Prevalence of Marine Debris Ingestion in Deep Sea Suction Feeding Cetaceans in North Carolina

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Introduction

Plastic pollution in the marine environment is a global phenomenon, impacting organisms across all trophic levels.[1] The ingestion of marine debris has been well documented in many large organisms including birds, pinnipeds, turtles, and cetaceans.[2] The feeding behaviour of deep sea suction feeding cetaceans, including: Kogiidae, Physeteridae, and Ziphiidae, has been suggested to increase susceptibility to marine debris ingestion.[3] Plastic ingestion has been previously documented in these families.[3,4,6] Thus, these species are the target of this study. The ingestion of plastic in cetaceans is often only reported on a case by case basis, with very few compiled reviews for specific regions. The northeast Atlantic is a hotspot for various cetacean species, with Cape Hatteras, North Carolina, considered a particularly important year-round habitat for several species of beaked whales.[5] **Therefore, this research aimed to review the North Carolina stranding database, collating data on necropsied cetaceans, to report the prevalence of ingested plastic specific to this region.**

Methods

- Reviewed historical stranding data for North Carolina from 1992 to 2017; only included if stomach content analysis had been conducted either during or post necropsy, and data was accessible (97 cases).
- Calculated percentage prevalence of marine debris by species.
- Categorised and calculated percentages for different types of plastic.

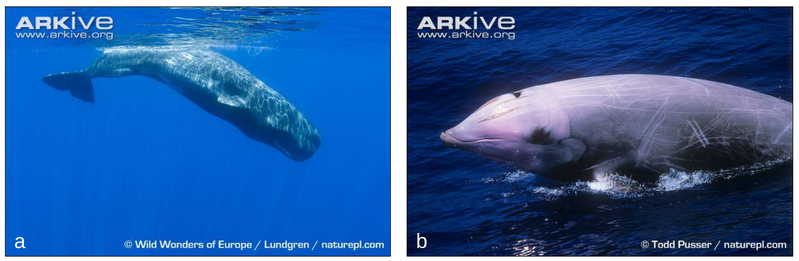


Figure 1. Representatives of two of the three families of deep sea suction feeding cetaceans, showing a) Physeteridae (pictured: *Physeter macrocephalus*), and b) Ziphiidae (pictured: *Ziphius cavirostris*). Other species analyzed include: *Mesoplodon spp.* (family Ziphiidae), and *Kogia breviceps* and *K. sima* (family Kogiidae). Photographs courtesy of ARKIVE.org.

Results

- 0% prevalence found in *Kogia sima*.
- Two cases (WAM 547 and 85-12-92 NHC-W, both *P. macrocephalus*) diagnosed cause of mortality as plastic ingestion from blockages.

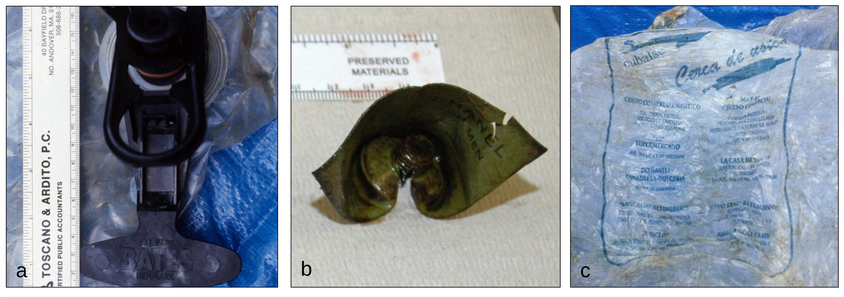
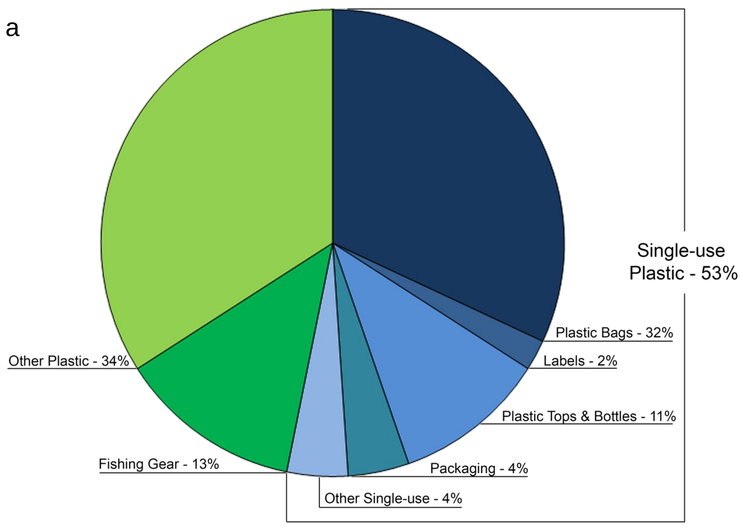


Figure 2. Brands and origins of plastic : a) Bates heavy-duty bag from Denmark (WAM 547), b) Chanel hand lotion bottle (KLC 112), and c) grocery bag from Cuba (WAM 547). Photographs courtesy of the Marine Mammal Stranding Program, UNCW.



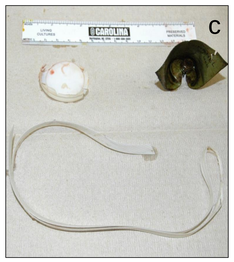


Figure 3. a) Visual representation showing the breakdown of the different types of plastics found ingested by deep sea suction feeding cetaceans stranded in North Carolina, with b) an example of an ingested carrier bag found in CAHA 224 (*M. europaeus*), c) various packaging materials found in KLC 112 (*M. mirus*), and d) the assortment of debris found in WAM 547 (*Physeter macrocephalus*), including plastic bags, fishing gear, and plastic wrap. Photographs courtesy of the Marine Mammal Stranding Program, UNCW.

