

# Killer whales (*Orcinus orca*) from the Bay of Fundy to the Equator, including the Gulf of Mexico

Steven K. Katona<sup>1</sup>, Judith A. Beard<sup>1</sup>, Philip E. Girton<sup>1</sup>  
and Frederick Wenzel<sup>2</sup>

<sup>1</sup> College of the Atlantic, Bar Harbor, Maine 04609, USA

<sup>2</sup> 51 Allerton St., Plymouth, Massachusetts 02360, USA

## ABSTRACT

One hundred seventy-seven reports of sightings or strandings of killer whales (*Orcinus orca*) in the western North Atlantic Ocean, from the Bay of Fundy to the Equator, including the Gulf of Mexico, were examined from the period 1817–1987 from published literature and unpublished data files. Reports were frequently sketchy, incomplete or duplicative. After eliminating potentially duplicative reports, plots of occurrence by latitude and month suggested the existence of a small seasonally-migrating population of killer whales along the United States eastern seaboard and possibly a year-round population south of 35° N. Owing to possible duplications between sightings, no reliable estimate can be made for the number of individual killer whales seen in this study area during a single year. The largest group of killer whales reported included approximately 40 animals. Prey species reported to be taken by killer whales in this study area and adjacent waters include finback, humpback, minke and pilot whales, bluefin tuna, mackerel, squid, herring and marine turtles, but evaluation of their relative dietary importance is not yet possible. Further research is needed for the entire region.

## INTRODUCTION

This report summarizes all available information on the occurrence of killer whales (*Orcinus orca*) in the portion of the western North Atlantic from the head of the Bay of Fundy (about 46° N) to the Equator and east to longitude 50° W. Previous reports (Goode 1884; Rhoads 1903; Caldwell *et al.* 1971a; Mead 1975; Gusey 1976; Leatherwood *et al.* 1976; Godin 1977; Leatherwood and Dahlheim 1978; Prescott *et al.* 1979; Winn *et al.* 1979; Katona *et al.* 1983) suggest that in the Atlantic the species ranges from the polar ice pack south to the Lesser Antilles and Gulf of Mexico, but is most abundant from New Jersey north.

## MATERIALS AND METHODS

Records of sightings and strandings of killer whales were compiled from an extensive search of published literature, from the unpublished data files of colleagues and from data files of major data clearing centers: the Cetacean and Turtle Assessment Program (CETAP), University of Rhode Island; Scientific Event Alert Network (SEAN) and Marine Mammal Event Program (MMEP), Smithsonian Institution; National Marine Fisheries Service (NMFS), Northeast Foreign Fisheries Observer Program; and Gulf of Maine Whale Sighting Network (GMWSN), College of the Atlantic. Solicitations for information were sent to all cetologists known to be active within the study area. In the Cape Cod region, where a number of killer whale sightings and strandings had been reported,



fishermen were interviewed, local newspaper archives were reviewed, and nature centers and historical societies were consulted for anecdotal accounts.

There has been almost no research effort specifically directed toward killer whales in our overall study area. All sightings or strandings summarized here represent opportunistic incidental observations. Most originate from programmes studying other marine mammals, but some originate from fishermen. The chance of directly observing killer whales or hearing about observations of them is not homogeneous throughout the study area, because of regional differences in the intensity and types of opportunistic effort and biases which might arise from the fact that different potential observers had different research, commercial or recreational objectives and different methods.

It was not practical to attempt quantification or tabulation of regional effort, owing to substantial yearly changes in the number and type of vessels used for commercial whale-watching or research. The cetacean fauna of the northern portions of our study area have been studied more intensively than in the south, and the Gulf of Mexico is especially deficient in studies that would be expected to find killer whales. The following qualitative summary of apparent effort is useful for interpretation of results.

Starting in about 1975, selected locations from the Bay of Fundy to Cape Hatteras have been extensively covered by naturalists on commercial whale watching vessels, scientists engaged in long-term research projects, and participants in a comprehensive study of the area's cetaceans and turtles (CETAP). Increased interest in cetaceans and consequent efforts to observe or study them have contributed to an overall increase in reports of killer whales during recent years. Many of the reports are duplicative. Others probably represent (some of) the same animals, seen at a different location or at a different time, but this cannot be proved owing to lack of photographs for individual identification.

Only a few of the reports of killer whales

discussed in this paper originated from commercial whalewatch tours. Nevertheless, since these tours contribute many thousands of observer hours each year, it is appropriate to summarize their distribution briefly. Since the late 1970's, several dozen whalewatch tour boats have visited productive fishing banks on a daily basis, weather permitting, along the northeast seaboard of the United States from May through September. Whalewatch tours are most concentrated in Massachusetts Bay and Cape Cod Bay, with fewer cruises north of New Hampshire and south of Cape Cod. The southernmost regular cruise is from Montauk, Long Island. Monthly cruises have visited the continental shelf break offshore from Ocean City, Maryland. Whalewatch tour vessels search mainly for baleen whales, particularly the finback whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), and right whale (*Eubalaena glacialis*), but the possible sighting of a killer whale would certainly be investigated and reported. High interest in such sightings has produced some of the duplication in records that we encountered, because informally communicated versions of the same sighting spread rapidly to appear in different data files or publications. Except for trips from Ocean City, Maryland, most whalewatch tour efforts are concentrated on the continental shelf and within about 25 naut. miles off the coast, an important bias in view of the demonstration by Reeves and Mitchell (1988 - this volume) that killer whales are widely distributed across the North Atlantic Ocean in areas far from shore.

Coverage of the northern portion of the study area has also been provided by several scientific investigations concentrating on cetaceans, including aerial surveys by Woods Hole Oceanographic Institution (Cape Cod area, 1950-1970), the New England Aquarium's Right Whale Survey in the Bay of Fundy (1982 - present, late July-October); the NMFS Northeast Foreign Fisheries Observer Program (1976 - present, year-round); College of the Atlantic's Mount Desert Rock Research Station (1973 - present, June-



late September) and Gulf of Maine Whale Sighting Network (GMWSN; mainly pre-1985, year-round opportunistic sightings); the Center for Coastal Studies' Cetacean Research Program in Cape Cod Bay and Massachusetts Bay (1976 – present, intense effort from April through October, sporadic effort from November through March); and the Smithsonian Institution's collaborative Marine Mammal Stranding Program (1975 – present, year-round, North American coastline).

A comprehensive programme to identify species of marine mammals and marine turtles inhabiting and/or migrating through waters of the eastern U.S. continental shelf between Cape Hatteras, North Carolina, and the Canadian Border was carried out by the University of Rhode Island's Cetacean and Turtle Assessment Program (CETAP) from 1978–1981 (CETAP 1982). Approximately 229,112 naut. miles of aerial and ship surveys were done to estimate the size, temporal and spatial distribution of marine mammal and turtle populations and to describe areas of particular importance to them. Aerial surveys took place in all seasons and visually sampled approximately 7% of the sea surface area in the CETAP study area. Additional aerial surveys studied right whales.

Long-term research efforts from Cape Hatteras to the Equator (excluding the Gulf of Mexico) include New England Aquarium's aerial surveys for right whales along the Georgia and Florida coast (1984 – present, February and March); investigations of bottlenose dolphins along the east and west coasts of Florida (1971 – present); studies of humpback whales during winter in waters of the Dominican Republic (1978 – present), northwestern Puerto Rico (1978–1984), Virgin Bank (1985, 1986), Bequia (1982 – present) and during the northward migration at Bermuda (1980–1986, mainly April). Additional efforts include a study of southern Caribbean small whale fisheries in the early 1970's; and 188 hours of aerial surveys conducted offshore from eastern Venezuela in 1979.

Long-term research projects on cetaceans

in the Gulf of Mexico have concentrated on the bottlenose dolphin (*Tursiops truncatus*), which is primarily a coastal species. Coastal observations have taken place off Sanibel Island and Sarasota, Florida; Mississippi Sound; and Port Aransas, Texas. Offshore effort has consisted of aerial surveys during 1980–1981 offshore from Brownsville, Texas; Marsh Island, Louisiana; and Naples, Florida (Fritts *et al.* 1983) and aerial surveys during 1984–1986 from Key West, Florida, to the Mexican border out to approximately 100 naut. miles from shore (NMFS, Southwest Fisheries Center, unpublished data).

## RESULTS AND DISCUSSION

Following removal of apparently duplicative reports, potentially unique records of sightings and strandings of killer whales were listed (Appendix 1) and examined for patterns of occurrence (Figs. 1–5). Sightings of killer whales on different days were treated as unique, even if the locations were not far apart. Reports of killer whales were only included in our data file if they contained information on date and location. If a geographical location was given, but no position coordinates were included, we assigned approximate coordinates. Such estimated coordinates are enclosed in parentheses in Appendix 1.

