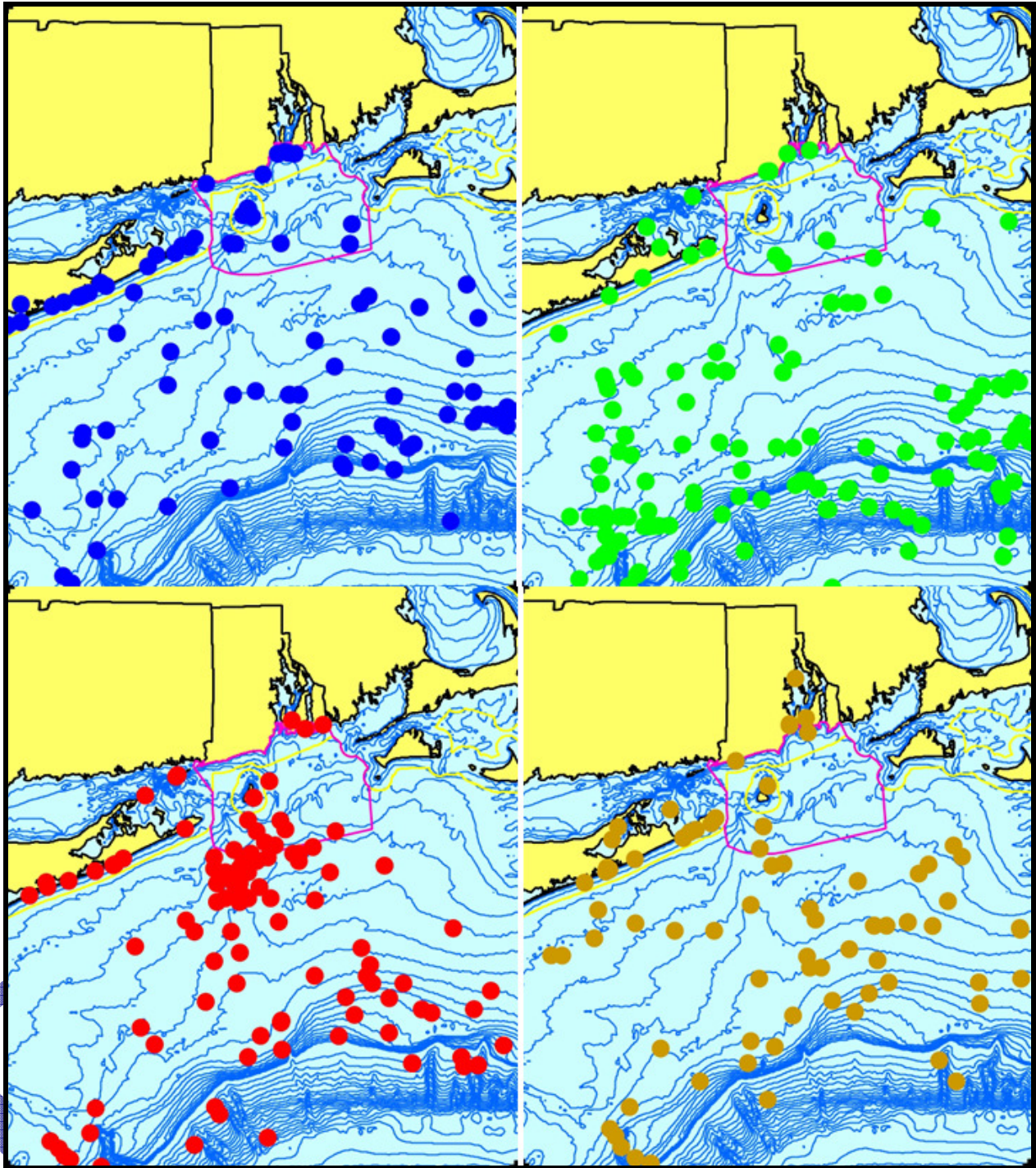


Figure 42. Aggregated sighting, stranding, and bycatch records of short-beaked common dolphins in the Rhode Island study area, 1882–2007 (n = 435: winter = 95, spring = 146, summer = 114, fall = 79, unknown = 1).

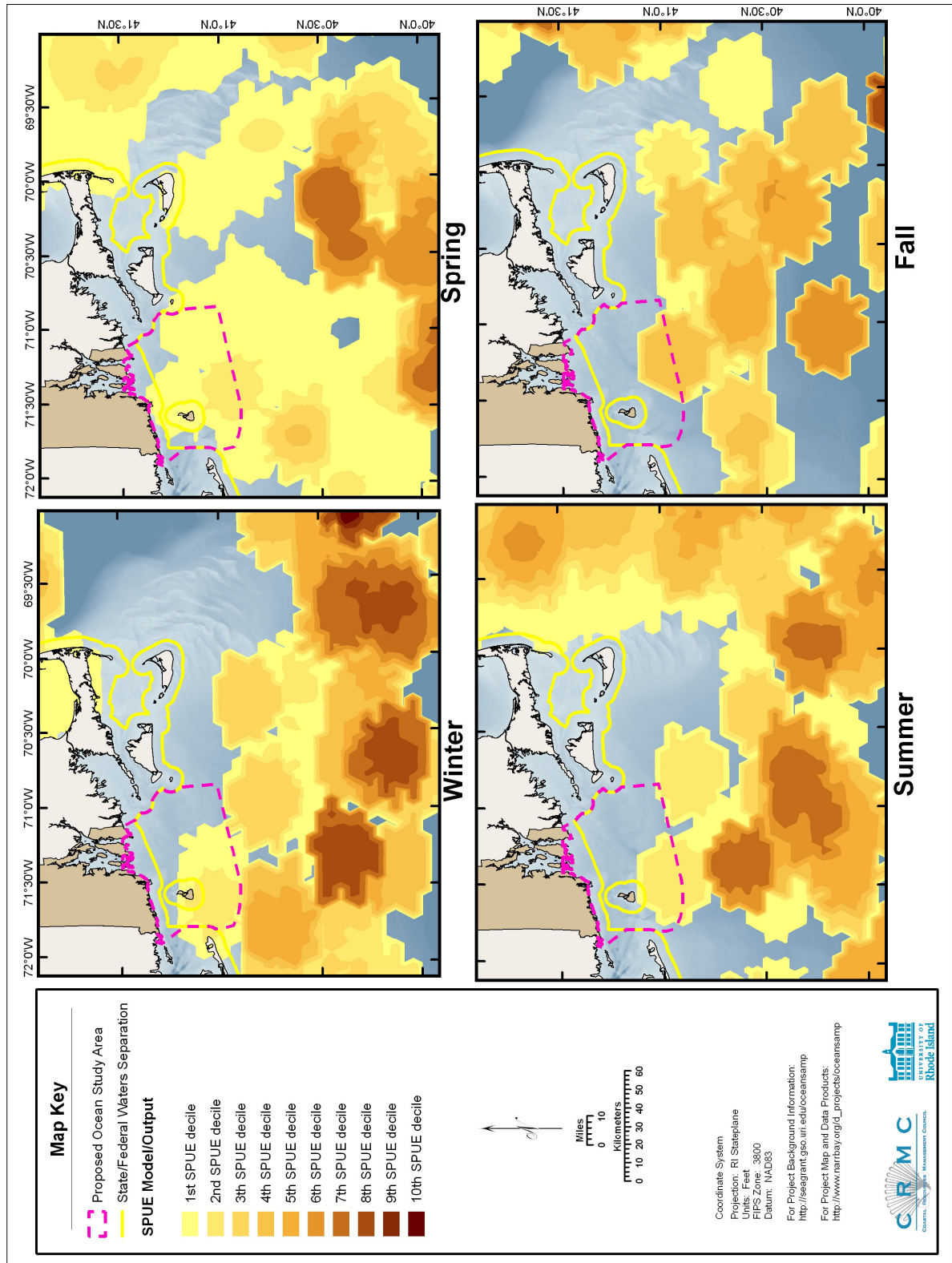


Figure 43. Modeled seasonal relative abundance patterns of short-beaked common dolphins in the Rhode Island study area, corrected for uneven survey effort.

Table 4. Rhode Island strandings of short-beaked common dolphins

Date	Locality	Notes
21 Nov 1983	Block Island, N of state beach	225-cm female
31 May 1986	Newport, near the mansions	live-stranded, was pushed off
25 Jun 1990	Newport, Coasters Harbor	205-cm female, alive, died 2 days later
02 Dec 1991	Newport, Bailey's Beach	181-cm male
26 Feb 1996	Point Judith, just inside east wall	206-cm, 78-kg male; both mandibles fractured, undigested food in stomach
14 Mar 1996	Narragansett, near Ft. Varnum	216-cm male
05 Dec 1996	Block Island, near Dories Cove	219-cm male
14 Feb 1997	Block Island, SW corner	176-cm male, propeller wounds
19 Jan 1998	Newport, Price's Cove	
15 Jul 1998	Middletown, Sachuest Point	
01 Jun 1999	Little Compton	
04 Nov 1999	Newport, Bailey's Beach	
05 Nov 1999	Westerly, Weekapaug Beach	
06 Dec 1999	Jamestown, Beavertail Point	
31 Dec 1999	Block Island	
30 Mar 2000	South Kingstown, Matunuck	
05 Apr 2000	South Kingstown, Town Beach	
09 Jun 2000	Block Island, Old Harbor	
14 Dec 2000	Westerly, Misquamicut Beach	
22 Dec 2002	Block Island, Old Harbor	
05 Jan 2003	Portsmouth, Island Park	
27 Oct 2003	Narragansett, Bonnet Shores	198-cm female, lactating, probably the mother of the calf seen earlier that day swimming alone off the Bay Campus; very worn teeth and thin blubber
05 Sep 2004	Warwick	

Conclusions

Short-beaked common dolphins are very likely the most abundant marine mammal in the Rhode Island study area. They are also likely to occur in the SAMP area in all four seasons of the years. Although there are few serious management concerns about the population, their relative abundance would put them in the second tier of priority species relative to the SAMP.

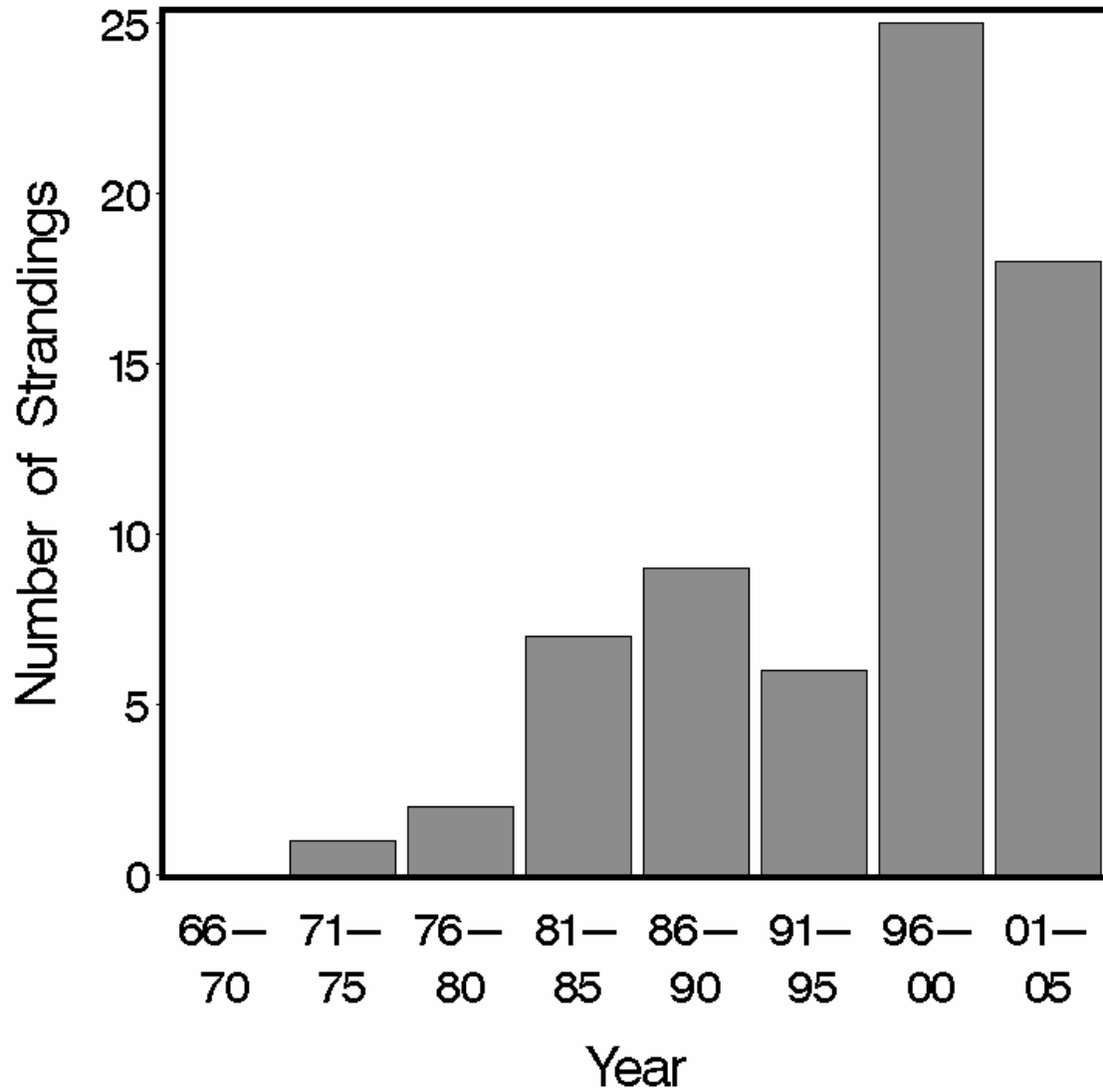


Figure 44. Five-year stranding frequencies for short-beaked common dolphins in the Rhode Island study area, 1966–2005.