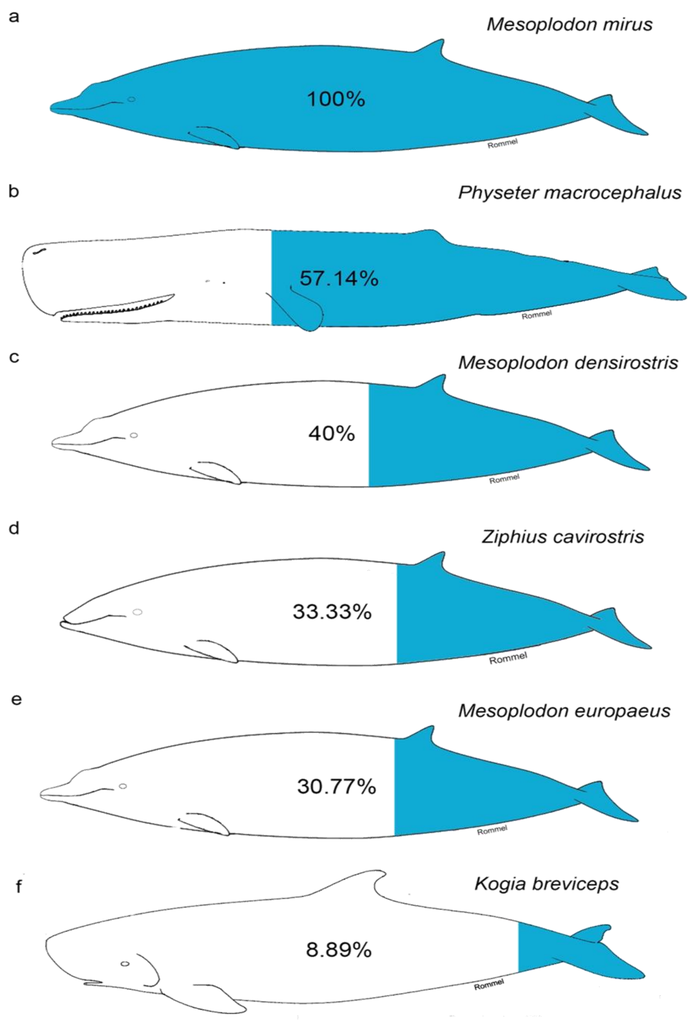


Figure 4. Prevalence of plastic ingestion in stranded cetaceans in North Carolina as a percentage for a) *Mesoplodon mirus* (n=2,2), b) *Physeter macrocephalus* (n=4,7), c) *M. densirostris* (n=2,5), d) *Ziphius cavirostris* (n=1,3), e) *M. europaeus* (n=4,13), and f) *Kogia breviceps* (n=3,44). Species outlines courtesy of Dr. Rommel.

Discussion

- The species featured all echolocate, primarily feeding on cephalopods.[3,4] Thus, floating plastic may be confused for this prey.
- Alternatively, if debris items are in close proximity to prey, it may be difficult to differentiate visually at decreased distances.
- Low prevalence in Kogiidae, suggests that these species aren't as susceptible to marine debris ingestion as previously considered.[3]
- The high prevalence (100%) in *M. mirus* suggests this species is particularly susceptible to plastic ingestion within North Carolina waters, and thus, should be a species of concern as Cape Hatteras is an important year-round habitat for several species of beaked whales.[5]
- Majority of debris likely originated from land, either via direct input, or transportation in the runoff of rivers. Thus, greater waste management and clean-up efforts should be focused in the riverine environment.

Future Research & Conclusions

- Microplastic presence was not assessed, though they are known to accumulate POPs, which become bioavailable to the organism after ingestion.[1] Thus, future research efforts should be focused here.
- Total standings that had stomach content data analysed and accessible was low (97/241). This could be due to a low priority, or if the stomach was frozen for later analysis, sequential steps can be hard to trace.
- Future strandings would benefit from mandatory stomach content analysis, with an addition section on the Human Interaction data sheet, however this procedure should not interfere with pre-existing methods to analyse dietary patterns.
- **Although high prevalence was recorded in some species, data comes from strandings only, which are opportunistic encounters. Thus, the extent of marine debris ingestion is likely underestimated in this study.**

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Literature Cited

[1]Andrady, A. L. (2011). Microplastics in the marine environment. *Marine Poll Bull*, *62*(8), 1596-1605.
[2]Derraik, J. (2002). The pollution of the marine environment by plastic debris: a review. *Marine Poll Bull*, *44*(9), 842-852.
[3]de Stephanis, R., Giménez, J., Carpinelli, E., Gutierrez-Exposito, C. and Cañadas, A. (2013). As main meal for sperm whales: Plastics debris. *Marine Poll Bull*, *69*(1-2), 206-214.
[4]Lusher, A., Hernandez-Milian, G., O'Brien, J., Berrow, S., O'Connor, I. and Officer, R. (2015). Microplastic and macroplastic ingestion by a deep diving, oceanic cetacean: The True's beaked whale. *Environ Pollut*, *199*,185-191.
[5]McLellan, W. A., McAlarney, R. J., Cummings, E. W., Read, A. J., Paxton, C. G., Bell, J. T., and Pabst, D. A. (2018). Distribution and abundance of beaked whales (Family Ziphiidae) Off Cape Hatteras, North Carolina, USA. *Mar Mam Sci*.
[6]Stamper, M., Whitaker, B. and Schofield, T. (2006). Case Study: Morbidity in a Pygmy Sperm Whale *Kogia breviceps* due to Ocean-Bourne Plastic. *Mar Mam Sci*, *22*(3), 719-722.