

Plastic debris ingestion by cetaceans along the Texas coast: two case reports

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Summary

A young male pygmy sperm whale stranded alive on Galveston Island, Texas, USA and was transported to a holding tank where he died 11 days later. During necropsy, the first two stomach compartments (forestomach and fundic chamber) were completely occluded by a plastic garbage can liner, a bread wrapper, a corn chip bag and two other pieces of plastic sheeting. The small connecting channel joining the fundic chamber with the last stomach compartment, the pyloric chamber, prevented passage of the debris farther along the gastrointestinal tract.

A young female minke whale beached alive on Matagorda Peninsula along the Texas coast. Due to poor physical condition and the impossibility of transport, the whale was euthanized. Necropsy revealed several pieces of plastic in the stomach. Gastric compartmentalization was similar to that of the pygmy sperm whale. A single piece of plastic was found in the forestomach and a second in the connecting channel. The pyloric chamber contained three other sections of plastic, along with approximately a meter of fishing line, entangled in a mass of leaves and twigs.

Key words: foreign bodies, Cetacea, pygmy sperm whale, *Kogia*, minke whale, *Balaenoptera*, pollution, marine debris

Introduction

In recent years there has been increasing concern regarding man-made debris and its impact on the marine environment (Dahlberg and Day, 1984; Day and Shaw, 1987; Laist, 1987; Wolfe, 1987). Heightened activities by offshore oil and gas industries, freight shipping traffic, fishing enterprises and beach goers have contributed to the burden of human-generated artifacts injected into surrounding waters.

Several reports document the effects of such items on a variety of wildlife species, particularly marine turtles and birds (Day *et al.*, 1985; Bauer, 1986; Fry *et al.*, 1987). US stranded marine mammal network records maintained at the Smithsonian Institution in Washington, DC have documented nine other cases of plastic ingestion by various species of cetaceans (Mead, pers. comm.). The following report describes severe gastric obstruction by plastic bags and debris in a pygmy sperm whale calf and the presence of several pieces of plastic in the stomach of a young minke whale.

Results

Pygmy sperm whale

A 2.5 m pregnant pygmy sperm whale (*Kogia breviceps*), accompanied by a 1.8 m male calf, stranded alive on a Galveston Island beach (29°16.8'N × 94°48.1'W) on 1 January 1984. Officials at Sea-Arama Marineworld in Galveston arranged transport of the animals to a holding tank in the park for observation and treatment.

External features examined for species identification included height and position of the dorsal fin, as well as tooth count and the occurrence of throat grooves (Fig. 1). Dorsal fin height of the calf was 6.5 cm (3.6% of total body length). In the dwarf sperm whale, *Kogia simus*, the dorsal fin is said to be taller relative to total body length (Caldwell and Caldwell, 1989) and in records of the Texas Marine Mammal Stranding Network, the dorsal fin has ranged from 6.2 to 7.4% of total body length for *Kogia simus* (n=3). Nagorsen (1985) states that dorsal fin height in *Kogia simus* is greater than 5% of total body length. The tip of the dorsal fin was positioned 104 cm from the tip of the rostrum (58% of total body length). The dorsal fin is located more posteriorly in *Kogia breviceps* than in *Kogia simus* (Nishiwaki, 1972). There were 12 teeth in each lower arcade. Tooth counts have been given for *Kogia breviceps* and for *Kogia simus* as 10-16 and

