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Mass human-caused mortality spurs federal action to protect endangered North Atlantic right whales in Canada

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ABSTRACT

"If we don't take robust, science-based, coherent measures to protect these highly endangered North Atlantic right whales, we're really playing Russian roulette with the entire future of the Canadian fish and seafood industry," Fisheries and Oceans Minister Dominic LeBlanc, CBC New Brunswick, 16 June 2018.

Governments are required to demonstrate that they manage natural resources in an environmentally and economically sustainable manner. Evidence of an environmental conservation problem is often not considered sufficient by government to warrant a change in the way human activities are managed until the problem becomes a societal crisis (e.g., large effects on economics, operations or infrastructure). Governments are then challenged to nimbly implement effective reactionary measures that both solve the problem and protect livelihoods. The mass mortality of North Atlantic right whales (*Eubalaena glacialis*) that occurred over a 3 month period in Canadian waters in 2017 due at least in part to fishing gear entanglements and ship strike is an example of a situation wherein evidence of a growing conflict between whales and humans was not acted upon until it became an emergency. The disaster galvanized a number of recent federal environmental initiatives into a powerful government force that was able to collaborate with many non-government groups in promptly responding to the problem. This led to commendable implementation and enforcement of crisis management measures. However, implementation came after many mortalities had already occurred because management plans were developed extemporaneously. Further, the need for crisis management negatively impacted local communities and industries. The eventual implementation of federal regulations led to zero attributable right whale deaths and a profitable fishery in the area of highest whale densities the following year. This shows that government leaders can act effectively on issues of environmental conservation, but that these actions can be drastic (i.e., requiring significant and rapid change to human activities) if there is a historic lack of action to address chronic conservation problems. Being proactive requires acting in proportion to evidence, using plans that are adaptive, precautionary and based on science. Canada must now look to sustainable, preventative measures to reduce right whale mortality risk.

1. Inadequate federal action given evidence of a human-whale conflict led to emergency

North Atlantic right whales (*Eubalaena glacialis*, hereafter, right whales) are a shared migratory transboundary species that is managed and protected by Canada and the US. Right whales are an IUCN Red List Endangered Species protected federally since 1970 under the US Endangered Species Act and 1973 under the US Marine Mammal Protection Act (National Marine Fisheries Service 2005), and since 2003 under the Canadian Species at Risk and Fisheries Acts [1]. Adult right whales die prematurely almost exclusively from ship strikes and fishing gear entanglements, and conservation strategies to reduce these risks have been studied, documented and implemented for decades [1–11]. Mortality and injury events are rarely observed as they occur, and live whales or carcasses may move hundreds of kilometers after an event before being observed, so it is unknown how many mortalities and injuries have occurred in Canadian waters historically. At least fourteen right whale carcasses and twenty injured right whales have been sighted in Canadian waters between 1988 and 2014 [4,12-14,42-44][1]. At present, less than 450 right whales remain [15] and

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[1] Annual North Atlantic right whale report cards published from 2006 through 2016 available at https://www.narwc.org/report-cards.html

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anthropogenic mortality rates are not decreasing, on average, in spite of many management interventions in both countries [5,16].

Four departments of the Canadian federal government share responsibility for managing the harmful effects of human activities on marine mammals; Environment and Climate Change Canada, Fisheries and Oceans Canada, Parks Canada, and Transport Canada. The shipping industry in Canada is obligated under the Canada Shipping Act, the Canada Marine Act, and the Marine Mammal Regulations to protect marine ecosystems and species. To mitigate harm to right whales from shipping, Canada had previously changed shipping routes around the two designated right whale critical habitats; Grand Manan Basin, locaed in the Bay of Fundy, in 2003 and Roseway Basin, located on the Scotian Shelf, in 2008 (Figs. 1a and 2, [9,11,17]). Commercial fisheries in Canada are required to incorporate conservation objectives and strategies, including those that mitigate interactions with marine mammals, in their Integrated Fisheries Management Plans. Until 2017, no mandatory regulations for fisheries had been implemented to mitigate potential interaction between fishing gear and right whales, although the risk and cost-benefit analyses to support this implementation had been published and communicated directly to Government of Canada [18,19]. A Recovery Strategy was published in 2009, and thereafter no significant new federal action to protect right whales occurred until the 2017 mortality crisis (Fig. 2). This historical lack of action was substantiated in a 2018 audit by the Office of the Auditor General of Canada, which concluded that the Canadian government, and its four responsible departments, failed to use existing policies and tools to proactively manage threats to marine mammals from commercial fisheries and marine vessels, and that until the 2017, there had been inadequate efforts to fulfill this responsibility [20].

