MARINE MAMMAL AND SEA TURTLE ENCOUNTERS WITH MARINE DEBRIS IN THE NEW YORK BIGHT AND THE NORTHEAST ATLANTIC

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ABSTRACT

The incidence of ingestion of synthetics by, and entanglement of, marine mammals and sea turtles in the New York Bight (1979-88) and in Iceland (1985) was documented and related to the ecology of these animals. Post mortems of 88 cetaceans, 37 pinnipeds, and 116 sea turtles in the New York Bight revealed ingestion of synthetics in 24 animals. Differences were observed among the groups of animals. Synthetics were found in 3 mysticete whales, in 7 odontocete whales (3 delphinids, 3 physterids, and 1 phocoenid), and in 14 sea turtles (10 leatherbacks, *Dermochelys coriacea*, 3 loggerheads, *Caretta caretta*, and 1 green, *Chelonia mydas*). No synthetics were found in the gut of any pinnipeds or in Kemp's ridley turtles, *Lepidochelys kempi*. Seventy-five individuals were entangled, including 4 mysticetes, 13 odontocetes, and 58 sea turtles. In Iceland, 6 of 82 examined fin whales, *Balaenoptera physalus*, contained ingested synthetics, and 5 of 95 showed signs of previous entanglement. The types of synthetics ingested and the rate of occurrence of both ingestion and entanglement were related to the feeding behavior, timing, and distribution of the species. The results indicate that certain species of marine mammals and sea turtles are more likely to interact with debris than others. In these animals ingestion of synthetics and entanglement appear to be frequent and widespread.

INTRODUCTION

Increased human use of the oceans and inshore waters has resulted in large amounts of man-made materials with which marine organisms come into contact. Organisms interact not only with waste products and floating debris but also with actively used fishing gear. Numerous efforts have been conducted worldwide to assess the amounts (Wehle and Coleman 1983; Bean 1987), types (Carpenter et al. 1972; Dixon and Dixon 1981; Dahlberg and Day 1985; Center for Environmental Education 1987a, 1987b; Henderson et al. 1987), and sources of these materials (Horsman 1982) and their impacts on marine organisms (Shomura and Yoshida 1985; Coe and Bunn 1987; O'Hara 1989). The interactions of marine organisms with these materials, and the

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resulting impacts, are better understood when the ecology of the individual species is considered.

Many marine species have global distributions and occur in both populous and remote areas. An abundance and diversity of marine mammals and sea turtles are found in the New York Bight. This is one of the most heavily stressed coastal regions in the world. With New York City at its apex, the bight is a major port for shipping and fishing. This region's coastal population of over 25 million places heavy demands upon the marine environment through activities such as recreational boating, fishing, and dumping of wastes. In contrast, the Arctic region, which supports large populations of marine mammals (Remmert 1980), is one of the few remaining areas in the world where man's influence is still limited. Despite its remoteness, it has been shown that sperm whales in this region were also impacted by marine debris (Martin and Clarke 1986).

The objective of this research was to examine the incidence of ingestion of synthetics by, and entanglement of, different types of marine mammals and sea turtles in the New York Bight and to provide comparisons with whales in Iceland waters.

METHODS

The study was conducted during the period of 1979 through 1988 in the New York Bight and in Iceland during the summer of 1985. Data on ingested materials in the New York area were collected during post mortems of digestive tracts in stranded animals. Only those stranded animals for which reliable necropsies could be performed were included in this study. Animals examined included 37 pinnipeds, 88 cetaceans (19 mysticetes and 69 odontocetes), and 116 sea turtles (Table 1). Data from Iceland were collected by examining the gut contents of 82 fin whales, *Balaenoptera physalus*, at a whaling station in Hvalfjordur during the 1985 season.

Data on entanglement were also collected during the post mortems of both the New York and Iceland specimens (Fig. 1). In New York, a large number of stranded live animals were also examined for evidence of entanglement, e.g., visible scars as reported by Hare and Mead (1987) or actual attached debris, and in Iceland, 13 additional fin whales were examined for entanglement only.

RESULTS

Ingestion of Synthetics

Evidence of ingestion of synthetic materials was found in 24 animals in the New York Bight during this study (Table 2). The frequency of occurrence varied among groups. Synthetics were present in the gut of three individual mysticetes and in seven odontocetes. Among the odontocetes, 3 out of 8 physterids, 3 of 50 delphinids, and 1 of the 9 phocoenids examined contained synthetic materials. There was no evidence of ingestion of synthetics in any of the pinnipeds.

