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A “war” over lobster and whales: The issue-attention cycle, media discourse, and political ecology of right whale science and conservation in six US newspapers

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News organizations and journalists are important and influential actors in environmental politics. Their reporting on social and environmental issues often follows issue-attention cycles (IACs) that emphasize drama and problematization to maintain public interest. This study examined nearly 13 years of news coverage to understand the media discourse about the Critically Endangered North Atlantic right whale (NARW) and its conservation. Content analysis and critical discourse analysis were used to analyze 356 texts published in six large US newspapers between January 1, 2010 and March 15, 2023. NARW conservation and management received increased public attention and an IAC began in 2017 after an Unusual Mortality Event began, with 75 percent of the sampled articles ($n=267$) published from 2017 on. *The Boston Globe* published a majority of the sampled texts ($n=209$) and *Globe* reporter David Abel was the most prolific journalist with 50 bylines. The coverage featured six themes representing threats to the species, science and technological development, and tourism, local lifestyle, and culture. The most common topic was that of American lobster fishing gear and whale entanglements ($n=162$, 45.5%). In that discourse journalists emphasized the political ecology of NARW conservation, focusing on disagreements between whale experts and advocates and commercial lobster fishermen and their allies as they sought to influence decision making by the National Marine Fisheries Service. Journalists presented the issue through a conflict frame and each group used distinct discursive strategies in an attempt to shape the discourse and public opinion related to new or stricter regulations for the commercial lobster fishery designed to reduce the risk of entanglement for NARWs. Findings suggest that this IAC related to NARW science and conservation has already moved through at least three of five key stages and will inevitably lose public interest, which has important implications for future communication and advocacy related to NARW conservation. This case study demonstrates the continued importance of media to conservation – as public forums for discussion, essential parts of organizational strategies for change, and as an externality that can influence conservation outcomes. Support for communication research and practice are vital to successful conservation.

KEYWORDS

right whale, American lobster, issue attention cycle, marine conservation, entanglement, environmental journalism, conservation conflict, media discourse

Introduction

A great deal of conservation work takes place not in ecosystems but in human institutions like board rooms, courtrooms, and mass media (Snyder, 2015). Effective conservation requires understanding the interplay of ecology, politics, and society (Asmutis-Silvia, 2009; Bennett et al., 2017; Bennett, 2019). Language and media are especially important to understand in environmental politics as the complex social practices, processes, and power associated with human communication – also known as discourse – shape realities and can reinforce and reproduce a status quo in society as much as they can challenge and transform it (Wodak, 2014). News media organizations through their reporting and audiences' interpretations of it play a particularly powerful, non-neutral role in shaping public perception, discussion, and action on environmental issues (Killingsworth and Palmer, 2012; Lester and Hutchins, 2012; Hutchins and Lester, 2015). While individual news stories certainly have effects on public discussion and perceptions, the overall media discourse – related texts that shape meaning around a topic over time – can help place the words, sentences, and imagery within them in a broader social context, revealing human actors, their ideological positions and identities, and distributions of power (Wodak, 2014; Cotter, 2015; Ide, 2016). In the context of conservation and sustainability, explorations of media discourse can help scholars and practitioners understand how society engages with science and the environment, identify areas of agreement or disagreement, and contribute to constructive management of conflicts in pursuit of sustainability goals (Boykoff, 2008; Marino et al., 2023).

Journalism is an important social institution that also functions as a commercial enterprise (Schudson, 2002). Many US news media organizations are for-profit corporations that earn advertising revenue by appealing to the largest audience possible, which gives consumers the power to manage or influence news reporting and its practices through their interests and habits of consumption (McLuhan, 1964). To remain popular and profitable, news coverage often follows systematic issue-attention cycles (IACs), which Anthony Downs defined using the rise of modern American environmentalism in the 1960s as an example. Downs argued that IACs predictably follow the rise and fall of public interest in social problems through their representation in news media and other public spheres (Downs, 1972; Figure 1). Through IACs, media organizations and journalists simplify issues and exploit their most dramatic elements to capture and sustain public interest until audiences grow bored and shift their focus to some new topic (Downs, 1972). Cognitive biases in human psychology lead people to focus on and react strongly to the negative. These biases influence which topics people pay closest attention to and how they learn and share information (Baumeister et al., 2001; Bebbington et al., 2017). Defined by dramatization and problematization, the coverage that constitutes IACs exploits these cognitive biases to capture and sustain readers' attention (Soroka et al., 2019). While most social and environmental problems are of little interest to broad audiences

and remain largely obscured from public view, some receive moderate public attention, and few achieve “widespread, ‘celebrity’ status” (Nisbet and Hoge, 2007, p. 196). But even those problems that ascend to celebrity status inevitably fall out of favor, which can be detrimental to conservation efforts that typically require sustained interest and effort to achieve desired outcomes. Research related to IACs and environmental governance has been conducted in the contexts of climate change (McCombs and Shanahan, 1999), plastics pollution (Bailey, 2022), plant biotechnology (Nisbet and Hoge, 2007), ecosystem management (Bengston et al., 2001), and even metacycles of environmental reporting (Djerf-Pierre, 2013). This research focuses on the IAC as it relates to a notable case study in marine mammal science and conservation: the Critically Endangered North Atlantic right whale (*Eubalaena glacialis*; NARW).

Through their reporting media organizations effectively act as gatekeepers, deciding which topics reach the public and how they are presented (McCombs and Shaw, 1972). In the context of science and the environment, journalists and media organizations are not passive observers of the topics they cover, but active participants in representing and shaping societal understanding of issues by informing non-expert publics and policymakers, facilitating discussions in the public sphere, and inspiring or inhibiting collective action (Boykoff, 2009; Takahasi and Tandoc, 2016; Sachsman and Valenti, 2020). Changes in traditional news organizations and how reporting is done in the digital era have created a need for journalists to operate more as generalists than as specialists on a particular news beat, especially in science and environmental reporting, which has given sources increased influence over the co-creation of news coverage (Friedman, 2015; Hansen, 2020; Robbins and Wheatley, 2021). Those changes, in addition to trends in consumer expectations and behavior, have led journalists to increasingly present all perspectives as equally valid and scientific consensus as open debate where all perspectives have equal value or merit, and readers are left to draw their own conclusions, which can distort public perceptions of expert consensus, in part by creating controversy around issues on which experts broadly agree (Bennett, 2007; Koehler, 2016). Presenting scientific and environmental topics this way can make the already difficult job of communicating uncertainty and risk more challenging for scientists and communicators and can undermine science-policy efforts (Guenther and Weber, 2019). The outcomes of this approach have been studied in the context of climate change communication, where false-balance reporting serves oppositional interests, and undermines collective action in favor of the status quo (Stecula and Merkley, 2019). But journalists and readers value this approach because it seemingly exemplifies the journalistic norm of objectivity and grants individuals a sense of agency in evaluating the information presented to them and drawing their own conclusions, giving them reason to continue consuming and discussing the news (Schudson, 1998; Giannoulis et al., 2010). Such an approach to reporting also gives journalists credibility as honest brokers, which

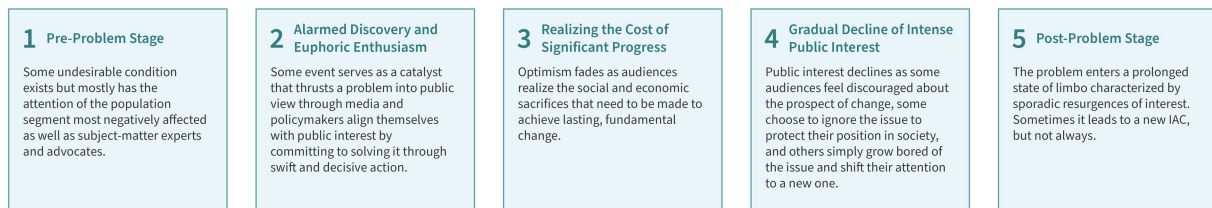


FIGURE 1
The five stages of Anthony Downs' issue-attention cycle and defining characteristics of each stage.

allows them to access and build relationships with sources who can help them develop their future reporting (Shoemaker and Reese, 2014).

The editorial decisions made by journalists and media organizations are both intentional and unintentional and can shape discourses, define realities, and have material effects on daily life and the environment (Luhmann, 2000; Ashmore et al., 2001; Keller, 2012). As a result, news media serve as a political arena where interest groups compete for public attention and seek influence over narratives and public discussions surrounding social and environmental subjects (Hilgartner and Bosk, 1988; Holthausen and Zeffass, 2015). This means there are ample opportunities for science and environmental communicators to bring important issues into public view through strategic communication and attempt to use that interest to inspire collective action, but news media have limited carrying capacities and interest groups and organizations compete with one another to have their interests covered. Additionally, journalistic norms, the political dimension of news media, and audience preferences and attention spans have created notable disparities between issues of high scientific importance and issues that non-expert publics believe are the most important (e.g., Legagneux et al., 2018; Tiller et al., 2019). In news media, topics related to biodiversity loss are particularly underrepresented compared to climate change, despite the two being interrelated crises with significant implications for society (Veríssimo et al., 2014; Farber, 2016; Geschke et al., 2023). In academic literature, communication and media about climate change is better represented than those about topics in biodiversity conservation (Akerlof et al., 2022). Marine and coastal environments are underrepresented in news media and academic literature and, as a result, are often less of a priority for people and governments compared to environmental problems on land, in part because there are inherent challenges associated with the environmental complexities of aquatic and marine environments and specific approaches needed to communicate about them effectively (Vincent, 2011; Kolandai-Matchett and Armoudian, 2020; Kolandai-Matchett et al., 2021; Reamer, 2022a).

This study combines content analysis (CA) and critical discourse analysis (CDA) methods to analyze the media discourse about the NARW published by six US newspapers between 2010 and early 2023. Specifically, the objectives of this research were to: (1) identify trends in US news media coverage about the NARW; (2) analyze a subset of the discourse to understand how media presented issues, events, and the discursive strategies actor groups employed in the discourse; (3) apply the IAC heuristic to the sampled coverage; and (4) reflect on findings to offer actionable insights related to the role of communication in NARW conservation and how this may relate other conservation contexts.

Background: North Atlantic right whales

Cetaceans – the order of mammals representing whales, dolphins, and porpoises – have been the subject of fascination throughout human history and offer examples of wildlife species that have achieved celebrity status (Brito et al., 2019; Mazzoldi et al., 2019). This is the result of decades-long efforts by scientists and environmental advocates that facilitated a cultural shift related to marine mammals, which took place alongside commercial whaling's collapse in the first half of the 20th century and continued on well after the last US whaling company closed for good (Reamer, 2022b). Such public adoration for cetaceans would not have been possible without communication and mass media because it is rare for most people to see or experience these animals for themselves (Reamer et al., 2023a). Today, as a result of a sustained and largely anthropomorphized narrative that focuses on their mysticism, sociability, and intelligence above all else, including their ecological importance (Peace, 2020; Finkler and Davis, 2022), cetaceans benefit from positive public perceptions and strong public support for their conservation and welfare (Naylor and Parsons, 2018; Giovos et al., 2019). Generally speaking, cetaceans are considered flagship species that symbolize and attract support for other causes in conservation, though some individual species are more acclaimed than others (Jepson and Barua, 2015). As a result, marine mammals command significant public attention and can stimulate “exaggerated” human responses, especially when they are in distress (Bossart, 2011, p. 676). This is a notable advantage that charismatic megafauna have in relation to conservation compared to species that are less popular and well-known, many of which are as important – if not more – to the functioning of their ecosystems (Brambilla et al., 2013). While there is strong public concern and support for these species, and that offers some hope of progress toward sustainability goals in the era of anthropogenic climate change and significant biodiversity loss, no issue, no matter how pressing, can hold public attention forever (Downs, 1972).

The NARW is one of three right whale species, named by whalers for being the *right* whales to hunt due to their proximity to shore and the biological and behavioral traits that made them easier to find, kill, and harvest than other species. Once abundant throughout the northern Atlantic Ocean with a population of as many as 21,000 whales, commercial whaling nearly drove this species to extinction and it has remained endangered since (Monsarrat et al., 2016). Hunting right whales for commercial purposes dates back to Basque whalers in the early 11th century, and was associated with local extinctions, particularly in the Bay of Biscay (Clapham and Link, 2006). It was not until the 18th and 19th centuries, as the US emerged as a global leader in commercial whaling, that whaling posed a

significant threat to the entire NARW population (Kraus and Rolland, 2010; van den Hurk et al., 2023). Unsustainable whaling practices facilitated by technological advances and a growing demand for whale products put whale stocks worldwide at risk of extinction and removed many of them as functional parts of their ecosystems (Parsons, 2013; Roman et al., 2014). Whalers drove the North Atlantic gray whale population (*Eschirichtius robustus*) to extinction in the 1700s (Mead and Mitchell, 1984; Lindquist, 2000; Garrison et al., 2019) and the NARW nearly shared the same fate as its population was reduced to as few as 100 individuals by the 1920s (Corkeron et al., 2018).