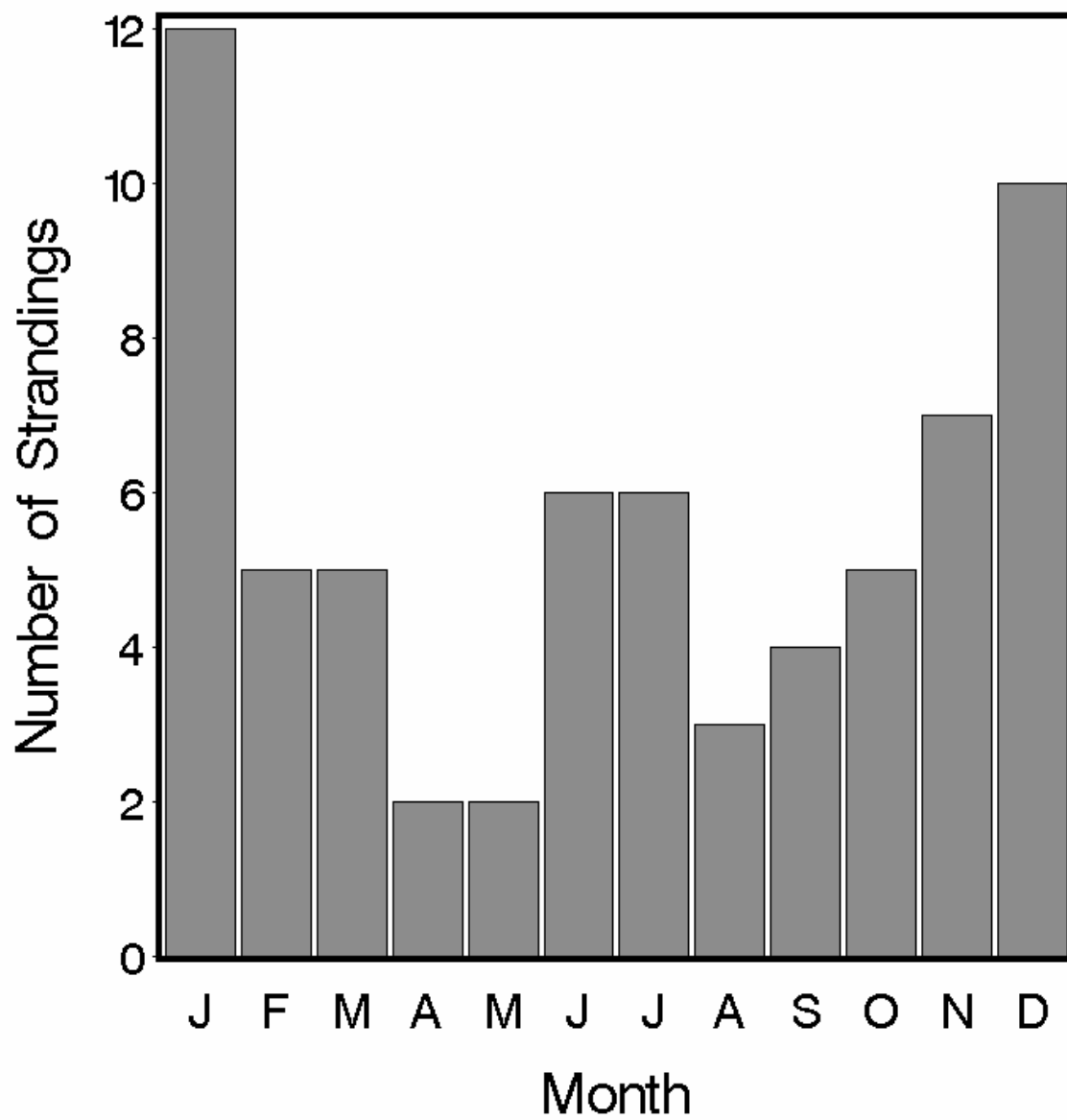


Figure 45. Monthly stranding frequencies of short-beaked common dolphins in the Rhode Island study area.

DRAFT

3.2.29. Striped Dolphin *Stenella coeruleoalba* (Meyen, 1833)

Description

Striped dolphins are typical of all the *Stenella* species in size and shape, and are very distinctively patterned (Jefferson et al., 1993; Perrin et al., 1994c; Archer and Perrin, 1999; Wynne and Schwartz, 1999; Archer, 2002). They are slender and long-beaked, with tall falcate dorsal fins. Adults are up to 1.5–2.5 m long, with the largest animal known at 256 cm. Animals in the Mediterranean may be somewhat smaller than those in the North Atlantic. The cape is dark blue-gray, very narrow above the eye and widest in front of the dorsal fin (at about the midpoint of the flipper), and ends less than halfway back from the dorsal fin to the tail. There is a prominent pale band (the spinal blaze) extending from just above the flipper upward and backward into the cape toward the dorsal fin. Below and behind the cape, the sides and back are lighter gray, fading into a whitish (sometimes pink) belly. The upper beak is black, and the lower is gray to black. There is a bold black stripe from the upper jaw to the eye, where it divides into one stripe to the flipper, often a short thin stripe ending above the flipper, and a very bold stripe extending the length of the body back to the anus.

Status

Striped dolphins are not listed under the U.S. Endangered Species Act or on the Rhode Island state list and are classified as Least Concern the IUCN Red List. There are no reliable estimates of the total abundance of striped dolphins in the North Atlantic. The first abundance estimate off the U.S. Atlantic coast was from the CETAP (1982) surveys, which estimated that there were 4,300 striped dolphins in the spring. That number was negatively biased for two reasons. The CETAP study used only aerial surveys for estimating abundances, and many aerial sightings could only be identified to *Stenella* sp. Secondly, the aerial surveys were almost entirely limited to continental shelf waters, and the majority of the striped dolphin sightings during the program were beyond the shelf (by shipboard observers). Kenney et al. (1997) attempted to address the first of those negative biases by partitioning the estimated abundances of unidentified *Stenella* sp. based on the proportions of identified sightings of striped, spotted,

and spinner dolphins, which derived striped dolphin estimates of 6,491 in winter, 12,025 in spring, 16,320 in summer, and 13,482 in fall. More recent NMFS surveys for marine mammal stock assessments (Waring et al., 2008), using shipboard surveys that extended well beyond the edge of the shelf, produced estimates of striped dolphin abundance off the U.S. east coast of 49,945 in 1998 and 94,462 in 2004, with an additional 6,505 in the Gulf of Mexico.

There has been a directed small-cetacean fishery in a number of coastal villages in Japan, with records back to the mid-19th Century but probably dating back to at least the early 15th Century (Perrin et al., 1994c; Archer and Perrin, 1999). Takes averaged 8,000–9,000 annually along one section of the coast and overall about 14,000 during the 1940s and 1950s, with peak catches of over 21,000 in 1942 and 1959 (Kishiro and Kasuya, 1993). Recent takes of striped dolphins in coastal small-cetacean fisheries in Japan were 300 in 2000, 484 in 2001, 642 in 2002, and 450 in 2003 (IWC, 2005, 2006). There have also been directed harvests in the Lesser Antilles and in the Mediterranean (Archer, 2002).

Mortality of striped dolphins as bycatch in commercial fisheries has been observed in a number of locations around the world (Archer and Perrin, 1999; Archer, 2002), including the Pacific tuna purse-seine fishery. There was no known bycatch mortality of striped dolphins in U.S. Atlantic commercial fisheries in 2001–2005 (Waring et al., 2008). In previous years, there was bycatch estimated in two fisheries. Two striped dolphins were killed in the bottom trawl fishery in 1991, which extrapolated to an estimated mortality for the entire fishery of 181 animals. The average annual striped dolphin mortality in the pelagic swordfish driftnet fishery in 1989–1998 (now closed) was 17.

A dolphin morbillivirus epizootic in the western Mediterranean Sea killed over 1,100 striped dolphins in 1990–1992 (Aguilar and Raga, 1993; Perrin et al., 1994c). A later survey estimated the Mediterranean population of striped dolphins at 225,000, which would suggest that the mortality rate from the epizootic was relatively insignificant (less than 0.5%). Toxic contaminants, particularly organochlorines, were suspected to have played a role, acting as an immunosuppressant that then allowed a naturally occurring virus to cause disease (Aguilar and Raga, 1993; Aguilar and Borrell, 1994). Blubber PCB levels as high as 2,500 ppm were measured in the stranded striped dolphins during that event, which were among the highest levels ever recorded in a cetacean.

Ecology and life history

Striped dolphins are gregarious and may be observed in very large herds. In the eastern tropical Pacific average school size was 28–83 animals (Wade and Gerrodette, 1992). The mean school size in Japan is about 100, while in the eastern North Atlantic it is only 10–30 (Perrin et al., 1994c; Archer and Perrin, 1999). The average school size observed off the northeastern U.S. was 64.9 (CETAP, 1982), with a range 1 to 500. This was the largest average school size of all species observed, nevertheless the modal group size was still relatively small at 20.

Striped dolphins are known to segregate into juvenile, adult, and mixed schools, and adult and mixed schools can be either breeding or non-breeding (Miyazaki and Nishiwaki, 1978; Perrin et al., 1994c; Archer and Perrin, 1999). Calves leave the mixed schools 1–2 years after weaning and join juvenile schools. Within breeding schools there are structured subgroups of only adult males or adult females.

Striped dolphins are very active and acrobatic, with frequent leaps, spins, and somersaults, and they may bow-ride (Perrin et al., 1994c; Archer and Perrin, 1999; Archer, 2002). They are known for an aerial behavior called “roto-tailing,” which involves making a high jump while rapidly rotating the tail.

Striped dolphins sometimes associate with yellowfin tuna in the eastern tropical Pacific, but less than short-beaked common dolphins and much less than spinner or pan-tropical spotted dolphins (Archer and Perrin, 1999). They are known to occur commonly in mixed schools with short-beaked common dolphins off Japan and in the Mediterranean. Off the northeastern U.S. they were observed to be associated with other species only on a few occasions, usually with common dolphins (CETAP, 1982). Globally, striped and short-beaked common dolphins tend to occur in areas where spinner and pan-tropical spotted dolphins do not (Perrin et al., 1994c).

Mass strandings are rarely observed in striped dolphins (Archer, 2002). There was a stranding of a group of 12 striped dolphins in North Carolina in 2005 (Waring et al., 2008).

Striped dolphins overall feed on a very wide variety of fish and squid, including both pelagic and benthic species, with sharp differences among geographic regions (Perrin et al., 1994c; Archer and Perrin, 1999; Archer, 2002). The dominant prey items off Japan are mesopelagic myctophids (“lanternfishes”). In the northeastern Atlantic their main prey is cod, and in the Mediterranean they primarily eat squid. Extrapolating from prey species, they may

commonly dive to 200–700 m for foraging. Stomachs of all stranded specimens examined in Long Island have contained squid beaks, suggesting a preference for squid in the Rhode Island study area (S. S. Sadove, pers. comm.).

Hassani et al. (1997) looked at the stomach contents of common and striped dolphins taken as bycatch in a pelagic driftnet fishery in the northeastern Atlantic. Both species fed primarily on squid, which comprised nearly 60% of the prey items in striped dolphins. Secondary prey in striped dolphins were crustaceans (shrimp and krill, about a third of diet), and fish were a relatively minor component.

The majority of the life-history data are derived from animals taken in the directed fishery in Japan, with additional data from animals caught in the tuna fishery (Perrin et al., 1994c; Archer and Perrin, 1999; Archer, 2002). Calves are born at 93–100 cm in length after a gestation period of 12–13 months. Calving may occur at almost any time of year with one or two diffuse peaks—winter and summer off Japan, spring or spring and fall in other areas. Lactation lasts for 1–1.5 years. Off Japan, calves grow to an average length of 166 cm at age 1, and to 180 cm at age 2. Between 2 and 3 years of age, males and females diverge in body size, with males growing larger and typically exceeding females by 10–15 cm as adults. Mean length at sexual maturity in females is 2.1–2.2 m. Maturity in females occurs at 5–13 years of age and in males at 7–15. Fecundity in females declines markedly age 30, but reproduction does not stop completely. In striped dolphins in Japan, the female age at maturity declined from 9.7 to 7.2 years, and the inter-birth interval dropped from 4 to 3 years, with both believed to be density-dependent responses to population declines caused by the small-cetacean fishery.

General distribution

Striped dolphins are distributed world-wide in temperate to tropical waters, although the distribution is poorly known in the South Atlantic where research has been sparse (Perrin et al., 1994c; Rice, 1998; Archer and Perrin, 1999; Archer, 2002). In the North Atlantic, they have the most temperate distribution of the five *Stenella* species, extending from northern South America to New England and Nova Scotia and from the Mediterranean to the British Isles. They are the most commonly sighted cetacean in the Mediterranean. There are a few sightings from Newfoundland, southern Greenland, Iceland, and the Faroe Islands, which may be extralimital.