Table 1.--Stranded marine mammals and sea turtles in the New York Bight from 1979 through 1988. A total of 461 live and dead animals were found along the shores or entangled in nets in the water.

Species	Number of individuals
Cetaceans	
Balaenoptera acutorostrata	5
Balaenoptera physalus	9
Deliphinapterus leucas	1
Delphinus delphis	15
Eubalaena glacialis	1
Globicephala melaena	14
Grampus griseus	1
Kogia breviceps	5
Lagenorhynchus acutus	4
Megaptera novaeangliae	4
Mesoplodon densirostris	1
Phocoena phocoena	9
Physeter catodon	3
Stenella coeruleoalba	7
Stenella plagiodon	3
Tursiops truncatus	10
Ziphius cavirostris	1
Unidentified	6
Pinnipeds	
Halichoerus grypus	2
Phoca groenlandica	1
Phoca vitulina	34
Sea turtles	
Caretta caretta	103
Chelonia mydas	15
Dermochelys coriacea	85
Lepidochelys kempi	122
Total	461

Among the sea turtles, varying amounts of synthetics were found in 10 of the 33 leatherbacks, *Dermochelys coriacea*, in 3 of 35 loggerheads, *Caretta caretta*, and in 1 of 4 green turtles, *Chelonia mydas*. Although there were 44 Kemp's ridleys, *Lepidochelys kempi*, examined in this study, none of these turtles contained synthetics in its gut.

In the Iceland survey during the summer of 1985, plastic material was found in 6 of the 82 fin whales examined.