Records of killer whales were found throughout our study area. Previous authors, e.g. Leatherwood *et al.* (1976) and Katona *et al.* (1983), suggested that killer whales prefer coastal waters, and the records summarized here include many sightings close to land. However, nearly 10% of the sightings shown in Figure 1 occurred along the continental shelf break or farther seaward. Data assembled by Reeves and Mitchell (1988 – this volume) from the American pelagic whale fishery show a significant concentration of sightings along the shelf break and farther offshore from the mid Atlantic states. These findings indicate that killer whale distribution in our study area probably has a more important offshore component than was previously appreciated.

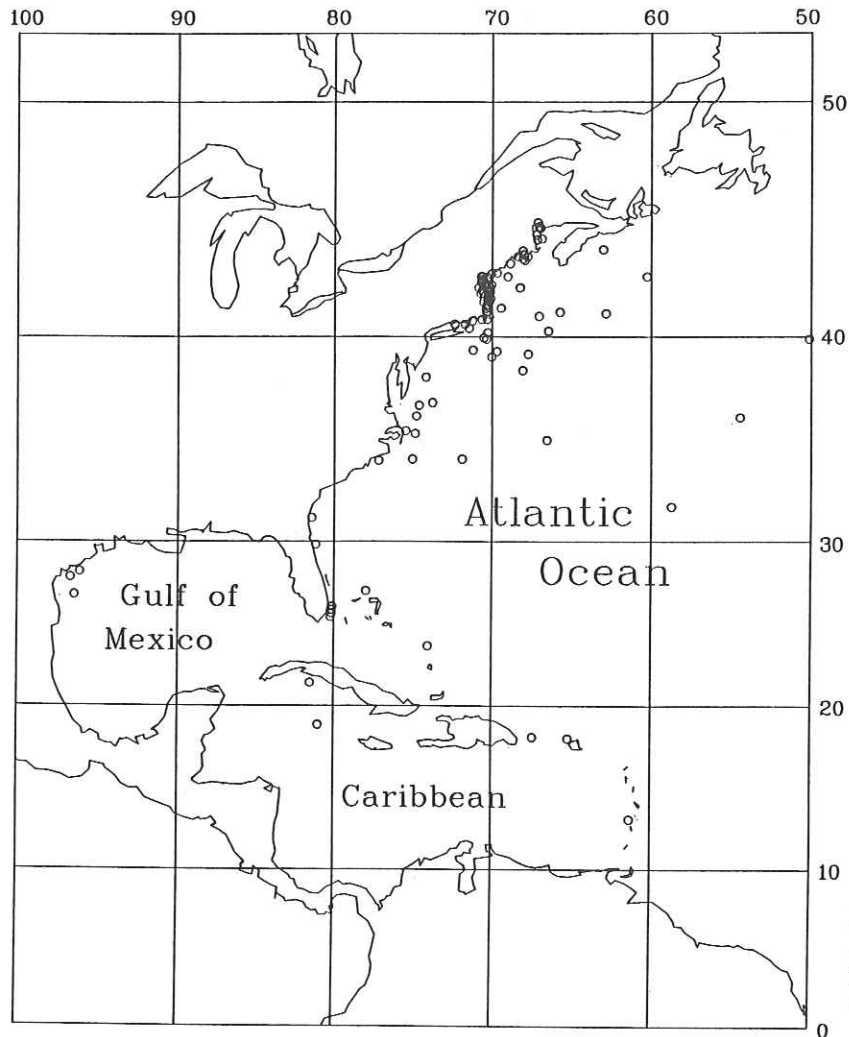


Fig. 1. Sightings of killer whales (*Orcinus orca*), Bay of Fundy to Equator, from published and unpublished sources. Each report is considered as one event.

It is not possible to estimate the size of our study area's killer whale population by summing different sightings; we have no way of knowing how many of the 177 sighting events included the same animal(s), because few animals were photographed for individual identification. Killer whales must be characterized as uncommon or rare in our study area. Despite intense, year-round effort, CETAP surveys produced only 12 sightings of killer whales during 1978–1981, representing only 0.1% of the 11,156 cetacean sighting events in that study; the approximately 85 killer whales

in those sightings made up only 0.05% of the 170,012 individual whales, dolphins and porpoises counted (CETAP 1982). The only available indication of (minimum) population size is the size of the largest herd seen at one time. Forty animals were seen together in the southern Gulf of Maine on September 5, 1979, and on August 14, 1986, two groups, totalling 29 animals, were seen in Massachusetts Bay. Those events provide the best current estimate (29–40) for the population visiting the northern portion of our study area. Herds of 25 killer whales near Puerto Rico (8 km SE of



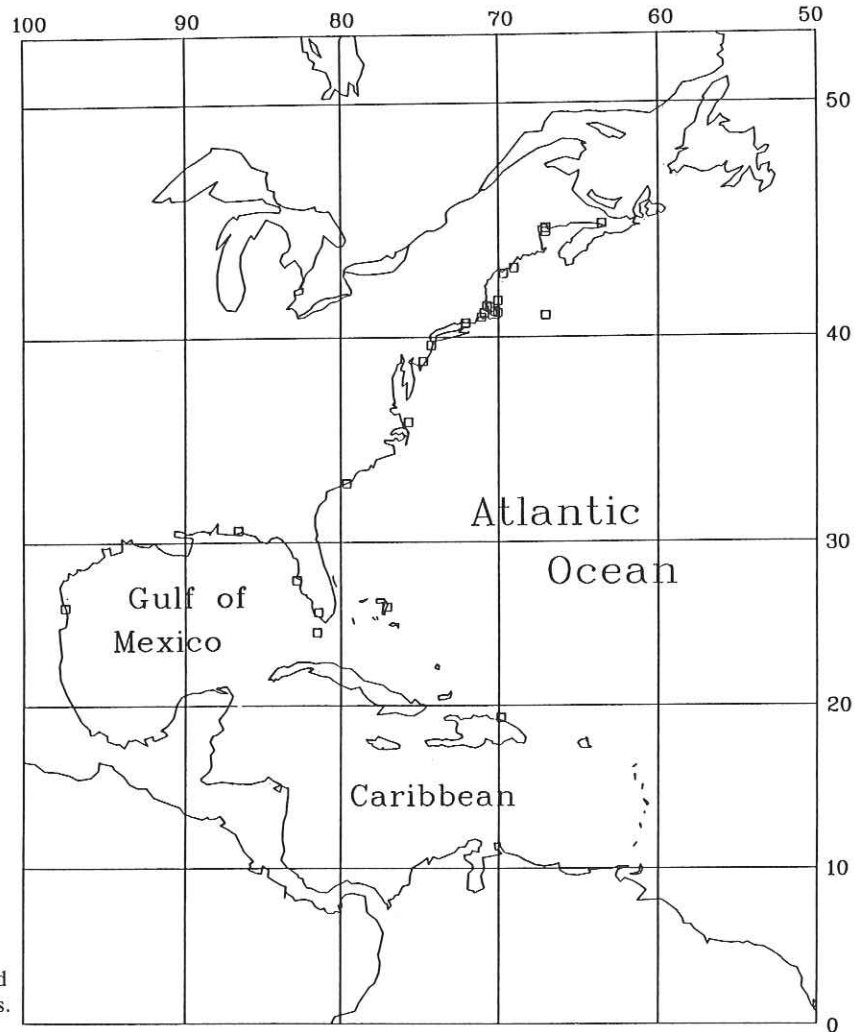


Fig. 2. Reported locations for strandings or floating carcasses of killer whales (*Orcinus orca*), Bay of Fundy to Equator, from published and unpublished sources.

Sightings of killer whales (*Orcinus orca*) in the Bay of Fundy to Equator, from published and unpublished sources. No report is considered a confirmed event.

by 0.05% of the population of dolphins and porpoises (Caldwell 1972). The only confirmed population of killer whales (100 km) population was first seen at one location together in the Gulf of Mexico on September 5, 1975. Two groups, totaling 100, were observed in Massachusetts Bay. The best current evidence is for a population visiting the area. Herds of 100 (8 km SE of

Culebra Island, 65°09'W, 18°13'W, February 23, no year listed by Erdman 1970) and 15 in the Gulf of Mexico (Event 166 in Appendix 1) provide minimum estimates for those two regions, respectively. At least 19 killer whales were present between 1967 and 1974 near St. Vincent Island in the lesser Antilles, since porpoise hunters killed that many (Caldwell and Caldwell 1975). It is not possible to evaluate possible overlap between any of these herds or individuals.

