EFFECTS OF ANTHROPOGENIC DEBRIS ON SEA TURTLES IN THE NORTHWESTERN GULF OF MEXICO

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ABSTRACT

Reports of sea turtles ingesting and becoming entangled in marine debris and the adverse effects associated with these encounters exist worldwide, but the magnitude of this problem has yet to be determined. Data collected from sea turtles stranded on the south Texas coast from 1986 through 1988 indicate that they are significantly affected by ingestion of and, to a lesser extent, by entanglement in marine debris. All five species of sea turtles found in the Gulf of Mexico, both male and female, posthatchling through adult, had eaten or were ensnared by debris. Plastics discarded at sea were involved in the majority of these incidents. The offshore oil industry, cargo ships, research vessels, commercial and recreational fishing boats, and other seagoing vessels are primarily responsible for the trash discarded at sea which threatens sea turtles in the Gulf of Mexico.

INTRODUCTION

Because of their widespread intentional exploitation by man in the past, sea turtle populations in the United States have declined and all species are currently considered either threatened with or in danger of extinction. The greatest threat to their survival today is man's incidental exploitation. Every year thousands of sea turtles are incidentally caught and drowned in the net trawls of shrimp fishermen, beach front development encroaches on valuable sea turtle nesting beaches and threatens their reproductive efforts, newly hatched sea turtles are run over by cars or die from heat and exhaustion after they are enticed to crawl from their nests towards the bright lights of a condominium instead of towards the comparatively dimly lit sea, and an unknown number of sea turtles die when they become entangled in or ingest nonbiodegradable anthropogenic marine debris.

Balazs (1985) was the first to examine the widespread effects and impacts of marine debris on sea turtles. He compiled reports from the literature and through personal communication on the incidences of

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entanglement in and ingestion of marine debris by sea turtles worldwide. Collectively, these reports painted a rather grim picture for the recovery of sea turtle populations. But precisely how much of a threat marine debris poses to sea turtles has not yet been determined. Because sea turtles spend most of their lives at sea and are generally inaccessible to researchers, it has been difficult to assess the magnitude of this problem on any population. The objective of the present study was to determine the extent of entanglement and ingestion for sea turtles found stranded on the south Texas coast.

METHODS

Data were collected from sea turtles found stranded on Mustang Island, North Padre Island, and South Padre Island, Texas, from 1986 through 1988.

Entanglement

Stranding forms submitted to the Texas Sea Turtle Stranding and Salvage Network coordinator were used to obtain information on entangled sea turtles. Information culled from these forms included species stranded, date stranded, condition of the turtle (i.e., alive or dead), size of the turtle (curved carapace length (CCL)), type of entanglement, and fate of the turtle.

Ingestion

Stranded turtles were necropsied following Wolke and George (1981). Prior to necropsy, the species was identified and CCL and width measurements were recorded. During necropsy, the sex of the turtle was determined by visual examination of the gonads. The esophagus, stomach, and intestinal tract were removed from the body cavity and all organs were examined for abnormalities: lesions, ruptures, and parasites. The contents of the digestive tracts were emptied onto a fine-meshed sieve and rinsed with water. Anthropogenic debris was separated from the other food items, catalogued, and saved for later analysis. The remaining food items were preserved in 10% buffered formalin.

RESULTS

Entanglement

Sea turtles became entangled when their head, limbs, or entire bodies accidentally were ensnared in debris or active fishing gear. During the 3-year study, 30 (7.5%) of the 400 sea turtles reported stranded were entangled (Table 1). All of the sea turtle species found in the northwestern Gulf of Mexico had been ensnared. These included 13 Kemp's ridleys, *Lepidochelys kempi*, 7 loggerheads, *Caretta caretta*, 6 hawksbills, *Eretmochelys imbricata*, 3 green turtles, *Chelonia mydas*, and 1 leatherback, *Dermochelys coriacea*. Commercial and recreational fishermen and their lost or discarded gear were responsible for the majority of these incidents. Sea turtles were found entangled in fishing line or hook (9), shrimp trawl (7), net or rope (5), plastic woven produce sacks (4), tar (3), trotline

Table 1.--Incidence of entanglement in sea turtles found stranded on the south Texas coast from 1986 through 1988.

Year	Number of turtles entangled (%)	Total number of turtles stranded
1986	14 (7.8)	179
1987	11 (10.1)	109
1988	5 (4.5)	112
All years	30 (7.5)	400

(1), and crab pot (1). Injuries resulting from their entanglement were responsible for the deaths of seven of these turtles. The remaining 23 turtles were rehabilitated at the University of Texas Marine Science Institute and, with the exception of 1 permanently injured (blind) turtle, were released back into the Gulf of Mexico.