Striped dolphins are frequently sighted off the northeastern U.S. and Nova Scotia (CETAP, 1982; Gowans and Whitehead, 1995; Waring et al., 2008). Their distribution off the northeastern U.S. during the CETAP surveys was primarily along the outer shelf and into deeper waters, despite the very strong bias of the sampling to the shelf. Unlike all other cetaceans of the region, there was very little seasonal pattern to their distribution. In addition, their depth distribution in the CETAP data was significantly deeper than any other species, with an average sighting depth of 2,076 m and with 90% of the sightings between 101 and 3,749 m. There have been no sightings south of Cape Hatteras during any of the recent NMFS surveys, although there are strandings in Florida to North Carolina and striped dolphins do occur in the Gulf of Mexico (Waring et al. 2008). Nothing is known of stock structure, e.g., whether the animals seen in the Gulf of Mexico and off the northeastern U.S. come from the same or separate stocks.

Historical occurrence

Cronan and Brooks (1968) reported a stranding of an “old,” 241-cm male on the town beach in Narragansett on 5 December 1966. They also indicated that there was a previous record for Woods Hole, Massachusetts. Waters and Rivard (1962) said that the species was very rare in New England and cited no recent Massachusetts records. Striped dolphins were not mentioned in De Kay (1842), Linsley (1842), or Goodwin (1935). Connor (1971) reported two historical stranding records for Long Island, but only one was within the Rhode Island study area—in May 1929 at Bellport. That is the oldest striped dolphin record in the study area. Other than the 1929 Bellport and 1966 Narragansett strandings, there is only one other pre-1970 striped dolphin record from the study area. The Harvard Museum of Comparative Zoology has a specimen from a 62-kg animal collected about 150 km south of Block Island on 27 July 1961 by M. R. Bartlett (MCZ51071).

Recent occurrence

Striped dolphins in the Rhode Island study area are observed either stranded on a beach or very far offshore, with few observations in between (Fig. 46). The records occur in approximately equivalent numbers in all four seasons, with 31.7% in the winter, 29.3% in

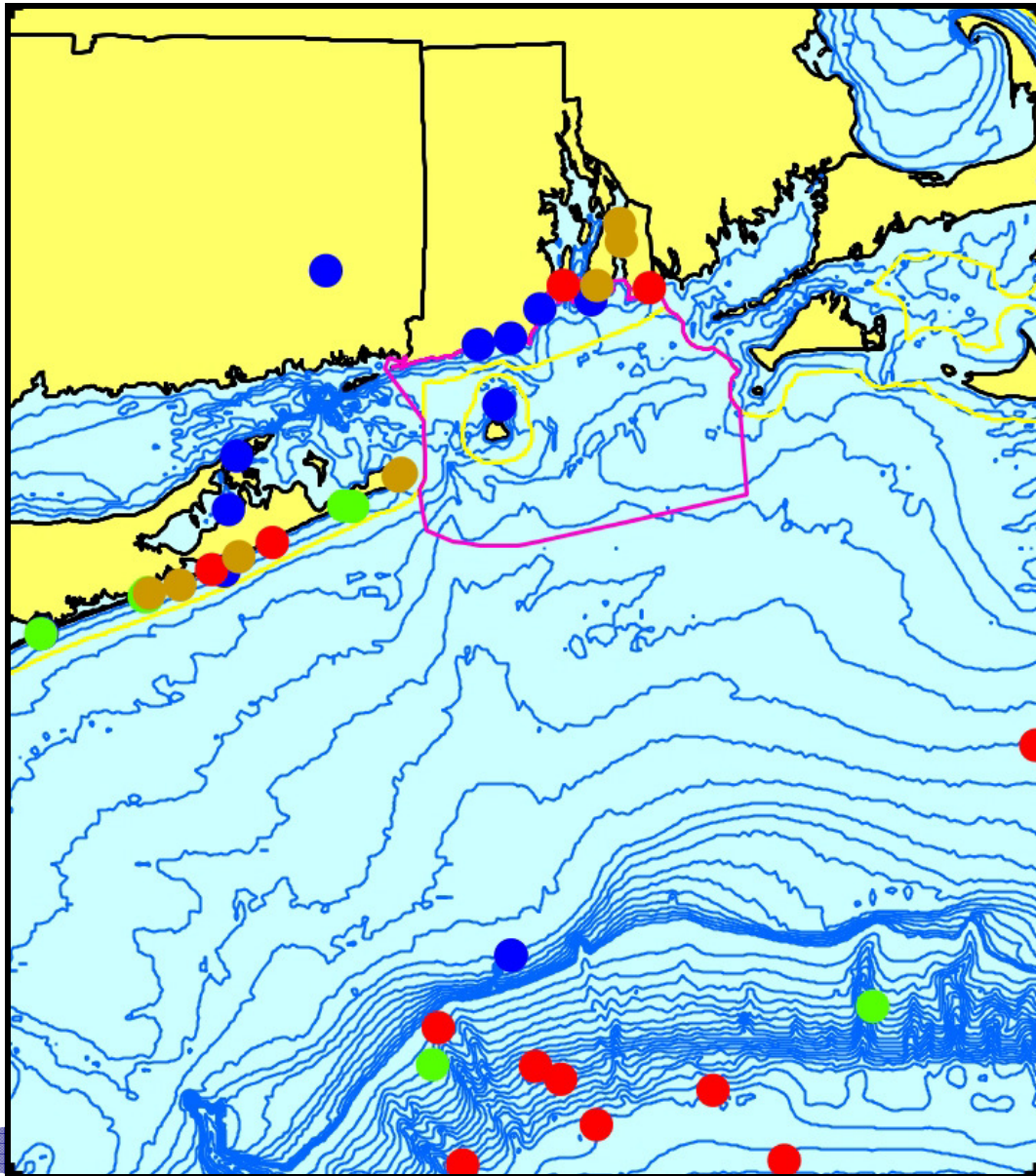


Figure 46. Aggregated sighting, stranding, and bycatch records of striped dolphins in the Rhode Island study area, 1929–2004 (n = 41: winter = 13, spring = 8, summer = 12, fall = 8).

summer, 18.5% in fall, and 19.5% in spring. That pattern may be misleading, however, since the sightings and strandings follow opposite trends. Striped dolphins are the sixth most common stranded cetacean in the region (Table 2). Strandings are primarily in fall (8, 29%) and winter (11, 39%), followed by spring (5, 18%) and summer (4, 14%). There are fewer than half as many sightings (13, including captures) as strandings (28), and they are mainly in the summer (8,

73%), with 3 (23%) in spring, 2 (15%) in fall, and none in winter. The seasonality in the sightings is surely due to sampling effort, especially from shipboard surveys beyond the shelf break. The survey data included too few sightings within our analysis area to develop SPUE estimates or produce relative abundance maps.

Stranding frequency has been relatively constant over time (Fig. 47). The small spike in the early 1990s may not be anything more than random interannual variability. Eleven of 26 strandings in the study area since 1966 have been in Rhode Island, which is a higher proportion than any for other cetacean. On 10 December 1978, a 174-cm striped dolphin stranded in Charlestown. A 147-cm juvenile stranded on First Beach in Middletown on 3 October 1980. A 121-cm calf stranded on the south shore of Little Compton on 26 June 1985. Later that year, on 7 September, a 241-cm adult live-stranded near the Stone Bridge in Portsmouth, but it died later that same day. A 235-cm adult male washed ashore on Matunuck Beach on 10 February with both jaws severely fractured; the trauma was judged to be evidence of some sort of collision. A 136-cm, 27-kg juvenile female was seen swimming near Seapowet Beach in Tiverton on the morning of 20 November 1995; it died and stranded that afternoon. Striped dolphins stranded in Cow Cove at the northern end of Block Island on 10 January 1997 and 22 January 2000. On 4 June 2001 at 15:30, Jamestown police reported that a dolphin was seen swimming erratically and seemingly in distress just off the beach at Mackerel Cove. It died and stranded by 17:15, when the carcass was recovered from the beach. It was a 201-cm adult or sub-adult male, and there was no discernible cause of death. Finally, a striped dolphin stranded near Sheep Point on the east side of Newport on 11 January 2002.

Conclusions

While striped dolphins are one of the most abundant cetaceans off the northeastern U.S., their distribution is very far offshore. They have never been sighted in or near the SAMP area, and do not pose any concern relative to the SAMP.

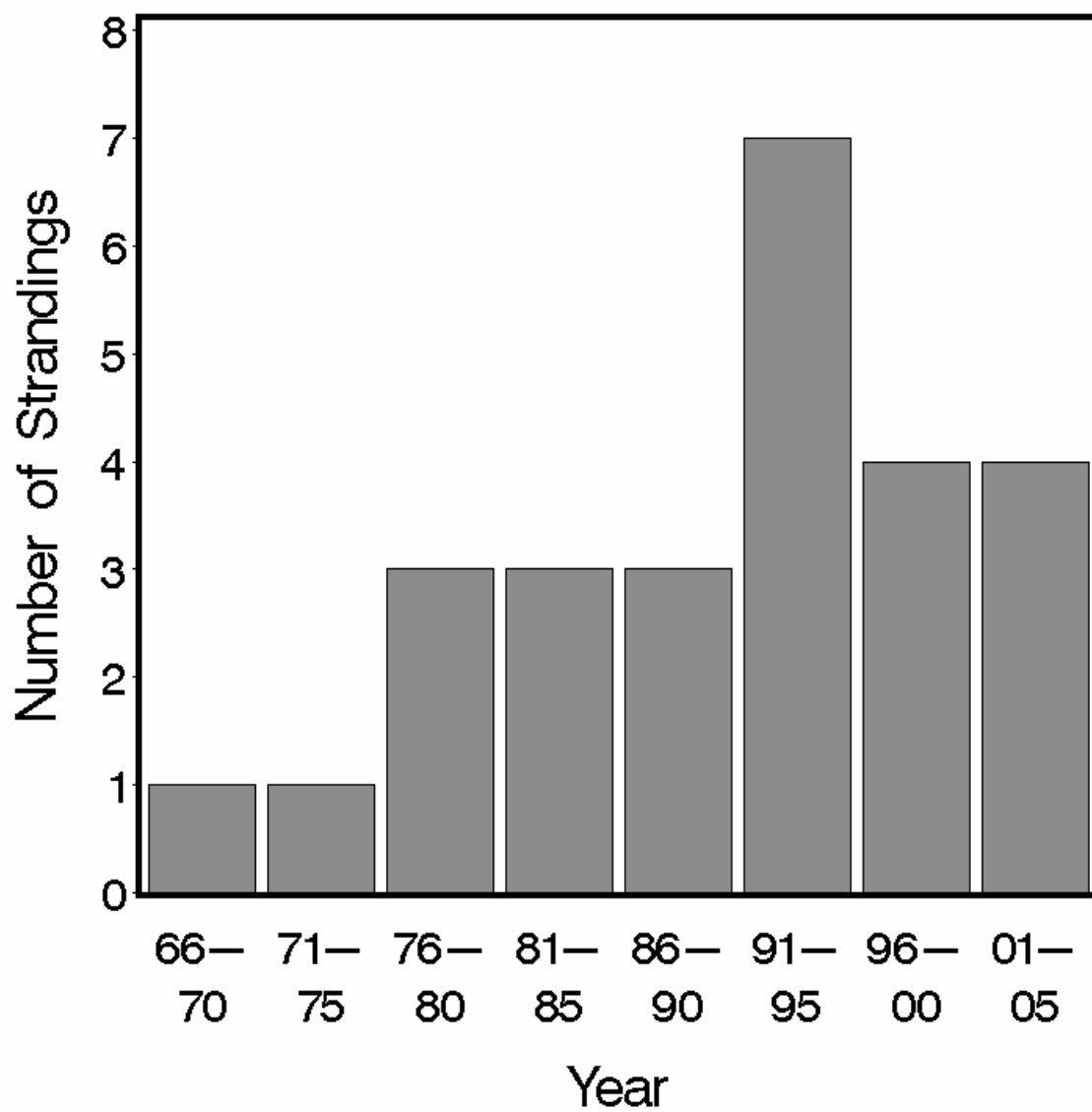


Figure 47. Five-year stranding frequencies for striped dolphins in the Rhode Island study area, 1966–2005.

3.2.30. Atlantic Spotted Dolphin *Stenella frontalis* (G. Cuvier, 1829)

Pan-tropical Spotted Dolphin *Stenella attenuata* (Gray, 1846)

The two species of spotted dolphins are broadly sympatric in the North Atlantic, are difficult to distinguish at sea, and have been frequently combined in survey and bycatch data, sometimes even in stranding data. It was not until the paper by Perrin et al. (1987) that the taxonomy of the spotted dolphins was sorted out. Prior to that, a variety of different common and scientific names were used, so it is not always clear which species may be referred to in particular instances. For example, Leatherwood et al. (1976) used the binomial *Stenella plagiodon* for the Atlantic spotted dolphin (*Stenella frontalis*), and used the common name bridled dolphin and binomial *Stenella frontalis* for the pan-tropical spotted dolphin (*Stenella attenuata*). Both are known from the Rhode Island study area, and they are combined here.