The latitudinal distribution of all sightings and strandings plotted by month (Fig. 5)

suggests a northward migration of killer whales into the latitude of Cape Cod Bay and Massachusetts Bay (about 42°N) beginning in May or June, with somewhat fewer sightings during the colder months. However, this pattern is not clear cut, as there are a few winter records of killer whales in the Gulf of Maine. Further indication of a seasonal or migratory population(s) of killer whales in the northern portion of the study area may be the presence of herds of animals in approximately the same area during approximately the same month of different years. Mayo (1982) reported that

local fisherman observed a group of 12–18 individuals in Cape Cod Bay and southern Stellwagen Bank for 5 to 10 days during the middle of August in 1976, 1977 and 1979. No photographs exist for these sightings, so it is not possible to say whether they represent a single pod.

Opportunistic photographs permitted the identification of one male and three subadults or females from our study area, and the movements of two of those individuals are consistent with the hypothesis that a small population moves through parts of the Hatteras-Fundy region seasonally. In the first case, a subadult or female was seen repeatedly between Provincetown, Massachusetts, and Eastport, Maine, during June to September, 1982 (Events 132–134, 136–140, 124, 144, 147, 155–161, see Appendix 1). The second whale, a male with a fist-size notch half way up the trailing edge of its dorsal fin, was seen in a pod of 7 animals on May 1, 1982, at 38°12'N, 74°13'W (Event 131) and four years later in a group of 3 on March 7, 1987, at 35°30'N, 75°30'W (Event 176). All photographs of killer whales were archived at Hubbs Marine Research Institute.

As Leatherwood and Dahlheim (1978) suggested, killer whales occur along the southeastern seaboard of the United States and in the West Indies. The records we summarize (Fig. 1, Appendix 1) suggest regular occurrence, probably year-round (Fig. 2), of killer whales south of about 35°N. Price (1982) and Brian Hoover (pers. comm., January 1987) reported the continued taking of killer whales as a secondary target species during recent years at St. Vincent, lesser Antilles. Fisherman from both the leeward and windward sides of St. Vincent who were shown a photograph of a killer whale said that this species was a common year-round visitor (Brian Hoover, pers. comm.), but Bequia whalers described it as rare and associated with deep, cool 40-fathom water to the west of that island (N. Ward, pers. comm.). Reports from fishermen should be interpreted cautiously, since some reported orca catches (and sightings) from the Grenadine Islands could, in fact, be

false killer whales, *Pseudorca crassidens* (N. Ward, pers. comm.).

Killer whales have been observed in the Gulf of Mexico (Caldwell and Caldwell 1973; Appendix 1, Fig. 1), but as Leatherwood and Dahlheim (1978) noted, their pattern of use of the Gulf is not clear. Killer whales have not been reported during any of the long-term studies on right whales, bottlenose dolphins, or humpback whales that have been conducted in the Gulf of Mexico, nor were they seen in 188 hours of aerial surveys conducted offshore in eastern Venezuelan waters (Giuseppe Notarbartolo di Sciara, in prep.). Failure to observe killer whales during recent aerial surveys (Fritts *et al.* 1983; NMFS, Southwest Fisheries Center, unpublished data) supports the hypothesis that the species is not common in Gulf of Mexico waters. Failure to observe killer whales in long-term coastal cetacean research projects at least indicates that killer whales do not come inshore in this area very often. The three previously unpublished opportunistic sightings reported below were well offshore. A herd (15–19) of killer whales was sighted and videotaped on August 27, 1985, 52 naut. miles east-northeast of Port Mansfield, Texas (Event 166, see Appendix 1). A single killer whale seen 5 days later (Event 167) could have been part of that group, as could individuals seen on approximately September 21, 1987, about 50 naut. miles offshore from Port Isabel, Texas (Tony Reisinger, pers. comm., Event 177). These sightings do not clarify whether the Gulf of Mexico is part of a territorial or migrational killer whale range.

More observational data from the U.S. southeast coast, Caribbean and Gulf of Mexico are needed before seasonal distribution can be discussed or any improved population estimates made. No photographs of living killer whales sufficient for individual identification of living animals have yet been obtained from any of these regions. We have not been able to identify any location within our overall study area where killer whales could be found with sufficient predictability to allow directed study. The abundance of killer whale

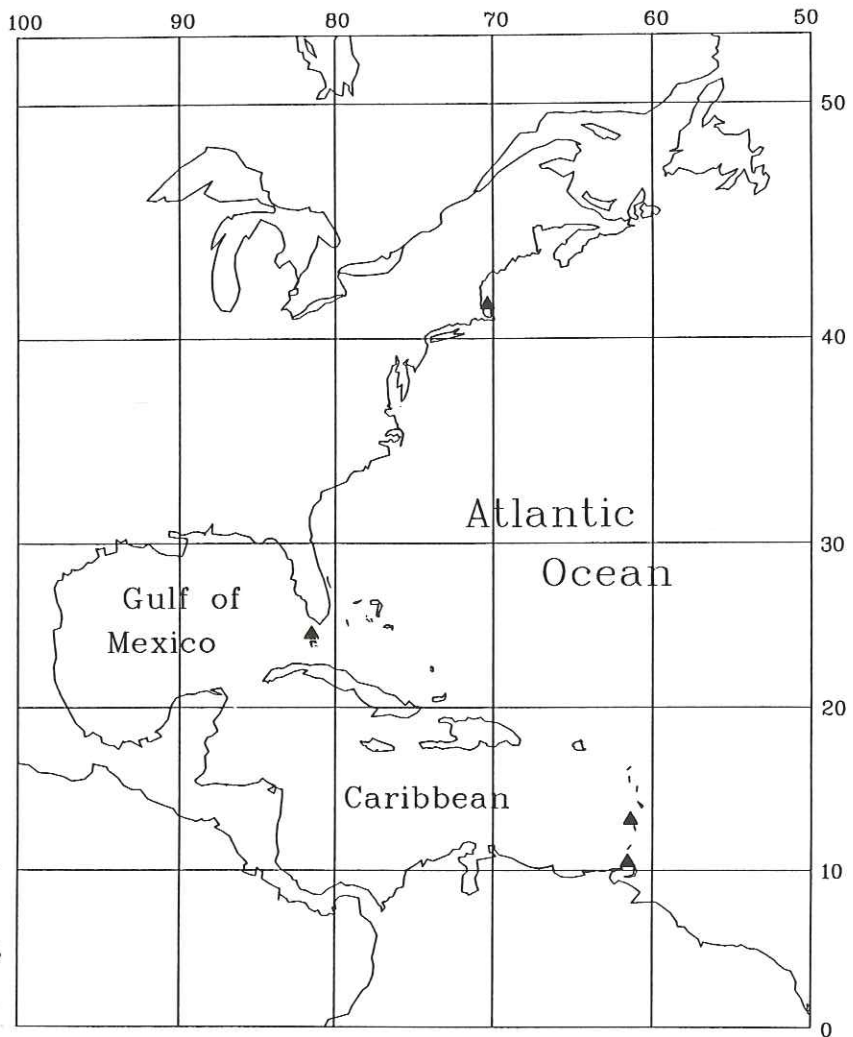


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Fig. 3. Fishery catch or intentional kill of killer whales (*Orcinus orca*), Bay of Fundy to Equator, from published and unpublished records.



sightings in the Gulf of Maine (Fig. 1) is certainly exaggerated by multiple sightings of the same individual during the summer of 1982 (see footnote to Event 132, Appendix 1). Those sightings are also responsible for the high number of killer whale sighting or stranding events in 1982 (Fig. 4). The frequency of killer whale reports in the Gulf of Maine may also be positively biased by unusually great observer effort during the warmer months and in locations where prey species such as schooling fish and baleen whales are most abundant. Nevertheless, fishing ledges in the southwest-

ern Gulf of Maine, such as Stellwagen Bank or Jeffrey's Ledge, do appear to offer the best opportunity for finding a herd of killer whales, even though such occasions might not occur every year and might be limited to August or September.

It seems likely that killer whale movements are linked to movements or changes in local abundance of prey populations, as has been suggested by Leatherwood *et al.* (1976), Prescott *et al.* (1979) and Winn *et al.* (1979). The following observational and circumstantial evidence bears on that hypothesis.