Managing human activities to prevent harmful interactions with right whales has always required direct observational evidence that the animals occur in high-risk areas. The only practical method of gaining insight into occurrence is consistent, dedicated monitoring using boats, airplanes and passive acoustic devices [21]. Long-term implantable satellite-monitored tags are not broadly used for right whales due to logistical constraints and concerns for whale health [22]. Due to the expenses associated with monitoring for right whales, in Canada these activities have been strongly focused inside the two critical habitats, Grand Manan and Roseway Basin, and these habitats are typically surveyed only by boat for a maximum of a few weeks each summer (Fig. 1a, [23]). Opportunistic (i.e. not survey-based) observations show right whales range across the western North Atlantic, including far north of these surveyed areas, while acoustic detections of right whales occur in Canada year-round. Knowledge of the distribution of right whales in Canadian waters is, therefore, extremely limited, which in turn has limited management to protect the species. The effectiveness of management plans that have been successfully implemented has relied on migratory whales remaining primarily in their known critical habitats, which occupy a very small portion of Canadian waters (Fig. 1a).

In 2010, summer sightings of right whales began to decline in these habitats, probably due to diminishing food availability in the Gulf of Maine (GoM) and Scotian Shelf regions [24–26]. Five years later, searches for right whales were initiated in targeted areas of the Gulf of St. Lawrence (GoSL) identified based on historical opportunistic sightings and the presence of oceanographic indicators of right whale food [1]. A relatively large aggregation of right whales was discovered in a previously unknown foraging area in the southern GoSL offshore east of Miscou Island and north of the Shediac Valley (Fig. 1b). Right whales had been sighted opportunistically in the GoSL for decades, and at least two carcasses had been documented in the region prior to 2015 [8,14]. It is not presently known whether these historical sightings indicated large densities of animals aggregated in undiscovered habitat, or if regional habitat use has recently increased.

The GoSL region supports some of the largest densities of pot and trap fishing effort in Canada, including snow crab valued at more than $246 million (2016 estimate; [27]), and a high frequency of transiting ocean vessels; thus it is now a region of high risk to right whales. Three dead right whales were discovered in the GoSL during the summer of 2015, and necropsies were not attempted on these animals so the causes of death could not be determined [13]. Evidence of increased risk to right whales in the newly discovered area increased in summer of 2016, when surveys re-located the aggregation, and two animals were observed entangled (one dead) in snow crab gear that was later recovered from the animals. The Mingan Island Cetacean Study, which regularly surveys for baleen whales in the Jacques Cartier Strait, north of Anticoste Island, reported a record high of 32 individual right whales using that area in 2016. To our knowledge, this evidence produced no action by the federal government to manage the persistent occurrence of an endangered species in an area of high risk and high value to coastal communities, the unusual number of deaths during this time, nor the entanglements in identifiable fishing gear.

