North Atlantic Right Whales: Can we Hope to 'Disentangle' them from their Status of Most Endangered Whale?

Extinction is a term most people are familiar with, but it is often overlooked when it comes up in news headlines. Many species across the world face the risk of disappearance, the North Atlantic right whale (NARW) being one of them. From being on the brink of extinction in 1935 to slowly recovering its population numbers after it became illegal to hunt them – NARWs have never had it easy (Kraus et al., 2016). However, since 2010, NARWs have experienced anthropogenic mortality due to fishing gear entanglement and other stressors plummeting their population (Kraus et al., 2016). Recent estimates show that fewer than 350 NARWs remain in the world today (NOAA, 2022).

Background Information on NARWs

NARWs (*Eubalaena glacialis*) are large-bodied cetaceans characterized by their generally black colouration and lack of a dorsal fin (NOAA, 2022). Perhaps a more recognizable feature of these whales is the white calluses (called callosities) found on their head, which occur due to whale lice (cyamids) residing on their skin (Lysiak et al., 2018). However, the callosity pattern of each right whale is unique, such that scientists can use them to identify individuals for conservation purposes (Lysiak et al., 2018).

NARWs are classified as baleen whales, meaning they have no teeth (NOAA, 2022). Instead, they have a series of keratinous plates (baleen) through which they strain large volumes of water to trap zooplankton for consumption (NOAA, 2022). Although NARWs can feed in the water column at any depth, they often dive to deeper levels to feed on small crustaceans (NOAA, 2022; Roman et al., 2016). When these whales frequent the surface to breathe, they defecate nutrient-rich feces that disperse rather than sink (Roman et al., 2016). This transport of nutrients to the surface enhances primary productivity, a process scientists termed "whale pump" (Roman et al., 2016). Overall, NARWs provide an essential ecosystem service of nutrient recycling (Roman et al., 2016).

The distribution of NARWs can range from the industrialized coastal waters of the Eastern United States (calving grounds) to Northern Canada (foraging grounds) (Lysiak et al., 2018). However, in their migratory path along North America's east coast, they can run into a myriad of fishing gear, which can cause death or injury (Lysiak et al., 2018). Given the life history traits of NARWs, this is problematic because population recovery upon a mortality-causing event will be slow (Oceana, 2022). Characteristically, these whales are slow to sexually mature and produce very few offspring in their lifetime (Oceana, 2022). These factors make these whales more susceptible to anthropogenic threats like fishing gear entanglement (Oceana, 2022).

The Entanglement Problem

In the past few decades, the entanglement of NARWs in fixed fishing gear has increased in severity and frequency (Lysiak et al., 2018). Fixed fishing gear can be described as stationary and anchored on one or more ends (Lysiak et al., 2018). Examples of such gear include pots,

buoys, vertical lines, traps, and gill nets (Lysiak et al., 2018). Gear entanglement can cause immediate mortality or become chronic when whales carry away all or some of the gear leading to sub-lethal consequences (Lysiak et al., 2018).

A 2018 study looked the how exactly chronic gear entanglement affects the normal body functions of NARWs (Lysiak et al., 2018). In this post-mortem retrospective study, a female NARW (Eg2301) was examined (Lysiak et al., 2018). Since a whale's baleen continually grows throughout its life in seasonal variations, it was the tissue analyzed in this study (Lysiak et al., 2018). From the baleen tissue of Eg2301, researchers longitudinally sampled a panel of steroid hormones (an indicator of stress response), thyroid hormones (an indicator of energy expenditure), and stable isotopes (an indicator of migration behaviour) to yield an 8-year chemical profile for Eg2301 (Lysiak et al., 2018). Eg2301 was first detected with gear entanglement in June 2004, where the rope was observed to be obstructing its mouth and interfering with its ability to feed (Lysiak et al., 2018). However, the chemical profile showed that 3 months before entanglement detection, Eg2301 began to exhibit an elevated stress response, increased energy expenditure (likely to compensate for increased drag caused by entangled gear), and significant catabolism of blubber lipid (a process which occurs in the absence of active feeding) (Lysiak et al., 2018). From these results, scientists were able to deduce that Eg2301 was entangled in gear for about 9 months, a period longer than they expected, and experienced significant, prolonged starving conditions before its death (Lysiak et al., 2018). This study exhibits that gear entanglement events are often underestimated in duration and can lead to severe consequences in the affected individual.