Killer whale sightings in the northern part of our study area increase when other cetaceans become common in spring and summer, but decrease after they leave. Mercer's (1985, unpubl. manus.) description of an attack on three finback whales by at least 24 killer whales in the southern Gulf of Maine (Event 101, see Appendix 1) and Clark's (1950) popular report of a killer whale feeding on a pod of pilot whales (*Globicephala* sp.) are the only accounts of predation on cetaceans along the U.S. east coast. The presence of killer whales sometimes helped concentrate pilot whales for the New England drive fishery (Goode 1884, pp. 17-18), although at other times they interfered by disrupting the herds. An attack by 25 killer whales on a larger whale at Culebra Island, near Puerto Rico, (Erdman 1970) suggests that wintering baleen whales may be eaten by killer whales in the southern part of our study area. Bequia whalers recounted an (undated) attack by a small group of (perhaps 5) orcas on a humpback calf accompanied by its mother. The killer whales breached repeatedly onto the calf, perhaps attempting to drown it (N. Ward, pers. comm.). Schevchenko's (1975) report that southern hemisphere killer whales feed on large whales more frequently in resource-limited temperate waters than in the more productive Antarctic region may be relevant to the southern portion of our study area, especially since it includes breeding grounds for both right whales (Kraus *et al.* 1987) and humpback whales (Katona 1986). Information from Canadian maritime waters adjacent to our study area also indicates that killer whales prey on baleen whales. Sergeant and Fisher (1957) hypothesized that killer whales in eastern Canadian waters migrated northwards in spring along the Newfoundland and Labrador coasts, following the migration of rorqual whales, then returned southward in autumn. Recent reports of killer whales attacking humpback whales on the Grand Bank (Whitehead and Glass 1985) and minke whales, *Balaenoptera acutorostrata*, in the Gulf of St. Lawrence (Wenzel and Sears 1988 - this volume) show that baleen whales might

be important diet items in eastern Canadian waters. We have no reason to question the accounts of predation noted above, but observers should interpret such incidents cautiously in view of Dolphin's (1987) finding that not all killer whale-humpback whale interactions observed in southeast Alaska were aggressive. The species ignored each other on some occasions, and in one case several humpbacks, including a mother, her calf and another small individual, joined with a pod of killer whales that was attacking a Stellar sea lion (*Eumatopias jubatus*).

One indication of the intensity of killer whale predation on baleen whales is the frequency of bites or toothmarks on their bodies. In cetaceans taken during Antarctic whaling, for example, parallel scars 3.0 to 3.8 cm apart, probably caused by killer whales, occurred most frequently on the flipper, flukes and, in the case of the fin whale, on the keel of the caudal peduncle and dorsal fin (Schevchenko 1975). Such scars occurred on 65.3% of sperm whales (*Physeter macrocephalus*), 53.4% of fin whales, 24.4% of sei whales (*Balaenoptera borealis*) and 6.4% of minke whales examined. Fresh signs of killer whale attacks on large whale species occurred only in temperate waters. Differences between the species led Schevchenko to hypothesize that nearly all minke whales fell victim to their attackers, but only young, old or sick sperm or fin whales died. Some sei whales may have been able to outrun their pursuers.

In comparison, within the western North Atlantic 14% (464 out of 3365) of the good quality photographs of humpback whale flukes that we examined for scarring possessed such parallel markings. Observed percentages of parallel-scarred humpbacks were higher than expected near Iceland (6/19, 32%), Newfoundland/Labrador (225/1405, 16%) and the Gulf of St. Lawrence (24/118, 20%), slightly lower than expected in Greenland (17/148, 11%) and the Gulf of Maine (57/493, 12%), and equal to expected in specimens from European waters (1/10, 10%). Similar parallel scars were seen in 8.7% (13 out of 149) of the fluke photographs of indi-



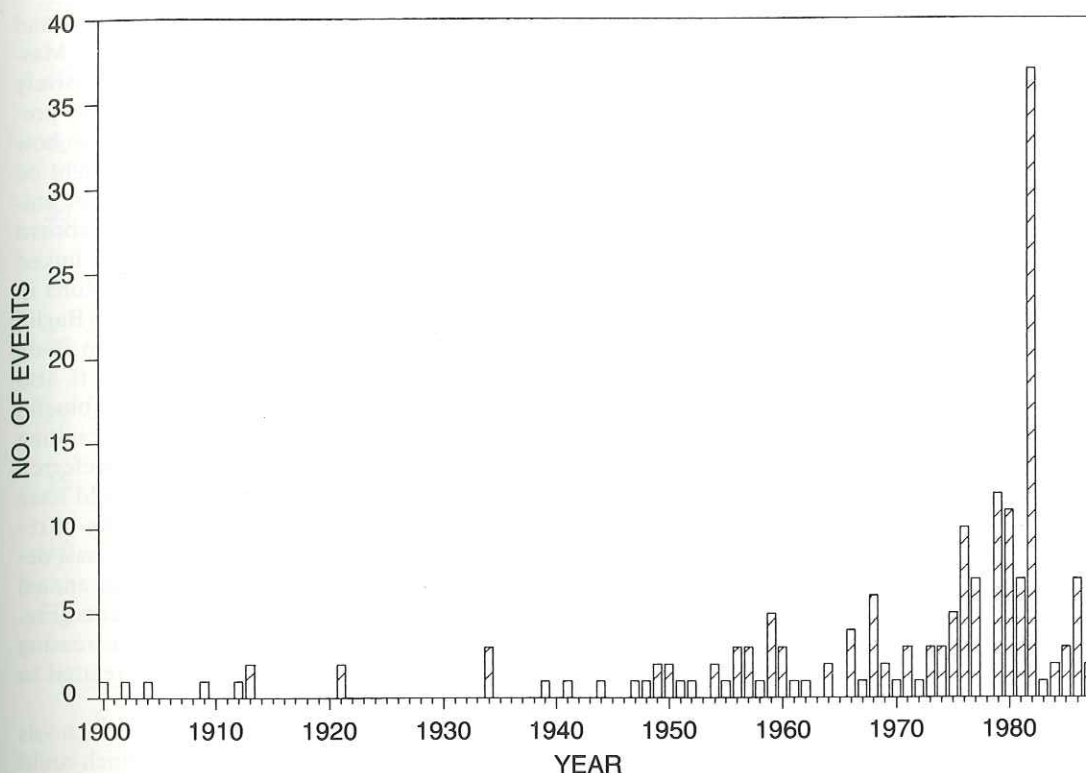


Fig. 4. Distribution of killer whale (*Orcinus orca*) sightings or strandings by year.

vidually identified right whales examined in the western North Atlantic (Scott Kraus, pers. comm.); about 1% of nearly 150 blue whales (*Balaenoptera musculus*) individually identified in the Gulf of St. Lawrence (Frederick Wenzel, unpubl. data); and about 1% of approximately 140 finback whales individually identified in the Gulf of Maine (Beverly Agler, pers. comm.).

Percentages of killer whale scarred individuals in species examined in the western North Atlantic is roughly correlated with the ranked tendency of these species to fluke up while diving (humpback > right >> blue = finback, Kenney and Winn 1987) and the consequent opportunity for photographing their flukes. Scarring percentages are also correlated with the amount of time spent by the various species in southern waters, as currently understood, perhaps reflecting migra-

tion to or through regions where killer whales were relatively abundant. Scarring percentages appear to be inversely related to adult size and swimming speed of the various species. Dolphin (1987) suggested that most scars are inflicted on young humpbacks, probably during migration when group size is low and defense compromised. This could help explain the high percentage of parallel-scarred flukes in Icelandic humpbacks, which must travel the greatest distance from their Antillean breeding range (Katona 1986).

Further analysis of killer whale scarring on large whales throughout the entire North Atlantic may yield more conclusive results. It should also be kept in mind that false killer whales, *Pseudorca crassidens*, or sharks could be responsible for some of the parallel scar marks found on large whales, as suggested by Dolphin (1987) and others.

Odontocetes may be important in the diet of killer whales in the southern portion of our study area, particularly after the large whales have migrated to northern feeding grounds. Killer whale stomachs from the southern coast of Japan contained remains of spotted dolphins (*Stenella* spp.) and pilot whales (Nishiwaki and Handa 1958); the year-round populations of spotted and spinner dolphins (*Stenella* sp.) and pilot whales found around St. Vincent (Caldwell *et al.* 1971b) might provide sufficient resources to sustain a resident population of killer whales.

Movements of killer whales in the Hatteras-Fundy region probably also respond to the migration and seasonal distribution patterns of non-cetacean prey species that they are known to consume in the Atlantic Ocean. These include the bluefin tuna, *Thunnus thynnus*, (Goode 1884; Mayo 1982; Leatherwood *et al.* 1976); herring, *Clupea harengus*, (Sigurjónsson 1984); and squid (Patricia Gerrior, NMFS- Foreign Fisheries Observer Program, pers. comm.).