Ingestion

Marine debris was found in the stomachs or intestinal tracts of 60 (54.1%) of the 111 turtles necropsied (Table 2). It was present in 52.3% of the loggerheads, 46.7% of the green turtles, and 87.5% of the hawksbills (Table 3). (No leatherbacks were necropsied during the study.) Shaver (pers. commun.) examined the gut contents of Kemp's ridleys stranded within the same study area and found debris in 29.8% of those turtles (Table 3). Plastic materials were most frequently eaten (Table 4). Most of this material (ca. 60%) was buoyant in nature, but some was not, indicating that sea turtles not only feed on debris floating on the surface of the water, but also feed on debris that is suspended in the water column or is on the bottom.

The incidence of debris ingestion was highest in those turtles stranded during December and lowest in turtles stranded during August (Fig. 1). However, seasonal trends should not be interpreted from these data because recent work by Lutz (pers. commun.) has revealed that sea turtles have the ability to retain plastic in their digestive tracts for prolonged periods of time.

Our ingestion data support Carr (1987), who warned that the young, advanced pelagic stage sea turtles were most vulnerable because they spend the first few years of their life in the open ocean, dependent upon drift lines (areas of high debris concentrations) for their food supply and shelter. Information on the size (carapace length) at which sea turtles become sexually mature (adult) is based upon data collected from females at their nesting beaches. The size at sexual maturity differs among the sea turtle species, varies geographically within a species, and is unknown for male sea turtles. For the purposes of this study, we defined posthatchling

Table 2.--Incidence of debris ingestion in sea turtles found stranded on the south Texas coast from 1986 through 1988.

Year	Number of turtles with debris (%)	Total number of turtles necropsied
1986	10 (40.0)	25
1987	32 (59.3)	54
1988	18 (56.3)	32
All years	60 (54.1)	111

Table 3.--Incidence of debris ingestion by the different sea turtle species found stranded on the south Texas coast from 1986 through 1988.

Species	Number of turtles with debris (%)	Total number of turtles necropsied
Loggerhead, *Caretta caretta*	46 (52.3)	88
Green, *Chelonia mydas*	7 (46.7)	15
Hawksbill, *Eretmochelys imbricata*	7 (87.5)	8
Kemp's ridley, *Lepidochelys kempi*[a]	31 (29.8)	104

[a]D. J. Shaver pers. commun.

Table 4.--Types of debris (and their occurrence) collected from the intestinal tracts of sea turtles found stranded on the south Texas coast from 1986 through 1988.

Type of debris	Number of turtles that had ingested that type	Percent (N = 111)
Plastic bag, pieces	39	35.1
Styrofoam	17	15.3
Plastic, hard pieces	15	13.5
Plastic, line or rope	10	9.0
Plastic beads or pellets	8	7.2
Balloons	7	6.3
Tar	7	6.3
Glass	2	1.8
Paper or cardboard	2	1.8
Aluminum	2	1.8
Stainless steel hook	1	0.9
Latex or rubber	1	0.9
Heat-sealed drink tab	1	0.9

