Whale Entanglement

M. Cooper Lemmond ‘27 and Alex J. Werth

Department of Biology, Hampden-Sydney College, Hampden-Sydney, VA 23943

Abstract

For my project this summer I focused on how entanglement affects the filter-feeding systems of baleen whales. Baleen whales are much different than regular whales and are easily distinguished from regular whales because unlike regular whales baleen whales do not have teeth. Instead, baleen whales have 2 rows of a keratinous material that makes up the front of their mouths that’s known as baleen which is attached to their gums. They are distinguished into six species while more species are still being uncovered. Theses 6 distinct species of baleen whales are as follows Balaenoptera, Eschrichtius, Megaptera, Caperea, and Balaenidae. Balaenoptera includes minke whales, sei whales, bryde’s whales, blue whales, omura’s whales, fin whales, rice whales. Eschrichtius includes gray whales, and the akishima whales [extinct]. Megaptera includes the humpback whale. Caperea includes the pygmy right whale. Lastly, Balaenidae includes bowhead whales, North Atlantic right whale, North Pacific right whale, and Southern right whale. Each of which consume organisms like krill, copepods, and fish.

Background Information

The entanglement of whales is an extremely important issue for many reasons. These reasons include that whales produce lots of the oceans fecal matter. Their fecal matter is vital to the survival of plankton and other microorganisms that facilitate our oceans and the world around us. Plankton alone contributes 50% the world’s oxygen, so if most of the whale population goes extinct there will be less nutrients available to these creatures which in turn could result in a substantial loss to the world’s global supply of oxygen and increase greenhouse gasses in our atmosphere. Furthermore, these creatures help maintain the overall stability of the ocean ecosystem as a top apex predator. Without an apex predator such as whales it will be extremely difficult to maintain populations of organisms such as krill and fish who feed on plankton and other organisms.

Entanglement accounts for approximately over 300,000 deaths to whales and dolphins annually due to entanglement according to the International Whaling Commission (IWC). Findings suggest that that “over half of some species of large whale have been entangled at one point in their lives,” according to the NRDC. “A recent retrospective study using photo-graphic evidence (i.e., scars) of current or past entanglements found that of 626 individual whales assessed over a 30-year time period (1980 – 2009), 82.9% had evidence of at least one entanglement and 59% of those animals had been entangled more than once (Knowlton et al. 2012) The culprit behind these unsettling statistics is in part due to the materials we use in most modern commercial fishing gear; these materials include but are not limited to nylon, polypropylene, and polyester.

So, what causes these animals to get in these situations in the first place? There are many reasons why a whale may become entangled. For instance, most fisheries operate in areas that coincide with the same places that whales come to feed and travel, this conglomeration of areas is known as the whale superhighway {Figure 1}.

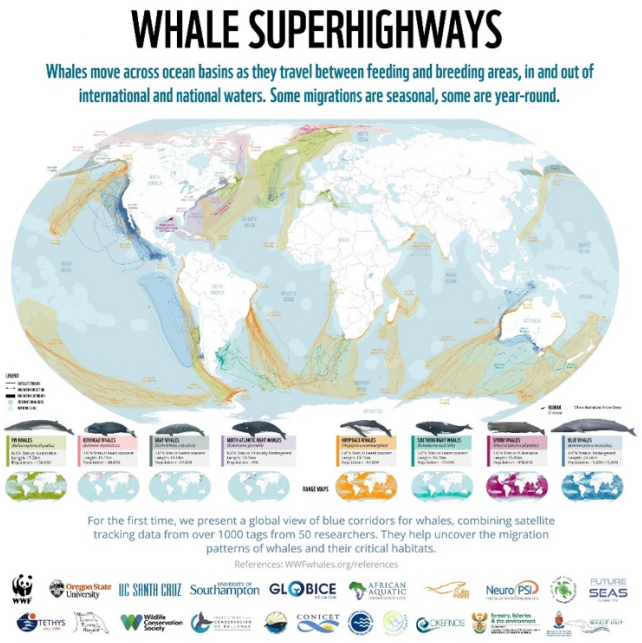
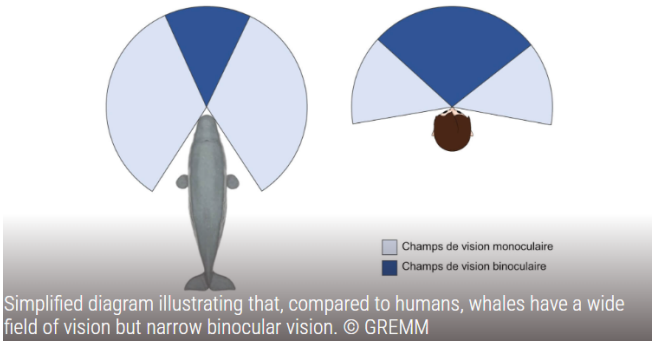


Fig. 1.