Experienced tuna fishermen have described killer whale predation on bluefin tuna in Cape Cod Bay (C. A. Mayo, Sr., pers. comm.; Mayo 1982). Bluefin tuna are migratory and it is possible that killer whales follow them. Between February and June, large bluefin tuna (136+ kg) spawn in the Gulf of Mexico and the Florida Straits (Rivas 1978; Baglin 1982). They are most plentiful around Jamaica in March and April, appearing on the Bahamian side of the Florida Straits in the first or second week of May (Bigelow and Schroeder 1953). They arrive off New Jersey, Long Island, southern New England and Cape Cod Bay in June, then move into the Gulf of Maine and appear along the southeastern part of the Newfoundland coast in mid- to late July (Bigelow and Schroeder 1953). Large bluefin tuna remain in these waters until October, then move south to the Caribbean Sea, whereas small (32 kg) and medium-sized (32–136 kg) bluefin stay mainly off the continental shelf between Cape Hatteras and Cape Cod (Rivas 1978). The timing of tuna migration is somewhat variable, since it depends partly on

oceanic currents and weather conditions and prey distribution. Cape Cod and Massachusetts Bays are the only areas extensively searched for whales while tuna are also present, so it is not yet possible to know how closely movements of killer whales might be linked with this species. Movements of animals along the U.S. southeastern seaboard and in the Gulf of Mexico could also be linked to spawning and migration of bluefin tuna in the Florida Straits or Gulf of Mexico (Baglin 1982). The period of greatest cetacean study effort in our area (1975 to present) is also characterized by substantially reduced bluefin tuna catches (Baglin 1982), perhaps resulting from overfishing. If bluefin tuna is a preferred prey of killer whales, this decline could have affected the distribution and frequency of recent orca sightings. Nevertheless, the past decade has not shown a decline in total annual killer whale sighting or stranding events (Fig. 4), probably resulting mainly from increasing cetacean study effort, but perhaps related to increased availability of other prey.

Migrating tuna prey extensively on schools of mackerel (*Scomber scombrus*), which could also be taken by killer whales, as was probably the case for a young killer whale observed among mackerel schools and around boats fishing for mackerel in June, 1982, 4 naut. miles off Hampton Beach, New Hampshire.

The long-finned squid (*Loligo pealei*) and the short-finned squid (*Illex illecebrosus*) are of commercial importance off the northeastern United States (Lange and Johnson 1981) and may be taken by killer whales on occasion. A single killer whale was observed offshore from Long Island, New York, on March 22, 1986, feeding on squid overflowing from the nets of a Spanish purse-seiner (Patricia Gerrior, NMFS Northeast Foreign Fisheries Observer Program, pers. comm.). This was the only reported interaction between killer whales and fisheries in our study area. Long-finned squid are abundant from Cape Cod to the Baltimore Canyon and short-finned squid from Newfoundland to the Baltimore Canyon (Lange and Johnson 1981). Large-scale cetacean surveys by CETAP and



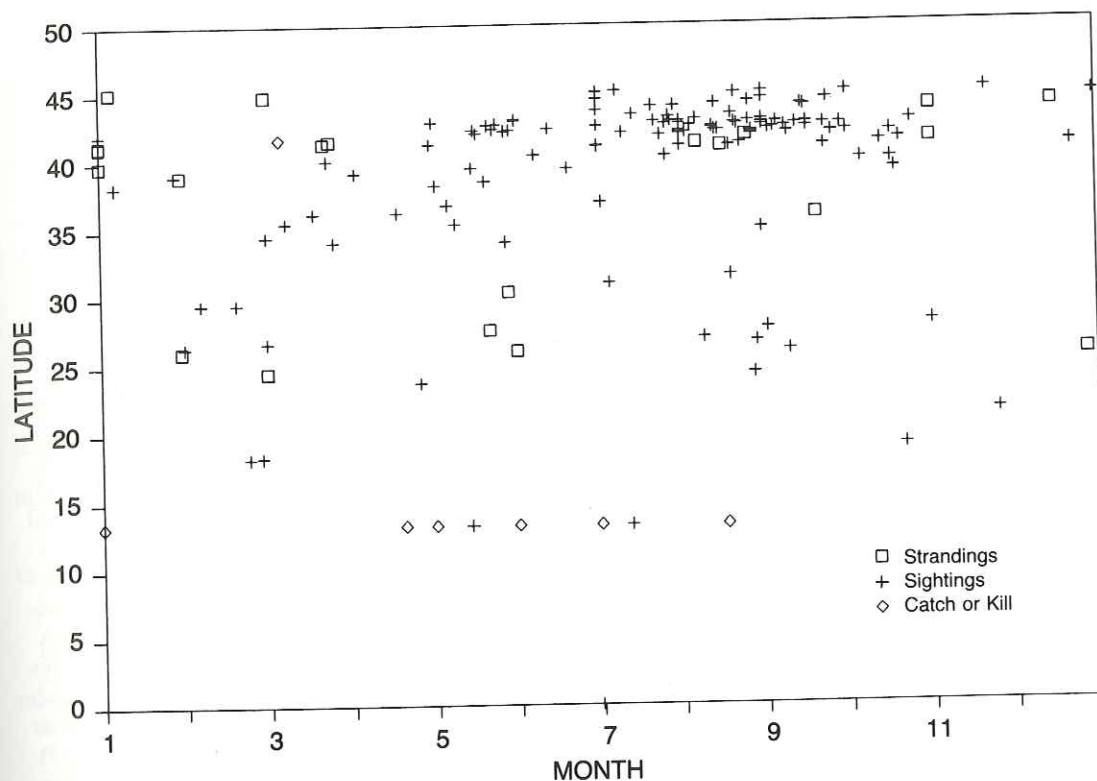


Fig. 5. Latitudinal distribution of killer whale (*Orcinus orca*) sightings or strandings by month.

the NMFS marine observer program covered some of this area at times when squid was probably present, judging from the presence of the predominantly teuthophagous *Globicephala melaena*, but no relationship between killer whales and squid was noted.

Herring (*Clupea harengus*), an important killer whale prey item in Icelandic waters (Sigurjónsson 1984), is seasonally abundant in coastal waters from Virginia to Nova Scotia, appearing in shallow water (less than 50 m) while spawning from late summer to late autumn (Boyar *et al.* 1973) at three important locations: Georges Bank-Nantucket Shoals; Jeffreys Ledge in the southwestern Gulf of Maine; and southwestern Nova Scotia (Cucci 1981). Three killer whales were seen on Jeffreys Ledge in September, 1982 (Event 154, see Appendix 1), when spawning herring would have been present. Killer whales have not been reported associated with herring

schools during at least four summers of observations in southwestern Nova Scotia (Carl Haycock, pers. comm.), but the same whale that had apparently been eating mackerel in June, 1982, (Event 138) was observed in Head Harbor Passage, New Brunswick, Canada, on August 20, 1982 with herring in its mouth (P. Turnbull, pers. comm., Event 151). A single large male killer whale seen near Cutler, Maine, from November through December, 1975, may have been eating herring, since schools of large herring were reported to be present. Further study is needed to learn the extent to which killer whales use this abundant food source.

Caldwell and Caldwell (1969) found remains of the leatherback sea turtle (*Dermochelys coriacea*) in the stomachs of 3 killer whales taken in the fishery at St. Vincent, Grenadine Islands.

If killer whales utilize all of the above prey

species and perhaps others within our study area, it is not clear why they are not more frequently reported from some areas where prey species are notably abundant seasonally, such as the Bay of Fundy, Great South Channel, or Georges Bank (Winn *et al.* 1987). Possible explanations might be relatively low observer effort or small size of the killer whale population in our study area.

### CONCLUSIONS

Variations in effort confound our ability to make any conclusive statements about the seasonality or population size of killer whales in this area. The data suggest that killer whales seasonally inhabit the U.S. eastern seaboard, but it is not yet possible to say whether they make regular latitudinal migrations along the coast during the course of a year or whether they regularly move onshore-offshore. A year-round population may exist south of about 35°N, particularly in the eastern Caribbean. No locations were identified where long-term behavioural study of individual pods could be accomplished easily. No meaningful estimate of the number of killer whales present in the study area during any one year is possible, owing to poor coverage of offshore waters, duplication of sighting reports, and inability to identify individual animals. The largest pod reported contained at least 40 animals and occurred in the southern Gulf of Maine. Observations or circumstantial evidence indicate that killer whales eat baleen whales, other odontocetes, bluefin tuna, schooling fishes, squid, and marine turtles in our study area, but it is not yet possible to evaluate the relative importance of those items to their diet. Ambiguities in existing data lead us to suggest that none of the methods that have provided information to date: stranding programmes, opportunistic sightings from whalewatch tours, shipboard surveys dedicated to other research, or randomized shipboard or aerial surveys are suitable for investigations of killer whales in this study area. Methods designed for a small, scattered or migratory population, possibly

with an important component far offshore, are needed for significant gains in understanding.

