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A timely opportunity to protect North Atlantic right whales in Canada

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ABSTRACT

The survival of federally protected North Atlantic right whales (*Eubalaena glacialis*) requires an immediate reduction in the risk of entanglement in commercial fishing gear. This paper argues that at least a 30% reduction in risk is needed to meaningfully contribute to the conservation of right whales. The argument follows from risk estimates calculated using time and space intersections of right whales and fishing gear in Canadian waters. Almost all the risk occurs during July, August and September (12%, 50%, 37% respectively) and the groundfish fishery contributed the greatest proportion (86%) of annual risk. Given that efforts in the USA to reduce entanglement risk through modified fishing gear have been unsuccessful to date, we address the alternative option of restricting certain fishing gear at times and locations where entanglement risk is elevated. There are many options that Canada could employ to achieve the above risk reduction and our results clearly point to the most effective and efficient action being seasonally restricted fishing in two relatively small regions; the Grand Manan Basin and the Roseway Basin. Fully a third (34% ± 4%) of the annual risk is associated with these two basins, though fishery catch estimates in the basins are relatively small and declining.

1. Introduction

Entanglement in commercial fishing gear measurably and negatively impacts the conservation of cetaceans globally [18,4]. From 1970 through 2009, the leading cause of death for whales in the Northwest Atlantic Ocean was entanglement in fishing gear, followed by natural causes and vessel strikes, though this ranking varies markedly among species [23].

The North Atlantic right whale (*Eubalaena glacialis*; hereafter, right whale) is an endangered species that is federally protected in Canada and in the United States of America (USA). Recovery planning by each nation specifies the need to reduce or eliminate deaths caused by human activity; particularly those due to fishing gear entanglement and vessel strikes [12,2,20,8]. Gear entanglement of right whales is real and measureable. Knowlton et al. [10] document that at least 16%, and as many as 26%, of all right whales show new entanglement scars annually. For the current population estimate of 522 (± 164) individuals [17], this equates to 109 ± 27 right whales potentially becoming entangled annually. From a mortality perspective, the best estimates are that between 1.2% ± 0.5 [25] and 4% [11] of all entanglements are lethal. This equates to between 2 and 5 right whales killed annually as a result of entanglement; an estimate that has yet to be refuted in recent assessments. For example, Waring et al. [26] estimate 3.4 fishery entanglement mortalities annually. Entanglements and other anthropogenic causes of death are the primary reasons for the species growth rate being less than expected and the viability of the species remains in jeopardy [12,13].

In an attempt to reduce lethal entanglements, the USA enacted laws that required changes to fishing practices, including mandating the use of sinking groundlines. Although changing the configurations and operations of fisheries seems to have potential to reduce risk, risk assessments [27], and other recent preliminary studies [16] suggests that these efforts are not successful. Alternatively, the simplest and most sound solution to reducing lethal entanglements is to minimize the probability that a whale will encounter fishing gear. Reducing the probability of encounters by at least 30% will prevent the deaths of at least 2 right whales every 3 years and as many as 32 fewer entanglements annually. This recommended risk reduction is enough to make the difference between the long-term recovery and extinction of right whales [5]. As right whales spend nearly equal parts of the year in Canadian and USA waters [1], achieving the above level of risk reduction requires action by both nations.

Previously, the Canadian government adopted policies that successfully reduced the probability of vessel strikes to right whales [24] and subsequently identified their known habitats as “critical habitats” ([2]; Fig. 1) deserving of protection. However, the Canadian government has