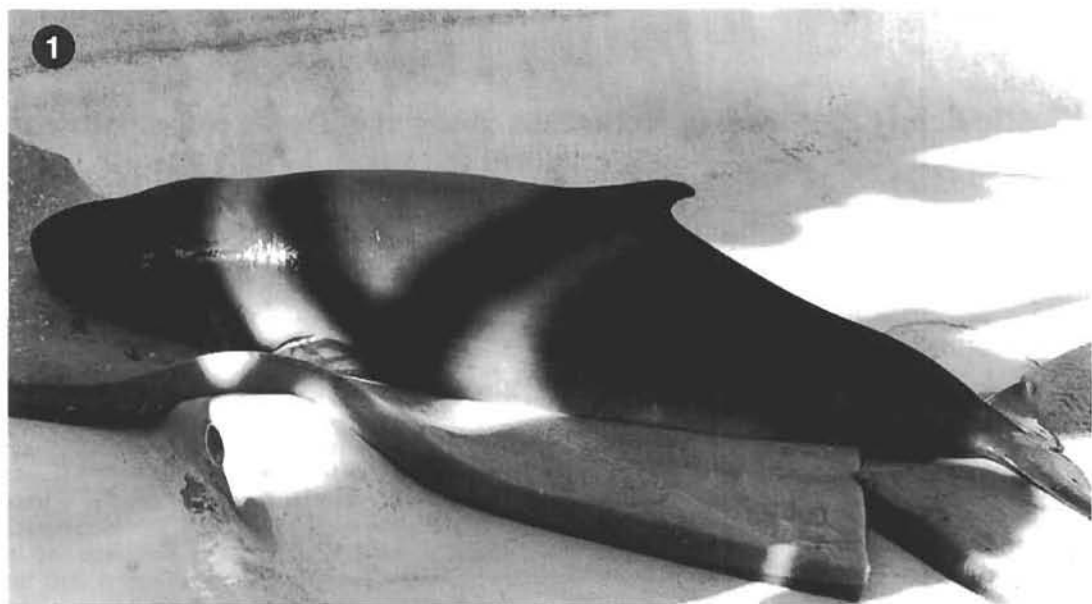


Figure 1. Photograph of pygmy sperm whale calf illustrating small dorsal fin and its posterior placement.

8–13 pairs, respectively (Caldwell and Caldwell, 1989), rendering this feature nondiagnostic in the present case. The throat grooves said to be present on some *Kogia simus* (Leatherwood *et al.*, 1983) were lacking in the stranded calf. Morphologic features of the accompanying female supported the diagnosis of pygmy sperm whale. Her dorsal fin measured 7.2 cm in height (2.5% of total body length), she had 13 pairs of mandibular teeth and her dorsal fin tip was located 187 cm from the tip of the rostrum (64% of total body length).

Both whales were examined by the Sea-Arama consulting veterinarian. Although both appeared weakened, only the female showed overt signs of serious debilitation. Both animals were placed on a regimen of antibiotics, corticosteroids and vitamins. In addition, electrolyte fluids, mixed with herring gruel, were given to the calf by stomach tube.

The female was supported upright in shallow water to assist her access to air with minimal exertion. The calf was allowed to move about freely and was often found voluntarily positioning himself near the mother's rostrum. However, the female weakened rapidly and died on the evening of 4 January. Necropsy demonstrated multiple active ulcerations throughout the glandular stomach chambers.

In contrast, the calf's condition appeared to be improving. Although initially swimming only at the surface of the pool, he gradually began to incorporate shallow dives into his swimming behaviours. It is often difficult to interest a stranded

cetacean in food but on the eighth and ninth days in captivity the calf accepted squid offered to him by Sea-Arama trainers.

However, on the tenth day, the calf was notably depressed and refused to eat. He weakened rapidly and died the same afternoon. The calf was transported immediately to Texas A & M University where necropsy demonstrated severe obstruction of the first two stomach chambers by an assortment of plastic bags, including a garbage bag, corn chip bag, bread wrapper and two other plastic bag pieces (Fig. 2).

The stomach of the pygmy sperm whale consists of four grossly definable components (Rice and Wolman, 1990) (Fig. 3). The first (forestomach) and second compartments (fundic chamber) are largest. The fundic chamber is followed by the connecting channel, a narrow tubular compartment. The fourth division, or pyloric chamber, is also tubular but the lumen diameter is considerably larger than that of the connecting channel preceding it. In this case, the small size of the connecting channel effectively prevented passage of the bags further along the alimentary canal. A serous fluid was found in the peritoneal cavity and an impression smear contained many neutrophils and bacteria, indicative of acute peritonitis (Fig. 4).