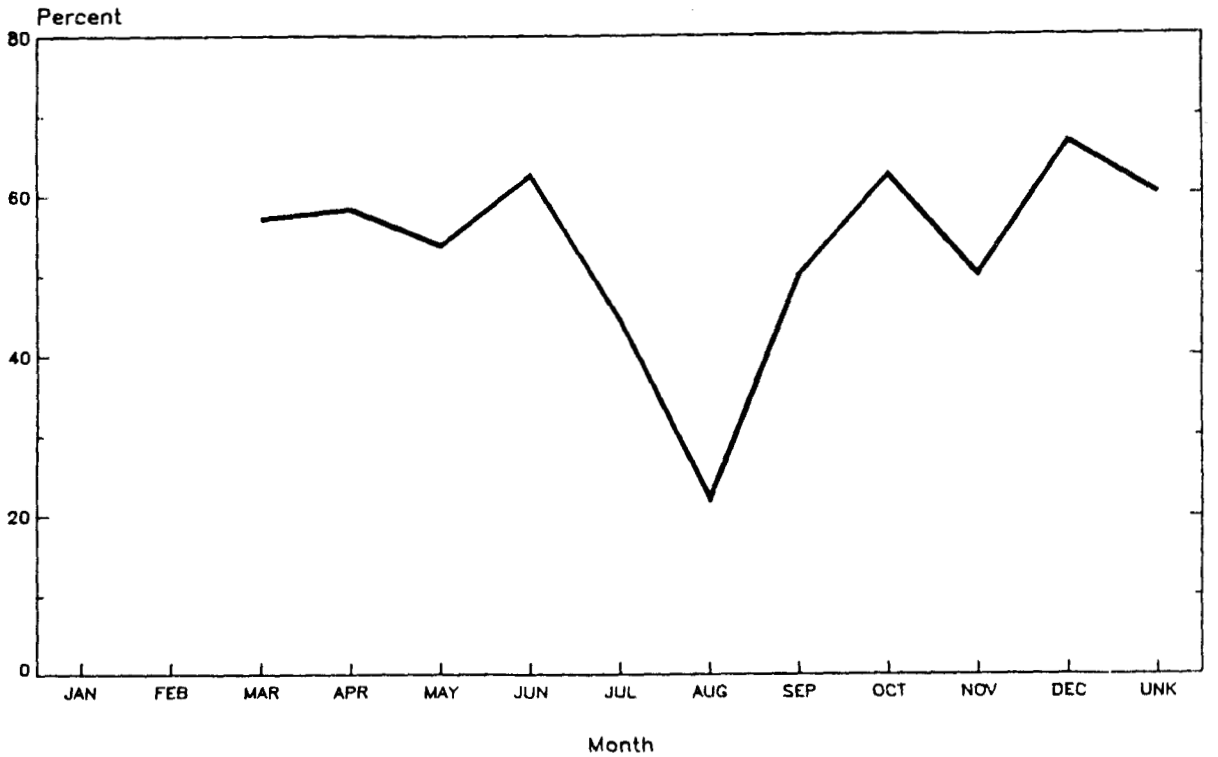

Figure 1.--Percent occurrence (by month) of anthropogenic debris found in the digestive tracts of sea turtles stranded on the south Texas coast.

to 40-cm CCL as advanced pelagic stage turtles, 40-80 cm CCL as subadult turtles, and ≥80-cm CCL or greater as adult turtles. We found debris in 70.8% of the advanced pelagic stage turtles, 55.4% of the subadult turtles, and 31.8% of the adult turtles (Fig. 2).

Debris ingestion resulted in the deaths of four of the turtles necropsied during this study (a noticeable obstruction or blockage in the digestive tract was observed), but could not be implicated in the deaths of the remaining 56 turtles. It was difficult to determine if the debris eaten had caused a turtle's death. For most cases observed, only small quantities of debris were present, and they were usually well mixed in the digestive tracts with the other food items and probably did not contribute to death.

DISCUSSION

A number of the turtles that washed ashore during the study were already missing a limb. Many of these losses were suspected to be the result of a prior entanglement, but because there was no proof, these turtles were not counted as having been entangled. Therefore, we feel that our entanglement numbers may be too small. The reasons why sea turtles become entangled remains unclear. Their natural curiosity towards objects