Such significant declines in whale stocks were a cause for concern and in 1935 the League of Nations established the Convention for the Regulation of Whaling and took specific action to ban right whale hunting (Wright et al., 2016). Fifteen countries, including the US, took additional action in 1946 by signing the International Convention for the Regulation of Whaling, which established the International Whaling Commission (IWC) as the body responsible for managing member nations' whaling activities through a legally binding Schedule (Gambell, 1977). The collapse of commercial whaling began around the 1940s as a result of declines in whale stocks and possibly the emergence and growing availability of cheaper and more accessible fossil fuels, though this is debated as York (2017) argues that fossil fuels exacerbated whaling in its final years. In 1982 IWC member states agreed to a ban on commercial whaling, which was implemented in 1986 (Wright et al., 2016). While some commercial and subsistence whaling still occurs, the threat to whale populations from whaling has been greatly reduced throughout the global ocean.

With reduced pressure from whaling, a global shift in attitudes toward whales and other marine mammals, and a complex patchwork of legal protections to facilitate their recovery, some whale stocks have recovered to sustainable levels and been re-established as functional parts of their ecosystems, including the Eastern North Pacific gray whale (Reamer, 2022b), the Pacific and Southern right whales (Corkeron et al., 2018), and multiple humpback whale populations (Bejder et al., 2016; Baines et al., 2021). Unfortunately, the NARW – a species that drew attention to the ecological harms of whaling and inspired the international community to protect whales and other wildlife – remains at serious risk of extinction. There were conservation gains in the 1990s and early aughts, but that progress was short-lived. The same biological and behavioral traits that left NARWs vulnerable to overexploitation by whalers make them vulnerable to environmental changes and anthropogenic activities like fishing and shipping today (Corkeron et al., 2018). The largest population estimate published by the North Atlantic Right Whale Consortium (NARWC) was nearly 500 individuals around 2010 (Pettis and Hamilton, 2012). Approximately 350 individual NARWs now remain due to a period of significant population decline beginning in 2017, and they are presently found almost exclusively along the eastern coast of North America, from Atlantic Canada to northern Florida (Pace et al., 2017; Pettis et al., 2023). While much of the population migrates seasonally, individual NARWs can be found in the northern portion of their migratory range year-round (Whitt et al., 2013).

Even after nearly a century of protection, the NARW is still one of the world's most endangered whales (Pettis et al., 2017; Hütt et al., 2023), an iconic and resilient species representing to some a sense of hope for progress in global biodiversity conservation, to others a symbol of society's continued deleterious effects on the marine

environment (Laist, 2017; Moore, 2022; Adloo et al., 2023; Brilliant, 2023). Models show that the population cannot afford to lose a single adult to anthropogenic causes in any given year and annual birth rates need to increase nearly three-fold for the species to have a chance of recovering to a sustainable level (Myers and Moore, 2020). Without significant policy actions to facilitate such a recovery, NARWs face extinction by the end of the century if not sooner, and it could become the first large whale to disappear from the Atlantic Ocean since the North Atlantic gray whale (Kraus et al., 2016; Moore, 2023). Given the decades-long depletion of the species and the presence of other whale stocks that are abundant throughout parts of its migratory range, cascading ecological effects resulting from the NARW's extinction are unlikely and more localized outcomes are unclear, though it would be a historic failure in conservation that could have notable social and cultural effects (Roman et al., 2014; Weatherwax, 2021).

NARWs exist in an incredibly complex social-ecological system that both supports and challenges their conservation (Figure 2). The transboundary nature of this species and its biology, along with the number of anthropogenic activities and industries that pose existential risks to the species throughout its range makes this case emblematic of the complexities, uncertainty, barriers, and conflicts associated with the conservation and management of marine and coastal resources in the Anthropocene (Bellanger et al., 2020). Some social and governance research about NARW conservation exists, with a focus on litigation, policy actions, and stakeholder perceptions of policy actions (e.g., Asmutis-Silvia, 2009; Asaro, 2017; Montes et al., 2018; Koubrak et al., 2021), but these topics are understudied compared to the biological, ecological, and technological dimensions of the issue. This study considers the role of journalism not only as the people and organizations tasked with representing environmental issues like NARW conservation through mass media, but as important and influential institutional actors in political ecology.

Methods

Media selection

Using the ProQuest NewsStand database, a digital collection of global newspapers and wire services, a search was conducted for articles and opinion-editorials (op-eds) containing the phrase “right whale” or “right whales.” Larger news media outlets tend to influence the news agendas of regional and local ones (Nisbet and Huge, 2007), so this study focused on six major US newspapers: *The Wall Street Journal*, *The New York Times*, *USA Today*, *The Washington Post*, *The Los Angeles Times*, and *The Boston Globe* (Table 1). The sample was delimited to articles published by these organizations between January 1, 2010 and March 15, 2023.

The initial search yielded 913 results. After removing duplicate ($n=444$) and irrelevant ($n=113$) results, 356 unique texts remained: 328 (92.1%) news articles and 28 (7.9%) op-eds. In some cases multiple op-eds were published together under a single headline to offer readers a point-counterpoint experience and grouped together in a single output from ProQuest NewsStand. For the purposes of this study, these groups of letters were counted as a single text and were coded together. This study focused solely on the written language of each text and did not consider the placement of stories in a publication nor did it consider the images, captions, or embedded multimedia as

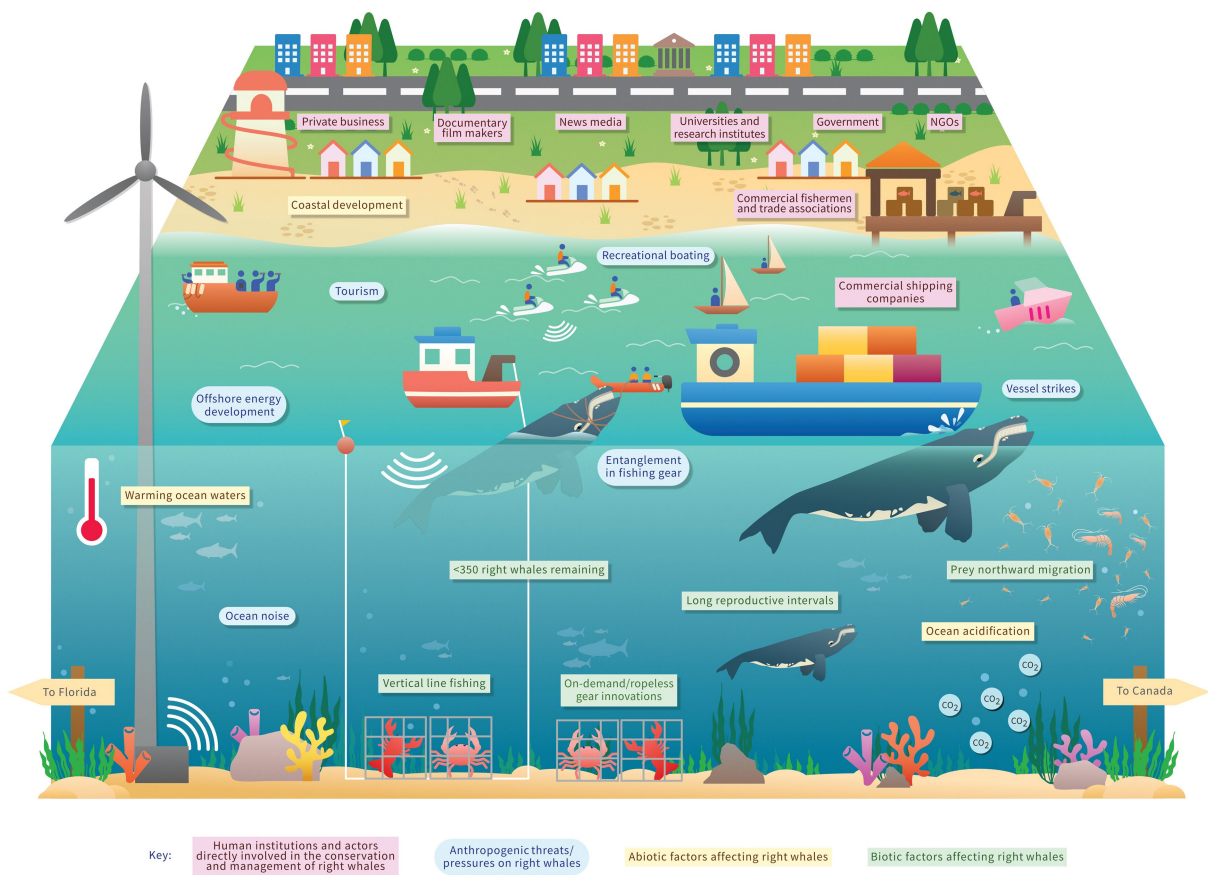


FIGURE 2
A graphic representation of the complex social ecological system in which the North Atlantic right whale exists.

these elements were not uniformly captured or accessible from the file generated by ProQuest NewsStand.

Following the search, a grounded theory approach was used to create a codebook (Charmaz, 1995; Khan, 2014). Patterns and themes observed during an initial reading of all 356 sampled articles informed the codebook's contents. The codebook was also designed to collect metadata related to sampled texts (e.g., author, publication, date of

publication, length of text), policy proposals and court cases mentioned in them, as well as the human stakeholders quoted and their organizational affiliations. Once the codebook was complete, two volunteers were trained to use it before they and author MR coded 30 randomly selected articles from the sample. Fleiss' (1971) kappa (κ) was calculated to test intercoder reliability for each content category in the code book before coding the full sample. Results ranged from κ

TABLE 1 Daily print circulation of each publication from March to September 2022.

Publication	Daily print circulation (March–September 2022)
<i>The Wall Street Journal</i>	697,490
<i>The New York Times</i>	329,780
<i>USA Today</i>	159,230
<i>The Washington Post</i>	159,040
<i>The Los Angeles Times</i>	142,380
<i>The Boston Globe</i>	68,810

Source: Statista, <https://www.statista.com/statistics/272790/circulation-of-the-biggest-daily-newspapers-in-the-us/>.

= 0.61 to $\kappa = 0.97$ or from “substantial” to “near perfect” agreement as defined by Landis and Koch (1977). After the assessment of intercoder reliability, author MR read and coded all articles.

Methods for analysis

This study used both CA and CDA in its exploration of US news media coverage of the NARW. CA (Krippendorff, 2018) and CDA (Carvalho, 2008; Wodak, 2014) are distinct methods with different applications to social science research that can be paired to be “complementary and ... mutually supportive in the exploration of social reality” (Hardy et al., 2004, p. 19). By combining these methods, it was possible to not only identify but understand the NARW IAC, its stages, and how the media discourse reflected and participated in debates about how to reverse the species’ decline. Specifically, CA first described the individual texts separate from their social contexts by capturing and quantifying fixed information about them. Doing so helped identify trends in the coverage, with a focus on which publications, journalists, and stakeholders were co-creating coverage and about which topics over time. The results of the CA helped focus the subsequent CDA that evaluated a subsample of the texts. CDA was used to critically examine the selected media discourse for their social contexts and the meaning contained within them. These elements included external events and their chronology, the perspectives that included sources represented, as well as how journalists and those sources co-constructed reporting about topics associated with the NARW and its conservation and management. Of particular interest were the linguistic choices – known as discursive strategies – that journalists and participating actor groups made in their engagement with journalists to shape the coverage, public discussions, and ultimately influence decision making that would have material effects on the NARW population (Carvalho, 2008).

CDA is intentionally broad and inclusive of many disciplines, theories, and methodologies as it is problem-oriented and “necessarily interdisciplinary and eclectic” (Wodak, 2014, p. 303). Uniting disparate approaches to CDA is an interest in investigating language used by privileged parties, whether written, spoken, or visual, to understand “the semiotic dimensions of power, injustice, and political-economic, social, or cultural change in society” regardless of discipline or topic of interest (Wodak, 2014, p. 303). Harrison and Loring’s (2020) diagnostic framework guided the CDA of the sampled news coverage because it is explicitly intended for use in the context of conservation and considers

narrative, actor groups, and chronology of events, among other storytelling elements, to understand these cases comprehensively through their “varied, heterogenous parts” (p. 2). Doing so can help identify opportunities for constructively managing often complex conflicts about natural resources (Harrison and Loring, 2020). Using this framework allowed for deeper exploration of the texts to understand their underlying meanings, reflections of events taking place in other social arenas, and the role media played in NARW conservation.