Minke whale

On 27 March 1988 a 5.8 m balaenopterid whale was reported stranded in the surf on Matagorda Peninsula near Port O'Connor, Texas (28°34.05'N × 96°3.05'W) (Fig. 5). Witnesses

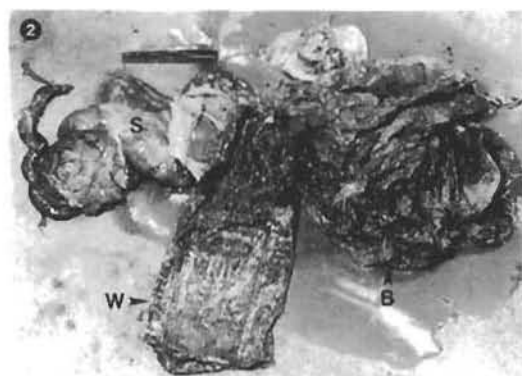


Figure 2. The stomach (S) of the pygmy sperm whale calf has been opened to reveal plastic bags, including a bread wrapper (W) and garbage bag (B), from the first two stomach compartments.



Figure 3. Intact stomach of the pygmy sperm whale stomach before opening compartments. Illustrated are the terminal oesophagus (E), forestomach (FO), fundic chamber (FU), pyloric chamber (P) and initial duodenum (D). Bar scale=ca. 7 cm.

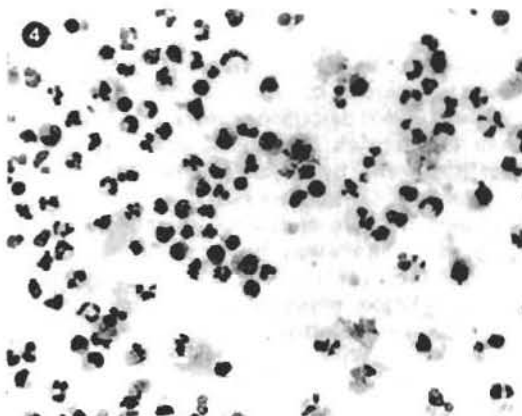


Figure 4. Impression smear from peritoneal fluid, stained with Giemsa's, illustrating numerous leukocytes.

claimed to have seen the whale in the surf as early as 25 March.

Photographs of the whale were submitted for species identification to the Smithsonian Institution and to Sea World Research Institute/Hubbs Marine Science Center, prompting tentative designation as a minke whale (*Balaenoptera acutorostrata*). This diagnosis was confirmed by measuring the long axis of a tympanic bulla (9.4 cm). Among the balaenopterids, such small bullae are found only in the minke (Mead, pers. comm.). Measurements of bullae from the collection of the Smithsonian Institution resulted in lengths from other balaenopterid whales (blue, fin, sei, Bryde's) in excess of 11.0 cm while those of two adult minkes were 8.0 and 9.5 cm. In addition, bullae lengths do not seem greatly affected by the age of the whale; bulla length in a neonate fin whale was 11.5 cm while that of adult fin whales ranged from 12.5 to 13.0 cm ($n=3$).

Upon examination by representatives of the Texas Marine Mammal Stranding Network, the whale was found to be a female and appeared to be severely weakened and emaciated. The attending veterinarian administered corticosteroids intravenously and intramuscularly. However, no significant response to therapy was apparent and, due to logistical difficulties in transporting an animal of this size from the beach and to its poor physical condition, the whale was euthanized by intravenous barbiturates.

The abdominal and thoracic cavities were examined immediately, revealing no obvious abnormalities. However, incidental findings included several pieces of plastic in the stomach (Fig. 6). Compartmentalization of the stomach was similar to that of the pygmy sperm whale. A single piece of plastic was found in the forestomach and a second in the connecting channel. The pyloric chamber contained three other sections of plastic, along with approximately a meter of fishing line, entangled in a mass of leaves and twigs. No other abnormalities were noted and a cause of death was not determined. Neither of the ovaries possessed corpora, confirming that the whale was sexually immature.