Description

Atlantic spotted dolphins are the most robust-bodied of the *Stenella* species, enough so that a young, unspotted animal may be mistaken for a young bottlenose dolphin. Adults are 1.7–2.3 m in length, with a tall, falcate dorsal fin, long but relatively thick beak, and moderately developed keels (Perrin et al., 1987, 1994a; Jefferson et al., 1993; Wynne and Schwartz, 1999; Perrin, 2002a, 2002e). They have a three-toned color pattern, with a dark gray cape that is widest below the dorsal fin, lighter gray sides, and a white belly. The tailstock is almost uniformly gray top and bottom. There is a pale gray “spinal blaze” that starts in the “shoulder” area above the flipper and extends upwards and backwards into the cape towards the dorsal fin, which may not be clearly visible on all individuals. The combination of spinal blaze and spots is diagnostic for *S. frontalis*. As in pan-tropical spotters, calves are born without spots. Dark ventral spots begin to appear at about the time of weaning. Around puberty, the ventral spotting increases and pale dorsal spots begin to appear. The spotting intensifies, such that it can largely obscure the margins of the cape and lateral gray bands, but the ventral spots remain distinct in adults and do not fuse together. The tip of the beak is often distinctly white, there may be thin white borders along the lips, and there is a dark stripe from the corner of the mouth to the eye and then to the flipper. This latter character is variable, with some specimens having the mouth-to-flipper stripe passing

below the eye. Along the eastern U.S., there are relatively distinct inshore and offshore forms, with the offshore animals smaller, lighter, and less heavily spotted than the inshore animals, i.e., more similar in appearance to pan-tropical spotted dolphins. The larger, more spotted inshore animals represent the stock that may be a separate subspecies referable to *Stenella frontalis plagiodon*. Some offshore animals may be nearly unspotted, even as adults.

Pan-tropical spotted dolphins are very similar in body form to spinner dolphins, with a slender body, long thin beak, and prominent keels on the tailstock (Perrin et al., 1987; Jefferson et al., 1993; Perrin and Hohn, 1994; Wynne and Schwartz, 1999; Perrin, 2001, 2002d). The beak is shorter and the dorsal fin is more falcate than in spinners. Body size in adults is 1.6–2.6 m, with averages of 187 cm for females and 200 cm for males. They are more slender than Atlantic spotted dolphins, averaging 10–30 kg less at the same body length. The basic body pattern appears essentially two-toned. The dark gray cape is very narrow at the head, curving up well above the eye, and dips low on the side in front of the dorsal fin. There is no pale spinal blaze in the cape as in *S. frontalis* and *S. coeruleoalba*. Behind the dorsal fin the cape margin rises to the back and behind it the tailstock is clearly two-toned, lighter gray dorsally and white ventrally. The tip of the beak is often white, and there may be thin white borders along the lips. There is a black stripe from the upper jaw to the eye, and one from the corner of the mouth to the flipper. Overlaid on top of the basic pattern is the spotting. Calves are born without spots—dark gray above and ivory white below. The belly gradually turns light gray. Spotting begins with dark gray spots on the throat and abdomen, followed by pale dorsal spots. The ventral spots gradually increase in number and size, first touching each other and causing a mottled ventral appearance, then fusing and fading to a slightly mottled to uniform pale gray. The spotting does not obscure the margin of the cape. The flippers, flukes, and dorsal fins are smaller than in Atlantic spotted dolphins.

Status

Atlantic spotted dolphins are not listed under the U.S. Endangered Species Act or on the Rhode Island state list, and are classified as Data Deficient on the IUCN Red List. Pan-tropical spotted dolphins are not listed under the U.S. Endangered Species Act, are not included on the Rhode Island state list, and are classified as Least Concern on the IUCN Red List. There are no

estimates of the total North Atlantic abundance number of either species of spotted dolphin. For continental shelf waters between Cape Hatteras and the Gulf of Maine, CETAP (1982) estimated only a few hundred undifferentiated spotted dolphins, however those estimates were exclusively from aerial surveys, and a large proportion of aerial sighting could be identified only to *Stenella* sp. Kenney et al. (1997) partitioned the abundance estimates of “unidentified *Stenella*” into striped dolphin, spotted dolphin, and spinner dolphin based on the proportions of identified sightings—with estimates of spotted dolphins (both species combined) of 589 in winter, 1,689 in fall, 1,975 in spring, and 2,441 in summer. The estimated abundances from the more recent NMFS stock assessment surveys are substantially greater, since the surveys included the area from Florida to the Nova Scotian shelf and extended much farther offshore (Waring et al., 2008). Atlantic spotted dolphins were estimated at 46,481 in 1998 and 50,978 in 2004. There is also an estimate of 30,947 in the Gulf of Mexico. Pantropical spotted dolphins were estimated at 13,090 in 1998 and 4,439 in 2004, with 91,321 in the Gulf of Mexico.

Atlantic spotted dolphins are intentionally taken in small numbers by traditional fisheries in St. Vincent in the Lesser Antilles and maybe at some of the other islands (Perrin, 2002e). They are also taken as bycatch in tuna purse seines off West Africa. Offshore stocks of pan-tropical spotted dolphins and spinner dolphins were most seriously impacted by bycatch mortality in the Pacific tuna purse-seine fishery. There is also a directed fishery for small cetaceans in some coastal villages in Japan. Takes of pan-tropical spotted dolphins in Japan totaled 39 in 2000, 10 in 2001, 418 in 2002, and 132 in 2003 (IWC, 2005, 2006). There are also similar small-cetacean fisheries in the southwestern Pacific (Perrin, 2002d).

The average annual mortality of spotted dolphins in U.S. Atlantic commercial fisheries in 2001–2005 was 6, all in the swordfish longline fishery (Waring et al., 2008). From 1989 to 1998, the average annual mortality of spotted dolphins (not differentiated to species) in the pelagic swordfish driftnet fishery was 16 animals per year, ranging from 0 to 51. That fishery was shut down after the 1998 season for excessive marine mammal bycatch. Six spotted dolphins from the driftnet bycatch were sent to the Smithsonian for examination and identification, and all six were the pantropical species.

Ecology and life history

Atlantic spotted dolphins tend to occur in groups of fewer than 50, most often 1–15, although schools of 100 or more may occur offshore (Perrin et al., 1994a; Perrin, 2002a, 2002e). They are very active, acrobatic, and frequent bow-riders, and commonly break the surface with the tip of the beak when surfacing. Long-term studies in the Bahamas by Herzing (1997) show very fluid groupings of individuals, with some evidence of segregation by age and sex. In the Bahamas, Atlantic spotted dolphins frequently associate with bottlenose dolphins (Herzing and Johnson, 1997). A tagged individual in the Gulf of Mexico made dives up to 40–60 m deep and 6 minutes in duration, but the majority of dives were shallower than 10 m (Davis et al., 1996).

Stenella frontalis feeds on small to large epipelagic and mesopelagic fishes and squid, and sometimes on benthic invertebrates (Perrin et al., 1994a; Perrin, 2002a, 2002e). It is probable that the diet differs between the inshore and offshore forms.

The available data for Atlantic spotted dolphins are more limited than for pan-tropical spotters, since there are not large samples of by-caught animals (Perrin et al., 1994a; Perrin, 2002a, 2002e). Calves are probably born at 90–100 cm. Females mature at about 190 cm along the U.S. Atlantic and 180 cm in St. Vincent in the West Indies. Males mature at 170–180 cm. The age at maturity in females in the Bahamas is estimated to be 9–15 years old (Herzing, 1997). The inter-birth interval is 1–5 years, averaging about 3.

Pan-tropical spotted dolphins may occur in schools from a few animals to several thousand (Perrin and Hohn, 1994; Perrin, 2001, 2002d). Within a large school there are distinct subgroups separated by age and sex—mother and calves, adult males, and juveniles—which tend to remain stable. There is evidence for an annual cycle of migration, inshore in spring and summer and offshore in fall and winter. They are very active, acrobatic, and frequent bow-riders. Dive data are limited, with dives known only up to 3.4 minutes in duration. In the Pacific, they commonly associate with spinner dolphins, short-beaked common dolphins, and yellowfin tuna.

Stenella attenuata in offshore Pacific waters feeds primarily on small epipelagic fishes, squid, and crustaceans, with some mesopelagic species (Perrin et al., 1973; Robertson and Chivers, 1997; Perrin and Hohn, 1994; Perrin, 2001, 2002d). Flying fish appear to be important prey, at least at times. The large inshore Pacific form may feed on larger benthic fishes. Archer and Robertson (2004) analyzed 203 stomachs from dolphins killed in the tuna fishery. Calves

began to feed on myctophids at about 6 months of age while still nursing, then shifted their diet more to squid during weaning.

Pan-tropical spotted dolphins are born at 80–85 cm, and reach body lengths of 129–142 cm by 1 year of age (Perrin and Hohn, 1994; Perrin, 2001, 2002d). Calving is spread out over an extended period, with peaks in spring and fall, and maybe also in summer. Both males and females begin to mature at about 160 cm, at which time males have a secondary growth spurt. Females mature at 9–11 years old, males at 12–15. The gestation period is 11.2–11.5 months. Lactation lasts is 1.4–2.1 years; the mean age and size at weaning in the Pacific bycatch sample analyzed by Archer and Robertson (2004) was 9 months and 122 cm. The inter-birth interval is 2–3 years. Both lactation period and inter-birth interval appear to vary in a density-dependent fashion with population status.

General distribution

Atlantic spotted dolphins are found only in subtropical and tropical waters of both the North and South Atlantic Oceans, between about 50°N and 25°S (Perrin et al., 1994a; Rice, 1998, Perrin, 2002a, 2002e). They appear to be more common on the western side of the basin—along the U.S. east coast to the Gulf of Mexico, Caribbean, and West Indies. There are scattered records from the South Atlantic near South America and Africa, and offshore, but there has been little research in those areas so they could be more common than the current data show. They are also known from the Azores, Canaries, and Cape Verdes, but not from Europe. There are numerous stranding records and older sighting records from the southeast U.S. for this species, and a few strandings along the northeast U.S. coast to Massachusetts.

Pan-tropical spotted dolphins are found in subtropical and tropical waters on both sides of the equator in all oceans between approximately 30–40°N and 20–40°S, a distribution nearly identical to that of the spinner dolphin (Perrin and Hohn, 1994; Rice, 1998; Perrin, 2001, 2002d). In the Atlantic the distribution seems to be mainly offshore and around oceanic islands. There are stranding records from Florida, and a scattering of strandings from North Carolina to Massachusetts.

In the western North Atlantic, distributional information about spotted dolphins has been confused by the occurrence of two similar species with overlapping ranges, confounded by the

previous uncertainty regarding common and scientific names. Sightings of spotted dolphins were relatively numerous north of Cape Hatteras during the CETAP (1982) surveys, comprising about 40% of the identified *Stenella* sightings, but they were not differentiated to species, principally because the majority of the sightings came from aerial surveys. (Striped dolphin was the most frequently sighted *Stenella*, at 57% of the identified sightings, with a few spinner dolphin sightings and one Clymene sighting). The spotted dolphin sightings ranged from the middle of the shelf out into very deep water, were most common off North Carolina and Virginia, and were rare north and east of Hudson Canyon. There were a few sightings identified to species, which were about three-quarters Atlantic and one-quarter pan-tropical spotters.

There have been additional sightings during the more recent NMFS assessment surveys, which have included a much larger shipboard component and have been able to identify a higher proportion of spotted dolphins to species (Waring et al, 2008). Spotted dolphins now make up 48% of the total *Stenella* sightings (with striped dolphins down to 49%), and pan-tropical spotters are less than 10% of the identified spotted dolphins. Sightings identified to pan-tropical spotters are almost all very far offshore, and mostly south of Cape Hatteras, but there were three sightings on the edge of Georges Bank. Pan-tropical spotted dolphins are the most commonly observed offshore cetacean species in the Gulf of Mexico, and are relatively common in the West Indies.

Historical occurrence

There are no historical records of either spotted dolphin from the Rhode Island study area. Cronan and Brooks (1968) did not mention either species for Rhode Island. The same is true for Waters and River (1962) for Massachusetts. Neither De Kay (1842) nor Linsley (1842) reported either species of spotted dolphins from New York or Long Island Sound, but both species were poorly known at that time, if at all. Goodwin (1935) mentioned Atlantic spotted dolphin (as *Prodelphinus plagiodon*) and said that the nearest known specimen was from New Jersey. Connor (1971) stated that *Stenella* “*plagiodon*” was a southern species reported from southern New Jersey.

Recent occurrence

There have been only nine scattered occurrences of spotted dolphins in the Rhode Island study area (Fig. 48). The first two confirmed spotted dolphin records for the Rhode Island study area were only two weeks apart in 1979. A shipboard observer sighted a pair of unidentified spotted dolphins offshore of the shelf break in the southeastern part of the Rhode Island study area on 16 August. On 1 September a CETAP aerial survey sighted a group of 100 unidentified spotters was sighted over the slope west of the August sighting. Another CETAP survey sighted a group of 40 on 22 August 1981 in the mid-shelf area south of Block Island. The other three sightings, all far offshore near or beyond the shelf break, came from an opportunistic sighting database originally created to map seabird distributions (PIROP, Programme Intégré des Recherches sur les Oiseaux Pélagiques)—two sightings of Atlantic spotters in July and October 1982 and one sighting of pan-tropical spotters in July 1984. All spotted dolphin sightings from the NMFS cruises beginning in the 1990s have been farther offshore and beyond the study area. Based on the overall sighting record now available from those surveys (Waring et al., 2008), it is most likely that spotted dolphins encountered in the Rhode Island study area would be *Stenella frontalis*, but *Stenella attenuata* is possible.