Results and discussion

Content analysis: Trends and themes in media reporting of the NARW

The sample included 356 unique articles and op-eds mentioning NARWs from the six selected publications between January 1, 2010 and March 15, 2023. Annual rates of coverage ranged from 8 to 52 texts per year, with 75 percent of all texts ($n=267$) published from 2017 on Figure 3. The Pearson correlation coefficient was calculated to assess the relationship between the estimated NARW population and the number of texts published annually, excluding the partial year 2023. There was a strong negative correlation between the two variables, $r(11) = -0.81, p < 0.001$. Decreases in the NARW population were strongly correlated with increases in news media coverage. This relationship is likely an indirect one as the changes in the NARW population inspired policy and conservation actions that affected key stakeholder groups, which journalists then took interest in.

The Boston Globe represented nearly 60 percent of the sampled texts ($n=209$), followed by *The Washington Post* ($n=45$, 12.6%) and *The New York Times* ($n=43$, 12.1%) (Figure 4A). Together, these three outlets published nearly 85 percent of sampled coverage about the NARW. The only years in which *The Boston Globe* published a minority of all texts about NARWs were 2010, 2022, and partial year 2023 (Figure 4B). Nearly all texts ($n=337$, 94.7%) were attributed to named authors. Only eight of those authors had more than five bylines during the study period, and these eight authors together represented nearly one-third of the sampled coverage ($n=108$) (Table 2). *The Boston Globe*’s David Abel was the most prolific author with 50 bylines (14% of all coverage, 23.9% of *Boston Globe* texts).

Nearly 82 percent of the sampled articles ($n=291$) defined a primary or focal threat to the NARW population (Figure 5). The three most frequently mentioned threat categories (entanglement in fishing gear, vessel strikes, and both entanglement and vessel strikes co-presented as equal) accounted for nearly 68 percent of the texts that focused on a threat ($n=198$). The remaining seven coded threats represented a combined 32 percent ($n=93$). In addition to public interest, accuracy of reporting matters greatly to environmental decision making. Studies focused on other topics in marine conservation like shark conservation (Shiffman et al., 2020), sea turtle conservation (Santos and Crowder, 2021), ocean acidification (Tiller et al., 2019), and even whales as climate engineers (Meynecke et al., 2023) have shown that media coverage does not always align with scientific consensus related to pressing environmental challenges and their possible solutions. In the NARW case the sampled media do appear to reflect scientific consensus in their reporting, which is that fishing gear entanglements and vessel strikes are the leading threats to the NARW population, with more than 80 percent of NARWs showing

Coverage in media increases in line with North Atlantic right whale population decrease

Best population estimate (based on the North Atlantic Right Whale Consortium Annual Report Card)

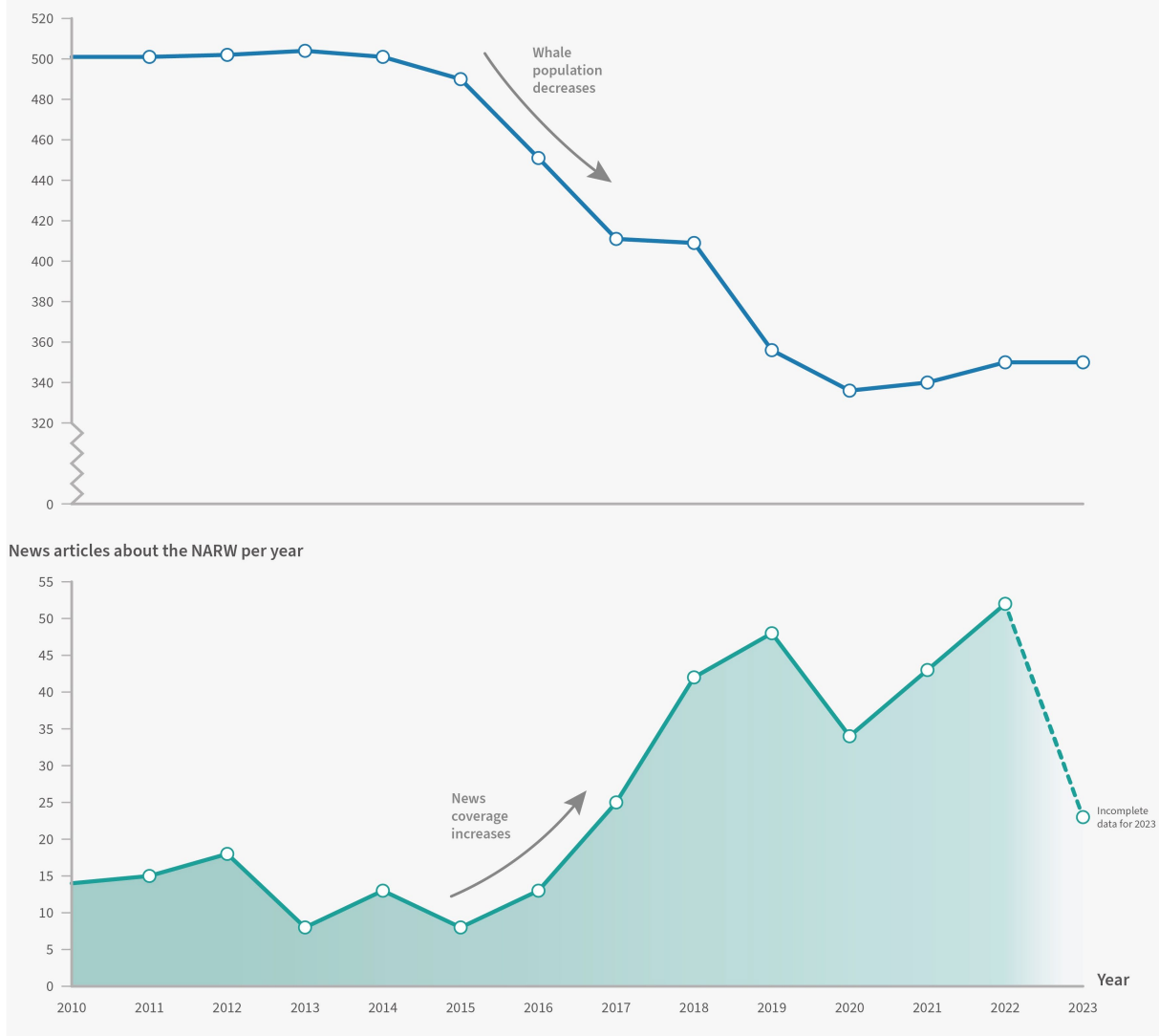


FIGURE 3

Line graphs showing the annual population estimate (above) and the number of texts about right whales published by the six sampled newspapers each year (below).

signs of past entanglement and the entire population at risk of ship strike injuries (Knowlton et al., 2022; Thomas et al., 2016).

Six key themes emerged from the sampled media coverage: (1) framings of certain threats and solutions related to (a) fishing gear and whale entanglements, (b) shipping and vessel strikes, (c) offshore energy development and ocean noise, or (d) climate and environmental change; (2) factual reporting on scientific or technological developments related to the NARW; and (3) the role of the NARW in shaping tourism and culture across geographies (Figure 6). Five of the 12 distinct threats to marine mammals as defined by Reynolds et al. (2009) were reflected in these themes, but seldom together, even though many of these threats are interrelated and need to be addressed holistically rather than separately. Macdonald et al. (2023) found a similarly fragmented approach in

their analysis of news media coverage of coastal development in Florida where news coverage focused on individual projects and decisions as though they were separate and did not draw connections to the overarching problems and drivers of unsustainable development.

Fishing gear and whale entanglements (1a) ($n = 162$, 45.5%) focused on vertical line fisheries, namely those for American lobster (*Homarus americanus*), Jonah crab (*Cancer borealis*), and snow crab (*Chionoecetes opilio*) in New England and Atlantic Canada, with an overwhelming emphasis on New England lobster fishing. These stories presented entanglement in fishing gear as a leading and urgent threat to the NARW population that can be addressed through policy and conservation actions that reduce the amount of fishing rope present throughout the NARW's range. Reported sightings of distressed and entangled whales and reports about disentanglement efforts by authorized organizations

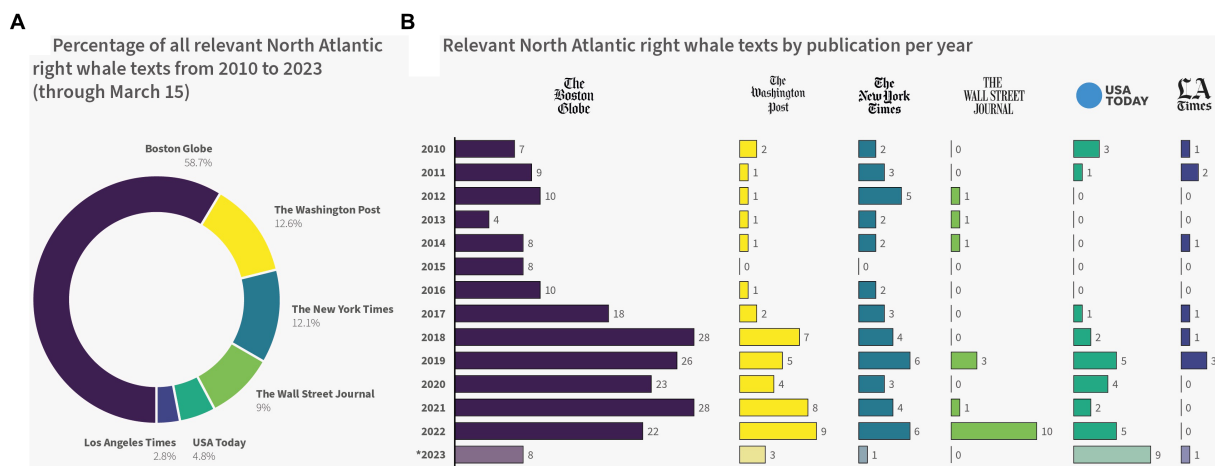


FIGURE 4 (A) The percentage of relevant texts published by each newspaper for the full sample period. (B) The number of relevant texts published by each newspaper annually for each year during the sample period.

TABLE 2 Journalists who wrote more than five articles during the study period.

Author	Affiliation	Bylines
David Abel	The Boston Globe	50
Steve Annear	The Boston Globe	10
Dino Grandoni	The Washington Post	10
Darryl Fears	The Washington Post	9
Karen Weintraub	USA Today	9
Dinah Voyles Pulver	USA Today	8
Travis Andersen	The Boston Globe	6
Emily Sweeney	The Boston Globe	6
Total		108

and individual citizens were also included in this theme. Quoted parties most often included whale scientists, environmental advocacy groups, individual fishermen, trade associations representing lobstermen, and state and local government administrators.

Shipping and vessel strikes (1b) ($n=98$, 27.5%) focused on the threat of ship strikes to whales by large commercial vessels and smaller recreational ones. Efforts to minimize risks through voluntary speed reductions and, less commonly, regulations and enforcement were also discussed. Articles from *The Los Angeles Times* were distinct in that they cited the NARW as an example of a species that benefitted from successful speed reduction efforts, which supported arguments made by West Coast environmental groups as they pursued protections for local species like blue and gray whales that are vulnerable to ship strikes. Reports of whales thought to be in distress as a result of a ship strike and the results of necropsies that implicated ship strikes as a cause of death were also present in this theme. Quoted parties most often included federal agencies, environmental groups, scientists representing a range of disciplines, and shipping companies. Very rarely were recreational boaters quoted in this or any NARW discourse.