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## APPENDIX 1

*Sighting and stranding records of killer whales (Orcinus orca) from the Bay of Fundy to the Equator. The Event No. corresponds to a point plotted on Fig. 1. 12-18 means between 12 and 18 whales were seen swimming together. 12/18 means that 1 group of 12 animals and 1 group of 18 animals were seen at this time and location. See also footnote.*

Event	Date	Location	Lat. (N)	Long. (W)	No.	Source	Comments
1s	Jan 1817	Nantucket	(41°15')	(70°00')	1	MMEP <sup>a</sup>	
2	Jul 1867	C Elizabeth, ME	(43°40')	(70°00')	2	Norton (1930)	"In a terrific battle w/ a swordfish"
3c	1871	Samana Peninsula	(19°25')	(69°50')	1	Rodriguez-Demorizi (1960)	
4	01 Jul 1896	46 naut. miles SE Norfolk Canyon	36°55'	73°49'	2+	C. Read (pers. comm.)	
5c	1900	Trinidad	(10°40')	(61°30')	1	di Sciara (in prep.)	Early 1900's; young female
6s	27 Mar 1902	Eastport, ME	(44°50')	(67°00')	1	MMEP; True (1904)	In Passamaquoddy Bay for several weeks
7s	14 Nov 1904	Harpwell, ME	(43°50')	(70°00')	1	MMEP; Norton (1930)	25'
8s	Jan 1909	Barnegat, NJ	39°45'	74°15'	1	MMEP; True (1909)	
9s	1912	Bulls Island, SC	32°50'	79°35'	1	Caldwell & Golley (1965); MMEP no. CMO37.58	Skull obtained from local resident
10	08 Aug 1913	S of Grand Bahama Is	26°54'	(78°00')	Sev.	Murphy (1947)	
11	18 Aug 1913	300 naut. miles E. Bermuda	31°31'	58°40'		Murphy (1947)	
12c	1921	off Florida Keys	(24°30')	(81°30')	1	MMEP no. STR04968	Juvenile captured in the Gulf Stream
13s	26 Dec 1921	Holloway Creek, FL	(25°41')	(81°26')	1	Moore (1953); SEAN; MMEP no. 00238119	Tooth only found near Everglades
14	1934	Hollywood, FL	(26°00')	(80°00')	1	MMEP no. STR00671	30', photos, attempted capture
15	Mar 1934	Palm Beach, FL	(26°40')	(80°00')	2	MMEP no. STR00672	Sighted several times in Gulf Stream
16	Mar 1934	New River Inlet, NC	(34°30')	(77°30')	1	Caldwell & Golley (1965); SEAN	
17	1939	W edge Gulf Stream	26°32'	(79°55')	1?	MMEP no. STR00674	
18s	27 Jan 1941	Cape May, NJ	(39°00')	(74°45')	1	MMEP; Ulmer (1941)	
19s	Jan 1944	Orient, NY	41°10'	72°20'	1	MMEP no. STR01033	Stranded alive
20	Feb 1947	Boca Raton, FL	26°20'	80°00'	3	MMEP no. STR00676	
21s	Mar 1948	Summerland Key	(24°30')	(81°30')	1	Moore (1953); SEAN; MMEP	
22c	05 Mar 1949	Hyannis, MA	(41°40')	(70°20')	1	Waters & Rivard (1962)	Killed in Lewis Bay
23	Aug 1949	Off Provincetown, MA	(42°10')	(70°15')	Pack	Waters & Rivard (1962)	Sighted offshore
24	Jan 1950	Cape Cod Bay	(42°00')	(70°10')	?	MMEP no. STR01949	Mentioned in Delphinus stranding report
25s	04 Jan 1950	Minas Basin, NS	45°10'	63°30'	1	Sergeant & Fisher (1957)	
26	Nov 1951	35 naut. miles SE Pt Aransas	(28°00')	(96°00')	1	Gunter (1954)	
27	19 Feb 1952	St Augustine, FL	29°30'	81°10'	6-8	MMEP; Layne (1965)	
28s	1954	Nantucket, MA	41°15'	70°00'	?	MMEP no. UM102494	
29s	23 Mar 1954	Mashpee, MA	41°30'	70°30'	1	MMEP no. 2626; T. Ramage (pers. comm.)	9', live stranding, towed to sea next day
30s	21 Mar 1955	Nantucket, MA	(41°20')	(70°10')	1	Little & Andrews (1982)	
31s	1956	Falmouth, MA	(41°35')	(70°40')	1	Waters & Rivard (1962)	Stranded on Waquoit Beach
32s	27 May 1956	East Pass, FL	(30°20')	(86°30')	1	MMEP; Caldwell <i>et al.</i> (1956)	
33s	Dec 1956	Narragansett, RI	(41°25')	(71°30')	1	Waters & Rivard (1962)	Washed ashore dead
34s	1957	Bay of Fundy	(45°00')	(67°00')	1	Sergeant & Fisher (1957)	
35	07 Jun 1957	SE of Georges Bank	40°24'	66°22'	3	WHOI	
36s	14 Dec 1957	Tenants Harbor, ME	(44°00')	(69°15')	1	MMEP; Mairs & Scattergood (1959)	

## Appendix 1 (continued)

Event	Date	Location	Lat. (N)	Long. (W)	No.	Source	Comments
37	Jul 1958	Montauk Point, NY	(41°00')	(71°45')	1	MMEP no. STR01034; CETAP MMEP described a large male no. HO99480-1	
38	23 Jul 1959	Cape Cod Bay	41°50'	70°15'		Schevill (pers. comm.)	
39	01 Aug 1959	Cape Cod Bay	41°55'	70°15'	?	WHOI	
40	02 Aug 1959	Cape Cod Bay	41°60'	70°15'		Schevill (pers. comm.)	
41	04 Aug 1959	N end Stellwagen	(42°30')	(70°25')	?	WHOI; Schevill (pers. comm.)	
42	18 Aug 1959	25 naut. miles SSE Nomans Land	41°00'	70°20'	2	WHOI; Schevill (pers. comm.)	Seen August 18-21
43	06 Feb 1960	Marineland, FL	(29°30')	(81°10')	1	Layne (1965)	0.5 naut. miles offshore
44s	Jun 1960	Gt Abaco Island	(26°00')	(77°00')	1	Backus (1961)	20'; stranded alive, many wounds, sharks
45	21 Dec 1960	80 naut. miles S Marthas Vineyard	(41°00')	(70°35')	?	WHOI	Good recordings
46	31 Aug 1961	150 naut. miles NNW Bermuda	35°00'	66°30'	?	WHOI	
47	22 Aug 1962	W of Nantucket Island	41°15'	70°20'	1	WHOI	
48	25 Aug 1964	S of Isle of Shoals	42°50'	70°40'	?	WHOI	
49	26 Aug 1964	Cape Cod Bay	41°57'	70°15'	?	WHOI	
50*	Jul 1966	Bay of Fundy	(45°00')	(67°00')	4	Neave & Wright (1968)	
51*	Sep 1966	Bay of Fundy	(45°00')	(67°00')	1	Neave & Wright (1968)	
52	09 Sep 1966	Cape Cod Bay	(42°00')	(70°10')	3	Greenbrier Nature Center (pers. comm.)	1 male, 2 females
53	Oct 1966	Bay of Fundy	(45°00')	(67°00')	3	Neave & Wright (1968)	
54	14 Sep 1967	Emerald Basin	44°02'	63°00'	1	Sutcliffe & Brodie (1977)	
55	25 Apr 1968	E of Bahamas	23°42'	74°00'	6	CETAP	
56	29 Apr 1968	45 naut. miles SE Halifax	41°12'	62°47'	?	GMWSN; CETAP	
57c	May 1968	St Vincent	(13°15')	(61°20')	3	Caldwell & Caldwell (1975)	
58	13 May 1968	St Vincent	(13°15')	(61°15')	6	Caldwell <i>et al.</i> (1971a)	2 females and 1 juvenile male taken from pod of 6
59	04 Jul 1968	St Andrews Sound, GA	30°59'	81°23'	1	H. Neuhauser (pers. comm.)	Year poss 1966 or 1967
60	11 Jul 1968	St Vincent	(13°15')	(61°15')	8	Caldwell <i>et al.</i> (1971b)	3 (incl. 1 6m male) taken from pod of 8
61s	29 Jan 1969	S Padre Is	(26°00')	(97°20')	2	Gunter (1954)	No specimen
62c	04 Jun 1969	St Vincent	(13°15')	(61°20')	4	Caldwell <i>et al.</i> (1971b)	
63	23 Feb 1970	Virgin Islands	18°13'	65°09'	25	Erdman (1970)	Attacking a large whale
64	1971	Cutler Harbor, ME	44°39'	67°10'	1	GMWSN no. 75250	Very large, came close to boats
65c	May 1971	St Vincent	(13°15')	(61°20')	3	Caldwell & Caldwell (1975)	
66c	Jul 1971	St Vincent	(13°15')	(61°20')	9	Caldwell & Caldwell (1975)	
67c	Jun 1972	St Vincent	(13°15')	(61°20')	1	Caldwell & Caldwell (1975)	
68c	Jan 1973	St Vincent	(13°15')	(61°20')	1	Caldwell & Caldwell (1975)	
69	17 Mar 1973	Oceanic	36°10'	54°24'	3-4	GMWSN	
70	02 Apr 1973	55 naut. miles S Atlantis Canyon	39°10'	70°00'	10-12	WHOI	
71c	May 1974	St Vincent	(13°15')	(61°20')	1	Caldwell & Caldwell (1975)	
72	summer 1974	Isle Shoals	42°59'	70°36'	1	GMWSN no. 74158	
73s	19 Sep 1974	Red Devil Hills, NC	(36°00')	(75°40')	1	MMEP	
74	21 Jul 1975	5 naut. miles S Isle Shoals	42°51'	70°34'	10-20	GMWSN no. 75083; CETAP	
75	27 Jul 1975	Mid-GOM	42°50'	60°15'	8-10	GMWSN; CETAP	Sighted July 27-28
76	28 Jul 1975	Mt Desert Rock	43°58'	68°05'	1	GMWSN	
77	15 Sep 1975	Mt Desert Rock	43°58'	68°05'	1	CETAP; GMWSN no. 75215	30' male, with 5 "blackfish"
78	31 Dec 1975	Cutler Harbor	44°39'	67°10'	1	GMWSN no. 75250; CETAP no. HO75551-258	In area 3 months, see event no. 77