Seventeen right whales were either killed or injured in the GoSL between 6 June and 15 September 2017; seven entangled in snow crab or unidentified fishing gear, four from blunt force trauma due to ship strike and the remainder from undiagnosed causes (Fig. 2, [28]). Increased snow crab fishing in the newly discovered habitat was likely an important causal factor behind the exceptionally severe event. Risk from crab gear was likely higher in 2017 relative to 2015 and 2016 because the quota was doubled in the southern GoSL due to an unusual increase in snow crab recruitment [27]. As a result, trap limits for all licenses were increased; the number of traps used throughout the season in the GoSL in 2017 was estimated to be 50,469, an increase from 43,105 in 2015 and 2016 [27,29]. This was the highest level of fishing effort recorded since the fishery began in the mid-1960s [29]. New entrants were also permitted, and some industry representatives contend that the lack of experience at setting gear by these new entrants may have contributed to the increase in right whale entanglements due to an increase in slack fishing line in the water. Risk analyses were not completed prior to the 2017 fishing season, but are currently underway. Prior to the mortality crisis, the Canadian government neglected to assess the risk to right whales in the GoSL, neglected to implement a precautionary regional management plan to protect right whales in the face of both direct and indirect evidence of a growing interaction with snow crab gear, and they also allowed a significant increase in fishing gear entanglement threat without apparent (and obliged) regard for the safety of right whales using the area. This is a clear demonstration of a lack of integrated management, which was an explicitly identified shortcoming in the report of the Office of the Auditor General of Canada [20].

The Canadian Ministers of Fisheries and Oceans and Transport each showed great leadership in response to the 2017 mortality crisis. Within several weeks of the discovery of the first dead animals in 2017, their departments began implementing a series of unprecedented monitoring and risk reduction regulations and activities [29]. Several weeks were required to consult with non-government groups on the best course of action, develop management strategies that permitted safe operations for vessels and mariners, and implement these plans across a large portion of coastal Atlantic Canada. The pace of this process was commendable, but most of the mortalities and injuries had already occurred by the time the measures were in place (Fig. 2). The snow crab fishery in the region was closed after 8 carcasses and 4 live entanglements were discovered over 46 days, and the entirety of their annual quota had been caught (Fig. 2, [27]). A mandatory slow speed zone was implemented after 63 days and 3 additional carcasses were discovered (Fig. 2). Carcasses were found in varying states of decay, and some likely died days or weeks before they were discovered.

In the months following the crisis, the Canadian government worked with non-governmental groups and scientists to design and implement a number of mandatory regulations to track and minimize future risk, each of which came into effect on 28 April 2018 prior to the spring arrival of the right whale population in Canadian waters (Fig. 2, [40]). These new regulations included a large fishery closure area

