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Status of North Atlantic right whales: an update

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North Atlantic right whales (*Eubalaena glacialis*) continue to decline in number (Pettis et al. 2018). The best current estimate of their abundance is 411 (95% Bayesian credible intervals 389-430) individuals alive at the end of 2017¹, down from an estimate of 451 at the start of 2016. No calves were observed to be born in 2018, down from five in 2017, and 14 in 2016 (Pettis et al. 2018). To date (late February 2019), seven calves are known to have been born in the winter 2019 season.

In 2017, 17 right whale mortalities were documented, and in 2018, a further three whales were found dead. Of the twelve right whale carcasses were found in Canadian waters in 2017, the six for which a necropsy determination could be made died as a direct result of human activities (either definitely or probably), from either entanglement in fishing gear, or vessel strikes (Daoust et al. 2017). Of the eight carcasses found in US waters in 2017-2018, the cause of death of six could be determined, and all of these were attributable to anthropogenic causes. NMFS has declared the observed deaths to constitute an Unusual Mortality Event (UME), the website for this UME is:

<https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2019-north-atlantic-right-whale-unusual-mortality-event#causes-of-the-north-atlantic-right-whale-ume> .

In response to the observed mortalities in the Gulf of St Lawrence in 2017, in 2018 the Government of Canada announced a series of management measures designed to reduce the risk that North Atlantic right whales in the Gulf of St Lawrence would die as a result of human activities

(<https://www.canada.ca/en/fisheries-oceans/news/2018/03/government-of-canada-unveils-its-plan-for-protecting-north-atlantic-right-whales-in-2018.html> , <https://www.canada.ca/en/fisheries-oceans/news/2018/03/government-of-canada-unveils-its-plan-for-protecting-north-atlantic-right-whales-in-20180.html>). In 2018, no right whale carcasses were detected in Canadian waters, despite substantial survey effort. For 2019, similar management measures are to be enacted, albeit with some modifications (e.g. changes in the area of a static fisheries closure) (<http://www.dfo-mpo.gc.ca/species-especies/mammals-mammiferes/narightwhale-baleinenoirean/fm-gp/index-eng.html>).

Evidence is strengthening that the apparently increased occupancy of the Gulf of St Lawrence by North Atlantic right whales is in response to prey shifts, which are driven by ecosystem changes, that are in turn a result of climate disruption (Meyer-Gutbrod and Greene 2017; Meyer-Gutbrod et al. 2018).

The evidence that chronic entanglement in fishing gear is a significant physiological stressor of North Atlantic right whales is also becoming clearer. Chronically entangled right whales exhibit levels of fecal glucocorticoids an order of magnitude greater than those recorded from apparently healthy, non-entangled conspecifics (Rolland et al. 2017). Hormone samples from baleen corroborate this finding, with the indication that corticosterone, rather than cortisol, is an indicator of chronic stress from entanglement (Hunt et al. 2017, 2018, Lysiak et al. 2018). Entanglement has been identified as a

¹Estimate derived by subtracting 17 known deaths that were observed during 2017 from the model-based estimate of 428 (406-447) calculated for the start of 2017.

significant animal welfare issue previously (e.g. Moore and van der Hoop 2012). A recent review calls for greater consideration of the welfare issues of bycatch and entanglement generally, using North Atlantic right whales as an exemplar of the problem of entanglement (Dolman and Moore 2017). Another suggests that, along with the extinction risk that it poses, the welfare issues raised by bycatch of North Atlantic right whales should be managed seriously (Moore 2019).

Two recent studies have assessed the extent to which the recovery of North Atlantic right whales has been constrained by anthropogenic mortality. Both took 1990 as a starting point. One, using a simple additive approach, estimated that, had fisheries mortality since 1990 not occurred, the species could have been at an abundance of up to approximately 30% more than it was in 2016 (Kenney 2018). The other, based on a matrix population model, estimated that, had North Atlantic right whales increased at the maximum possible rate, (based primarily on a mark-recapture time series, Pace et al. (2017)), there would have been 75% more female North Atlantic right whales alive in 2015 than there were (Corkeron et al 2018). Both papers are clear in their findings that anthropogenic mortality has slowed the recovery of North Atlantic right whales over the past few decades, even prior to the current decline.

In conclusion, our understanding of the processes driving the recent decline in the abundance of North Atlantic right whales improved thanks to scientific work published in the past couple of years. Whales' movement ecology has changed in response to shifts in prey distribution, driven by climate disruption. Anthropogenic mortalities and morbidity are the primary proximate causes of the poor calving success, and the chronically low annual survival of North Atlantic right whales. The initial indications of the success of management actions taken by Canadian authorities in the Gulf of St Lawrence in 2018 suggest that deleterious anthropogenic activities can be mitigated when government agencies responsible for conservation implement meaningful measures that significantly reduce mortality.

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