In addition to the six sightings, there have been three spotted dolphin strandings in the Rhode Island study area. There was a live-stranding of a 216-cm, 47-kg pan-tropical spotted dolphin in Charlestown, Rhode Island on 11 October 1983. It died at Mystic Aquarium three days later. A 203-cm, 107-kg, pan-tropical spotter stranded in Amagansett, New York on 7 May 1983. The only confirmed Atlantic spotted dolphin stranding in the study area was a 209-cm animal stranded at Bridgehampton, Long Island on 23 May 1988.

Conclusions

Both spotted dolphin species have more subtropical and offshore distributions, and are not likely to occur in the SAMP area. Neither poses any conservation concern relative to the SAMP.

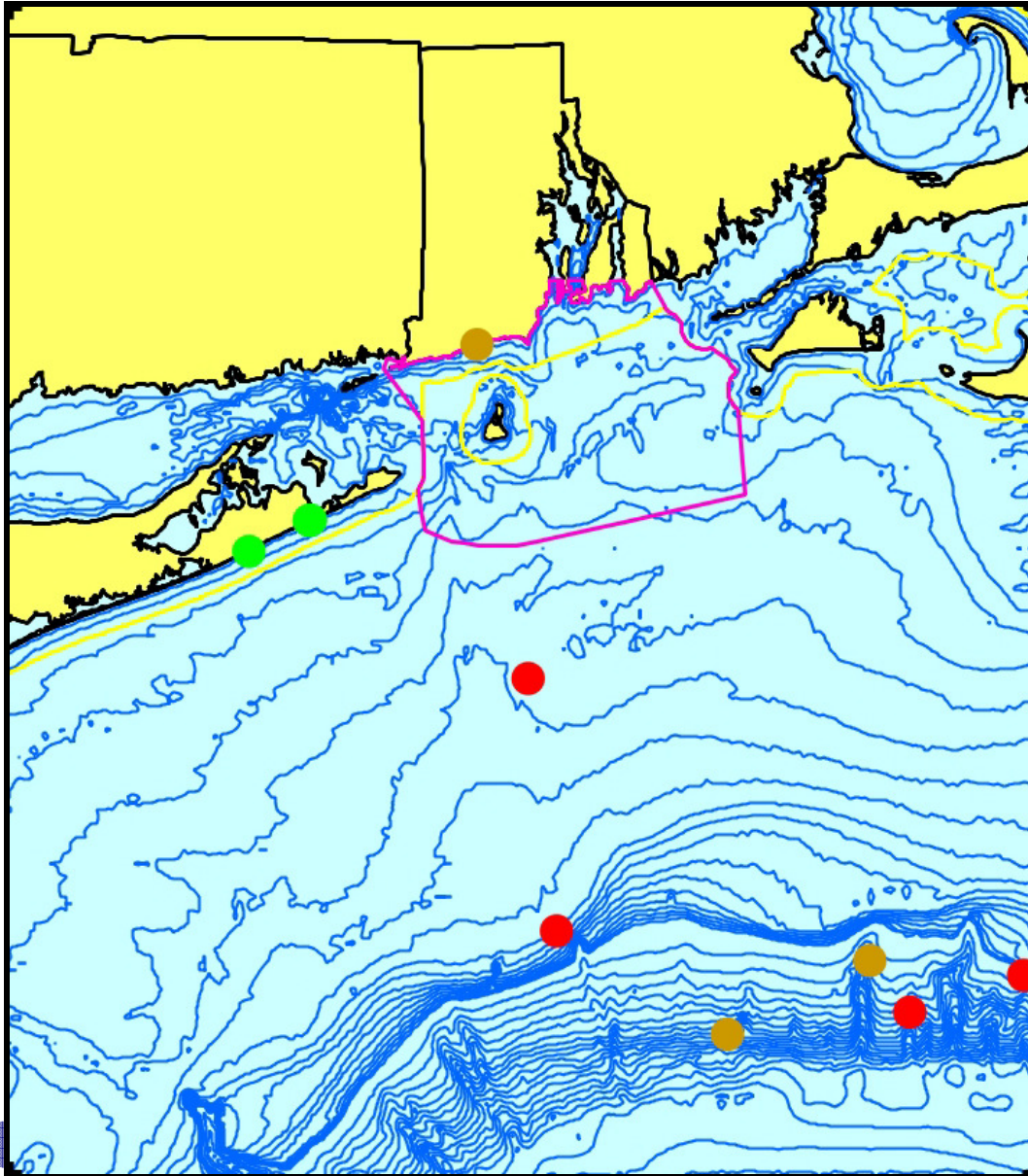


Figure 48. Aggregated sighting, stranding, and bycatch records of Atlantic, pan-tropical, and unidentified spotted dolphins in the Rhode Island study area, 1979–1988 (n = 9: winter = 0, spring = 3, summer = 3, fall = 3).

3.2.33. Harbor Seal *Phoca vitulina* Linnaeus, 1758

Pinnipedia includes three families of marine carnivores that are characterized by retention of all four limbs as flattened, simplified flippers—Phocidae (seals), Otariidae (sea lions and fur seals), and Odobenidae (walrus). Pinnipeds are not as completely adapted to the marine habitat as are cetaceans or sirenians, since all species must leave the water to give birth, either to a terrestrial habitat or onto sea ice. Recent morphological and molecular studies have concluded that Pinnipedia belongs within Order Carnivora, Suborder Caniformia (Rice 1998; Wozencraft 2005).

Phocids are sometimes referred to as “hair seals,” “earless seals,” or “true seals.” Phocids and otariids differ in a number of anatomical and life-history characteristics, with the walrus often intermediate (see Table 4 in Riedman, 1990 for a more detailed review). Otariids possess external ear pinnae, which are absent in seals and walrus. Seal flippers are completely furred with well-developed terminal claws. The hind-flippers are oriented directly backwards with opposed soles, and cannot be rotated underneath the body for locomotion on land, which is accomplished by caterpillar-like wriggling. In water, seals swim via alternating, lateral strokes of the hind-flippers, while using the fore-flippers mainly for maneuvering. Sea lions and fur seals have at least partially furless flippers with more rudimentary, subterminal claws. The pelvis and hind limbs can rotate underneath the body for walking on land. In water, they swim by simultaneous flapping of the long fore-flippers and use the hind limbs more as rudders. Seal coats have little underfur, and a seal is insulated by a thick layer of blubber. Fur seals have dense underfur for thermal insulation and the least developed blubber layer, while sea lions have less dense underfur and moderately thick blubber. The walrus moves on land like a sea lion and in the water like a seal. It is essentially hairless with thick blubber. Seal pups grow extremely fast and wean quickly. The mother fasts completely during lactation in almost all species. In otariids and walrus, lactation can last two years or more, pup growth is slower, and the mother feeds during lactation.

There are no sea lions or fur seals in the North Atlantic. Pinnipeds of the North Atlantic and adjacent waters include the walrus and nine species of Phocidae. Only five seal species are confirmed as occurring in the Rhode Island study area. Three seal species have (or had) very restricted distributions—the Caspian seal (*Pusa caspica*), Mediterranean monk seal (*Monachus*

monachus), and Caribbean monk seal (*Monachus tropicalis*, extinct since the mid-20th Century). The walrus (*Odobenus rosmarus*) and bearded seal (*Erignathus barbatus*) have Arctic distributions and occur rarely in U.S. waters but not south of Cape Cod. Although De Kay (1842) wrote that walrus “were formerly numerous on our coast, but are now scarcely ever found south of Cape Sable,” there is no evidence to support his conjecture. There are no confirmed records in the Rhode Island study area. Historical walrus breeding populations in the Gulf of St. Lawrence and on Sable Island off Nova Scotia were extirpated in the early 18th Century (Lavigne and Kovacs, 1988). The nearest recorded walrus occurrences to New York were in Massachusetts in 1734 and 1937 (Cardoza et al., 2006). Similarly, there is a bearded seal stranding record in Massachusetts in 2002 (Sardi and Merigo, 2006), but none in the mid-Atlantic.

Description

Harbor seals are relatively small animals, with adults 1.7–1.9 m long (Jefferson et al., 1993; Wynne and Schwartz, 1999). Males are slightly larger than females. Harbor seals vary in color from very light gray or tan to brown to almost black, with extensive spotting. The basic spotting pattern is light with dark spots. In some individuals the spots coalesce, particularly on the back, giving the appearance of a dark color with sparse, light mottling. In general the belly is lighter than the back. Whether an individual is wet or dry will greatly change its appearance, with completely dry individuals often light-colored. Pups shed their white lanugo in utero and are born with the same spotted coat pattern as adults. A harbor seal has a rounded head with a concave puppy-like face and only a short distance from eyes to nose. Nostrils are close together at the bottom and look like the letter “V” when seen from head-on.

Status

Harbor seals are not listed under the U. S. Endangered Species Act or on the Rhode Island state list, and are classified as Least Concern on the IUCN Red List.

A peak count of 271 harbor seals between the Massachusetts-Rhode Island border and eastern Long Island Sound was reported for March 1987 (Payne and Selzer, 1989). They suggested an upper bound of 374 based on their highest counts at each haul-out. Only Fishers

Island, New York consistently had more than 50 animals, with a peak of 101 in March 1986. Schroeder (2000) estimated that the total number present in Narragansett Bay in 1999 was between 825 and 1,047. Ronald and Gots (2003) reported that the total seal count in southern New England in the spring of 1999 was nearly 6,100 animals.

The increase in harbor seals south of Cape Cod parallels that observed in the population's breeding range along the Maine coast. Gilbert et al. (2005) used aerial surveys to count seals hauled out on ledges along the entire Maine coast, and used radio-tagging data to correct for the proportion of seals hauled out at any given time. Between 1981 and 2001, seal counts increased from 10,543 to 38,014 (6.6% per year). Counts of pups increased at an even higher annual rate of 14.4%. The corrected estimate of the total abundance of harbor seals in Maine in late May and June of 2001 was 99,340 (95% CI = 83,118–121,397). The number of ledges used as haul-out sites also increased over that span of years, from 336 to 556, with the number used as pupping sites growing from 186 to 496.

Harbor seals were hunted by Native Americans for subsistence, then by early European settlers for oil, meat, and leather (Lavigne and Kovacs, 1988). In recent times, commercial hunting has never been of any great importance. Seals are commonly perceived as competitors for commercially valuable fish stocks. Bounties were paid on harbor (and gray) seals in both Maine and Massachusetts into the 1960s, resulting in depletion of the population overall and its extirpation from pupping sites in Massachusetts (Katona et al., 1993). Bounty payments in New Brunswick, Canada persisted until 1976 and were re-instituted in at least two years in the 1980s (Terhune, 1985). Harbor seals were also hunted for sport in the U.S. prior to passage of the Marine Mammal Protection Act in 1972, as reported for eastern Long Island by Connor (1971).

Harbor seals are taken as by-catch in a variety of U.S. and Canadian commercial fisheries, including gillnets, drift nets, long-lines, bottom trawls, midwater trawls, purse seines, trammel nets, fish traps, herring weirs, and even lobster traps (Woodley and Lavigne, 1991; Waring et al., 2008). The latest estimate of average numbers of harbor seals killed annually in the northeastern U.S. sink gillnet fishery was 882 for 2001–2005, plus an undetermined number in the bottom trawl fishery. It is as yet unclear how much of the U.S. fishery-related mortality represents seals from breeding sites in the U.S. versus Canada. Other known sources of human-related mortality in the northeastern U.S. and Canada include boat strikes, entrainment in power plant intakes, entanglement in aquaculture facilities, and intentional shooting.

More is known about disease as a population impact for harbor seals than for other marine mammals (Bigg, 1981). A relatively large number of diseases are known, and there have been several significant epizootics. Epizootics where the underlying cause was never determined were reported in Iceland in 1918 (Dietz et al., 1989b) and in the Shetland Islands in the 1920s (Bonner, 1972). There have also been several recent epizootics where the cause has been determined.

At least 500 harbor seals died in New England in 1979–80 (Geraci et al., 1982). The epizootic began in Cape Cod Bay in December 1979 and spread north along the Maine coast. The animals died from bacterial pneumonia caused by *Mycoplasma* spp. These bacteria are normally present in healthy seals, and can cause an infection known as “seal finger” in humans who have been bitten by a seal (Hartley and Pitcher, 2002; Mazet et al., 2004). At least three different species have been isolated from harbor seals or humans bitten by harbor seals (Geibel et al., 1991; Ruhnke and Madoff, 1992; Baker et al., 1998). The seals that contracted pneumonia were also infected with a strain of influenza A, and the hypothesized explanation was that the influenza lowered their immune response to the *Mycoplasma*.

There was a second, smaller epizootic in New England harbor seals in 1982 that killed only about 60 animals (Hinshaw et al., 1984). It was first recognized in Narragansett Bay. In that case, the underlying cause was a different strain of influenza A virus that normally is found in birds.