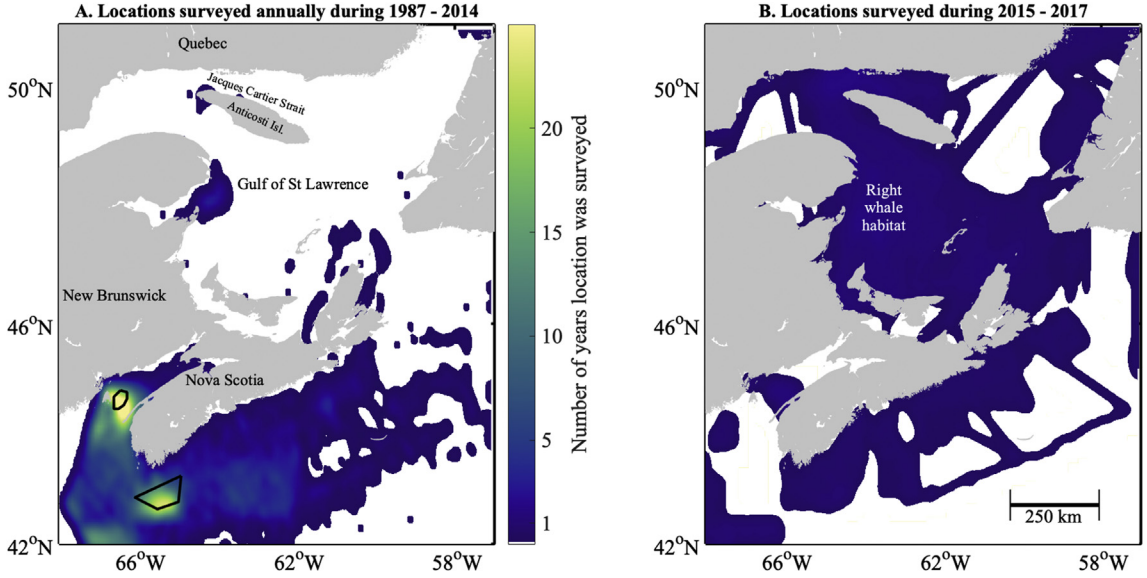

Fig. 1. Recent expansion of dedicated visual survey effort for right whales expended in Canadian waters beginning in 2015. Panel A depicts the number of years (colorbar; 1–25) that each 5″ squared grid cell of ocean was surveyed during 1987 through 2014. White depicts regions of the ocean that were never surveyed during this time period. This illustrates the focus of survey effort was in and near the Grand Manan and Roseway Basin right whale critical habitats (black polygons). Missing from Panel A is effort by Mingan Island Cetacean Study who have surveyed for rorqual whales from small vessels in the Jacques Cartier Strait region of the GoSL annually since 1978. Panel B depicts 5″ grid cells surveyed at least once during 2015, 2016 or 2017 in relation to the newly discovered right whale habitat in the Gulf of St. Lawrence.

encompassing the highest whale-density region, dynamically managed fishery closure areas, a reduction in snow crab quota and trap limits, a mandatory 10-knot maximum speed limit throughout much of the western GoSL, and dynamically managed shipping lanes in the Honguedo and Jacques Cartier Straits. These measures were supported by a significant collaborative, multi-sectoral, and multi-platform monitoring program that increased surveillance for right whales across Atlantic Canada (Fig. 1b). Regional snow crab and lobster fisheries closed on 30 June 2018, and not one of the more than 100 individual right whales sighted in the area during May and June of 2018 was documented as either entangled or struck. This outcome strengthens the understanding that separating threatening activities, in space and time, from vulnerable species is an effective way of reducing (but not eliminating) risk. It further demonstrates that strong and decisive action by governing bodies can significantly reduce human-caused threats to marine mammals using available management tools. However, the 2017 mortality event was unusually severe, and the regional management measures implemented are probably not sufficient to reduce entanglement rates below the long-term annual average of 2.5 documented entanglement mortalities per year [7]. For example, two animals were observed entangled (one likely in snow crab gear, one unidentified) in the GoSL after the snow crab fishery ended in 2018, and a third animal was discovered entangled in the Bay of Fundy in unidentified gear. Rates of entanglement at this level may still lead to extinction by negatively affecting both mortality and birth rates [7,15,26,30].

2. Guiding principles for acting on evidence

Economic sustainability requires a clear demonstration of responsible use of resources that are a common good. Conserving biodiversity is not just about protecting nature, it is also about protecting the economy. In this case, failure to act in the years prior to the right whale mortality crisis was not only detrimental to the whales, it also jeopardized market access for highly valuable Atlantic Canadian fisheries that form the backbone of the regional economy. This was evident from several following examples. The Marine Stewardship Council certification awarded to the GoSL snow crab fishery in 2012 was temporarily suspended in early-2018 as a result of these right whale deaths, and a review is being undertaken [31]. The port city of Charlottetown P.E.I., which relies on cruise ship revenues, lost important seasonal income when at least ten vessels were re-routed in 2017 to maintain their schedules during the period the mandatory speed restrictions were in effect [32]. The US launched its own investigation into the 'Unusual Mortality Event' as eleven US senators expressed concern for right whale conservation and lobbied NOAA to review Canada's compliance with the US Marine Mammal Protection Act (MMPA), which will soon (in 2021) require fisheries that import seafood comply with US standards for minimizing harm to marine mammals [33]. These actions were a direct consequence of the exceptionally large number of right whale mortalities in 2017.

Right whales are predicted to go extinct in as little as 30 years if long-term average mortalities are not significantly reduced [26], and there is no evidence that mortality rates are declining on average [15], which leads us to conclude that international pressures and possibly sanctions to preserve this and other marine species are more likely to increase, not decrease, in the future. It is, therefore, imperative to the ongoing operation of our ocean-based industries, and the conservation of marine endangered species, that Canadian federal leadership on whale conservation be strengthened. The high-profile right whale situation is a 'flag-bearer' for an awakened need for action by the Canadian federal government to protect ocean resources. For example, in 2018 chinook salmon (*Oncorhynchus tshwaytscha*) exploitation rates were reduced by 25–35% in an effort to restore the food supply of southern resident killer whales (*Orcinus orca*) in British Columbia [34]. Federal support for endangered marine mammal recovery has increased under the auspices of the Ocean Protection Plan and other initiatives. This momentum must be maintained to ensure the survival of these species.