These chronic gear entanglement incidents that affect individual fitness can go on to impact the viability of the whole population. A 2021 study demonstrates that entanglement in fishing gear is associated with shunted body growth (Stewart et al., 2021). To evaluate how NARW body size has changed in recent years, researchers collected body length measurements using aerial photogrammetry over 20 years (Stewart et al., 2021). The whales included in this study were well-documented and born between 1981 and 2019 (Stewart et al., 2021). Data analysis of age and length indicated that NARWs born in recent years are about 7% shorter than whales born in the 1980s (Stewart et al., 2021). The results of this study indicate that this length reduction could be attributed to the increasing rates of entanglement the NARW population had begun to experience since 2010 (Stewart et al., 2021). Decreased body size is problematic because shorter whales have lower reproductive success and an increased probability of facing a lethal entanglement event (Stewart et al., 2021). These findings show that the sub-lethal effects of gear entanglement can significantly threaten the growth of a population in dire need of recovery.

Entanglement in fishing gear, as described above, is one of the biggest threats to NARW abundance growth and recovery. To fully understand the impact of this anthropogenic threat, a 2018 study estimated the population trajectory of NARWs in the absence of entanglement mortality and serious injury (M&SI) (Kenney, 2018). The researcher assumed that all entanglement M&SI was 0 every year and modelled NARW abundance from 1990 to 2016 (Kenney, 2018). This population trajectory was compared to a baseline model of NARW

abundance (Kenney, 2018). It was discovered that the 2016 NARW abundance estimate was 24.6% greater in the absence of entanglement M&SI compared to the baseline model (Kenney, 2018). This study demonstrates that the NARW population would be in much better condition without the threat of entanglement.

Solutions to the Entanglement Problem

Even though NARWs are currently classified as endangered, there is hope that they can be 'disentangled' from this status through the conservation efforts currently underway (NOAA, 2022). Many organizations, like the National Oceanic and Atmospheric Administration (NOAA), are working with policymakers and fishermen to develop and implement recovery plans for the NARWs (NOAA, 2022). At the same time, scientists are concentrating their efforts on providing field research and data that could aid in this initiative. Although the entanglement problem cannot be fully eradicated, its impact on the population of NARWs can be reduced.

An important aspect of the entanglement problem is the strength of the fishing gear ropes. Previous research demonstrates that a lethal or sub-lethal entanglement event occurs because the whale is unable to break free of the rope (Knowlton et al., 2015). To better understand the relationship between rope strength and entanglement outcome, a 2015 study examined ropes recovered from live and dead whales (Knowlton et al., 2015). For each rope, researchers measured diameter, polymer type, and breaking strength (Knowlton et al., 2015). Rope properties were then compared to individual whale characteristics (i.e., life history, severity of injury, and entanglement configuration) (Knowlton et al., 2015). The results showed that injury severity increased with rope strength (Knowlton et al., 2015). Ropes derived from adult NARWs relative to juvenile NARWs were also greater in strength (Knowlton et al., 2015). In other words, adult NARWs were not found in weaker ropes because they could break them, unlike juvenile NARWs, who could not overcome the rope strength and died (Knowlton et al., 2015). More importantly, the researchers concluded that using ropes with a breaking strength of 1700 lbs or less could decrease entanglement mortality by 72% (Knowlton et al., 2015). Since most forces involved in current fishing operations are less than 1700 lbs, this reduction in fishing line strength will also not harm fisheries (Knowlton et al., 2015). Overall, this study presents gear modification as a solution to the entanglement issue.

While decreasing rope strength is a preventive measure, scientists have also made progress in whale disentanglement techniques. NARWs often have the lowest success rate when disentanglement techniques requiring the whale to be physically restrained are used because they are not very tractable (Moore et al., 2010). For this reason, scientists prefer to use an approach involving sedation to safely disentangle the whale (Moore et al., 2010). A study conducted in 2010 attempted to develop a chemical sedative to enhance fishing gear removal from NARWs (Moore et al., 2010). The researchers performed trials on moribund beached whales to determine an effective protocol for drug use and delivery that still allowed the whale to voluntarily respire and swim (Moore et al., 2010). The researchers successfully administered this sedative through darts to two entangled right whales and freed them from the gear entangling them (Moore et al., 2010). This study depicts a safe and effective method by which mortality due to entanglement can be reduced.

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