Marine Policy 68 (2016) 91–99

Contents lists available at ScienceDirect

Marine Policy

journal homepage: www.elsevier.com/locate/marpol

Mitigating vessel strikes: The problem of the peripatetic whales and the peripatetic fleet

Julie Reimer [a,*], Caroline Gravel [b,1], Moira W. Brown [c,d], Christopher T. Taggart [e]

[a] Marine Affairs Program, Dalhousie University, 1355 Oxford St., PO Box 15000, Halifax, NS, Canada B3H 1R2
[b] Shipping Federation of Canada, 300 St. Sacrement Street, Suite 326, Montreal, QC, Canada H2Y 1X4
[c] Canadian Whale Institute, 20 Morning Star Lane, Wilson's Beach, NB, Canada, E5E 1S9
[d] New England Aquarium, Central Wharf, Boston, MA 01969, United States
[e] Oceanography Department, Dalhousie University, 1355 Oxford Street, PO Box 15000, Halifax, NS, Canada B3H 4R2

ARTICLE INFO

Article history:
Received 5 January 2016
Received in revised form
19 February 2016
Accepted 19 February 2016
Available online 24 March 2016

Keywords:
Baleen whales
Real-time alerts
Vessel strikes
Fleet receptivity
Right whale

ABSTRACT

A survey questionnaire designed to determine mariner knowledge and awareness of endangered whales, existing conservation measures, and mariner receptivity to near real-time conservation technology on the bridge is herein reported. The survey, distributed by the Shipping Federation of Canada, yielded 43 responses. The majority of respondents were interested in receiving information on endangered whales and conservation measures in eastern Canada and USA Gulf of Maine regions (72% and 79%, respectively). Eighty-four percent of respondents indicated a preference for receiving whale alerts via Navigational telex (NAVTEX) and 79% listed NAVTEX as the most "not disruptive" means of receiving the alerts. A similar 72% also listed Automatic Identification Systems (AIS) as "not disruptive", and 58% identified AIS as the preferred reception format. The results show that the commercial fleet is moderately receptive to near real-time whale alerts on the bridge. It is concluded that to better understand mariner willingness to participate in whale conservation, researchers should consider defining the response required of mariners when receiving such alerts. The results also suggest that future conservation programs should use communication formats that are most familiar to, and favoured by, mariners while being the least disruptive to bridge protocols; i.e., NAVTEX and AIS.

1. Introduction

1.1. Anthropogenic threats to baleen whales

The life histories, ecological requirements, behaviors and spatial distributions of baleen whales result in chronic exposure to various anthropogenic threats. Despite attempts to mitigate the threats, some continue to hinder the recovery of endangered baleen species. The two most prominent threats are entanglement in commercial fishing gear and lethal vessel strikes [1–3]. Some species are more prone to these threats due to habitat requirements and behavior [4]. While each threat represents a considerable impediment to survival and population recovery for endangered species, the latter issue, vessel strikes, is the focus of much research.

Vessel strikes are recognized by the International Whaling Commission as a worldwide threat to large whales and a leading cause of whale mortality [2] that has been studied in the Northern and Southern hemispheres of both the Atlantic and Pacific oceans [5]. In all oceanic regions the risk of vessel strike represents a pressing conservation issue, although the magnitude of the risk depends on the relative distributions of the vessels and the whales, and from a management perspective the whales' conservation status. Vessel strikes, particularly in the NW Atlantic, have been well-documented and addressed relative to the Southern Hemisphere [5]. In the NW Atlantic, where six species of baleen whale are resident at certain times of the year, vessel strikes are a leading cause of mortality and population suppression [4], despite the implementation of several conservation measures.

1.2. Baleen whales of the Northwest Atlantic

The six species of baleen whales in the NW Atlantic that make northward migrations to feed between the months of May and December [1,6] include blue (*Balaenoptera musculus*), minke (*B. acutorostrata*), sei (*B. borealis*), fin (*B. physalus*), humpback (*Megaptera novaeangliae*), and right (*Eubalaena glacialis*) whales. Theses whales are afforded varying levels of protection throughout their migratory range because the population status among

* Corresponding author.
E-mail address: juliereimer2@gmail.com (J. Reimer).
[1] Current address: Université de Montréal, C.P. 6128, Succursale Centre-ville, Montréal QC, Canada H3C 3J7.

http://dx.doi.org/10.1016/j.marpol.2016.02.017
0308-597X/

species differs between Canadian and American waters.

Blue and right whales are listed as 'endangered' in Canada under the Species at Risk Act, SARA; [7], and fin whales are listed as 'special concern'. In the United States of America (USA), blue, fin, sei, humpback, and right whales are listed as 'endangered' under the Endangered Species Act, ESA; [8]. Minke whales are not listed under either Act. Despite the discrepancies, conservation measures instituted by each nation are largely focused on protecting the endangered right whale. Although various measures have been implemented to help protect the right whale, they are assumed to also afford protection of other baleen whales [9,10]. Vessel strikes are a threat to all baleen whales, and strikes involving the above whales are relatively frequent in the NW Atlantic [11,12]. The enhanced focus on the right whale in the NW Atlantic stems from it being the most historically depleted baleen species, and on a world-wide per capita basis, suffers more vessel strikes than the other species [13].