Discussion

Ingestion of foreign objects by cetaceans in the wild has not been frequently documented. These remain the only confirmed cases of foreign body ingestion in the records of the Texas Marine Mammal Stranding Network from 1981 through 1988. However, of the 674 cetacean strandings reported during this period, only 138 stomachs were thoroughly examined for this possibility. Nine other cases of plastic ingestion by cetaceans on record at the

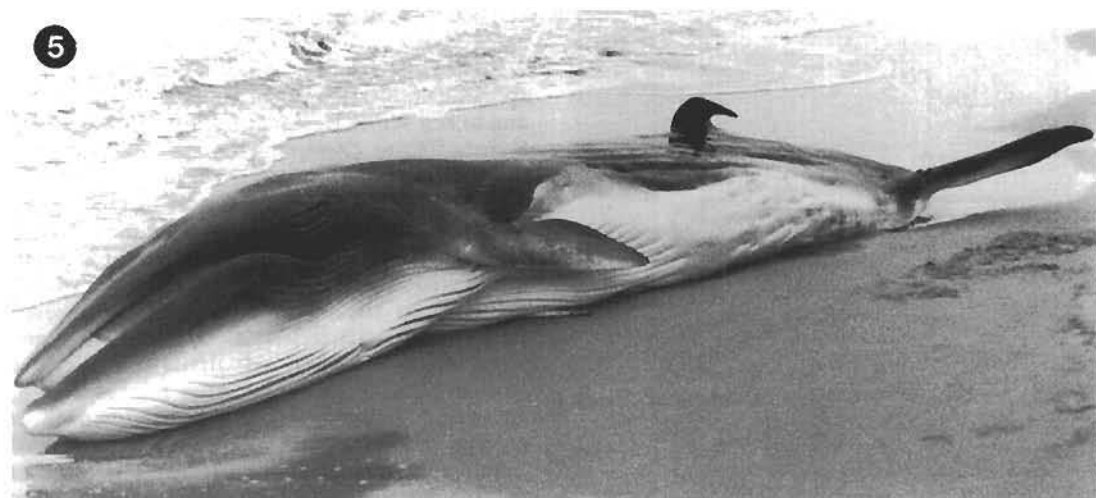


Figure 5. Photograph of beached minke whale.

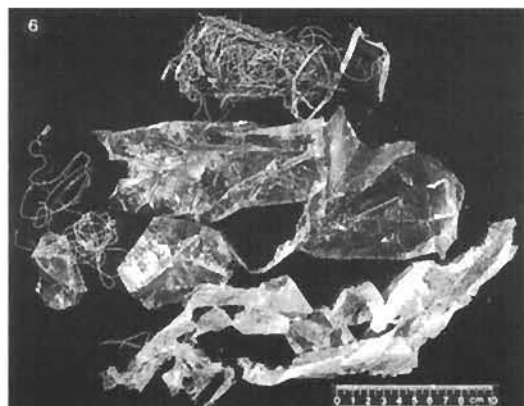


Figure 6. Debris recovered from stomach of minke whale, including pieces of plastic, fishing line and marine grass.

Smithsonian Institution in Washington, D.C. involve a variety of species, including a Gulf-Stream beaked whale (*Mesoplodon europaeus*), striped dolphin (*Stenella coeruleoalba*), Cuvier's beaked whale (*Ziphius cavirostris*), pygmy sperm whale (*Kogia breviceps*), dwarf sperm whale (*Kogia simus*), Dall's porpoise (*Phocoenoides dalli*), Risso's dolphin (*Grampus griseus*), sperm whale (*Physeter macrocephalus*) and minke whale (*Balaenoptera acutorostrata*) (Mead, pers. comm.). Kastelein and Lavaleije (1992) recovered part of a plastic bag and a section of fishing line from the stomach of a harbour porpoise (*Phocoena phocoena*). Plastic ingestion by a bowhead whale (*Balaena mysticetus*) from the Beaufort Sea along Alaska's north slope has been noted, consisting of a section of clear

plastic sheeting (approximately 12 × 12 cm) in the forestomach (George, pers. comm.).