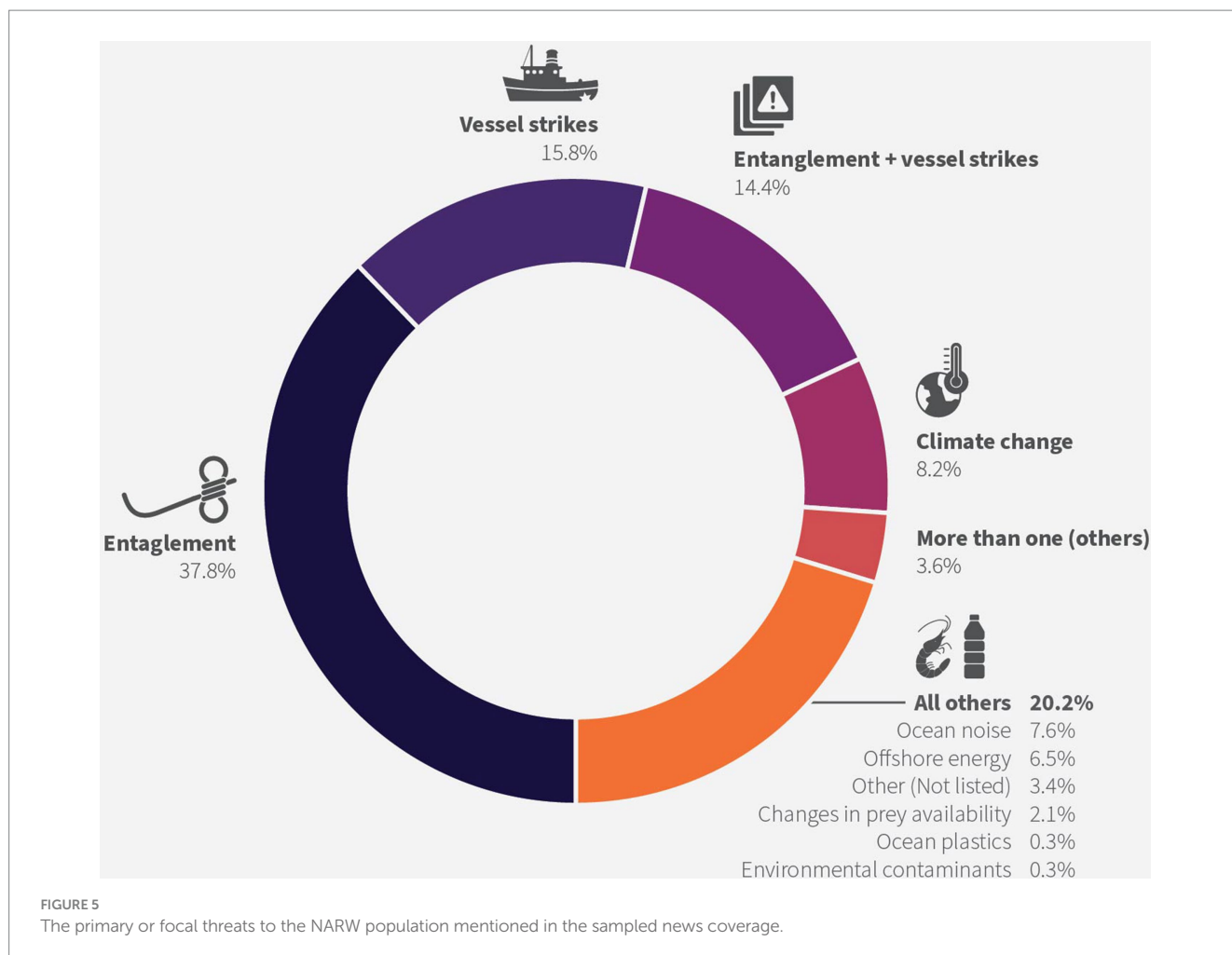
Offshore energy development and ocean noise (1c) ($n=41$, 11.5%) were presented together as a single theme, and published stories

covered both oil and gas exploration and offshore wind farms. Articles focused on the threats these activities may pose to marine life, including protected species like the NARW. Fossil fuel projects were a focus during Donald Trump’s presidency and almost universally opposed along the eastern seaboard, while wind farms were a focus during Barack Obama and Joe Biden’s presidencies and generated nuanced and heated debates about where these projects should be placed and the ecological and economic harms they may cause. Quoted parties most often included federal agencies, environmental groups, scientists across disciplines, state and local officials, coastal property owners, financial institutions, and energy companies.

Climate and environmental change (1d) ($n=38$, 10.7%) focused on changes in the marine environment and how they affect marine ecosystems and society. Ocean warming and acidification were commonly mentioned as both appear to have changed the distribution of planktonic food sources (primarily copepod *Calanus finmarchicus*) and influenced the migratory patterns and behavior of the NARW along with important commercially fished species like the American lobster. Climate change was presented in these stories as a passive event, as something that is happening to the environment rather than something that is anthropogenically caused through industrial activities and the use of fossil fuels. Quoted parties most often included federal agencies, environmental groups, and scientists across disciplines.

The theme of science and technology (2) ($n=40$, 11.2%) represented stories that plainly presented the findings of new research, summarized reports and white papers, or covered research, development, and implementation of technologies relevant to the NARW and other cetaceans. Quoted parties most often included scientists across a range of disciplines, engineers, environmental research organizations, and federal agencies.

The final theme was tourism, local lifestyle, and culture (3) ($n=25$, 7%). These texts focused on the NARW as a symbol of maritime culture and heritage and as an asset for local tourism operators, with a focus on New England communities. Stories about whale sightings – from land and from whale watching vessels – art projects, events like film screenings and educational events, and



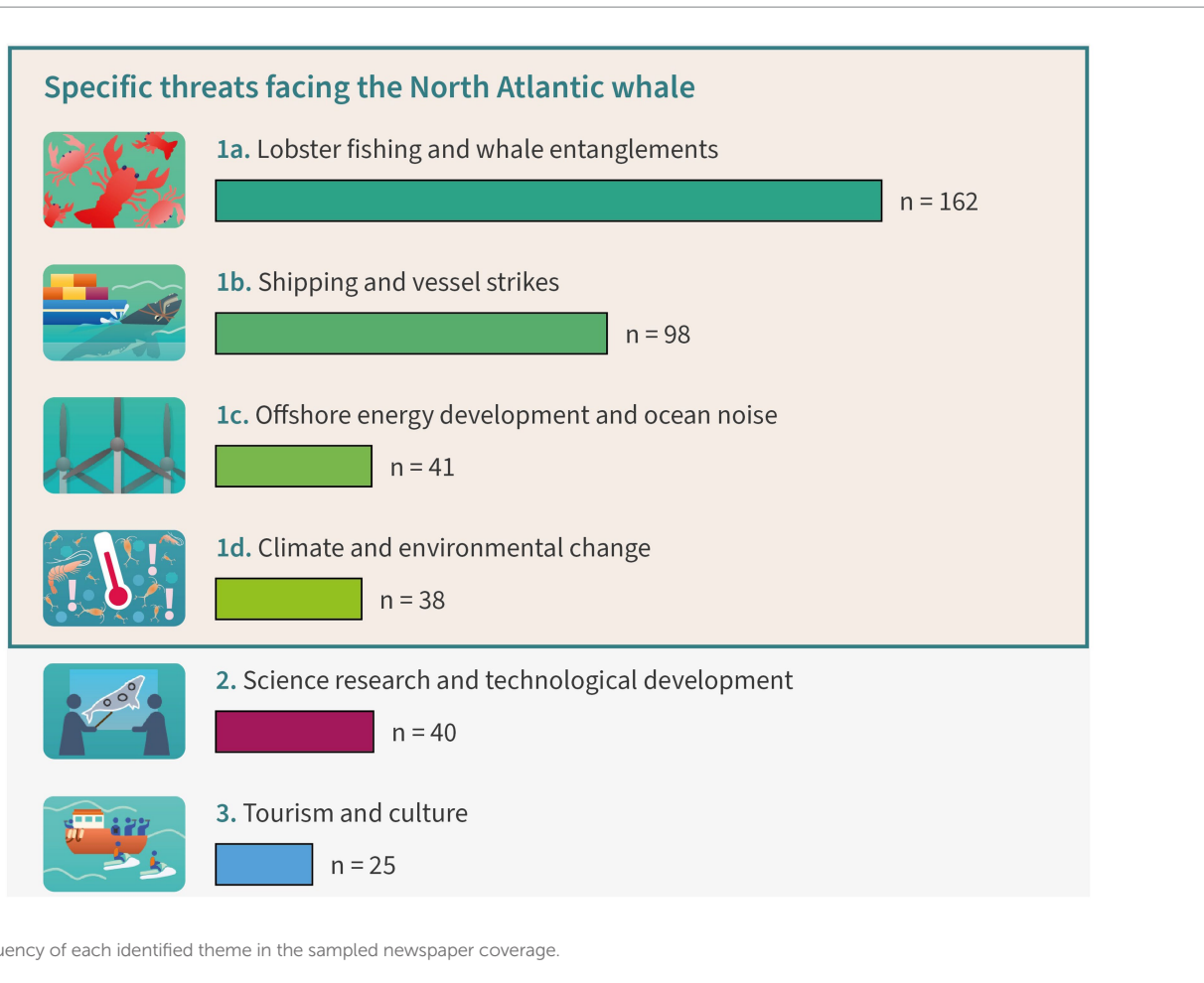
recognition of the NARW through local governmental proclamations were all part of this coverage theme. What stands out most about this theme is that NARW sightings were framed as special and awe-inspiring experiences, especially for people who spotted individuals or groups of whales in waters beyond their expected migratory range (Ruckstuhl, 2018). This messaging runs counter to scientific consensus and the other coverage themes in which the whales' rarity or observable shifts in range or behavior are not cause for celebration but concern and, in some cases, alarm. Quoted parties most often included individual citizens, whale watching operators, artists, event host organizations, and tourists.

Critical discourse analysis: Conflicts associated with fishing gear and whale entanglements

The focal theme of the sampled media coverage was fishing gear and NARW entanglements in New England, suggesting that this was the most contentious issue and the easiest to dramatize for media consumers. One hundred sixty-two texts (141 articles, 21 op-eds) focused on fishing gear and whale entanglements were published in the selected publications. More than 80 percent of these texts were published from 2017 onward ($n=130$). *The Boston Globe* alone

represents about 60 percent of the news coverage about this topic. Similar to the full sample, *The Boston Globe*, *The New York Times*, and *The Washington Post* together accounted for 85 percent of all sampled news coverage focused on fishing gear and whale entanglements as a threat to the NARW (Figure 7). One hundred thirty-one (80.9%) of the texts in this discourse identified one or more geographic settings related to the whales themselves or their conservation and management: New England ($n=99$), the southeastern US ($n=19$), the National capital region ($n=17$), Atlantic Canada ($n=17$), and other locations beyond these four key regions ($n=12$). The subsample of texts focused on fishing gear and whale entanglements was selected for further analysis because it represented almost half of the sampled coverage. Additionally, these texts were the most detailed and included other themes like vessel strikes and climate change.

Through their coverage of this theme, news organizations and journalists focused on the political ecology of this case rather than its scientific and technical dimensions. Specifically, journalists showed their readers an on-going power struggle over two natural resources that are symbolic of and important to the New England region, defined the problem as a nearly impossible choice between the two, and described a beleaguered federal agency tasked with finding a way to manage it all. The coverage was a reflection not of a single event or disagreement, but of a long-standing, dynamic conservation challenge. In a region where commercially fished and protected species



cohabitate, and where many human user groups who rely on coastal and marine resources intersect, contentious debates over management strategies have played out repeatedly. Journalists generally presented efforts to protect NARWs from entanglement using a conflict frame (Putnam and Shoemaker, 2007), often referring to it as a battle, fight, race against time, or a war being waged between one of the world's most economically valuable fisheries and wildlife experts and advocates. It was not presented as a saga where environmental groups and fishermen clashed directly or where fishermen were in direct conflict with the whales. In fact, many of the quoted lobstermen claim to have never seen a NARW, which could be viewed either as support for the position that there is not a problem or as evidence of the whales' endangerment. Instead, the central story was an on-going political drama playing out in human institutions as two stakeholder groups sought to influence decision-making processes that involve the conservation and management of multiple aquatic resources and industries. Despite stakeholder groups repeating their commitments to working together to break the cycle of conflict and achieve a "peaceful and productive coexistence" (Abel, 2018a,b), journalists presented the saga as a dichotomous, winner-takes-all scenario that required "one side...to suffer" (Voyles Pulver, 2023) and that would ultimately be decided by NMFS, which some stakeholders described as the "fox guarding the henhouse" (Abel, 2019c). One quote from the sampled media exemplifies the overall dramatization of the discourse:

"The trio are entwined in a drama playing out in the rich waters of the Gulf of Maine, which faces an existential crisis as climate change shifts the migration patterns of lobsters and whales alike. The lobster industry, about as close to an icon of New England as there is, has become embroiled in a maelstrom as conservation groups seek to protect the last 340 North Atlantic right whales." (Nanos, 2022).

