



Mass strandings of seven toothed and baleen whale species in Northern Norway in March 2020 call for further investigation

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Abstract

Monitoring whale strandings are a key aspect of ecosystem management as stranded animals can provide indications on ecosystem health, pollution and adverse effects due to anthropogenic activities. Most mass mortality events are reported for toothed whales and rarely involve baleen whales. In the course of one month in spring 2020, 17 whales belonging to seven different species, stranded on the shores of Northern Norway, above the Arctic circle. This multi-species event included humpback (*Megaptera novaeangliae*), fin (*Balaenoptera physalus*) and sperm whales (*Physeter macrocephalus*), that were accompanied by northern bottlenose whales (*Hyperoodon ampullatus*), a white-beaked dolphin (*Lagenorhynchus albirostris*), a long-finned pilot whale (*Globicephala melas*) and a harbour porpoise (*Phocoena phocoena*). We discuss some potential causes of death based on the previous literature and available information for the area, highlighting the need for further investigation on cetacean strandings at high latitudes. Ultimately, the reasons for the stranding could only be identified by a thorough examination of all the animals, which was unfortunately not conducted. As the threats to polar ecosystems and access to local shores are likely to increase, reports of cetacean mortality are also expected to surge, particularly in high latitude regions where climate variations and anthropogenic activities are increasing. This study makes recommendations for future steps and considerations for monitoring networks and standardized sampling methods for future marine mammal stranding events. Finally, we suggest that national and international efforts based on the collaborative relationships are implemented, considering the multiple facets of animal ecology and health as an achievable step in the near future.

Keywords Whale conservation · Mass strandings · Norwegian Arctic · Monitoring · Network

Introduction

Whale strandings are common globally, although to date there are still many challenges in identifying their cause. Large mass mortality events (MMEs), in particular, tend to involve toothed whales and are considered rare in baleen whales due to their less gregarious behaviour (Perrin et al. 2009). MMEs of baleen whales have often extended over several months and large areas, involving mostly coastal whales. Multi-species strandings are even more rare and

indicates that some complex event may have happened that disrupted this species' habitat.

In March 2020, seventeen large whales (four humpback *Megaptera novaeangliae*, one fin whale *Balaenoptera physalus*, one unidentified, and six sperm whales *Physeter macrocephalus*) stranded on the beaches of Northern Norway (Fig. 1). The event took place over the course of 29 days and was accompanied by additional strandings of two northern bottlenose whales (*Hyperoodon ampullatus*), a white beaked dolphin (*Lagenorhynchus albirostris*), a long-finned pilot whale (*Globicephala melas*) and a harbour porpoise (*Phocoena phocoena*) (Bjørge et al. 2020; Johansen 2020a).

The location of the strandings, the Lofoten-Vesterålen archipelago, is known for its marine biodiversity richness, and sustains an important male sperm whale foraging ground at the continental shelf edge (Madsen et al. 2002). Humpback whales are often sighted during the winter months, although sporadic sightings have also been reported throughout the year (Jourdain and Vongraven 2017; Ramm 2020;

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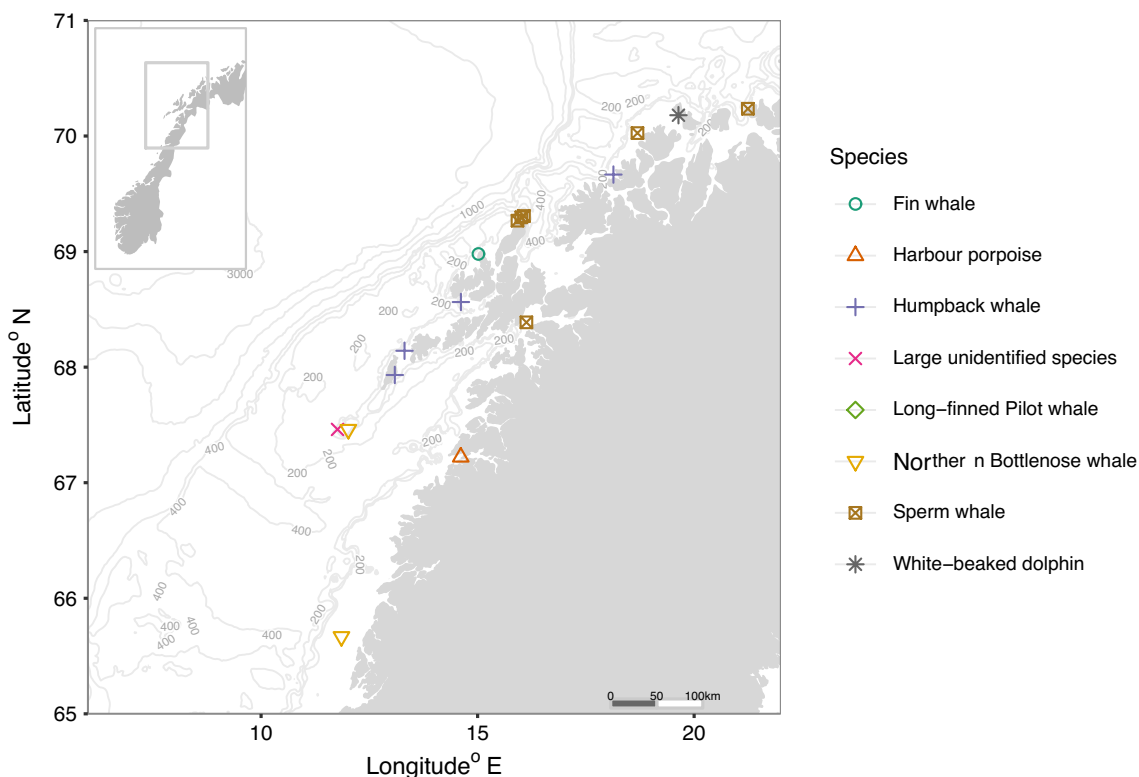