The most significant epizootic to date in harbor seals occurred in the North Sea in 1988, killing about 18,000 seals (Dietz et al., 1989b; Heide-Jørgensen et al. 1992). It began in April on Anholt Island in the Kattegat between Denmark and Sweden. It spread from there to the north along the coast of Norway and west to the Netherlands, Great Britain, and Ireland. Seal counts declined by 60% in the Kattegat and Skagerrak. Some areas experienced 90% mortality in 40–60 days, and in the Wadden Sea the number of carcasses recovered exceeded the highest previous aerial survey count. The highest incidences occurred in areas where seals had congregated for pupping or molting, with less severe outbreaks where first introduced in the fall. The immediate cause of mortality was acute bacterial pneumonia, with *Bordetella bronchisepta* an important cause. There were secondary infections by herpes and picorna viruses, but the underlying cause appeared to be a morbillivirus. It was first identified as canine distemper virus (CDV) (Dickson, 1988; Osterhaus et al., 1988). Eventually the infectious agent was identified as a closely related

morbillivirus now called phocine distemper virus (PDV) (Cosby et al., 1988; Osterhaus and Vedder, 1988). Dietz et al. (1989a) tested samples from 40 harp seals and 90 ringed seals collected in Greenland in 1985, prior to the 1988 epizootic, for the presence of antibodies to CDV, and found 30% positive in the harp seals and 4% in the ringed seals. It is now hypothesized that the virus was introduced to North Sea harbor seals from harp seals in a year when the harp seals dispersed unusually far southward (Heide-Jørgensen et al., 1992; Markussen and Have, 1992). A smaller PDV outbreak in the North Sea in 2002 killed hundreds of seals (Jensen et al., 2002).

Duignan et al. (1993) reported PDV in harbor seals from Long Island, New York. In an expanded study, Duignan et al. (1995) detected PDV antibodies in 37% of harbor seals and 73% of gray seals from New England, but not at all in Pacific harbor seals. There was usually little or no evidence of disease. In the winter of 1991–92, strandings increased in New England, and the PDV antibody detection rate increased to 83%. Morbillivirus lesions were observed in six animals, and a case of morbilliviral encephalitis was detected in archived tissue from an animal stranded in 1988. The authors hypothesized that high levels of PDV without disease outbreaks in gray seals are maintained by their large population size, high recruitment rate, and innate resistance, while infection is maintained in the smaller harbor seal population through contact with gray seals.

Dunn and Wolke (1976) reported seal heartworm infestation in harbor seals from New England. They found pulmonary, vascular, and hepatic lesions caused by both adult worms and microfilariae. The 1988 PDV epizootic in the North Sea provided very large sample sizes for parasite studies, and North Sea harbor seals carried a variety of nematodes, cestodes, trematodes, and acanthocephalans (Claussen et al., 1991a, 1991b). Five species of nematodes were very common. Seal heartworm was present in 32% of individuals. The lungworms *Otostrongylus* and *Parafilaroides* were present in 26% and 27%, respectively. The presence of heartworm and lungworm was inverse to age, with *Parafilaroides* and heartworms absent in adults. The two common gut nematodes, *Contracecum* and *Pseudoterranova* (sealworm), present in 10% and 88% of animals, increased in occurrence with age.

Ecology and life history

Harbor seals are generally solitary when in the water, but gregarious when hauled out (Bigg, 1981; Burns, 2002; Ronald and Gots, 2003). Unlike many other pinnipeds that haul out only for reproduction and molting, harbor seals regularly haul out for resting. When hauled out, seals are observed sleeping for short periods with intervals of scratching, vocalization, yawning, jostling for position, or scanning for predators or other disturbance. Sometimes there are gray seals mixed in at harbor seal haul-outs, especially from Massachusetts north. In the Rhode Island study area, however, gray seals are most often juveniles and are difficult to identify except by experienced observers. Groups of seals on haul-outs show no evidence of sociality or structuring, but are simply aggregations of individuals that come together in order to utilize a limited resource. In addition, hauling out in groups is believed to be an anti-predator strategy. Terhune (1985) showed that as the number of seals in the group increased, the duration of time spent scanning decreased and the intervals between scans increased.

Hauling-out behavior is a function of tide stage, wind, temperature, precipitation, and time of day (Pauli and Terhune, 1987a, 1987b; Schneider and Payne, 1983; Burns, 2002; Ronald and Gots, 2003). The largest numbers of seals are likely to be hauled out at low tide in late afternoon on a calm, sunny day. Haul-out use also drops off when air temperatures get very cold. The seals are also extremely sensitive to disturbance when hauled out, and they may retreat to the water with only slight provocation—by humans, boats, aircraft, or potential predators.

What appears to be a relatively simple behavior pattern of hauling out at low tide each day and returning to the water between haul-out periods, presumably for foraging, can actually be quite complex. Individual harbor seals have been rehabilitated after stranding and released with satellite-linked radio tags. Single individuals have been recorded as using multiple haul-outs between Cape Cod, Massachusetts and Downeast Maine, interspersed with apparent foraging trips to one or more consistent locations tens of kilometers offshore in the Gulf of Maine. (see the WhaleNet satellite tagging program page at http://whale.wheelock.edu/whalenet-stuff/stop_cover.html for both currently active tags on a variety of marine vertebrates and archived data and maps from previous tags.)

Harbor seals are relatively flexible in their selection of haul-outs, and can be found on rocky ledges and reefs, islets, mudflats, sand bars, gravel bars, sandy beaches, cobble beaches,

glacial icebergs, sea ice, and man-made objects such as floating rafts and docks (Boulva and McLaren, 1979; Burns, 2002; Ronald and Gots, 2003). Important characteristics include protected locations that are relatively inaccessible from the land side and that have unobstructed access to water. Since harbor seals do not maintain breathing holes in the ice, when bays, inlets, and other nearshore waters freeze, the seals are pushed offshore where the ice edge provides water access (Ronald and Gots, 2003).

Annual molt occurs over two or three months from midsummer through early fall, after pupping (Bigg, 1981; Burns, 2002). Haul-out frequency increases somewhat during the molt. Yearlings molt first, followed by subadults, adult females, and then adult males. During molt there is an overlapping progression of age and sex classes.

Typical harbor seal dives last 3–4 minutes, but they are capable of diving to 30 minutes and depths of 500 meters (Bigg, 1981; Burns, 2002). Frost et al. (2006) reported a study of Alaskan harbor seal pups using satellite-linked telemetry tags. Tagged pups increased their amount of time in the water and maximum dive depths during their first 3–6 months. Then time in the water and maximum dive depth both decreased, suggesting foraging seasonality. Percent time in the water was lowest in July (68%) and highest in November (89%). Tagged pups spent 50% of their swimming time diving in the upper third of the water column and only 5% in the deepest third, evidence that pups do not feed on or near the bottom during their first year.

Harbor seals are flexible in their prey selection (Bigg, 1981; Nowak, 1999; Burns, 2002; Ronald and Gots, 2003). Small to medium-sized fishes are the dominant prey, followed by squid and octopus, and then by crabs and shrimp. Types of fish eaten include a number of economically important commercial species. Among these are cods, hakes, mackerel, herring, sardines, anchovy, smelt, shad, capelin, sand lance, trout, salmon, rockfish, sculpins, and flounders. Shrimp may be particularly important prey for pups after weaning. Seals appear to feed on what is most abundant. Payne and Selzer (1989) collected scats from haul-outs in Maine and Massachusetts to look at prey preferences. They found clear geographic differences. Sand lance was the dominant prey at all three Cape Cod, Massachusetts sites: 87% of the diet at Race Point (tip of Cape Cod), 85% at Monomoy Island (at the “elbow”), and 50% at Jeremy Point (on the west side in the middle of the “forearm”). Squid comprised the next most abundant food item (22%) and then gadids, herring, and flounders in decreasing importance. Mackerel and skate were also eaten. At the Isles of Shoals off southern Maine (about 100 km from Race Point), there

was no dominant prey type. Gadids and rockfishes were about equal at 22% each, flounders and herring both were >10% of the diet, and cunner, sand lance, and skate were also eaten. The diet of harbor seals along Long Island, based on stomach contents of stranded animals and some observations of feeding, includes herring, mackerel, squid, flounder, green crabs, mussels, cod, and silver hake (S. S. Sadove, pers. comm.).

Harbor seal pupping in the Gulf of Maine takes place in late May and June (Katona et al. 1993). Pupping occurs from the Isles of Shoals at the Maine/New Hampshire boundary northward into Canada. Pupping formerly occurred south to Cape Cod (Katona et al., 1993), and recent evidence indicates that pupping has resumed at Manomet, Massachusetts on the west side of Cape Cod Bay. Single pups are born approximately 70 cm long and weighing about 10 kg (Wynne and Schwartz, 1999). The white lanugo is shed in utero, and the pup is born in a spotted juvenile coat, essentially the same as the adult pattern.

Harbor seals are unique among phocids. In other seals, pups remain at the birth site until after weaning, and the mother tends to remain with or close by the pup for the entire lactation period, feeding little or not at all (Riedman, 1990). Harbor seal pups are precocial, swimming and following the mother within hours of birth (Bigg, 1981; Riedman, 1990; Burns, 2002; Ronald and Gots, 2003). At many pupping sites the pup has no other option, since the location is submerged at high tide. After the mother and pup leave the birth site, the pup follows the mother closely, sometimes riding on her back during the first week. They haul out at intervals, when nursing takes place. Adult females spend a larger proportion of their time hauled out during lactation (Thompson et al., 1989), but are able to feed throughout lactation (Burns, 2002). Pups are weaned at 3–6 weeks of age (Bigg, 1981; Burns, 2002). Harbor seal pups may continue to remain with and follow their mothers for 2–4 weeks after weaning.

Ovulation and mating occur very soon after weaning (Bigg, 1981; Thompson, 1988; Riedman, 1990; Burns, 2002). Mating takes place in the water. Males are largely unable to defend breeding sites or females, resulting in a promiscuous or slightly polygynous mating system (Riedman, 1990). Implantation of the embryo is delayed for 1.5 to 3 months.

Female harbor seals become sexually mature at 2–5 years of age, most at age 3 or 4, and reach physical maturity at age 6 or 7 (Bigg, 1981; Burns, 2002). Males take about a year longer. Most (85–92%) mature females give birth each year. First-year mortality rate is 20–60%, after which it is 5–20% (Boulva and McLaren, 1979), and the mortality rate in males is higher than in

females after sexual maturity. It is commonly assumed that a large proportion or even a majority of the harbor seals in southern New England are juveniles, and there is some published support for this (Payne and Schneider, 1984; Whitman and Payne, 1990; Katona et al., 1993). Waring et al. (2006a) captured and radio-tagged 21 harbor seals and estimated age for 17 near Cape Cod, Massachusetts in March 2001. Fourteen (82%) were adults, one (6%) was a subadult, and two (12%) were juveniles. It is still possible that the proportion of juveniles is higher in the Rhode Island study area. Alternatively, perhaps perceptions of the age structure in the region are somewhat biased by the reliance on strandings for data. Adults, sub-adults, and juveniles cannot be easily differentiated except by close examination, and mortality and stranding rates can be expected to be higher for younger animals. Gilbert and Wynne (1987) reported that all of the harbor seals taken in the gillnet fishery in the Gulf of Maine were young of the year.

In harbor seals, predation impacts pups to a larger extent than adults. Predators of pups include polar bears, red foxes, Arctic foxes, Steller's sea lions, eagles, ravens, and gulls (Burns, 2002; Ronald and Gots, 2003). In eastern Canada, the three major sources of mortality in the pups are stillbirth, abandonment after birth, and sharks (Boulva and McLaren, 1979). Stobo and Lucas (2000) reported that the rate of shark predation (with Greenland shark an important predator) on harbor seal pups at Sable Island increased markedly, from 20% of pups in 1980–1993 to about 25% in 1994 and 1995 to 45% in 1996. Shark attacks on adult seals seem to be directed preferentially towards females.

General distribution

Harbor seals occur in coastal waters of both the North Atlantic and North Pacific (Bigg, 1981; Riedman, 1990; Burns, 2002; Ronald and Gots, 2003). In the western North Atlantic, they are common from southern New England north to Labrador, Greenland, and Iceland. They are mainly seen hauled out or relatively close to the shore. North of Cape Cod harbor seals can occur year-round. However, south of Cape Cod (Rhode Island to New Jersey) seals occur only during winter migration (October to early May) (Payne and Selzer, 1989). There are occasional records from as far south as Florida (Caldwell and Golley, 1965; Caldwell and Caldwell, 1969; Caldwell et al., 1971; Waring et al., 2008). As with pinnipeds in general, records of in-water observations are much less common than records of stranded animals or seals on haul-out sites. Harbor seal

sighting and bycatch records away from shore are concentrated in relatively shallow water. Lens (1997) reported seven individuals taken in a Spanish deep-water trawl fishery on the southern edge of the Grand Banks, showing that harbor seals are capable of long-distance foraging movements and can occur far offshore.

The annual patterns of movement in the harbor seals of New England and Atlantic Canada are complex (Bigg, 1981; Riedman, 1990; Katona et al., 1993; Nowak, 1999; Burns, 2002; Ronald and Gots, 2003). Some sources call harbor seals migratory, while others say they are non-migratory, sometimes differentiating between migration and “seasonal movements.” In Maine and Atlantic Canada, harbor seals can be observed year-round (Boulva and McLaren, 1979; Katona et al., 1993; Baird, 2001), while in southern New England they are very clearly seasonal, occurring from September to late April–early May (Payne and Schneider, 1984; Payne and Selzer, 1989; Sadove and Cardinale, 1993; Schroeder, 2000). Only a minority of the population winters in the Rhode Island study area, and does not remain for pupping. However, since the 1990s, small numbers have been reported to remain around Long Island year-round and pupping has been observed on Great Gull Island and Fishers Island (S. S. Sadove, pers. comm.). One hypothesis for why harbor seals depart from the Rhode Island study area just prior to the time of pupping is the presence of predators. Many large predatory sharks are more common south of Cape Cod than to the north in the Gulf of Maine (Kenney et al., 1985b; Collette and Klein-MacPhee, 2002).