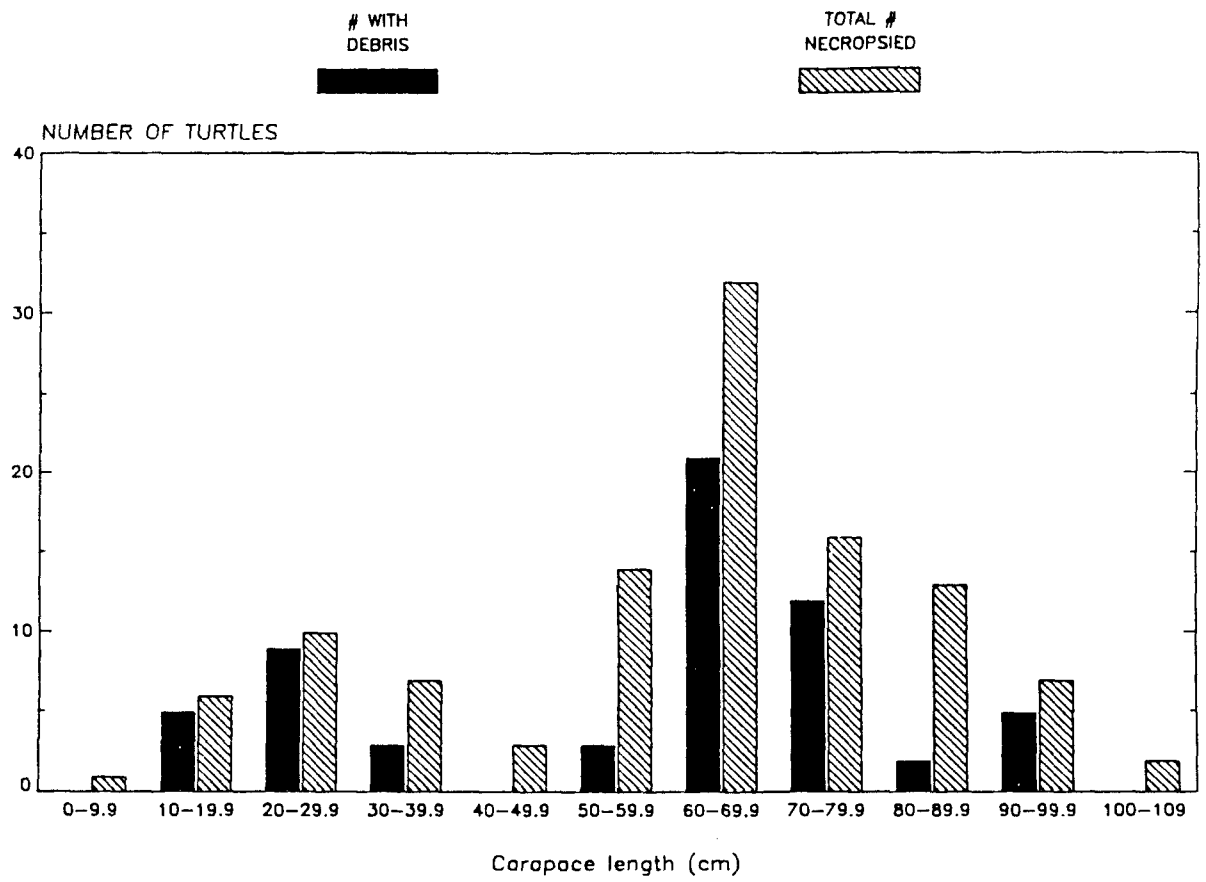

Figure 2.--Occurrence of anthropogenic debris found in the digestive tracts of sea turtles stranded on the south Texas coast from 1986 through 1988 (by carapace length (cm)).

adrift in the water is most often cited as the reason for their propensity for probing near and becoming ensnared in debris. It is likely that sea turtles are attracted to these floating objects because they are seeking food or shelter.

An unusual relationship was found between hawksbills and plastic woven produce sacks (onion sacks). The four incidents of entanglement in those sacks reported here all involved advanced pelagic stage hawksbills (their CCL ranged from 19.4 to 28.5 cm) had their head or limbs caught in the plastic fibers of a produce sack. In addition to our four reports, we know of two other hawksbills that were found entangled in the exact same manner. In 1988, one was found stranded on Galveston Island, Texas (M. Duronslet pers. commun.), and the other was found in April 1989 on the beach at Rancho Nuevo, Mexico (R. Byles pers. commun.). What affinity, if any, hawksbills have for onion sacks is unknown. More behavioral studies of all of the sea turtle species are necessary before we can explain how and why they become involved in these situations.

Debris was eaten by more than half of the turtles necropsied during this study, and while this ingestion did not appear to result in the deaths

of the majority of these turtles, its presence in the digestive tracts of so many is indicative of the pervasiveness of anthropogenic debris in the northwestern Gulf of Mexico. It has been suggested that sea turtles eat debris because it resembles their natural prey or perhaps because epizoic or epiphytic growth on the debris has attracted the turtle. Before man began discarding his nonbiodegradable wastes into the oceans, sea turtles did not have to differentiate between what was edible and what was not, because essentially everything was edible. In the Gulf of Mexico, the offshore oil industry, cargo ships, research vessels, commercial and recreational fishing boats, and other seagoing vessels are primarily responsible for the trash discarded at sea which eventually is consumed by many sea turtles. Prevailing currents and winds drive virtually all of the trash that is dumped into the Gulf of Mexico (and to a lesser extent the Caribbean) to the northwestern Gulf of Mexico and onto the Texas coast.

Annex V of MARPOL (implemented domestically by the Act to Prevent Pollution from Ships) came into effect on 31 December 1988. This annex prohibits the dumping of plastics at sea and regulates how far from shore other anthropogenic debris may be discarded. The passage of this law probably will not deter the many who have grown accustomed to dumping their trash overboard. This law needs to be enforced at sea and at the ports, and those who are guilty should be fined as one means of controlling the oceanic debris problem. Most importantly, people need to be educated and convinced to save their refuse until they can properly dispose of it on land.

Certain bodies of water such as the Mediterranean Sea were given special designation under Annex V of MARPOL. These areas have been afforded extra protection because of their unique oceanographic or ecological conditions, and it is now illegal to discard any type of debris in these waters. The Gulf of Mexico was considered a candidate for this special protection, but was not designated as such when Annex V was passed. The semienclosed nature of the Gulf of Mexico, the prevalence of marine debris in these waters and on adjacent beaches, and the importance of this area as a habitat for sea turtles (in particular the critically endangered Kemp's ridley sea turtle) should be enough justification for its designation as a special area. The likelihood that a sea turtle inhabiting the Gulf of Mexico will come into contact with anthropogenic debris is quite substantial.

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