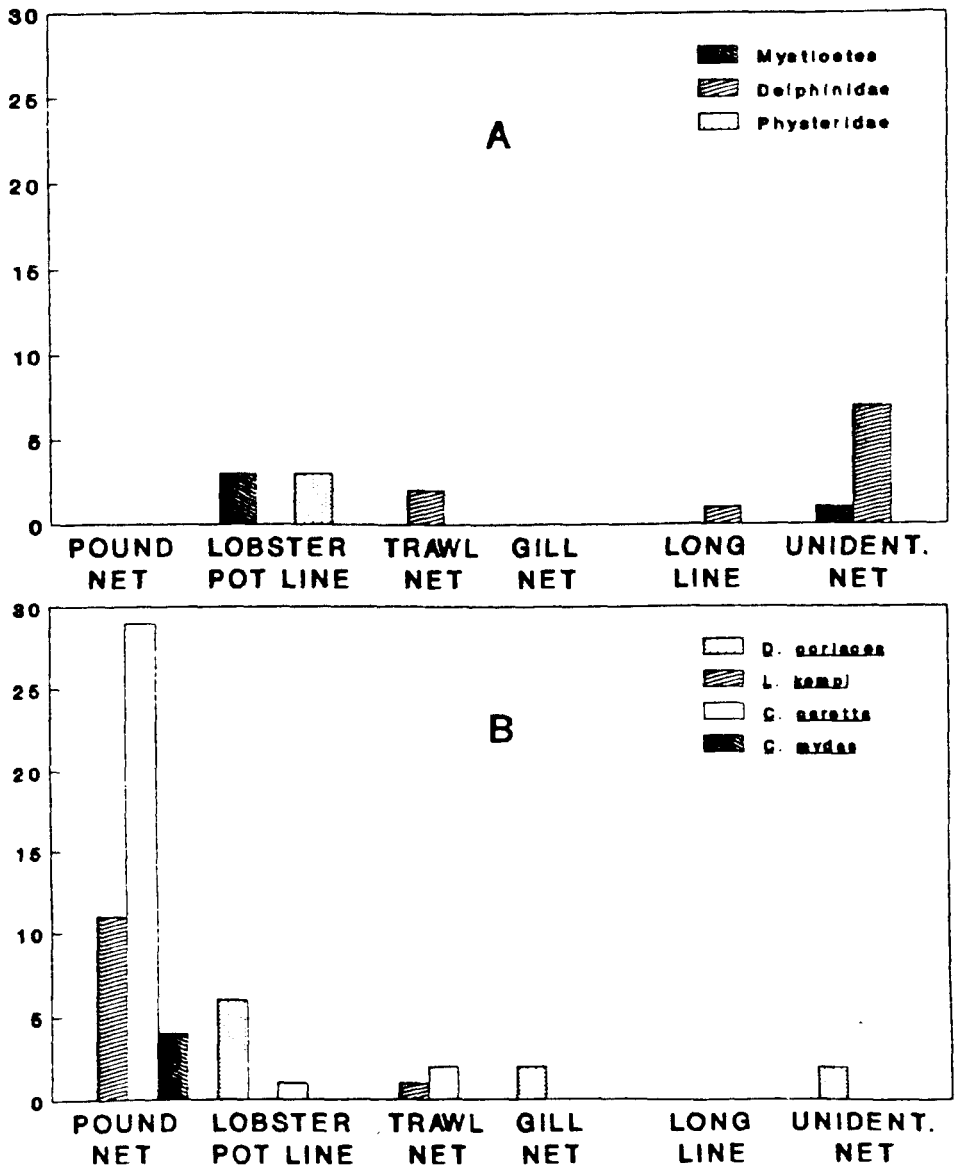

Figure 1.--The incidence of entanglement in different types of gear for marine mammals (A) and sea turtles (B) in the New York Bight from 1979 through 1988.

A wide variety of debris was observed in the stomachs of the animals examined in this study. The various types of debris found in the guts of cetaceans in the New York Bight included plastic toys, cups, polypropylene line, plastic bags, plastic sheets, and some unidentifiable synthetics. Similar materials were found in the Icelandic whales as well. One of these fin whales contained plastic that unfolded to a 1 × 2 m sheet. The most prevalent types of ingested debris observed in cetaceans from both study areas were plastic bags and small pieces of plastic sheeting.

Table 2.--Gut content analysis of marine mammals and sea turtles in the New York Bight from 1979 through 1988 and of fin whales, *Balaenoptera physalus*, from Iceland during the summer of 1985.

Location	Number examined	Number with synthetics
New York Bight		
Cetaceans		
Mysticetes	19	3
Odontocetes		
Delphinidae	50	3
Phocoenidae	9	1
Physteridae	8	3
Ziphiidae	2	0
Pinnipeds		
Phocidae	37	0
Sea turtles		
Dermochelyidae	33	10
Cheloniidae		
Caretta caretta	35	3
Chelonia mydas	4	1
Lepidochelys kempi	44	0
Total		24
Iceland		
Cetaceans		
Mysticetes		
Balaenoptera physalus	82	6

Various lengths of monofilament line, small pieces of different colored plastic, and numerous small polystyrene balls had been ingested by sea turtles. Most of the synthetic material in sea turtles, however, was clear, thin plastic. In some instances entire plastic bags were present, and these were the predominant synthetic material found in leatherback turtles.

For several stranded animals there was strong evidence that ingestion of synthetics was contributory or causative of death. In one pygmy sperm whale, *Kogia breviceps*, a hard, black plastic ball had completely blocked the pyloric valve. The surrounding tissue was hemorrhagic and there was

extensive necrosis. This animal was also severely emaciated upon death. Another whale, a pregnant sperm whale, *Physeter catadon*, was found with approximately 300 m of polypropylene line wrapped around its jaw and extending into the stomach. The esophagus and stomach were hemorrhagic and the lower jaw was gangrenous at the time of death. Five leatherback turtles had a large bolus of plastic occluding their digestive tracts. One such bolus was made up of 15 quart-size plastic bags and was blocking the pyloric opening.

Entanglements

From 1979 to 1988 there were a total of 75 individuals in the New York Bight that exhibited signs of entanglement with either debris or inactive or active fishing gear (Fig. 1). These individuals included 4 mysticetes, 13 odontocetes, and 58 sea turtles. No pinnipeds in this study were entangled in gear or debris. In Iceland, 5 of the 95 fin whales examined showed signs of previous entanglement.

Types of entanglement varied among groups of animals (Fig. 1). Three of the four mysticetes were entangled in lines from lobster pot floats, as were three sperm whales. Of the remaining odontocetes, seven exhibited evidence of the animal's having been entrapped in unidentified nets, two in trawl nets, and one in a longline. In the Icelandic fin whales, it was not possible to identify the form of entanglement gear which had made the scars.