## Appendix 1 (continued)

Event	Date	Location	Lat. (N)	Long. (W)	No.	Source	Comments	
described a large male	79	winter 1976	Bakers Island	44°15'	68°12'	1	GMWSN no. 76574; CETAP	"In" lobster trap, winter 76; unverified
	80	Aug 1976	Cape Cod Bay	(42°00')	(70°15')	12-18	Mayo (1982)	In area 5-10 days; reported by fishermen
	81	20 Aug 1976	Halibut Pt	42° 42'	70°38'	30	CETAP; GMWSN no. 76421; MMEP	2 mating
ust 18-21	82	21 Aug 1976	Gloucester breakwater	42°35'	70°38'	6	CETAP; GMWSN no. 76427	Males
miles offshore	83	26 Aug 1976	Cape Cod	42°03'	70°11'	10+	CETAP; GMWSN; MMEP	
ed alive, many	84	08 Sep 1976	N end Stellwagen	42°25'	70°25'	10-30	CETAP; GMWSN no. 76477; MMEP	10-30 orcas September 9-12, Race Pt-Stellwagen
harks	85	12 Sep 1976	Gloucester	42°37'	70°41'	5+	GMWSN no. 76478; MMEP	
ordings	86	16 Sep 1976	Graves Light, Boston	42°22'	70°53'	1	CETAP; MMEP	
	87	22 Sep 1976	Gloucester Harbor	42°37'	70°41'	5-6	MMEP	
	88	28 Sep 1976	Off Gloucester	42°37'	70°41'	sm gp	MMEP	Sighted September 8-12
	89	Aug 1977	S end Stellwagen	(42°10')	(70°15')	12-18	Mayo (1982)	In area 5-10 days
	90	Aug 1977	Mattituck, NY (LIS)	(41°00')	(72°30')	1+	MMEP no. STR02631	Reported by fishermen; bluefish in area
	91s	24 Aug 1977	Orleans, MA	41°47'	69°58'	2	MMEP no. SEAN 2332	1 cow/calf; stranded, pushed out, restranded
	92	26 Aug 1977	Stellwagen Bank	(24°20')	(70°15')	20-30	C. Haycock (pers. comm.), GMWSN no. 82024	Seen August 26-27
emales	93	26 Aug 1977	Near Brewster	(41°48')	(70°15')	25	Sealand of Cape Cod	1 cow/calf; report by fisherman
	94	26 Aug 1977	N Barnstable Harbor	41°48'	70°15'	2	CETAP; GMWSN no. 77687; WHOI	
	95	12 Oct 1977	Corsair Canyon	41°17'	66°08'	?	WHOI	Heard only; good recordings
	96	24 Mar 1979	E of VA/NC border	34°05'	71°52'	1	CETAP	
	97s	20 May 1979	Tampa Bay	27°32'	82°46'	1	MMEP	Dead; caught in haul seine
and 1 juvenile male	98	Jul 1979	SE of Georges Bank	41°05'	67°00'	4-6	CETAP	
n pod of 6	99	25 Jul 1979	S of Nantucket	40°19'	70°15'	6	CETAP	
1966 or 1967	100	Aug 1979	Ipswich Bay	(42°50')	(70°35')	1+2	B. Neelon, (pers. comm.)	Two sightings over the course of summer
m male) taken	101	Aug 1979	Halibut Pt	(42°40')	(70°30')	12-30	Mayo (1982)	In area 5-10 days; attacked 3 finbacks
of 8	102	06 Aug 1979	2 naut. miles E Isle Shoals	42°59'	70°34'	1	GMWSN no. 79769	Feeding on tuna
en	103	Sep 1979	Halibut Pt	42°42'	70°39'	24	Mercer (1985)	
a large whale	104	05 Sep 1979	Ipswich Bay	42°43'	70°37'	40	GMWSN no. 79602	With calves; feeding, tuna present
, came close to boats	105	15 Sep 1979	3 naut. miles E Mt Desert Rock	43°58'	68°05'	1	GMWSN	
	106	16 Sep 1979	Halibut Pt	42°42'	70°38'	2+	GMWSN no. 79767	Unspecified lg no. attacking small humpback
	107	19 Oct 1979	Great South Channel	41°25'	69°24'	1	CETAP	
	108	28 Feb 1980	Mona Passage	18°18'	67°20'	7-9	K. Balcomb (pers. comm.)	
	109	17 Apr 1980	51 naut. miles S Norfolk Canyon	36°15'	74°46'	4	CETAP; MBO	1 male, 3 others
	110	05 May 1980	19 naut. miles S Norfolk Canyon	36°46'	74°38'	5	T. Ramage (pers. comm.)	
ly 27-28	111	08 May 1980	30 naut. miles NE Cape Hatteras	35°22'	74°54'	1	CETAP	
with 5 "blackfish"	112	14 May 1980	Mouth Block Canyon	39°29'	71°13'	1	CETAP	
months, see event	113	19 May 1980	SE of Georges Bank	38°30'	68°00'	4+	K. Balcomb (pers. comm.)	1 solo, 1 w/ sev. females or subadults