Historical occurrence

Harbor seals have long been recognized as common residents in the northeastern U.S. (De Kay 1842; Allen 1880). (The Smithsonian dataset we obtained included only cetacean records, so we had no historical data from that source.) Cronan and Brooks (1968) reported seven 20th Century records from Rhode Island or nearby between 1933 and 1967. Seals were seen in Mount Hope Bay in 1933, 1938, and 1941. One was sighted off the URI Bay Campus on 10 December 1956, and another was seen in the Sakonnet River in November 1957. A dead seal was found floating in the Bay in the fall of 1957 and collected as a specimen for the survey conducted by Cronan and Brooks for their study. One seal was captured in a fish net off Newport in August 1967. Waters and Rivard (1962) wrote that harbor seals were usually seen in

southeastern Massachusetts in late winter and early spring and had formerly been much more abundant, but were rare south of Massachusetts. All historical sources concur that harbor seals were relatively common around Long Island and Connecticut (De Kay, 1842; Linsley, 1842; Merriam, 1884; Goodwin, 1935; Connor, 1971).

Recent occurrence

Harbor seals are regularly observed around all coastal areas throughout the Rhode Island study area, and occasionally well inland up bays, rivers, and streams (Fig. 49). It should be noted for all the seals that the available data are strongly dominated by stranding records, which comprised 446 out of 507 total records for harbor seals (88%). Seals are very difficult to detect during surveys, since they tend to be solitary and the usual sighting cue is only the seal's head above the surface. In addition, seals were specifically excluded from data collection efforts during CETAP, and there is no centralized repository for opportunistic seal sighting information outside of small localized collections. Although the harbor seal is generally referred to as a winter resident in the region, their period of occurrence is significantly broader. Of the available records, 52.5% are in spring, 31.2% in winter, 9.5% in summer, and 6.9% in fall. In the Rhode Island study area, there are no records offshore of the 90-m isobath (Fig. 49). From counts on haul-outs in Narragansett Bay, Schroeder (2000) showed that seals usually start arriving in September, steadily increase in numbers until April, then depart relatively abruptly in May.

Payne and Selzer (1989) identified six haul-outs in Narragansett Bay in the 1980s. Their peak counts were 43 at the Dumplings off Jamestown and 36 at Rome Point in North Kingstown, and only one animal was ever seen at Block Island. The numbers of harbor seals in the Rhode Island study area have increased dramatically since then. Schroeder (2000) reported 21 haul-outs around Narragansett Bay and 6 at Block Island during 1994–1999 (Fig. 50). The largest haul-out was a clump of rocks located 230–370 m off Rome Point in North Kingstown, with a maximum count of 170 animals. However, some haul-outs used in the 1960s–1980s had apparently been abandoned or nearly abandoned. The maximum count at the Dumplings was 2. The peak counts at the two largest haul-outs in Block Island were 54 and 16 (see below). Her results indicated that the number of harbor seals in Rhode Island had increased by an order of magnitude from the 1960s to the late 1990s.

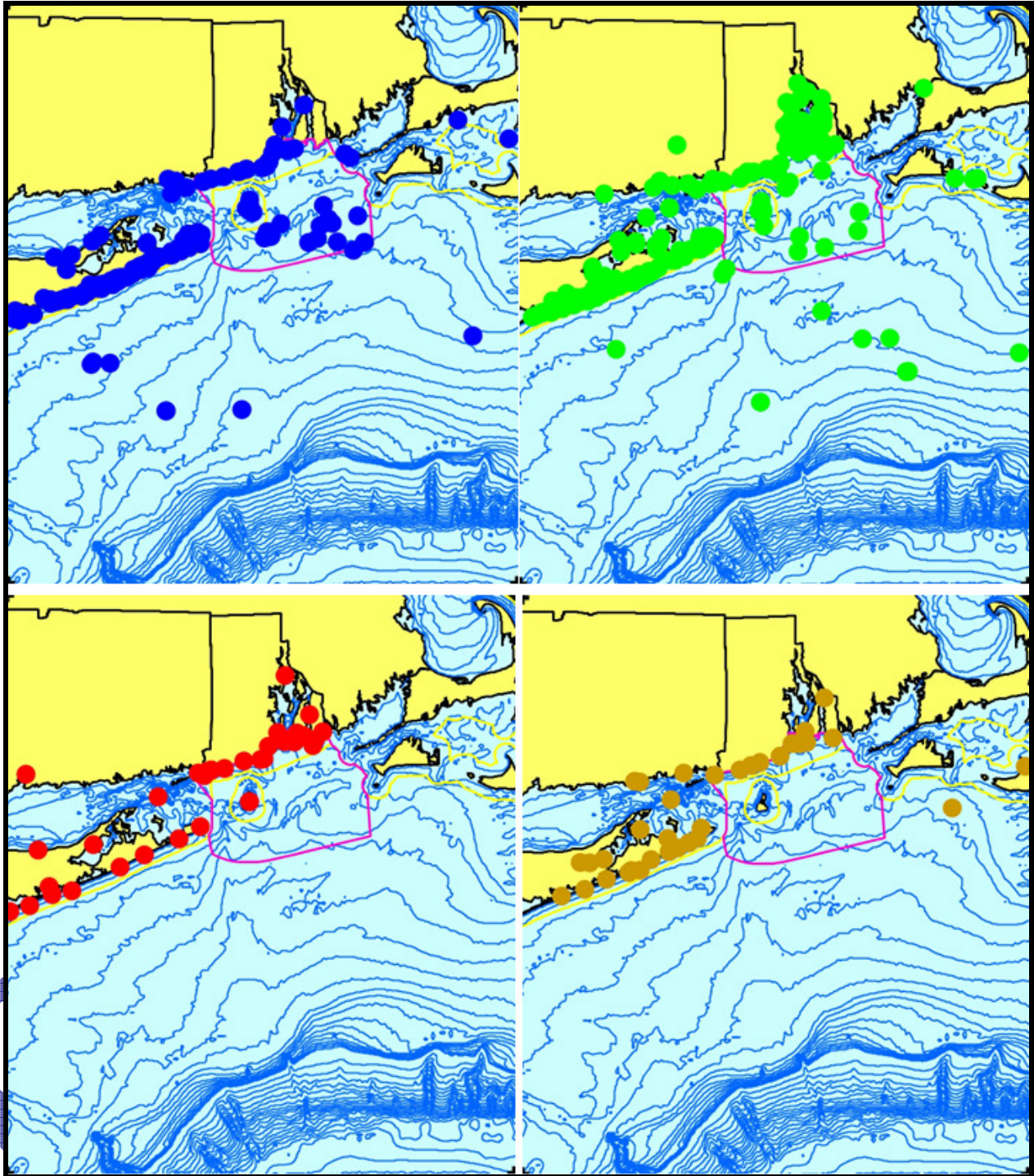


Figure 49. Aggregated sighting, stranding, and by-catch records of harbor seals in the Rhode Island study area, 1954–2005 (n = 507: winter = 158, spring = 266, summer = 48, fall = 35).

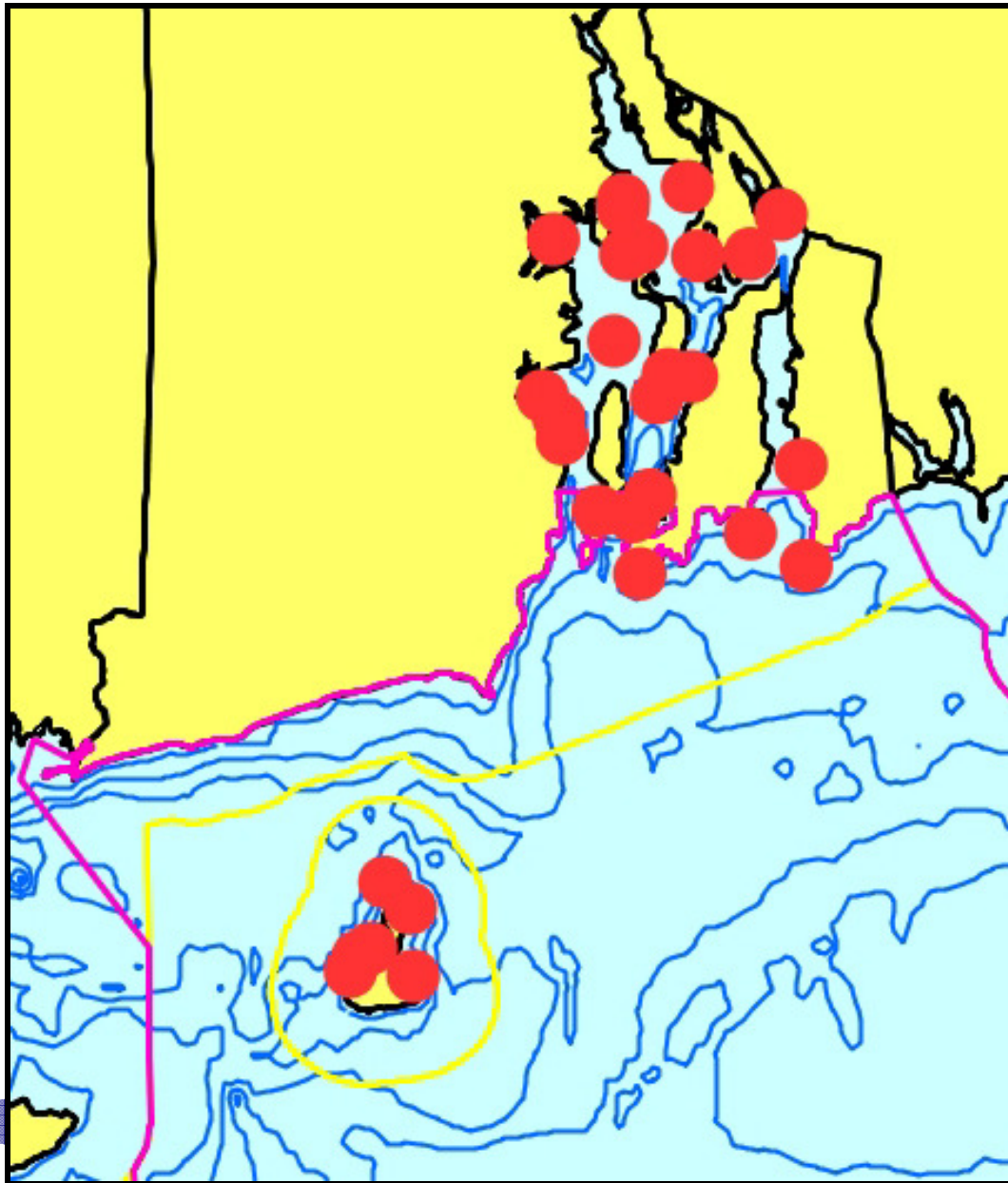


Figure 50. Harbor seal haul-outs in Rhode Island: 1966–1976, 1981, 1986–1987, and 1994–1999 (based on Schroeder, 2000).

Schroeder (2000), collaborating with Scott Comings of The Nature Conservancy, identified six harbor seal haul-outs at Block Island (Table 5). The largest haul-out is at Cormorant Cove in the southwestern corner of Great Salt Pond (see below). The other five are around the periphery of the island. Pebble Beach is on the southeastern part of the island, near Old Harbor. Two haul-outs are at the northern end of the island, at Clay Head and Sandy Point.

Finally, there are two haul-outs on the southwestern side, first identified during the final season of Schroeder's research—Dorie's Cove and Grace's Cove.

Table 5. Maximum monthly counts of harbor seals at the six Block Island haul-outs during the 1997–98 and 1998–99 seasons (Schroeder, 2000).

Haul-out (season)	Month					
	Dec	Jan	Feb	Mar	Apr	May
Cormorant Cove (97–98)	–	–	47	52	22	0
Pebble Beach (97–98)	–	–	–	12	14	0
Clay Head (97–98)	–	–	–	8	0	0
Sandy Point (97–98)	–	–	–	0	2	0
Cormorant Cove (98–99)	52	52	54	53	43	0
Pebble Beach (98–99)	16	8	8	10	9	0
Clay Head (98–99)	3	5	4	6	10	0
Sandy Point (98–99)	2	3	0	6	0	0
Dorie's Cove (98–99)	0	1	2	3	3	0
Grace's Cove (98–99)	0	0	1	2	4	2

In Rhode Island, seals utilize different haul-out types around Narragansett Bay compared to those on Block Island (Schroeder, 2000). Nearly all of the haulouts around the Bay are rocky ledges and isolated rocks that are mostly submerged at high tide. The exception is Spar Island, which is a man-made dredge-spoil island in Mount Hope Bay. At Block Island, there are several haul-outs on cobble and sandy beaches around the island, but the haul-out used by the largest number of seals is a wooden raft moored in Cormorant Cove. Around the eastern end of Long Island, Payne and Selzer (1989) identified the most important haulouts in the 1980s, in order of decreasing counts, as Fishers Island, Great Gull Island, Montauk Point, Gardiners Island, Sag Harbor, and Falkner Island (CT). These continue to have the largest aggregations, and constitute locations where access is restricted by physical characteristics or by extensive private or

government property holdings, and there are other haul-outs all around the eastern end of Long Island and along both the Atlantic and Long Island Sound shores (Sadove and Cardinale, 1993). The numbers of individuals at Long Island haul-outs range from about 20 to 500 (S. S. Sadove, pers. comm.). There are also known haul-outs in Connecticut (A. Ferland, Maritime Aquarium, pers. comm., R. Nawojchik and H. Medic, Mystic Aquarium, pers. comm.).