Ocean conservation can be misconstrued as leading to the elimination of ocean industries, but this is not always the case. Conservation does not always require severe, compromising actions. The crisis management actions taken by the Canadian government in 2017 and 2018 were needed because of a dearth of action throughout much of the previous decade (Fig. 2, [20]). Conservation requires actions that are precautionary, adaptive, science-based, and implemented proportionate to the evidence [35–37]. A more tenable course of action in the

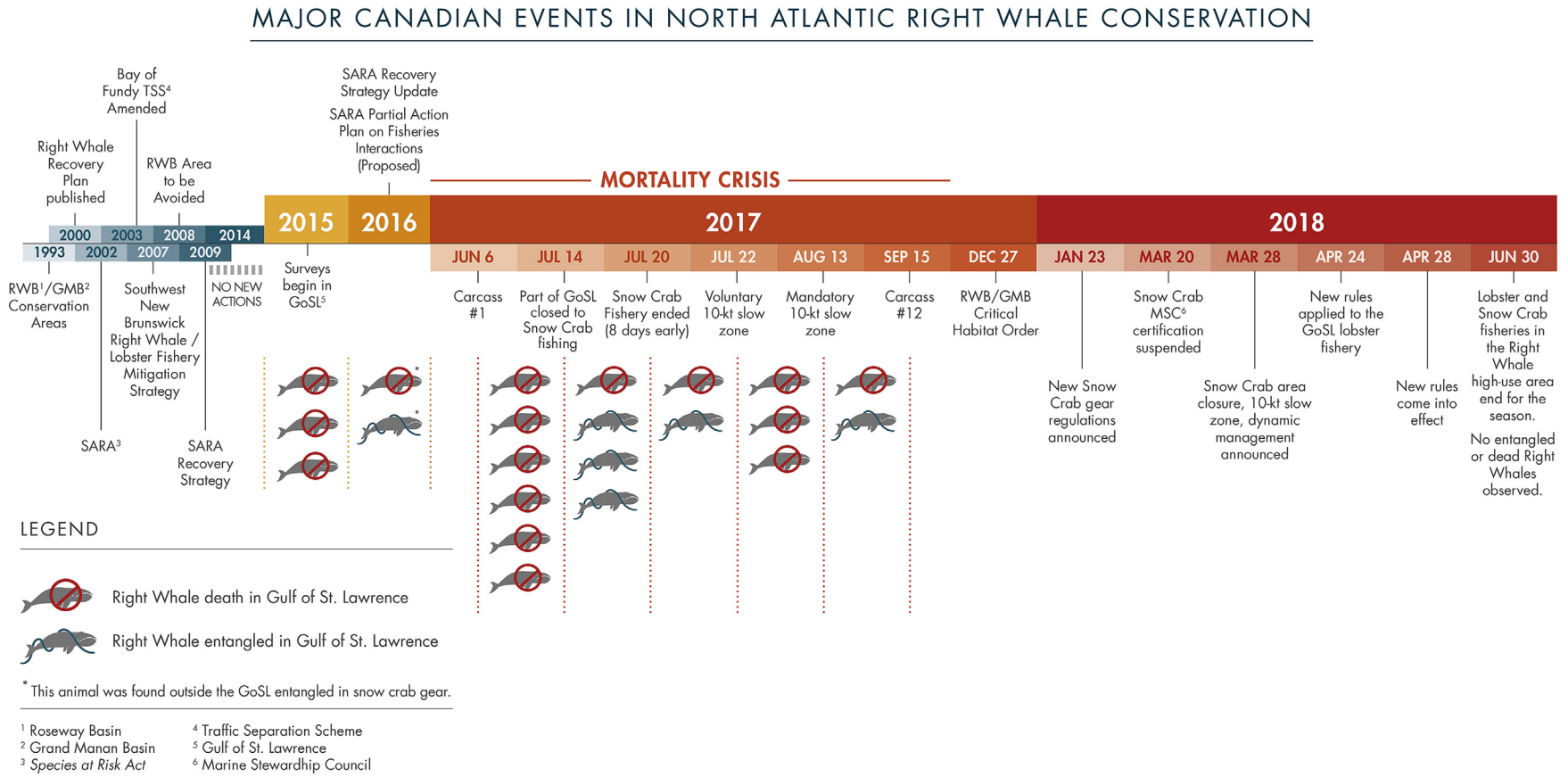

Fig. 2. Timeline of the major Canadian events related to the conservation of North Atlantic right whales since 1993, through the 2017 mortality crisis and the subsequent regulatory response in early 2018. Carcasses and entangled whales sighted in Canadian waters prior to 2015 are not included in this figure for brevity, but are discussed in the text.

right whale situation would have been achieved if a plan to monitor and mitigate risk was implemented in which rights-holders, constituents, industries, and the public were consulted on, aware of, and prepared for prior to a crisis situation developing. Carrying out such plans require clear and transparent action every time there are new observations (i.e. evidence) related to the conservation objectives, but the action undertaken should be proportionate to these observations. For example, the report of a mortality of an endangered species in the region of extreme risk does not necessarily require an immediate shut-down of fishing operations, but it should require a smaller, proportionate investment, such as an investigation to determine the cause of this death (necropsy efforts were not mobilized in response to several 2015 and 2016 carcasses). Increasing evidence of harmful interaction (or the potential for interaction) between priority species and a risk factor must lead to a corresponding increase in action.

In all cases, the action that arises from an observation must be based on existing scientific knowledge or, if knowledge is deficient, implemented using principles of the scientific method [38]. This allows unbiased knowledge to be gained from carrying out a management plan, that can then be improved through time [35]. Managers and policy makers must act despite uncertainty, and because all observations are incomplete, it is wise that these actions be precautionary; intended to prevent irreversible or long-term changes to our ocean ecosystems. This is established as the necessary course of management in Canada's Oceans Act [39].