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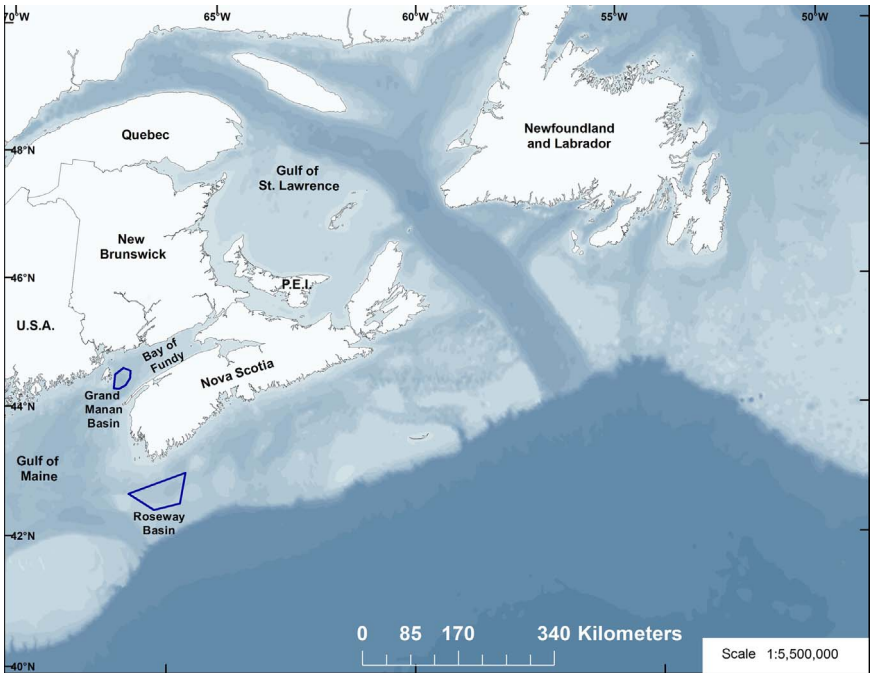

Fig. 1. Map of the domain for this research showing the two Canadian Species at Risk Act Critical Habitats: Grand Manan Basin and Roseway Basin.

yet to adopt any policies designed to reduce the risk of death due to fishing gear entanglement. Therefore, the goal of this research was to first, quantitatively determine where and when right whales are most exposed to entanglement risk in Canada, and second, provide options for policies that would serve to effectively and efficiently reduce the risk presented by commercial fisheries while at the same time minimizing economic consequences to the fisheries wherever and whenever possible.

2. Materials and methods

The domain for this research was the NW Atlantic Ocean between 40° and 51°N latitude and 48° and 71°W longitude subdivided into 3-min (0.05°N and W) grid-cells (76,620 grid-cells excluding land, rivers and lakes; Fig. 1). A monthly probabilistic spatial distribution of right whales was estimated using the Brownian bridge method described in Brillant et al. [1] based on 30 years of data (1978 through 2007). Probabilities for the occurrence of right whales were estimated for each grid-cell (*i*) within the domain; *P(Whale)i*, standardized (to 1) over the year and categorized by month. Unreasonably small probabilities were removed in the manner used in Brillant et al. [1] that maintained comparability among months.

The distribution of commercial fisheries in Atlantic Canada was estimated using data provided by Fisheries and Oceans Canada for thirteen fixed-gear fisheries from 1999 through 2012 (Table 1). The inshore lobster fishery was not included in this analysis because data for that fishery are collected at a large spatial scale that is incomparable with the other fixed-gear fisheries. The distribution of fishing was expressed as an annual probability for a set of a particular fishery (*j*) to occur in each grid cell (*i*), for each calendar month, and relative to the other fisheries in each year examined.

$$P(Set_j)_i = \frac{Set_{ij}}{\sum_i \sum_j Set_{ij}}.$$

A set is an amount of gear placed in the water for the purpose of capturing specific species. Sets can consist of different components among fisheries. For example, a set for the crab trap fishery may be a

Table 1
Annual average sets, annual relative risk to lethally entangle North Atlantic right whales, and relative risk per 1 000 sets of gear from 1999 through 2012 with the study area for thirteen types Canadian fishing gear examined in this study.

Fishing Gear	Average annual sets (SE)		Average % relative risk (SE)		Relative risk (%) per 1 000 sets
Groundfish longline	21 650	(1 726)	55.41	(3.9)	2.6
Groundfish gillnet	16 897	(668)	30.58	(4.2)	1.8
Crab trap	38 101	(2 085)	7.45	(1.0)	0.2
Lobster trap (LFA 38b, 41)	945	(121)	3.52	(0.8)	3.7
Herring gillnet	2 260	(277)	2.19	(0.8)	2.3
Shark pelagic longline	360	(24)	0.39	(0.2)	1.1
Hagfish trap	225	(29)	0.36	(0.1)	1.6
Swordfish pelagic longline	229	(70)	0.02	(< 0.1)	0.1
Tuna pelagic longline	215	(85)	0.02	(< 0.1)	0.1
Unsp. gear and Trap net	8	(3)	0.01	(< 0.1)	0.6
Mahimahi pelagic longline	175	(45)		0	0
Shrimp trap	28	(19)		0	0
Whelk trap	2 908	(462)		0	0