Fig. 1 Map with the sites where the majority of stranded whales were found (based on Bjørge et al. 2020). Note: only one reported sighting was located in southern Norway

Aniceto et al. 2020). Bottlenose whales and fin whales are assumed uncommon in the region, although fin whale vocalizations and visual observations have been reported during winter and summer, respectively (Øygard 2018; Leonard and Øien 2020). Minke whales (*Balaenoptera acutorostrata*) and killer whales (*Orcinus orca*) are also often sighted during that period of the year though none were found. Killer whale high mobility in the Norwegian Sea (Dietz et al. 2020) following the Norwegian Spring Spawning herring (*Clupea harengus*) migration (Similä et al. 1996; Kuningas et al. 2014; Vogel et al. 2021) or Atlantic Mackerel (*Scomber scombrus*) (Nøttestad et al. 2014) could have spared these animals from a similar fate.

Strandings of large whales in Norway are not uncommon. The seasonal presence of large densities of humpback whales during the winter (Broms et al. 2015; Jourdain and Vongraven 2017), and residency of sperm whales (Rødland and Bjørge 2015) in the region, together with an increase in the awareness of their presence in small localities, raise the chances of strandings being detected and reported. However, the last recorded mass-stranding of whales in this region occurred in the late 80s (Christensen 1990) where the author concluded that the animals had not died in Norwegian waters, but rather drifted from other locations around the North Atlantic. Similarly, the specimens in 2020 also appeared to be already deceased during the

event and presented different degrees of decomposition (see Dahlen and Christoph Noever 2020). Yet, both the humpback and sperm whales were observed to be relatively fresh (no signs of external decomposition or breakage of the outer tissue) and appear to have originated from the Norwegian Sea, West of the Lofoten islands (Johansen 2020a). The overarching goal of this review is to increase awareness of this events globally and prioritize management and conservation actions.

Materials and methods

We review a mass stranding event occurring in Northern Norway in 2020 (as reported by Bjørge et al. 2020), highlighting potential causes and respective counterarguments for the deaths of baleen and odontocete species based on the previously reported global events. We briefly summarize evidence from historical studies on different cetacean species and identify features and common causes for stranding.

Results and discussion

As whales are considered sentinels of the marine ecosystem, they are globally exposed to multiple stressors. Ship strikes, by-catch, anthropogenic noise, chemical pollution