Several accounts document ingestion of a variety of objects by captive cetaceans. Brown *et al.* (1960) reported starvation in a Pacific white-sided dolphin (*Lagenorhynchus obliquidens*) in which the entire stomach was found to be occluded by seven cotton gloves. These authors noted several fatalities occurring in oceanaria as a result of foreign body ingestion. Ridgway (1965) added 'flashbulbs, cups, plastic toys, net floats, and rubber balls' to the list of swallowed foreign objects. He described ingestion of a rubber suction cup with apparently no ill effects in a Pacific white-sided dolphin; the cup remained in the stomach until the dolphin died from other causes about one year later. In at least one case, stasis of fish in the forestomach (presumably due to extensive mucosal ulceration) resulted in gastric and oesophageal occlusion (Ridgway and Johnston, 1965).

Successful clinical intervention in cases of foreign object ingestion by cetaceans has been documented. Ridgway (1965) described removal of a plastic float from the stomach of a Pacific bottlenose dolphin (*Tursiops gilli*) by manually reaching into the forestomach. On another occasion, a special snare was used with an endoscope to retrieve an eye-glass piece swallowed by a bottlenose dolphin (Wirtschaftler, 1977).

The two cases presented in this report represent exposure to man-made debris in the natural environment. With regard to the pygmy sperm whale, around-the-clock surveillance by Sea-Arama staff assured that there had been no exposure to the recovered debris while in the holding tank. Unfortunately, presence of a gastric foreign body

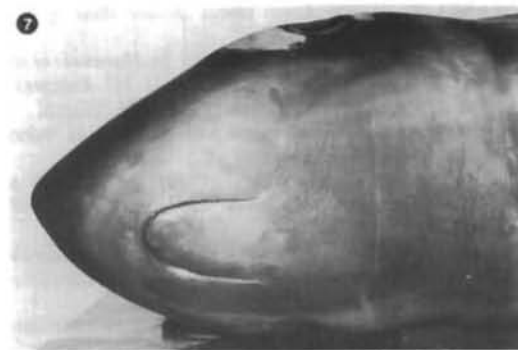


Figure 7. Ventral view of head and neck of a *Kogia* illustrating small, underslung lower jaw.

was not suspected in the pygmy sperm whale on the basis of clinical signs; however, had their existence been known, successful removal of the bags would have been hampered by the unique anatomy of the mouth of the pygmy sperm whale.

Foreign body ingestion by the pygmy sperm whale is especially interesting when mouth structure is considered. Unlike most cetaceans, the mouth of *Kogia*, rather than being large and 'scissor-like', consists of a rather small lower jaw positioned beneath an overhanging rostrum (Fig. 7). This feature, coupled with the relatively small size of the calf, suggests that the animal had to exert considerable effort to swallow bags in such quantity.

Since a portion of the bags had contained processed foods, chemoreception may have played a role in detection of the plastic by the calf. Taste buds, perhaps rudimentary, have been described in some species of odontocetes (Donaldson, 1977; Yamasaki *et al.*, 1978; Nachtigall and Hall, 1984) and might serve as the receptors for such a stimulus. In addition, pygmy sperm whales are thought to feed exclusively on squid (Nishiwaki, 1972), and it is conceivable that these bags, suspended and glittering in the water column, may have triggered an instinctual ingestive response by a young calf inexperienced in prey consumption.

The circumstance of plastic ingestion by the minke whale is also speculative. Little is known of the distribution and feeding habits of this species in the western Gulf of Mexico during this time of the year. However, if the 'lunge' or 'engulfment' type of feeding strategy attributed to rorquals were used (Pivorunas, 1979), incorporation of this material into the ingesta could easily occur. The clinical significance of the plastic swallowed by the minke whale is also unclear. The narrow lumen of the connecting channel has been described in other mysticetes (Jungklaus, 1898; Hosokawa and Kamiya, 1971; Tarpley *et al.*, 1987) and concern

has been expressed regarding the liability such an arrangement poses for gastric obstruction in cases of foreign body ingestion (Albert, 1981). However, while the connecting channel was partially occluded along a portion of its length by the section of plastic sheeting, three other pieces had successfully passed to the next compartment, the pyloric chamber. Therefore, the threat of total blockage was reduced in this case since the plastic sections were relatively small.

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