The dominant discourse in the coverage centered on fishing gear and whale entanglements, and was what Hodgson et al. (2022) define as a resistance narrative, characterized by "antagonistic messaging, built from stories that implied there was no other choice but to act combatively, as a form of defence or protection against an implied enemy – in other words, to fight" (p. 633). This is to be expected given news organizations' interest in conflict and drama and the adversarial nature of public policymaking in the United States (Downs, 1972; Kelman, 1992; Putnam and Shoemaker, 2007). The sampled discourse was not entirely contentious, however. There were individual texts that reflected a more cooperative discourse characterized by "a more tolerant – and in some cases, positive – reaction to the conflict, where [stakeholders] expressed a readiness and willingness to engage constructively in conflict management and make progress" (Hodgson et al., 2022, p. 635).

Percentage of all relevant texts on fishing gear and entanglement from 2010 to 2023 (through March 15)

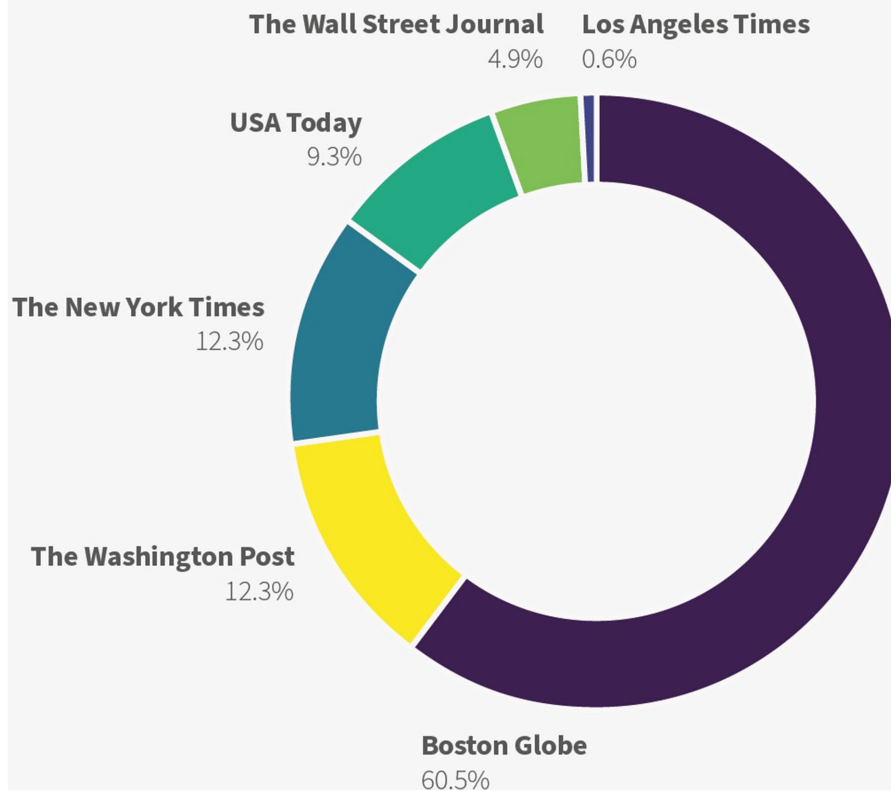


FIGURE 7

The percentage of texts about fishing gear and whale entanglements published by each newspaper for the full sample period.

Downs outlined three characteristics that could be used to identify social problems likely to go through the Downs (1972). Based on the sampled coverage, NARW conservation met those criteria (Table 3) and did move through the IAC, at least in part. Figure 8 shows where the IAC stages appeared to transition and notable events leading up to or associated with those transitions.

Notable events during the issue-attention cycle

NARW science and conservation remained in the *pre-problem stage* until 2017. That summer at least 12 right whales unexpectedly died in Canada's Gulf of St. Lawrence due to fishing gear entanglement and vessel strikes, leading NMFS to declare an Unusual Mortality Event (UME) (Pettis et al., 2018). This marked the beginning of IAC stage two, *alarmed discovery and euphoric enthusiasm*. Throughout 2017 and 2018 regulators in the US and Canada acted swiftly and decisively to implement emergency rules that resulted in fishing area closures and shortened lobster fishing seasons (Davies and Brilliant, 2019). Environmental groups initiated a series of federal lawsuits aimed to force the National Marine Fisheries Service (NMFS) to do

more to protect the NARW in US waters (Andersen, 2018) and experts reported regular updates related to the population, like that of 2018's reproductive season, when observers failed to identify the birth of even a single calf, a first since the 1980s (Pettis et al., 2018). Lobstermen began publicly resisting proposals from regulators and scientists that would impose new or stricter regulations on their industry in order to protect the shrinking NARW population (Abel, 2018b,c). The combined significant ecological event paired with the actions of US and Canadian governments to prevent further losses appear to have played important roles in moving the IAC out of the pre-problem stage and into public view, laying the groundwork for a conservation conflict to play out in media and other human institutions.

In 2019, the IAC moved into its third stage: *realizing the cost of significant progress*. News media coverage began to highlight the actions that would reduce the risk of mortality for NARWs, with an emphasis on lobster fishing gear and whale entanglements. News stories about the impacts regulatory decisions would have on fishing fleets and individual fishermen began appearing, as did op-eds for and against further protective actions. That fall, the Atlantic Large Whale Take Reduction Team (ALWTRT), a cross-sectoral collaborative group convened by NMFS, reached a near-consensus agreement to reduce the amount of vertical line lobster

TABLE 3 Characteristics of a problem likely to go through the IAC with examples from the NARW case study.

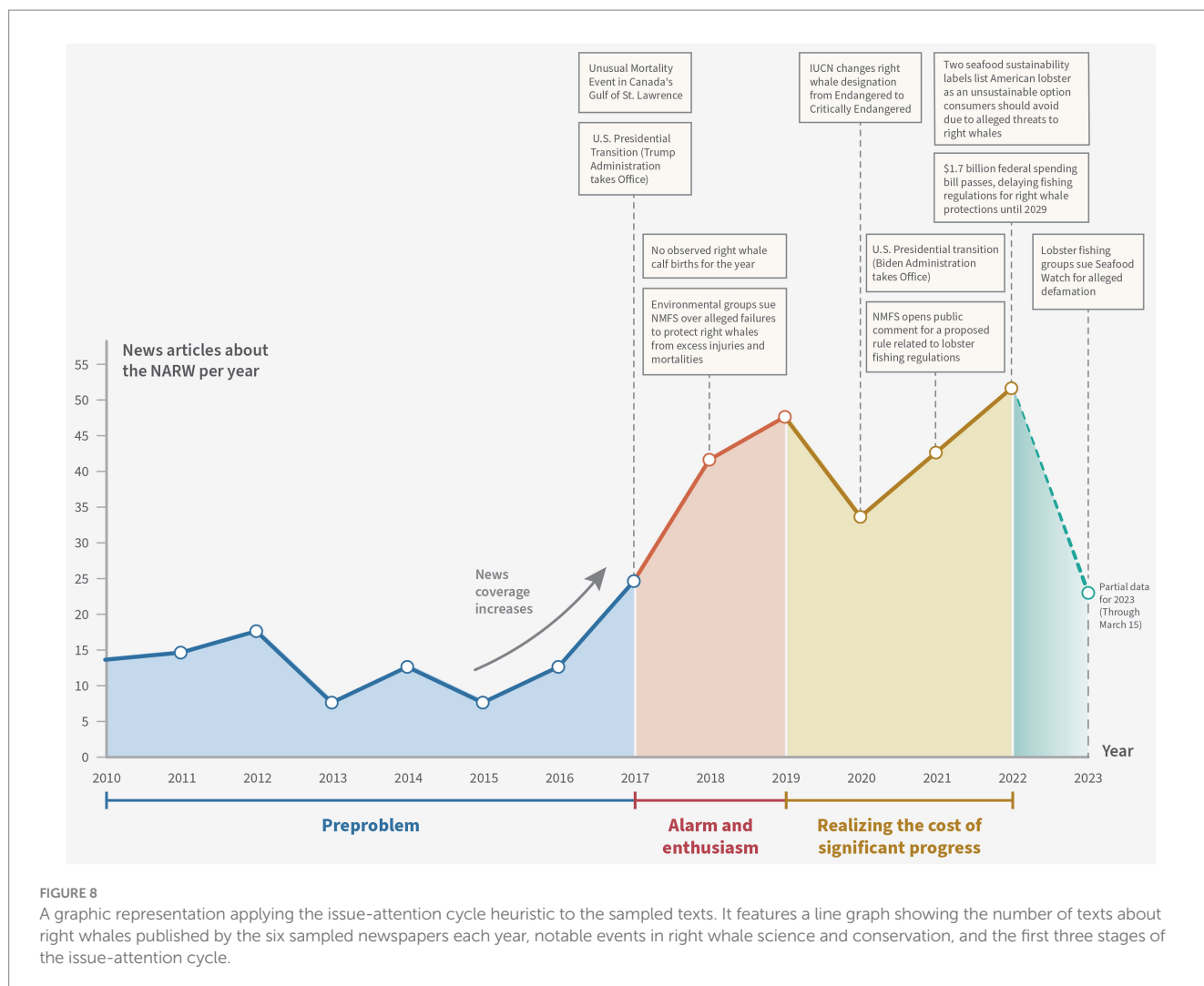
Characteristic	Description	NARW example
Who the problem affects most	The majority of people in a society do not suffer from the problem nearly as much as some numerical minority	The NARW has been depleted for so long that the ecological effects of its extinction would likely be quite limited; the social and cultural effects of this extinction are unclear, though it is unlikely it would affect some majority in society unless it was part of a larger ecological collapse
Source of the problem	The sufferings of the problem are generated by social arrangements that provide substantial benefits to a majority or a powerful minority of the population	Industrial uses of the ocean like fishing and shipping are economically important but also pose risks to the NARW population; There are approximately 5,000 commercial lobstermen operating in the region, a relatively small group with obvious power and influence
The problem's excitement	The problem has no intrinsically exciting qualities or no longer has them	The NARW has been at-risk of extinction for nearly a century and both research and policymaking are complex processes that occur over timescales that are long enough to lose public interest

fishermen would use by nearly 60 percent as a way to reduce the risk of entanglement for NARWs (Abel, 2019a). A few weeks later the State of Maine withdrew from the agreement and forced NMFS to pursue formal rulemaking to remain in compliance with statutory requirements and more recent legal rulings. At this point, the issue moved from a more exclusive and controlled political and regulatory arena to a more public one, thus inviting new actors into the mix and creating opportunities for shifts in power dynamics (Nisbet and Huges, 2007). Around the same time, the Trump Administration began weakening or undoing federal environmental regulations in support of its economic agenda and creating a period of added uncertainty and instability. Examples include allowing commercial fishing to resume in Northeast Canyons and Seamounts Marine National Monument (Fears and Eilperin, 2020), taking steps to advance seismic testing associated with offshore oil exploration in federal waters along the Atlantic (Fears, 2019), and taking steps to allow the consideration of business interests and economic impacts related to endangered species listing and management (Editorial Desk, 2019).

Media coverage declined in 2020 compared to the previous two years even as the IUCN elevated the NARW's conservation status from Endangered to Critically Endangered, the last stage before a species is considered extinct in the wild (Abel, 2020c). The decline in coverage does not appear to indicate waning public interest. This is because IACs are not measured by frequencies of coverage on a given topic but of patterns of coverage and its contents. Additionally, as Petersen (2009) points out, IACs do not often progress in neat, linear trajectories; some issues cycle between the second and third stages repeatedly before public interest declines, especially in cases that unfold over longer timescales. In this case, the single-year decline in coverage appears to be associated with the COVID-19 pandemic, including an intense public interest in navigating a global public health event and interruptions that widespread shutdowns caused for wildlife research and public policy processes (Gaynor et al., 2020; Miller-Rushing et al., 2021). Coverage resumed its upward trend in 2021 as NMFS began formal rulemaking related to the NARW and important judicial decisions were issued (Abel, 2020a,b,d; Fox, 2022a,b). Other notable media about the NARW were also released during this period, including the first and so far, only two documentary films focused on the species and its plight: *Entangled* (dir. David Abel and Andy Laub, 2020) and *Last of the Right Whales* (dir. Nadine Pequenez, 2021). The release of these films supports the idea that audiences were still believed to be interested in the topic. *Entangled*

was notable because it mirrored David Abel's coverage of the NARW in the *Boston Globe* by focusing on the struggle between whale experts and advocates and New England lobstermen and their allies as they sought to influence decision-making by NMFS (Reamer et al., 2023b).