Because of very few sightings during surveys, SPUE analysis or relative abundance modeling was not possible for any seal species.

Annual stranding frequencies since 1993 (the start of the NE regional stranding network dataset available from NERO) are shown in Figure 51. Strandings were highest in the early 1990s. The numbers of strandings were lower on average in 1997–2002, with one-year spikes in 1998 and 2001, then generally higher again.

Harbor seal strandings occur year-round in the study area, with a seasonal trend that closely mirrors the trends in counts on Rhode Island haul-outs shown by Schroeder (2000; Fig. 52). Strandings are least common in July and August and more frequent from November to June, with a peak in April and May. The stranding records from Mystic Aquarium included 44 harbor seal strandings in Rhode Island in 1976–1992. Combined with the Rhode Island records from the NERS data, there were strandings in Rhode Island every year beginning in 1985, and in significant numbers beginning in 1987 (Fig. 53). There is no evidence for an increase in 1991–92, during the regional PDV eipizootic. The pattern is similar to that seen in the regional data, with higher numbers in 1987–1998, a lower rate in 1999–2002, and then a return to similar levels.

Conclusions

Harbor seals are really the only resident marine mammal within Rhode Island state waters, including Narragansett Bay and Block Island. If construction activities for a wind farm or other development project were to be restricted to winter in order to mitigate potential impacts on endangered whales and sea turtles, one effect would be to put those activities into a season of higher seal numbers. The proposed installation of wind turbines in state waters southeast of Block Island would be closest to the seal haul-out at Pebble Beach near Old Harbor, where there might be 15 or more seals at any one time (Table 5). That construction might require both an Incidental Harassment Authorization or specific mitigation elements.

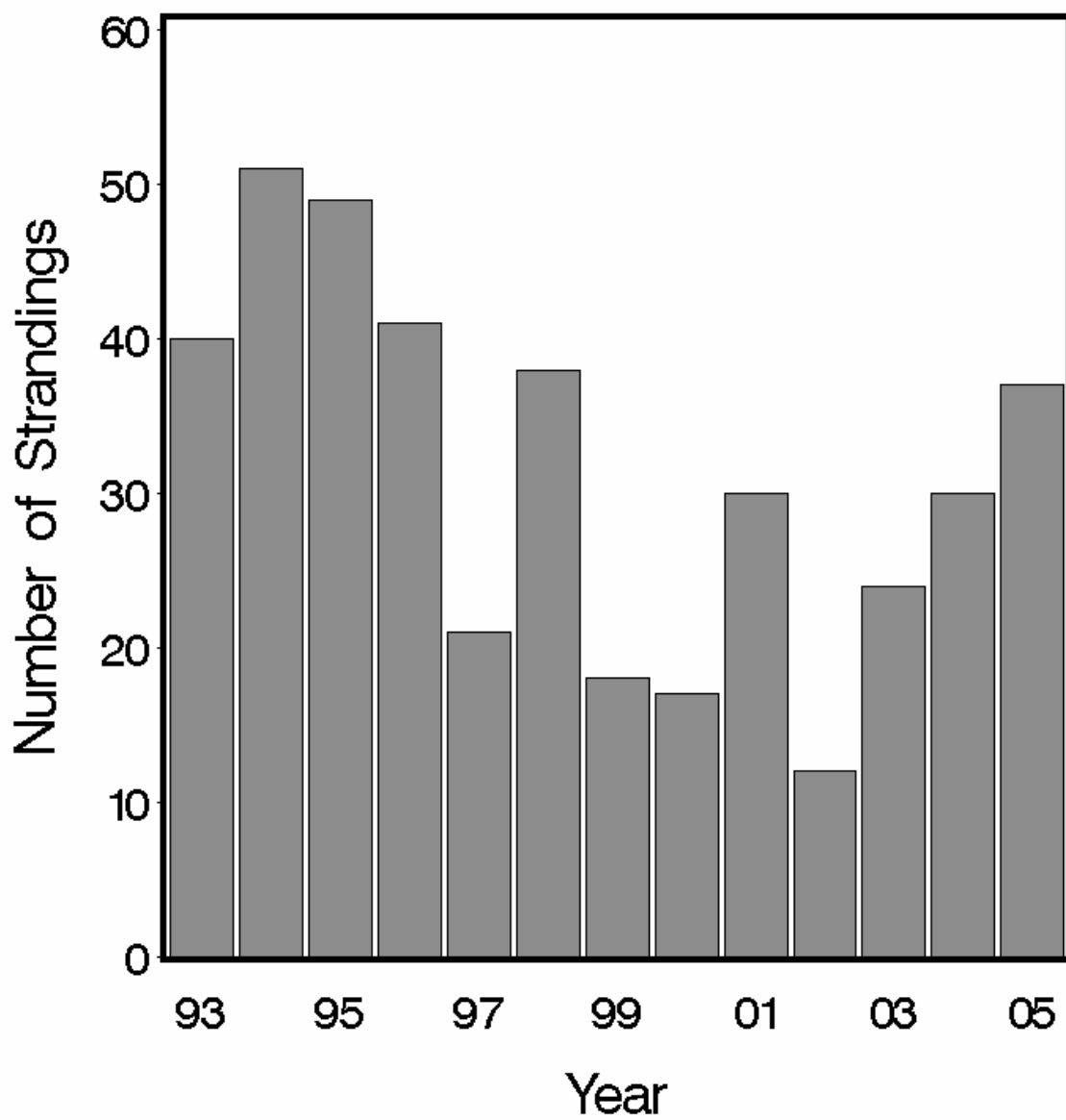


Figure 52. Annual stranding frequencies for harbor seals in the Rhode Island study area, 1993–2005.

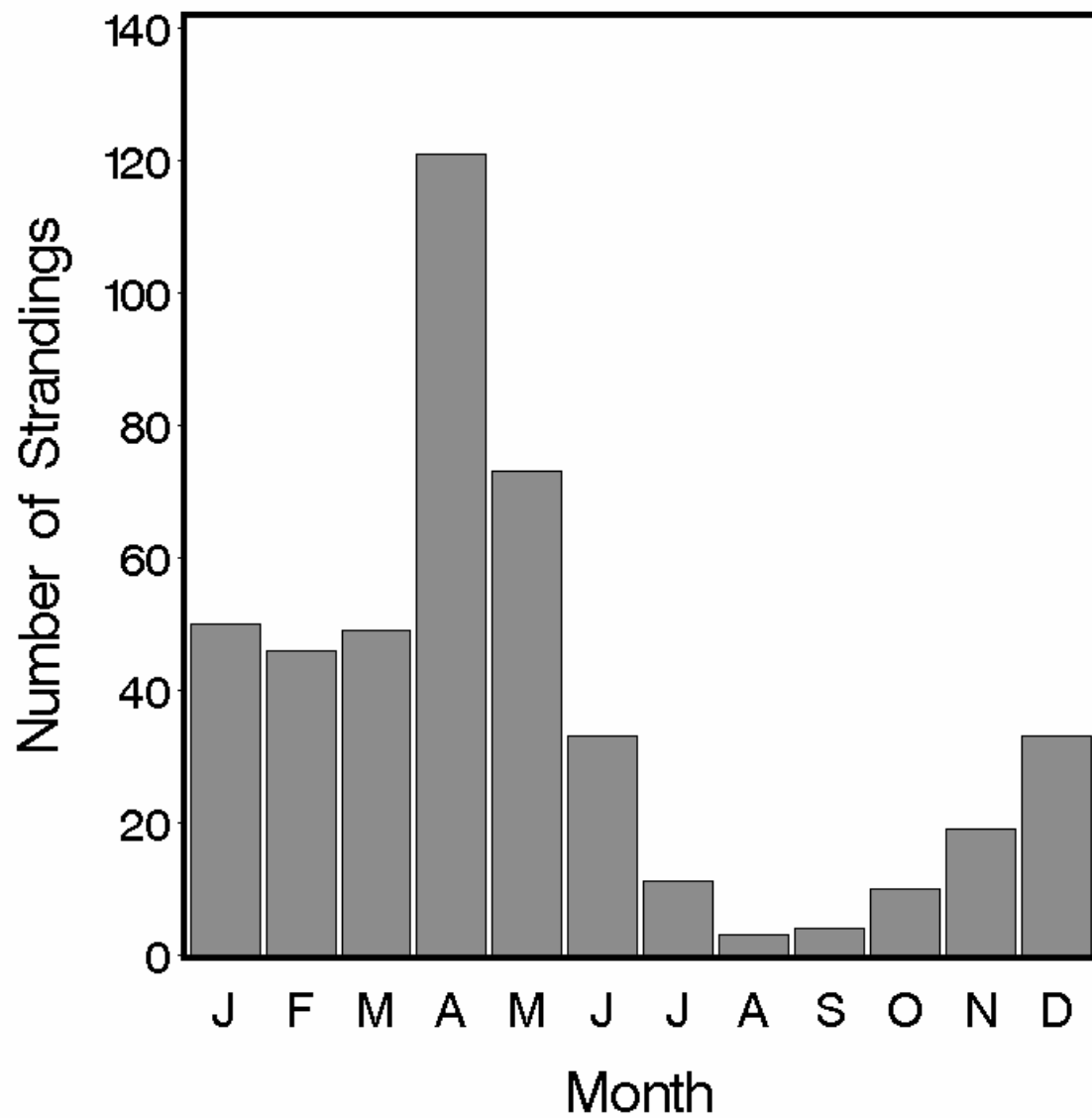


Figure 53. Monthly stranding frequencies of harbor seals in the Rhode Island study area.

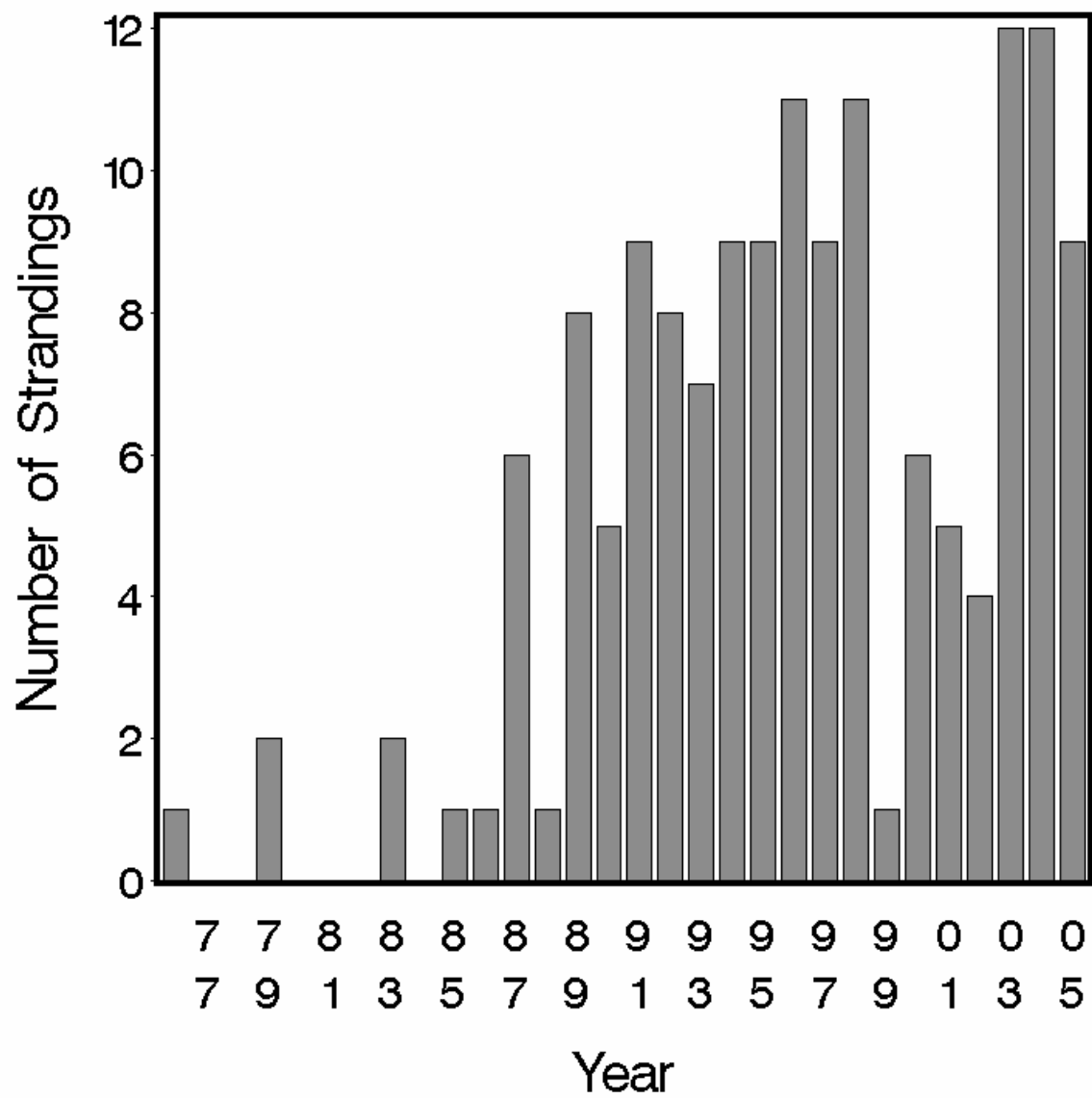


Figure 54. Annual stranding frequencies for harbor seals in Rhode Island alone, 1976–2005.