The implementation of these highways has been extremely instrumental in creating new policies to protect whales. For example, when ships are in areas located within the whale superhighway, they must travel at 10 knots so as to make sure that these gargantuan creatures have time to move out of the way. Another reason is that these creatures are color bind having only one cone of vision “which corresponds to a color between red and green, depending on the species.” Also, these creatures cannot see well in front of themselves as depicted in figure 3. Though the exact extent of their lack of vision is understudied, we can conclude that this is clearly a

major factor as to why whales may become entangled in the first place.



Simplified diagram illustrating that, compared to humans, whales have a wide field of vision but narrow binocular vision. © GREMM

Fig.2.

The effects of entanglement are that when a whale comes in contact with a fishing line it can wrap around important body parts that can hinder vital functions like breathing, feeding, reproducing, and swimming. This occurs when a whale accidentally knocks into a line becoming entangled. The whale will likely perform actions such as barrel rolls to remove the line, but in the process, it may actually manage to entangle itself further. The only tried and true method of removing these lines is to have them cut off by professional whale rescue crews, which is not a menial task. Overtime the fishing line manages to tighten around the whale which can impede blood flow and do to the abrasive nature of the fishing line tearing through whale blubber and leaving penetrating scars vulnerable to infection. The worst of these cases involved a whale off of the coast of British Columbia whose fluke had become completely severed {Figure 3}.

Fig.3.

What kinds of fishing gear do these whales find themselves entangled in? Using data collected from NOAA's National Whale Entanglements Records from 2017-2022, I concluded that the most common fishing gear whales find themselves entangled in are lines & buoys, nets, traps, and monofilament {Figure 4}.

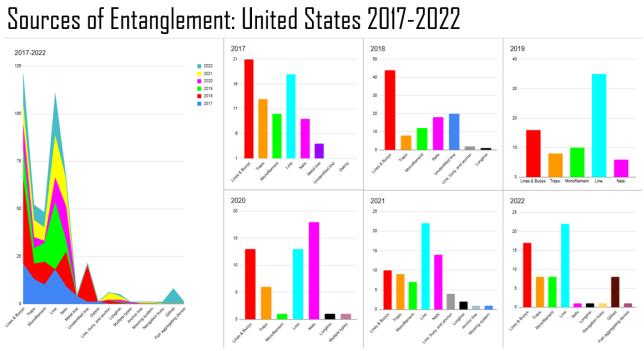


Fig. 4. The graph on the left of the diagram is an overview of all the data over the past 5 years, while the columns on the right of the diagram provide a year-by-year basis for the data. The Y-axis represents the total number of entanglements, and the X-axis represents the types of gear involved within the 5-year period of entanglements.

Lab Work

In this experiment Professor Werth and I wanted to test if entanglement affects the filter-feeding systems of baleen whales. The experiment involved the use of a flow tank that was composed of a motor, water chamber, and a water channel. In order to test this experiment, we placed a large rack of baleen within the water chamber and introduced plastic particles that would act like plankton being engulfed by a baleen whale. To simulate entanglement, we used ropes made of a variety of materials like nylon and wrapped it around the baleen which introduced a gap. In order to increase the size of the gap one of us pulled on the rope against the baleen, and in order to decrease the size of the gap we reduced the tension of the rope against the baleen. This gap was considered as we were observing the implications of entanglement. Then we turned on the engine which was connected to a propeller used to move water through the system. The motor had a low setting, medium setting, and a high setting. We started with the low setting which produced little to no results. Then we turned on the medium setting which we used for most of the experiment and began to notice that vortexes of water formed around the edges of the chamber and more particles were observed entering the gap. Next, we reduced the size of the gap which decreased the speed and intensity of the vortex and allowed less particles to flow through the gap. Finally, these results were recorded using a borescope controlled by the

other person during the experiment positioned in different angles around the baleen. These results conclude that some aspects of the natural mechanism involved in filter feeding used by the baleen whale were affected by the entanglement.

REFERENCES

Hook, B. (2023, May 31). Phenomenal Phytoplankton: Scientists Uncover Cellular Process Behind Oxygen Production. Scripps Institution of Oceanography. https://scripps.ucsd.edu/news/phenomenal-phytoplankton-scientists-uncover-cellular-process-behind-oxygen-production

Little, S., & Stanton, K. (2024, July 22). 'Gut-Wrenching' Photos Show Humpback Whale with Severed tail on B.C. Coast. Global News. https://globalnews.ca/news/10636849/humpback-severed-tail/

Holland, J. (2018, October 31). An Entangled Whale Tell-All. Hakai Magazine. https://hakaimagazine.com/news/an-entangled-whale-tell-all/#:~:text=The%20North%20Atlantic%20right%20whale,flipper%20and%20shredded%20her%20skin

Goldbogen, J. A., Cade, D. E., Calambokidis, J., Friedlaender, A. S., Potvin, J., Segre, P. S., & Werth, A. J. (2017). How Baleen Whales Feed: The Biomechanics of Engulfment and Filtration. *Annual Review of Marine Science*. https://doi.org/10.1146/annurev-marine-122414-033905