News media coverage again increased in 2022, reaching an all-time high for the sample. That fall, two seafood sustainability labels – Monterey Bay Aquarium's Seafood Watch Program and The Marine Stewardship Council – rescinded their recommendations of American lobster to consumers as a sustainable fishery, leading national retailers and restaurant chains to halt sales of the seafood, which drew media attention and the ire of lobster fishermen and the Maine Congressional delegation, among others (Grandoni, 2022; Nanos, 2022). This decision came at a sensitive time and the widespread recognition of this seafood sustainability labeling program appears to have worked against NARW conservation in this instance as media reported on the decision and its impacts. NMFS' own seafood sustainability program, FishWatch, notably kept American lobster listed as a "smart seafood choice," contradicting third-party labels (NOAA Fisheries, 2023). In early December 2022, President Joe Biden hosted French President Emmanuel Macron for the first White House state dinner since 2019. A celebration of American cuisine and the nation's blue collar workers, the menu for the evening featured American lobster as the main course. Lobstermen and environmental groups alike were outraged and the event drew public backlash from stakeholders on both sides of the issue. Whale advocates cited multiple federal court rulings that determined the US government had for years been failing to do enough to minimize the risk of entanglement for the NARW while lobstermen and their Members of Congress expressed disbelief that the same government that, they claimed, had for years been trying to regulate fishermen out of business would choose to serve their product for such an elite event (Peterson and Kamp, 2022). Later that month the US Congress passed an essential \$1.7 trillion omnibus spending bill, the Consolidated Appropriations Act, 2023 (H.R. 2617) to avert a federal government shutdown that would have had widespread consequences for the American people and economy. As part of the bill, legislators included three right whale provisions unrelated to the federal budget. The first appropriated funding for the development of technologies that would aid in right whale conservation through NMFS. The second ordered NOAA to conduct a continuous plankton survey. And the third was the result of advocacy from the Maine Delegation, explicitly preventing NMFS from issuing new regulations for the lobster fishery until December 31, 2028, citing the 2021 ALWTRT plan as sufficient to meet the requirements of both the ESA and MMPA. The provision blocking



new regulations was the only one that earned media attention as it was a surprise to environmental groups and lobster fishermen alike and there was little time or opportunity to lobby lawmakers for an amendment before the bill was voted on and ultimately approved. President Joe Biden signed the appropriations bill into law in the final days of 2022, which again elicited strong reactions from environmental groups and the lobster industry (Andrews, 2022; Joselow, 2022; Peterson, 2022).

Trade associations representing lobster fishermen sued Monterey Bay Aquarium in early 2023, claiming defamation associated with its decision to rescind the fishery's sustainability certification and damages associated with an unspecified decrease in consumer demand for American lobster (Bella, 2023). While the sample for this study only includes a partial year of news media coverage from 2023, the aftermath of the \$1.7 trillion omnibus spending bill may mark an inflection point signaling the transition into stage 4 of the IAC for the NARW: a *gradual decline of intense public interest*. This is because there is little left to do in this decade that would achieve new or stricter fishing regulations without an act of Congress and the President's signature. Without legislative action to restore NMFS' authority to make rules for the commercial lobster fishery, all remaining paths forward are now voluntary on the part of the lobster fishermen, at least in the near term. While there are other looming threats to the species

–like vessel strike risks– that advocates can try to address through policymaking, it is unclear if these will attract anywhere near the same level of public attention as fishing gear and whale entanglements or if they will emerge as part of the IAC's post-problem phase, which Downs called “a prolonged limbo – a twilight realm of lesser attention or spasmodic recurrences of interest” (1972, p. 40).

Human actor groups and their discursive strategies

To understand the discourse requires an understanding of which human actor groups were included and how they participated. This is because inclusion in media is a privilege that allows these groups to gain visibility and express power within and over the discourse (Holzscheiter, 2005). The sampled media coverage about fishing gear and whale entanglements centered on three actor groups represented by diverse individuals and organizations: whale experts and advocates, governmental organizations, and commercial lobstermen and their allies (Figure 9). It was extremely rare that journalists included voices beyond these three privileged groups. For example, only one story included an Indigenous perspective in the form of a single quote from an elder of the Elsipogtog First Nation in Canada (Abel, 2019b) and

another engaged with New England restaurant owners and chefs to get their reactions to Seafood Watch and Marine Stewardship Council's decisions to list American lobster as a seafood choice for consumers to avoid (Nanos, 2022). No human actor group is monolithic, but their portrayal in the sampled news media coverage largely was, likely as a result of journalistic norms and strategic communication efforts. The process of recruiting and calling upon sources is particularly notable because, as Steele (1995) notes, expert recruitment is often "circular" as sources recommend other sources they trust, thus biasing the framing of a story or body of coverage (p. 802). In the case of the NARW, the focus on these three central actor groups may have left readers feeling like this problem was not accessible to them and only for these specific groups to address when, in reality, broader public support and engagement in federal policymaking processes is important.

Overall, the three central actor groups had a series of core arguments and engaged with journalists to offer information and experiences that supported those arguments. Fishing gear and whale entanglements are only one dimension of NARW conservation, but it appears to have been the easiest for journalists to dramatize as the issue emerged and developed because whales are iconic and beloved (Naylor and Parsons, 2018), the US American lobster fishery is one of the nation's most economically valuable fisheries and is emblematic of life in New England (Billings, 2014; Zou et al., 2021), and public policymaking processes in the US are often inherently adversarial (Kelman, 1992; West, 2005). Whale experts and advocates largely used empirical evidence and stories of known individual whales to argue for new and stricter regulations related to rope used in fishing to reduce the risk of whale entanglements. Commercial lobstermen and their allies largely relied on local knowledge, scientific uncertainty, and their industry's history and economic importance to argue against new and stricter regulations for the lobster fishery to reduce the risk of whale entanglements. Governmental organizations largely focused on sharing information related to the how and why behind regulatory decisions. Specifics for each group's characteristics and discursive strategies are provided in each section below. Supplementary Table S1 offers the full analysis as guided by Harrison and Loring's (2020) framework.

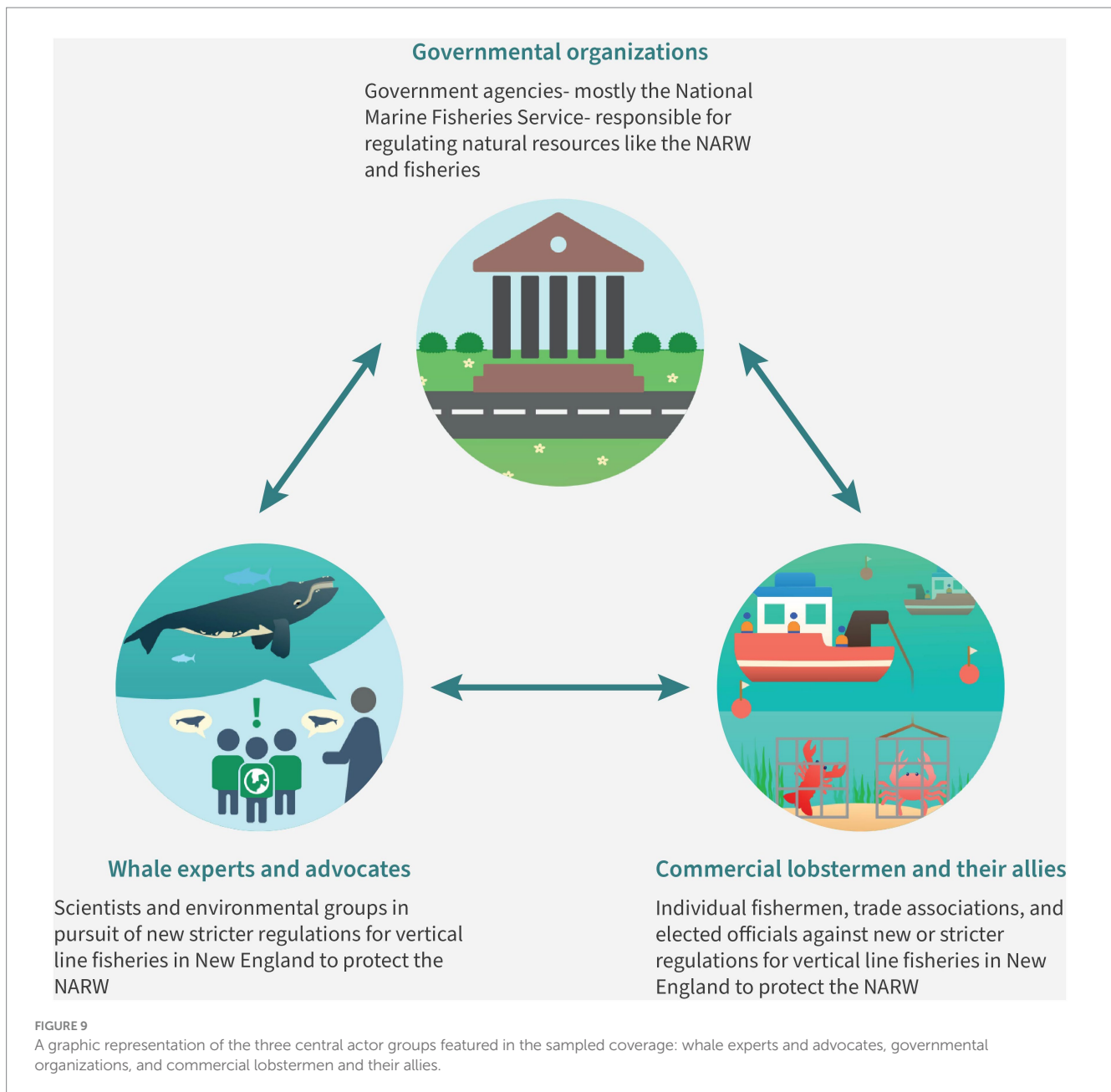
Whale experts and advocates

The leading voices in the coverage about fishing gear and whale entanglements were experts who knew the whales' plight well and were closely involved in efforts to ward off their looming extinction – researchers, whale observers, and wildlife conservation advocates. These groups can be subdivided into two distinct subgroups: science and conservation organizations and advocacy groups. Science and conservation organizations focused on the production and sharing of knowledge through empirical research, led on-water interventions like whale disentanglement, and performed necropsies of stranded or retrieved whale carcasses. These organizations represented more than half of all quotes attributed to environmental groups ($n=206$, 50.9%). The three most mentioned science and conservation organizations were New England Aquarium ($n=86$), the Center for Coastal Studies ($n=41$), and Woods Hole Oceanographic Institution ($n=36$), all three of which are based in Massachusetts. Advocacy groups focused on using knowledge to inform policy decisions about the NARW through processes like litigation and policy development and were more

outspoken than research groups, willing to make more assertive statements about what should be done based on the available scientific knowledge, legal requirements, and moral imperatives. Advocacy groups received nearly half of all quotes attributed to environmental groups ($n=199$, 49.1%). The most frequently mentioned advocacy groups were Conservation Law Foundation ($n=29$), headquartered in Boston, MA, Oceana ($n=25$) and Defenders of Wildlife ($n=16$), both of which are based in Washington, DC. The International Fund for Animal Welfare or IFAW ($n=19$) was also commonly quoted and can be considered both a science and conservation and an advocacy organization as it focuses on advocacy campaigns and hosts its own marine animal rescue program headquartered in New England.

Whale experts and advocates used their experiences and decades of empirical research to create a narrative focused on the whales and their conservation. On the whole, coverage focused on right whales at the population level, the same level at which agencies are required to manage protected species (Reamer, 2022b). With decades of research and photo-identification records to draw from, experts and advocates could tell detailed stories about individual right whales and refer to them by name (e.g., Bayla, Snow Cone's calf), familial relationships, or catalog number (e.g., NARW #3560), a strategy that can be used to establish or strengthen personal connections with non-human animals (Milstein, 2011; Schweitzer, 2014). While the stories of named whales often focused on their welfare or suffering, especially in cases of births, injuries, or mortalities (Moore, 2022), this kind of coverage largely avoided anthropomorphic characterizations of whales. This is notable as anthropomorphization is a common strategy in mass media coverage of nonhuman animals, particularly marine mammals, that has shown to be flawed and ineffective for broad audiences (Grasso et al., 2020; Peace, 2020).