The majority of the entanglements occurred in sea turtles, and there were clear differences among the species. The chelonid turtles (loggerheads, greens, and Kemp's ridleys) were primarily caught in pound nets (44 out of 48 turtles), while leatherbacks were entangled in other types of nets (4 of 10) and in lobster pot lines (6 of 10).

The incidence of death among entangled animals was related to the type of entrapping gear. Those types of gear which can hold an animal underwater were more frequently associated with the animal's death. The odontocetes which showed evidence of net entanglement had all died of drowning. These animals appeared healthy prior to death, exhibiting full stomachs, normal blubber thickness, and no specific disease etiology. One leatherback turtle became entangled in a lobster pot line and could not be freed. This animal also drowned. There was no mortality among the 44 turtles entrapped by pound nets, which only encircle an animal and do not confine it under water.

DISCUSSION

Between the years of 1979 and 1988, 461 stranded and entangled animals were found in the New York Bight. These strandings included 17 species of marine mammals and 4 species of sea turtles, and many of the data were collected from carcasses that had washed up along the shores of Long Island, New York. The prevailing wind and current patterns are such that most carcasses in the Long Island Sound or in the eastern bays are transported to shore, but many of those in the ocean float farther out to sea. Thus, while some areas provide an accurate account, strandings along the entire

ocean shore probably grossly under-represent the number of pelagic animals that are impacted.

The incidence of ingested synthetics varied among species. The observed patterns could be attributed to several ecological characteristics of the animals: feeding behavior, seasonal occurrence, and habitat. The type of synthetic found in 19 of 24 animals was floating or neutrally buoyant plastic. Much of this type of refuse originates on land or comes from recreational boating near shore and concentrates inshore during the summer when human activity is highest. Many of the cetaceans are deep water animals, but during the summer they often move inshore, where they have been observed to be feeding heavily. It is likely that ingestion of synthetic materials increases at this time. Animals that stranded during the winter months, such as seals and most Kemp's ridley turtles, contained no synthetic materials.

The ingestion of synthetics also corresponded to the feeding behavior of animals. The mysticetes and a few odontocetes feed throughout the water column by capturing large quantities of food at a time. Plastics and other floating materials are probably ingested along with prey species. Leatherback turtles feed almost exclusively on jellyfish (Mortimer 1981) and probably actively feed on plastic that resembles their prey. Conversely, the Kemp's ridley feeds very selectively on crabs off the bottom and seals in the New York Bight feed primarily on crabs and benthic fish and neither was found to contain debris. In many cases where synthetics were evident, it was difficult to ascertain the direct cause of death due to the decomposed state of the carcass. However, in some animals, the ingestion of synthetic debris caused serious damage and probably resulted in the death of the animal.

The entanglement data were valuable in determining the effects of different types of debris and fishing gear on the species studied. All of these animals must come to the surface to breathe. Debris in the water column or at the surface, such as floating line, can entangle these animals during their normal activities. Lobster pot float lines proved to be a major source of entanglement for pelagic animals such as fin whales, sperm whales, and leatherback turtles. These lines can be more than 100 m long and virtually undetectable below the surface. Types of active or inactive fishing gear that hold animals below the surface, such as longlines, trawlers, and gillnets, can drown marine mammals and sea turtles. Other types of gear that merely confine animals are not a problem. Most of the Kemp's ridley, loggerhead, and green turtles were caught in pound nets with no observed mortalities.

This study examined the impact of two forms of ocean debris. However, there are many other human activities that can affect marine mammals and sea turtles. Recreational boating contributes heavily to fouling the inland waters, and a large proportion of the animals in this study had been struck by boats. Other problems such as heavy metals, pesticides, and sewage runoff are epidemic in many coastal waters. While their effects on marine life may not be immediate, pollutants may result in health problems and have detrimental effects on the long-term survival of populations.

Martineau et al. (1985) showed that ingestion of toxicants drastically reduced the reproductive rate of beluga whales. It is possible that ingestion of debris and entanglement of animals have similar long-term effects, and the numbers of impacted animals are probably much higher than shown in this study (Kraus 1990)

Although the magnitude of the problems of ocean debris is not yet fully realized, this study indicates that the impact of human activity is not restricted to highly populated areas such as the New York Bight. It occurs globally and is found even in such remote areas as Iceland.

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