and habitat loss (Clapham et al. 1999; Bossart 2011) are some of the most predominant causes for mortality. Moreover, since ocean conditions directly influence quality and availability of prey, the effects of climate change are a raising concern (Simmonds and Isaac 2007; Häussermann et al. 2017). Threats to marine ecosystems and human access to local shores are likely to increase, which may lead to a surge in reports of strandings. Whale strandings can not only provide information on the individual cause of death, but also information on animal biology, oceanographic drifting, and changes in the marine environment. Although the cause of mortality of cetaceans cannot often be conclusively identified (Gulland et al. 2005; Coughran et al. 2014), some baleen whales and multi-species mortality events have been linked to bio-oceanographic conditions, such as harmful algal blooms (HABs) (Fire et al. 2010; Lefebvre et al. 2016; Wilson et al. 2016; Häussermann et al. 2017). In this assemblage, all individuals could not be tested for viruses or bacteria, due to the quick intervention of the coast guard for removal of the carcasses and the delayed response by sampling teams. Although there was no clear/visible evidence of pathological modifications that could be attributed to such a cause (see Dahlen and Christoph Noever 2020), it is not possible to discard this hypothesis without further investigation. Satellite imagery from the time was not possible to obtain due to strong cloud coverage (Johansen 2020b). Furthermore, offshore winds were very predominant (Met. no 2020) and can also allude to a cause of the mass mortality found in Norway. Strong and persistent wind and storm events may cause strandings through disorientation, confused navigation due to bathymetric conditions, distraction from feeding activities, or additional energetic costs (Vanselow and Ricklefs 2005; Evans et al. 2005; Pierce et al. 2007). The unusual strong winds towards land could indeed have brought to shore animals that died of different causes and at different periods of time, raising questions about the number of dead animals unaccounted for in Norwegian waters. Also, winds can boost marine productivity and may result in a net movement of cetaceans following their prey towards the same location; thereby, increasing the number of whales available to strand in the region (Evans et al. 2005). However, a 25-year study on humpback whale strandings in Australia showed that most of the stranded whales were calves and juveniles and suggests that mortality due to weather events seems to be less likely than mortality due to effects of human activity or water quality (Meynecke and Meager 2016). The only potentially lethal sound-related mechanism for a baleen whale are very intense noises associated with blasting in close proximity (Ketten 1995). This could injure the animal and cause hemorrhage or provoke panic, displacement, favor entrapment (Goldbogen et al. 2013) and

even decompression sickness (Bernaldo De Quirós et al. 2019). Military activity in the region has been reported in national news (Skeie and Sörgård 2020), although there has been unclear information concerning any activities during that period of time. In addition, air-gun shooting for petroleum exploration did not occur in the region nor during that period of time (Oljedirektoratet 2020). The strongest argument against the hypothesis that intense noise is the cause of the stranding, is the lack of evidence as we could find only a single reported stranding of baleen and odontocete species at the same time due to military sonar (Balcomb III and Claridge 2001). The most likely answer to the question “why have the whales stranded?” would be through a thorough examination of all the carcasses, which was unfortunately not performed at the time.

In the case of the Northern Norwegian stranding events here discussed it was not possible to conclude a cause of death and the hypotheses mentioned above are for now only speculative. Yet, as we experience borealization of species and increased interactions with anthropogenic activities, we urge national and international authorities globally to intervene and assess the causes and implications of all stranding events. Although this study does not account for cumulative threats to marine mammals, we recognize that there is a multitude of combined natural and anthropogenic contributors to ecosystem alteration. Similarly, we recognize that there are several stranding events that occur naturally over time, although it is important to emphasize that the absence of strandings in a region does not implicate an absence of deaths due to external pressures (i.e., absence of evidence does not mean evidence of absence). The establishment of an integrative stranding network at a national level is, therefore essential for long-term assessments of change in marine ecosystems and governance initiatives. Such network is already underway, which signifies a great incentive to improve management and conservation efforts. However, quick response teams are still under multiple nonprofit organizations and the lack of integration of efforts is an issue that we advise being tackled sooner rather than later.

We therefore make the following recommendations: 1) Establish regular workshops and discussions amongst stakeholders (scientists and management institutions, such as the International Whaling Commission and the North Atlantic Marine Mammal Commission), in collaboration with maritime security agencies (Norwegian coast guard) to provide a better integration amongst institutions and allow results to be brought to the governance level; 2) Develop a unified reporting system that will allow for quick and thorough response for local teams with standardized sampling methods and metrics; 3) Create a single database for stranding events that allows for the national scientific community to work more collaboratively on improving the current knowledge of marine mammal wildlife. It is important to

consider the need for a multidisciplinary approach, including toxicologists, oceanographers, acousticians and ecologists among others, to broaden the scope of the network, solve the causes of stranding, and cover the long Norwegian coastline. Finally, we recognize that complexity-focused approaches to marine mammal research and conservation are poised to advance (Lewison et al. 2018), and suggest that national and international efforts based on the collaborative relationships are implemented, considering the multiple facets of animal ecology and health as an achievable step in the near future.

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Authors' contributions ASA, LT, and PB conceptualized and designed this review. ASA procured information on the stranded animals. ASA led the writing of the manuscript with input of LT, AR and PB. All authors approved the submitted version.

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Availability of data and material All data and material used in this study are available upon request to the corresponding author.

Declarations

Conflict of interest The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest. Furthermore, there were no non-financial conflicts in the development of this study.

Consent for publication All authors consent to the publication of this manuscript.

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