Rather than speaking about policy actions as punitive, whale experts and advocates spoke about them as catalysts for the kind of change that was needed on a scale and at a pace that could support the NARW's recovery and survival while minimizing economic harms to people and businesses. In this case the preferred policy action indicated in the sampled coverage was initially the development and implementation of weaker fishing rope (Thebault, 2016). After the summer of 2017 the preferred policy action for this group shifted to requiring drastic reductions in vertical line and the adoption of on-demand or so-called ropeless fishing gear (Abel, 2018b) – lobster and crab traps that store their endline and floatation devices until the operator uses an acoustic signal to deploy them for collection (Moore, 2019; Alkire, 2022). This option was presented by experts and advocates as a win-win proposal that would reduce the risk of entanglement for NARWs – as required by both the Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA) – by decreasing the amount of rope in the water column while allowing lobster fishing to continue. In some cases adoption of this gear would allow fleets to fish for a longer season or in previously restricted areas. This communication strategy was in apparent recognition of the fact that the scientifically ideal solution – removing all rope from the water column to remove the risk of entanglement entirely – was and is not a realistic goal. On the whole, whale experts and advocates focused on rope, not fishermen, as a threat to the whales. These groups did not say they wanted the government to halt all commercial fishing, but advocated for changes in fishing practices, citing research that showed the new gear may even benefit fishermen in the long run,



relating to both sustainability of the fishery and profits (Myers and Moore, 2020). Instead of focusing on what they were hoping the industry group would sacrifice, they communicated their own tempered expectations and framed related decisions as a win for fishermen and for the NARW population. As Fortnam et al. (2023) point out, however, the idea of mutually acceptable trade-offs that is the current basis for and end-goal of many conservation development initiatives are difficult to achieve in practice due to tensions between social, economic, and ecological objectives and the stakeholders they affect. Conservation technologies also have substantial limitations, including their potential to dull public support and policy action to address the root causes of environmental problems (Harrison et al., 2019; Jenkins, 2022; Jenkins, 2023). When whale experts and advocates acknowledged the barriers to achieving progress, it was through language that portrayed the lobster fishery as what Steneck et al. (2011) call a

gilded trap – a feedback loop that is difficult to break free from because financial incentives for maintaining the status quo are significant and outweigh concerns over associated social or ecological risks and their consequences.

To achieve their goals, scientists and environmental organizations largely relied on the knowledge deficit model in this discourse, which focuses on the use of empirical facts to inspire change, a strategy that has been shown to be generally ineffective but is persistent in science and environmental communication (Simis et al., 2016). Their arguments and strategies for engagement also remained largely unchanged throughout the sampled coverage, even as lobstermen's rhetoric intensified. Whale experts and advocates consistently shared facts throughout the sampled coverage – like the remaining population count, which is mentioned frequently ($n = 118$, 72.8% of all articles in the theme) – but simply repeating how few right whales remain and reiterating the threats they face may not appeal to as broad of an

audience as lobster fishermen who cited specific hardships that new or stricter regulations could cause them and their communities. Whale experts and advocates failed to offer readers specific consequences that could be avoided by saving the NARW from extinction beyond their intrinsic value and legal and moral imperatives. There was one notable exception, however. In an article about artists who receive funding to make sculptures from salvaged fishing gear, one artist made a strong, though unfounded, ecological argument: “For instance, we may love the North Atlantic right whale, and not realize the codependent species—an entire system—that would disappear with their extinction” (Parson, 2021). While some more dramatic stories of individual animal welfare (or lack thereof) appeared in the sampled coverage, they were less common than articles that focus on empirical facts and complex policy processes ($n=41$) (McGrath, 2023).

Environmental research and advocacy groups also acted as science arbiters and issue advocates in the whale protection discourse, and presumably did so in their other interactions with decision makers (Pielke, 2007). The science arbiter role appeared when these organizations supported decision making with knowledge produced by empirical means (Pielke, 2007). An example is the annual Report Card produced by the NARWC, which synthesizes and contextualizes recent research for use in research, media interviews, public engagement, and policy processes. These organizations also acted as issue advocates when they used their knowledge in attempts to reduce the scope of available choices from many to a few or even one (Pielke, 2007). Their strong support for ropeless gear is a clear example of a preferred option because its adoption would reduce the amount of rope in the water column and allow crab and lobster fishermen to operate their businesses without the disruption of emergency or seasonal closures where NARWs are present.

Governmental organizations

Governmental organizations across all three branches of government and at local, state, and federal levels were the second most represented voices in the coverage about fishing gear and whale entanglements. NMFS was the most quoted ($n=84$) given its role as the agency responsible for managing both protected species and marine fisheries in federal waters. Other federal agencies quoted include the Bureau of Ocean Energy Management under the US Department of Interior ($n=12$), Fisheries and Oceans Canada ($n=12$), and the US Coast Guard ($n=4$). State and local governments also participated in this discourse with the most quoted actors including the current and former governors of Maine ($n=12$) and state-level agencies with authority to manage natural resources in state waters ($n=9$). This discourse also included federal judges ($n=10$), but always indirectly by quoting judicial opinions and other legal documents, as it is not customary for judges to speak directly to reporters in the way executive agencies and elected officials do. In some cases agency spokespersons or employees were directly quoted as part of an interview or press conference, but in many instances journalists quoted agencies or described their positions through the use of public statements, news releases, or official documents.

Engagement by federal agencies was defined by a factual approach to sharing decisions, how these decisions were made, and why government involvement was needed in the first place. It was overall a much plainer and more indirect mode of engagement compared to the approaches of whale experts and advocates and commercial lobstermen and their allies. Due to statutory requirements and institutional norms

associated with government employees and public administration, this discourse was one that aimed for objectivity and emphasized commitments to fairness in process and trustworthy decision-making. In instances where spokespersons from these agencies engaged directly with arguments from either of the other two stakeholder groups, they often cited studies by their own biologists or those that the agency had used in its decision-making (Sullivan, 2023). Reporters sometimes used language that framed government agencies as “caught in the middle of the debate” (Voyles Pulver, 2023), though there were no examples in which governmental agencies or their representatives presented themselves this way. Judicial opinions issued throughout the sample did acknowledge the complexity of the issue, however, often in cases where judges ruled against NMFS for failing to adequately protect the NARW population. In these instances, judges offered no specific remedy and instead left it to the agency and relevant parties to decide, either voluntarily or through rulemaking, how to address this failure (Fox, 2022a). Legislators and elected officials were the exception to the tendency towards neutrality and focus on process, as the nature of their work allows them to speak more freely and subjectively.

In contrast to the whale experts and advocates who leveraged science arbiter and issue advocate approaches, governmental actors in their procedural discourse used an honest brokerage approach to discuss the NARW population and options to save it (Pielke, 2007). Decision-makers often clarified and sometimes expanded upon possible policy choices using different sources of knowledge and perspectives, as is often required by statutes like the National Environmental Policy Act and the Administrative Procedures Act. An example of honest brokerage is the listing of proposed rules, which present multiple alternatives for publics to consider and react to through public comment and are then considered as an agency develops its final rule. In some cases, including some within this discourse, the agency explicitly defined their preferred alternative and offered justifications for the selection of the options presented.

Commercial lobstermen and their allies

Commercial lobstermen who operated or worked for fishing fleets in New England waters and their allies in the region and beyond were often quoted in the coverage about fishing gear and whale entanglements. Commercial lobstermen and their allies can be subdivided into four distinct subgroups: industry trade associations, nonprofit organizations with fisheries-related missions, individual fishermen and their families, and local businesses that depend on fisheries but are not directly involved in fishing, such as seafood wholesalers, restaurant groups, and markets. Individual fishermen were the most frequently quoted of these subgroups ($n=73$). The three most commonly quoted organizational actors were industry trade associations, the Maine Lobstermen’s Association ($n=26$) and Massachusetts Lobstermen’s Association ($n=24$), and Saving Seafood, a nonprofit organization based in Washington, DC that conducts media and outreach on behalf of the seafood industry and shares news with industry members ($n=10$).

As the IAC progressed and media coverage increasingly cited lobster fishing gear as a leading problem, lobstermen received more representation in the coverage. Commercial lobstermen and their allies participated largely by stating their commitment to achieving a productive and peaceful coexistence with NARWs and redefining the issue as one

that unfairly and inaccurately villainized the fishery (Joselow, 2022; Caulfield, 2023). They also referenced a decades-long evolution in conservation attitudes on the part of the fishery, and that they are and have been willing partners and stewards of the ocean and its many resources (Acheson, 1975a,b; Acheson and Gardner, 2011; Acheson, 2013). Specifically, they spoke about a situation defined by uncertainty by describing new or stricter regulations as a significant and existential threat to their freedoms, identities, livelihoods, and communities, which they did by referring to themselves as an endangered species equivalent to the NARW (Kaplan, 2018; Russell et al., 2021; Kamp, 2022). Notably, these groups were quoted as stating that their counterparts who fished in other areas of the NARW's migratory range, namely in Atlantic Canada, should be the ones burdened with the regulations they defined as an existential threat to their own industry and way of life (Abel, 2018b,c). This strategy was one that both shifted blame and fed into a separate, long-standing territorial dispute between the US and Canadian lobster fisheries (Abel, 2015). Commercial lobstermen and their allies also focused on the direct and indirect economic value of their businesses, their historic willingness to develop and participate in sustainable fishing practices, and the lobster fishery's place in New England's maritime heritage and culture as one of the region's last remaining blue-collar industries. They illustrated these points and the immediacy of the economic and social hardships they would face under stronger regulations through story to make this issue personal for newsreaders and policymakers. For example, one series of articles showcased some of the reasons lobster fishermen were resistant to compensation schemes and adopting on-demand gear, quoting two fishermen who both mentioned a sense of pride in their work and what it meant to their personal identities to be out on the water and making their living by fishing (Russell et al., 2021; Russell and Overton, 2021). In a series of stories about a coalition of lobstermen who championed ropeless gear and worked alongside environmental groups in pursuit of wider spread adoption of the technology, cooperating lobstermen were villainized, called traitors by other lobstermen while state governmental agencies denied special permits to pilot the innovative gear in areas closed to fishing, creating new conflicts for audiences to consume even within solutions-oriented stories (Abel and Stoico, 2022; Abel, 2022a,b).

Coverage quoting lobstermen and their allies contextualized right whale conservation efforts alongside other pressures facing their industry in the region, including environmental changes, market pressures, regulatory efforts, and the COVID-19 pandemic (Russell et al., 2021; Russell and Overton, 2021). This coverage essentially presented audiences with the story of fisheries as social struggle, describing complex socioecological systems that are defined by relationships, not just "between fishers and nature, but also between fishers and others in their human environment" (Bavinck et al., 2018, p. 46), allowing commercial lobstermen to frame themselves as resisting injustice and leaning into conflict and dramatic elements to reframe the discourse in service of their desired goal: resisting new or stricter regulations.

Fishing groups' engagement with media in other contexts have been documented in the literature, with fishermen "clashing first perhaps over ... how a fishery is prosecuted (e.g., gear issues), and then later contesting the management regime itself" (Harrison and Loring, 2020, p. 3). In this case, the commercial lobster fishery engaged with journalists in a similar fashion. Rather than blaming the protected species (Grant-Smith, 2015; Dayer et al., 2019), minimizing the care advocates or the public have for the whales, or even denying that right whales are at risk of extinction, fishing groups appear to have recognized that it is "more efficacious to question the need for

environmental regulations by challenging evidence of environmental degradation rather than the goal of environmental protection" (Dunlap and McCright, 2011, p.146). They did so by using manufactured uncertainty and leveraging knowledge gaps by questioning the validity of existing scientific evidence that informs management decisions (Michaels and Monforton, 2005). The sampled media suggests that lobstermen applied the lessons of other industrial groups in engaging with news organizations to successfully resist regulations, which is not difficult to do in a situation like the NARW case study that is defined by uncertainty. The use of manufactured uncertainty in this way has become more common in public discourses about science policy (Oreskes and Conway, 2010; Oreskes, 2015), disguised and normalized as skepticism, which is a "fundamentally important feature of democratic decision-making" (Boan et al., 2018, p. 367). Public perceptions and policy support are "particularly vulnerable" to these strategies, which then has effects on public dialogues and participation in decision making (Boan et al., 2018, p. 366). Table 4 lists examples of arguments included in the sampled coverage that aligned with the three tactics associated with manufactured uncertainty.