## Appendix 1 (continued)

Event	Date	Location	Lat. (N)	Long. (W)	No.	Source	Comments
114	Jul 1980	Stellwagen Bank	(42°30')	(70°20')	5+	T. Rumage (pers. comm.)	
115	26 Jul 1980	Stellwagen Bank	(43°10')	(70°30')	1	T. Rumage (pers. comm.)	
116	19 Aug 1980	Off C Porpoise, ME	43°21'	70°25'	1	GMWSN no. 80101	
117	Sep 1980	Machias, ME	(44°30')	(67°30')	4	T. Rumage (pers. comm.)	
118	16 Oct 1980	160 naut. miles S Grand Bank	(40°00')	(50°00')	2	T. Rumage (pers. comm.)	
119	23 May 1981	Gloucester, MA	(42°40')	(70°30')	1	T. Rumage (pers. comm.)	
120	26 May 1981	Hatteras Inlet, NC	34°03'	75°03'	3	MMEP no. 00038	Male (28'), female (22'), and calf (6')
121	19 Jun 1981	38 naut. miles S Veatch Canyon	39°24'	69°41'	1	CETAP	
122	Jul 1981	Grand Manan, NB	(44°30')	(66°50')	1	T. Rumage (pers. comm.)	
123	22 Sep 1981	SE of Block Island	41°03'	71°25'	20+	CETAP	
124	05 Oct 1981	S of Marthas Vineyard	40°01'	70°2'	1	CETAP	
125	17 Oct 1981	35 naut. miles S Bear Seamount	39°18'	67°40'	2-4	T. Rumage (pers. comm.)	
126	1982	Head Hbr, NB	44°57'	66°54'	4	B. McInnis (pers. comm.)	One week prior to next event with lone female
127	1982	Mortons Ledge	44°55'	66°58'	1	B. McInnis (pers. comm.)	F, lots of fish, seen next day Coffins Ledge
128	05 Jan 1982	Ocean City, MD	38°12'	74°13'	7	MMEP no. SEAN7634	5 females (18-20'), 2 males (28')
129c	19 Apr 1982	St Vincent	(13°15')	(61°20')	1	Price (1982)	Female chasing fish
130	May 1982	Cashes Ledge	42°50'	69°00'	2	J. Tripp (pers. comm.)	4-5' dorsal fins, breaching,
131	01 May 1982	38 naut. miles E Ocean City NJ	38°12'	74°13'	7	R. Naveen (pers. comm.); MMEP	Photos; 1 male, 3 female
132**	15 May 1982	Stellwagen Bank	(42°15')	(70°10')	1	Katona <i>et al.</i> (1973)	Breach photo
133	16 May 1982	S Stellwagen	(42°00')	(70°10')	1	C. Read (pers. comm.)	Sighted from May-Nov; see note
134	22 May 1982	Graves Light, Boston	42°18'	71°01'	1	MMEP no. SEAN7604	In area May 21-June 1
135	26 May 1982	Gloucester	42°35'	70°40'	2	M. Weinrich (pers. comm.)	1 of these sighted freq. in Gulf of Maine in '82
136	26 May 1982	15 km off Race Pt	42°09'	70°25'	1	MMEP	
137	28 May 1982	Hingham, MA	42°15'	70°53'	1	Quincy Patriot Ledger	Circling, followed fish schools
138	Jun 1982	4 naut. miles off Hampton Beach	42°55'	70°38'	1	Mercer (1985)	Young female feeding on mackerel
139	Jun 1982	Isle of Shoals	(43°00')	(70°35')	1		Swimming with whitesided dolphins
140	12 Jun 1982	Seal Harbor, ME	(42°20')	(68°15')	1	Katona (1983)	Photos by Bowman and Marion
141	29 Jun 1982	40 naut. miles SE Montauk	40°32'	71°29'	3	S. Sadove (pers. comm.)	
142	07 Jul 1982	Colson's Cove, NB	45°05'	67°04'	1	A. Abbott to R. Reeves (pers. comm.)	Followed boat, curious
143	13 Jul 1982	E of Jeffreys Ledge	(68°30')	(43°20')	8	G. Gormley (pers. comm.)	Secondhand report from S. Mercer
144	20 Jul 1982	Tenants Harbor, ME	43°58'	69°11'	1	A. Fuller (pers. comm.),	Curious, circled boats
145	12 Aug 1982	Stellwagen	42°25'	70°10'	10/20	CCS	2 pods, incl cow/calf
146	12 Aug 1982	Stellwagen	42°20'	70°05'	2/3	CCS	
147	13 Aug 1982	Long Island-Swan Island, ME	44°08'	68°22'	1	S. Grierson (pers. comm.)	Rope from lobster gear thru mouth, released
148	13 Aug 1982	Stellwagen	42°10'	70°05'	15/20	CCS	
149c	16 Aug 1982	St Vincent	(13°15')	(61°20')	2	Price (1982)	8m female with 4m calf, nursing, with teeth



## Appendix 1 (continued)

Event	Date	Location	Lat. (N)	Long. (W)	No.	Source	Comments
150	20 Aug 1982	Lubec, ME	44°53'	67°01'	1	S. Kraus (pers. comm.)	
151	20 Aug 1982	Head Harbor Passage, NB (44°55')	(66°55')		1	NEA	Female?, small dorsal fin; photos
152	25 Aug 1982	Bear Island-Suttons Island	44°17'	68°16'	1	R. Bowman (pers. comm.)	
153	Sep 1982	Stellwagen	42°30'	70°00'	24	Mercer (1985)	
154	Sep 1982	Jeffreys Ledge	42°55'	70°10'	3	Mercer (1985)	Mid-September
155	02 Sep 1982	Hingham, MA	42°15'	70°53'	1	Quincy Patriot Ledger	Circled around boat
156	04 Sep 1982	Boston Harbor	42°20'	71°01'	1	S. Kraus (pers. comm.)	Next to New England Aquarium Discovery Barge
157	23 Sep 1982	Frenchman's Bay, ME	44°26'	68°12'	1	Mrs. B. Jones (pers. comm.), GMWSN no. 82025	Followed boat, fed it lobster bait
158	25 Sep 1982	Provincetown Harbor	(42°00')	(70°10')	1	WHOI	Young; has been in harbor 1 week
159	Oct 1982	Provincetown Harbor, MA	42°05'	70°10'	1	Provincetown Harbor Master	Visitor describes patting a gentle whale
160	16 Oct 1982	Provincetown	42°02'	70°14'	1	T. Ramage (pers. comm.)	October 16-17, photographs of teeth
161	20 Nov 1982	Dipper Harbor, NB	(45°05')	(67°04')	1	B. Scott (pers. comm.)	Followed boat, "friendly"
162	24 Nov 1982	Vero Beach, FL	(21°30')	(81°30')	4	MMEP	
163	1983	Near Hampton Shoal Light	(42°50')	(70°40')	1	NE Whale Watch	
164	09 Jul 1984	Cape Cod Bay	42°00'	70°10'	2	CCS	
165	15 Aug 1984	Georges Bank	(41°00')	(67°00')	1	R/V Hatteras, Duke University	
166	27 Aug 1985	52 naut. miles ENE Pt Mansfield	26°40'	96°19'	15	T. Amos (pers. comm.)	3-4 males; large pod; videotaped
167	01 Sep 1985	27 naut. miles off Pt Aransas	27°39'	96°34'	1	T. Amos (pers. comm.)	1 male, 20'
168	23 Oct 1985	Jeffreys Ledge	42°50'	70°22'		Mercer (1985)	
169	22 Mar 1986	Long Island, NY	40°04'	70°31'	1	NMFS	Male, 18', feeding on squid from nets
170	25 Jul 1986	Gloucester Harbor	42°40'	70°40'	1	M. Weinrich (pers. comm.)	Juvenile, 12-14'
171s	06 Aug 1986	Nomans Land Island, MA	41°15'	70°50'	1	MMEP	
172	14 Aug 1986	Stellwagen	42°10'	70°00'	12/17	CCS	Breaching, traveling
173	14 Aug 1986	Stellwagen	42°10'	70°05'	7/9	CCS	Breaching, traveling
174	26 Aug 1986	Stellwagen	42°05'	70°20'	7/7	CCS	Sited over 7 hrs
175	20 Oct 1986	Grand Cayman Island	(19°00')	(81°00')	8-9	A. Zigler (pers. comm.)	1 male, 1 calf
176	07 Mar 1987	N of Cape Hatteras	(35°30')	(75°30')	3	D. Lee (pers. comm.)	1 adult male w/ distinctive notch; 1 humpback
177	09 Sep 1987	50 naut. miles off Port Isabel	(26°00')	(96°15')	3	T. Reisinger (pers. comm.)	

x See abbreviations of source in text.

s Denotes stranding

c Denotes fishery catch or intentional kill

\* Schevill (1968) questioned the accuracy of sightings in Events 50 and 51.

\*\* This sighting (Event 132) was the first of at least 21 sightings of this particular killer whale in 1982 (Events 132-134, 136-140, 142, 144, 147, 150-152, 155-161). The whale was photographically identified on some occasions by five parallel raised scratches on its left flank posterior to the saddle patch. In all sightings the whale was alone and appeared curious about boats and people, frequently approaching them closely. The whale was seen between Provincetown and Gloucester during May and June; at several locations around Mt. Desert Island, Maine, in mid-June; near St. Andrew's, New Brunswick, in early July; then back to the Mt. Desert Island area in mid-August. On August 13 a killer whale that was probably this animal was entangled in lobster fishing gear between French-

boro Long Island and Swans Island, Maine. The rope through its mouth was removed by two lobstermen (S. Grierson, pers. comm.). The lobstermen said that the whale lifted its head onto the side of their boat making it easier for them to cut the line from its mouth. The rope left an abrasion on the skin around the mouth. The whale was seen near Lubec and Eastport, Maine, in the third week of August, near Mt. Desert Island, Maine on August 25, then at Hingham, Massachusetts (September 2) and Boston (September 4) and Provincetown (mid-September through mid-October). While at Provincetown the whale accepted food thrown into the water or dangled on lines from piers or boats. Examination of photographs of the whale's mouth taken at Provincetown on October 16-17 (Tim Ramage, pers. comm.) showed that teeth in the lower jaw were worn to approximately half their normal length, teeth on the left side of the upper jaw were worn to the gumline and several teeth were apparently misaligned.

On two occasions people guided the whale to sea after it entered shallow water. At Wellfleet, Massachusetts, people forced it out of a tidal creek and at Hingham, Massachusetts, a boat "led" it around a sandbar (J. Prescott, New England Aquarium Memorandum, 22 Oct. 1982).

The last sighting of an animal that could have been this whale occurred on November 20, 1982, at Dipper Harbor, New Brunswick.