1.3. Existing conservation measures

Over the past decade various agencies collaborated to implement several conservation measures in the NW Atlantic to reduce the lethal risk of vessel strikes to right whales (Appendix A). Canada implemented an amendment to the International Maritime Organization (IMO) adopted Traffic Separation Scheme (TSS) in the Bay of Fundy and a voluntary Area to Be Avoided (ATBA) in Roseway Basin on the Scotian Shelf [10,14] and coincidently identified critical habitat [10] for both regions. Along the east coast of the USA, conservation measures include Mandatory Ship-position Reporting, mandatory vessel-speed restrictions, recommended routes, and Seasonal and (or) Dynamic Management Areas (SMAs and DMAs respectively) [12,14,15]. Many of these measures have been successful in reducing vessel-strike risk to right whales through altering the probability of vessel-whale co-occurrence or by reducing the lethality of strikes through vessel speed restrictions [12,14,16]. However, some of these measures, including speed restrictions, have not been overly successful in achieving compliance amongst vessel operators [17,18]. The degree of success across conservation measures is not equivalent, as each measure relies on an informed, cooperative, and compliant fleet.

Compliance can be determined by several factors including the knowledge of regulations and the severity of consequences for non-compliance that is related to the costs and benefits of compliance [19–21]. The shipping industry can experience considerable costs when complying with regulations prescribed for the protection of whales [22]. Despite costs, some conservation measures in the Northwest Atlantic (NWA) have been effective in reducing strike risk to baleen whales, and right whales in particular, due to a highly compliant fleet and cooperative industry [14]. If conservation information is presented as a collaborative endeavor between industry and conservation agencies, mariners may be more likely to comply with new measures. Moreover, the commercial shipping industry is inherently peripatetic and the effectiveness of existing conservation measures may be hindered by their contrastingly stationary approach to management of whale species that are also inherently peripatetic, and perhaps increasingly so.

1.4. Emerging conservation technologies

Whale conservation initiatives have typically resulted in semi- or permanent spatially-defined coastal regions [20] under the implicit assumption that the whales would continue to aggregate in the defined regions and make use of defined migration corridors. In Canada, no conservation measure seeks to relay near real-time information to mariners regarding the locations of large whales in the NWA. In the USA, near real-time information on right whale presence is available near the port of Boston [21] and in the southeast via the Early Warning System for right whales [23]. However, as whales respond to environmental change, migration patterns and regional residency can become less predictable [24], and thus conventional protection measures (e.g., spatially fixed regions) may fail to provide sufficient protection. Further, the expansion of protection regions throughout the range of the whales is currently an untenable option. Since whale distributions are heavily influenced by the availability of food [25], and prey species are influenced by environmental variability, the distributions of whales may change as prey acclimate to seasonal or climate variations. Therefore, the risk of vessel strike is likely to persist and may worsen as whale movements and aggregations become less predictable while remaining at risk from the fleet. Near real-time measures may improve the effectiveness of mitigating vessels strikes as it is more adaptable than existing spatially fixed measures assuming the fleet can adequately respond to changes in whale distributions. Such measures are technically feasible and may provide improved protection over greater swaths of whale habitat. Near-real time conservation may be achieved by linking passive acoustic monitoring (PAM) technology to vessel communication technology.

In recent years, researchers have been addressing large whale conservation with acoustics [20,26,27]. PAM systems make use of acoustic technology and processing systems to classify some large whale species and their habitats by using identifiable whale sounds. Conventional PAM devices collect and store acoustic data while moored in some fixed location in the ocean and the data cannot be analyzed until such devices are recovered [28]. These data are thus not applicable in near real-time and do not address the disconnect between mobile vessels, mobile whales, and stationary conservation measures. Some fixed PAM moorings are used for near real-time whale detections in the Boston TSS [21,29]. To address the mobile whale issue, Baumgartner et al. [30] proposed the use of autonomous underwater vehicles (AUVs) i.e., ocean gliders, to process, classify, and report acoustic detections of four baleen whales species in real-time. When paired with communication technologies used by the commercial shipping fleet, sending such reports on whale locations to the bridge of a vessel in near real-time can be imagined.

Professional mariners regularly receive information on navigational hazards, weather conditions, and other marine activities through several media that are used variably among mariners (Appendix B). These media include Very High Frequency (VHF) radio, the Automatic Identification System (AIS), and Navigational Telex (NAVTEX). In addition, Canada channels information via various media that include Marine Communications and Traffic Services (MCTS) operated by the Canadian Coast Guard (CCG) through VHF, Notices to Mariners (NOTMAR), bridge placards, and navigational charts. While some of these media are inappropriate for communicating near real-time information, others can feasibly transfer information on whale locations from ocean gliders to the bridge. Two questions arise: (1) are mariners willing to use such near real-time information if/when received on the bridge to help mitigate vessels strikes?, and (2) what media do mariners prefer to receive such information? Knowing these answers may be critical to the implementation of near real-time vessel-strike mitigation because the receptivity of the target group (the fleet), is essential to producing the desired conservation outcome [30].

1.5. Implementing near real-time whale conservation

Bringing near real-time conservation information via whale location alerts to the bridge is dependent on a cooperative fleet that is receptive to an emerging technology and the continued