



Recent Scientific Publications Cast Doubt on North Atlantic Right Whale Future

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The North Atlantic right whale, *Eubalaena glacialis*, was near extinction by 1935, when whaling for this species became illegal. In 1992, 295 right whales were estimated alive (Knowlton et al., 1994), and growth from 1990 to 2010 averaged 2.8% per year (Waring et al., 2016), bringing the population to about 500 individuals in 2015 (Pettis and Hamilton, 2015). However, since 2010, calving rates have dropped by nearly 40%, and the last four decades have seen increasing numbers of right whales killed by entanglements in fishing gear and collisions with ships combined (Knowlton et al., 2012; Van der Hoop et al., 2013; Pace et al., 2014). Recent U.S. and Canadian regulatory actions (slowing ships and moving shipping lanes) appear to have been successful at reducing ship kills (Laist et al., 2014; Van der Hoop et al., 2015).

However, the National Marine Fisheries Service (NMFS) draft 2015 marine mammal stock assessment for right whales reports that between 2009 and 2013 an average of 4.3 right whales were killed by human activities each year, with nearly all of these deaths attributable to entanglement in fishing gear (Waring et al., 2016). For context, from 1970 to 2009, 44% of diagnosed RW mortality cases were due to ship kills and 35% were due to entanglements (Van der Hoop et al., 2013). From 2010 to 2015, 15% of diagnosed right whale mortalities were due to ship kills and 85% were due to entanglements (Pettis and Hamilton, 2015; Waring et al., 2016). In January of 2016, an announcement on expanded critical habitat for right whales included this quote, “We’re making significant progress in reversing the population decline of the species, and are seeing signs of recovery” (NOAA, 2016). In contrast to this optimistic view of right whale recovery, our review of the recent science suggests that fishing gear entanglements are increasing in number and severity, and that this source of injury and mortalities may be overwhelming recovery efforts.

Almost four decades of research based on the ability to identify individual whales has yielded immense amounts of information about this population’s biology. The right whale catalog and sightings database provide information on the age and sex of individuals, movements and habitat use patterns, reproduction, mortality, and the impacts of human activities on the population (Hamilton et al., 2007). Multiple research programs run concurrently on genetics, endocrinology, health, feeding, stress, and acoustics in many institutions (Kraus and Rolland, 2007). From these large datasets, mathematical models that describe trends in population growth and demographics as well as the effects of human activities on health and mortality have been developed (Schick et al., 2013; Robbins et al., 2015; Rolland et al., 2016).

Since 1980, the leading causes of mortality in right whales have been collisions with ships and entanglements in fishing gear, which combined caused half of the 99 confirmed right whale deaths (Van der Hoop et al., 2013). That estimate is a minimum, since the other half includes natural

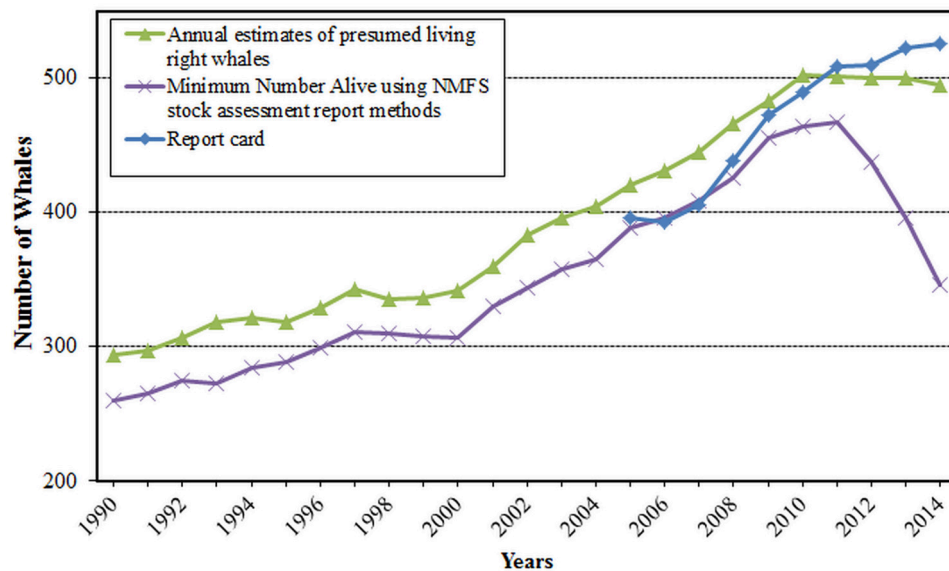


FIGURE 1 | Assessments of the North Atlantic right whale population based on three available assessment methods (from Pettis and Hamilton, 2015); (<http://www.narwc.org/pdf/2015%20Report%20Card.pdf>).

mortalities and deaths where the cause could not be determined, and not all dead whales were discovered. Since U.S. NOAA regulations lowered ship speed limits in the vicinity of right whale habitats in 2008, deaths from vessel strikes have declined (Laist et al., 2014; Van der Hoop et al., 2015). In contrast, despite a nearly 20-year US federal effort to reduce accidental kills of whales in fishing gear, sub-lethal and lethal entanglement rates have increased (Van der Hoop et al., 2013; Arthur et al., 2015; Knowlton et al., 2015), and there is no evidence that current fishing regulations have been effective at reducing mortality (Pace et al., 2014). As of 2015, 83% of all right whales display scars or carry ropes indicative of past entanglements. Sub-lethal entanglements can cause reproductive failure and declining health long after the entanglement is over (Rolland et al., 2016; Van der Hoop et al., 2016).

Attempts at population viability analyses on right whales have largely failed due to the dual complications of capture heterogeneity (in tag-recapture population assessments) and small sample sizes. There are however early indicators of population well-being, including health assessments, scarring rates and frequencies, reproductive rates, and necropsy data, all of which precede changes in population size and demographics, and all of which indicate declines in this population (Knowlton et al., 2012; Pettis and Hamilton, 2015; Rolland et al., 2016).

From this extensive research, three points emerge. One, until recently, the population was growing at 2–3%/year (Waring et al., 2016), although this rate is less than one-half of the growth

rate (6–7%) of all other well-studied right whale populations around the world (Best et al., 2001). Two, in recent years, population growth rates appear to be declining (Figure 1), likely due to a combination of anthropogenic mortalities and reduced calving rates (Kraus et al., 2007; Pettis and Hamilton, 2015). Three, mortalities and serious injuries from fishing gear entanglements remain far higher than the limits mandated by US Endangered Species Act and Canadian Species At Risk Act regulations, further jeopardizing recovery and leaving the population vulnerable to declines (Knowlton et al., 2015; Waring et al., 2016).

In conclusion, right whales are not yet a conservation success story. Right whales need immediate and significant management intervention to reduce mortalities and injuries from fishing gear, and managers need a better understanding about the causes of reduced calving rates before this species can be considered on the road to recovery. Failure to act on this new information will lead to further declines in this population's number and increase its vulnerability to extinction.

AUTHOR CONTRIBUTIONS

All authors have a long history (>20 years) of research and significant contributions to right whale research in the North Atlantic. In the context of this paper, all authors have contributed data, analyses, writing, and editing, as well as conceptual development to this submission.

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Conflict of Interest Statement: 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.

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