As of 2018, the risk tolerance for killing right whales is near zero (e.g., in the US, the Potential Biological Removal (PBR) threshold is less than one whale per year) because their population size is small and declining, however there is currently no management tool available that has been proven capable of reducing risk below PBR while allowing fishing and shipping operations to continue unabated in or around high use whale habitats. The Canadian government has taken numerous precautionary actions to ensure that the risk in 2018 was low. The short-term measures put into place in 2018 have arguably been successful from the government's perspective because no right whale deaths were documented during that time, the snow crab fishery caught the entirety of their quota, and commercial shipping in the Gulf of St. Lawrence was able to continue. These strong actions will continue in 2019 and hopefully beyond to address the Auditor General's 2018 finding that the government still has yet to apply sustained planning, policies, tools and measures to protect this and other species [20]. In particular, solutions that lead to significant declines in long-term average mortality rates are needed [7]. A transition to ropeless fishing is the most promising prospect for permanently reducing entanglement risk, and Canadian fishermen have been engaging in the development of this technology since the 2017 crisis. Meanwhile, the Canadian government must continue to work to establish long-term, sustainable rules that provide conservation protection and ensure ongoing economic sustainability of our ocean industries.

3. Conclusion

Monitoring (i.e., collection of evidence) and proportionate action in response to evidence in years prior to 2017 almost certainly would have lessened the mass mortality of right whales. Conservation action is not always drastic, but prolonged ignorance of evidence makes drastic, crisis management action more likely. Actions must be done proportionate to the evidence, and based on science, but also be adaptive and precautionary. A transparent plan will ensure there are fewer surprises in the management of our ocean industries, our natural resources and our marine wildlife, and basing these actions on evidence provides justification for taking measured, and appropriate, actions. Like the 2017 right whale mortality crisis in the Gulf of St. Lawrence, future sustainability crises can be mitigated with early and rapid response to evidence with clear, broadly-supported plans and a willingness by strong government leaders to see those plans through.

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