Takeaways from nearly 13 years of newspaper coverage about the NARW

Experts and advocates have been describing the NARW as in crisis for decades (Kraus et al., 2005) and regularly communicate its status and outlook through the NARWC, academic research, and other forms of education and outreach. Even with regular and disciplined science communication, the issue received little coverage from larger newspapers from 2010–2016, which suggests that the factual and prolonged narrative of crisis and a looming extinction was not inherently interesting to readers. It was not until 12 NARW fatalities occurred in an area uncharacteristic of their typical range in 2017 that news media reported on the significant population decline, the complexities of its conservation, and the industries associated with the leading causes of injuries and mortalities, with a focus on the New England lobster fishery. Even with increased public attention, the focus and interest was primarily regional, with *The Boston Globe* and reporter David Abel playing leading roles in the media discourse by producing the most coverage on the issue. In the years that followed, public interest was not enough to encourage policymakers to take swift and decisive actions to help the species recover and thrive. In fact, this IAC resulted in decisions that undermined decades of conservation efforts, which appears at least partly due to journalistic choices and actor groups' strategies of engagement. What this case makes clear is that it is not an absence of sound science or an interest in saving the NARW that stands in the way of progress, but differences in human values, perceptions of what it means to peacefully coexist, and an incongruence between the urgency of ecological need and governmental decision making processes (Johnson et al., 2010; Briggs, 2022).

Increased public attention, while a desirable goal for scientists and communication practitioners, does not guarantee desired conservation outcomes, even for a beloved and iconic species. What it does guarantee is a limited window of opportunity to use communication in support of conservation goals before audiences grow bored and move on to another topic which is not helpful to conservation efforts like this one that require sustained attention and support. The cost of increased public attention in

TABLE 4 Boan et al.'s (2018) three tactics associated with manufactured uncertainty and how lobstermen and their allies who opposed changes to fishing regulations applied them throughout the sampled coverage.

Tactic	Examples from the sampled coverage
Deny the problem and vilify critics	<ul style="list-style-type: none"> a. Acknowledge that NARWs are at risk of extinction, but deny that it is because of commercial lobster fishing in New England waters b. Label environmental groups as unsympathetic, and describe them as wanting to end their industry through regulation c. Label NMFS as an ally sympathetic to environmental groups and incapable of managing the problem fairly and effectively
Deny the source of the problem	<ul style="list-style-type: none"> a. Leverage a lack of data related to traceability to deny that entanglements originate in New England waters; instead point to Canadian fishermen as the culprits, an extension of a longstanding territorial dispute between the two fisheries b. Leverage local knowledge by stating most fishermen have never even seen a live right whale in their years of fishing c. Point to vessel strikes as the more significant issue that needs to be addressed, question why this is not a focus for environmental groups or NMFS d. Point to NARW injuries and mortalities that still occurred, even when New England lobstermen were not fishing due to seasonal or emergency closures, as evidence against regulations e. Question the accuracy and trustworthiness of science used in decision making, often citing the ESA's best available science mandate f. Using the points above, argue that changes to fishing regulations will not benefit the right whale population
Claim the problem is too costly to resolve	<ul style="list-style-type: none"> a. Cite job losses and business closures as a consequence of proposed fishing regulations designed to reduce the risk of entanglement for whales b. Cite personal and financial hardships that may result c. Specifically resist ropeless fishing gear by citing the high costs to replace current traps with the expensive technology, the increased costs they would incur due to gear damage and loss, and concerns about the practicality of the new gear's use

the form of an IAC, then, is the probability that even well-meaning journalists who want to help address a particular problem through their reporting will use the storytelling norms and practices of their profession. Some of these practices can lead to escalations in conflict between stakeholders, or introduce the risk that a more public discussion will disrupt delicate power dynamics and may lead to undesirable policies or conservation outcomes. While news media are an asset to conservation, they can also hinder conservation progress. A strong understanding of news media, its role in environmental politics, and alternative approaches to covering complex and challenging environmental issues can help scientists, organizations, and practitioners achieve goals related to conservation and sustainability.

IACs move through distinct stages that rely on specific storytelling elements, but the timespan of these cycles and their stages varies greatly. Some problems move through the entire IAC quickly and others are more prolonged. It is difficult to anticipate which issues may move through the IAC, why, or how quickly, and it can be challenging to identify an IAC as it is happening. These cycles are not simply managed through strategic communication tools, in large part due to the fact that communicators in support of conservation cannot control journalists' reporting, how other human actor groups choose to communicate with the media, or externalities that arise and may change the course of the IAC (Bailey, 2022). Environmental organizations and communicators also have to choose whether to lean into the dramatic elements of an issue they are working on or to remain steadfast in more neutral and factual engagement. When it comes to conservation scenarios where species and business interests intersect, it is not unreasonable to expect that industry groups will work to be included in the discourse and use communication strategies to protect their status quo. Similar examples beyond that of the NARW where intensifying language in media and other human institutions led to division and contentious decision making include conservation of wolves in Spain and Germany, coyotes in Colorado, sea turtles in the Cayman Islands, and hen harriers in the UK (Walker et al., 2019; Draheim et al., 2021; Zscheischler and Friedrich, 2022; Marino et al., 2023; Pettersson et al., 2023).

The NARW IAC played out over a span of at least six years, representing a window of opportunity for conservation progress.

Unfortunately, despite increased public attention in NARW protections during this time, the simplification and the dramatization of the issue with an emphasis on fishing gear and whale entanglements – the most significant threat facing the species' survival – all appear to have led to undesired and unexpected outcomes. It remains unclear whether the NARW's IAC has been exhausted or if there is still time before it reaches the post-problem stage, but this decrease in public interest may negatively affect conservation and communication efforts related to the species in the foreseeable future. The obvious hope is that conservation efforts will be successful and inspire public attention and support for the NARW so that there is cause for celebration, but no such recovery appears to be likely in the near term. Additionally, such an achievement in conservation would not be inherently dramatic or problematic, a key feature in driving the IAC, and, as a result, would likely not earn significant media attention and initiate a new IAC unless it had negative consequences for fishermen or other industry groups. Now, instead of having access to journalists and regular opportunities to communicate with a large, non-expert audience, NARW experts and advocates will likely face greater competition with other environmental issues for inclusion in national media as they attempt to reduce the risk of vessel strikes and other threats to the NARW population. Examples of these competing issues include efforts to save the recently discovered and already endangered Rice's whale (*Balaenoptera ricei*) in the Gulf of Mexico (Rosel et al., 2021), on-going efforts in Oregon to further regulate Dungeness crab (*Metacarcinus magister*) fishing to protect whales from the risk of entanglement (Feist et al., 2021; Derville et al., 2023), significant warming and environmental changes in the Gulf of Maine (Record et al., 2019; Pershing et al., 2021), and media coverage and misinformation campaigns that use whales and other marine life to resist offshore wind energy development (Fleming et al., 2022; Thorne and Wiley, 2024).

The outcomes of this study also show that litigation, a common tool in conservation, can be risky. While it can be helpful in bringing attention to issues and forcing natural resource managers to act, the use of lawsuits by environmental organizations can also be criticized and undermined by Congress, the executive branch, and other interest groups (Nie, 2008; Asmutis-Silvia, 2009). In the case of the NARW,

litigation was a supplement to other collaborative actions because of the urgency of the situation, years of stalled progress, and worsening outlooks for the species; however, the judicial decisions that seemingly favored environmental advocacy groups and forced NMFS to use public rulemaking throughout the IAC drew media attention to the industry groups affected by those decisions. Instead of yielding stronger protections for whales, this created opportunities for the issue to move into more public forums, become simplified and dramatized, and allowed industry stakeholders to use counter-messaging in their engagements with media to define the issue in their favor, invite in new perspectives, and attempt to change the existing power dynamics. Environmental advocates and communicators should be aware of these possible outcomes and prepare for them when their organizations take an issue to court, especially in higher profile cases like the NARW's.

The findings of this study also show the importance of external events and politics in environmental journalism and conservation. The NARW IAC emerged and unfolded alongside a complex and uncertain political environment in which the Trump Administration actively sought to undo and destabilize environmental policy in favor of business interests and coincided with the COVID-19 pandemic that disrupted business and scientific interests worldwide. Even with their regimented and factual science communication, whale scientists and advocates were not able to overcome the challenges associated with communicating in such unprecedented social and political environments. What this case also makes clear is a growing willingness by some elected officials to undermine landmark environmental laws like the ESA and MMPA and decades of US leadership and environmental progress in favor of political wins (Corkeron et al., 2023). In this case, legislators did so through unrelated and unexpected means by adding a provision to funding legislation as a way to carve out exceptions for a specific industry and side-step conventional decision-making to strip agencies of their statutory authorities to make decisions. While efforts to weaken environmental laws and regulations in favor of business and other interests are hardly new, this case study highlights a concerning precedent that has far-reaching implications for the future of conservation policy and practice in the US and around the world, especially in the wake of the US Supreme Court's June 2024 ruling that reversed the Chevron doctrine, which for 40 years granted federal agencies the authority to use their subject-matter expertise to interpret statutes and make regulatory decisions (Loper Bright Enterprises v. Raimondo, 2024).

NARW conservation reflects a single, complex, and contentious case study in conservation and it has important implications for cases in wildlife and biodiversity conservation beyond the NARW, namely that understanding communication and discourse is an essential part of developing comprehensive conservation and management strategies and conducting comprehensive marine social science research (Hansen, 2011; Doley and Barman, 2023). Despite a growing interest in digital media, news organizations and journalists remain important and influential actors in environmental science and policy, which means media relations activities are integral to comprehensive organizational communication strategies. Organizations and funders should support and invest in social science and communication capacity, training, and expertise – not just media production – alongside science and technological development to increase the likelihood of achieving conservation goals. While actions like horizon scanning (Cook et al., 2014) can be useful in navigating the media environment and anticipating trends, a stronger approach would integrate strategic environmental communication so research and practice inform one

another as policy and conservation efforts play out. This integration can bridge scholarship and practice in ways that allow communicators to make informed decisions to help them achieve their organizational goals and improve the broader understanding of effective strategies in communicating wildlife and biodiversity issues, especially in marine and coastal environments (Liang et al., 2018).

Offering regular training related to conservation communication and advocacy may also be beneficial, possibly through partnerships with member associations like the International Environmental Communication Association and the Society of Environmental Journalists. For scientists and advocates, to understand the role of communication in making science actionable and teach the skills associated with effective public communication (Menezes, 2018) and the role of advocacy in their work (Nelson and Vucetich, 2009). For journalists and media organizations, to understand how their work influences environmental politics and find a balance between highlighting environmental problems and risking escalation of a conflict by focusing on their most controversial elements rather than collaboration and solutions (Soroka et al., 2019; Thier and Lin, 2022; Lough and McIntyre, 2023). Academic programs spanning the life and social sciences as well as the arts and humanities can help improve environmental communication in conservation by training boundary spanners (Goodrich et al., 2020) – professionals who can operate at the intersection of science and society – through interdisciplinary curricula and experiential learning that prepares future professionals for roles ranging from scientist to journalist to informed citizen, and to address complex environmental challenges at all scales, from the local to the global.

Limitations and opportunities for future research

This study addresses gaps in the literature about communicating biodiversity loss and marine conservation in news media (Legagneux et al., 2018; Kolandai-Matchett et al., 2021). Of course, there are limitations that need to be acknowledged. First, delimiting the study to published texts in six large US newspapers offers a valuable snapshot, but excludes coverage at the local and international levels and omits other important media forms like non-profit action campaigns, documentaries, and social media. These other texts could provide richer and more diverse perspectives on how NARW science and conservation are represented in media, how these media relate to one another, and how they might influence public discussions and decision-making. While this study identifies a relationship between media coverage, public engagement, and policy actions, it cannot definitively establish causality; as Bailey (2022) notes, the IAC is best used as a heuristic rather than a predictor of policy outcomes. Future research exploring public perception and behavioral change in response to media coverage would further strengthen the understanding of its influence and correlation with conservation outcomes. Although the codebook was developed in a methodical fashion and tested for its reliability prior to its use in collecting and analyzing the data, there is an inherently subjective aspect to these activities that cannot be eliminated. Furthermore, this study exacerbates two existing biases present in the literature by focusing on charismatic megafauna rather than exploring the plights of less popular species (Barua, 2011) and by restricting its scope to the US, reflecting a wider trend in environmental media research skewed

towards the Global North (Painter, 2021). This limitation underscores the need for future research to incorporate diverse global perspectives and ecological case studies. Finally, it is important to recognize that this analysis represents the second stage of journalistic production that considers the contents of media rather than the first or third stages which focus on how media are produced or measure the effects they have on audiences, respectively (Painter, 2021); understanding the production processes and audience reception of media narratives can offer invaluable insights beyond a text's contents.

Future research can build upon this work in an important way by conducting interdisciplinary social governance research related to the NARW and its conservation, as well as other marine species, to supplement biological and ecological research and technological development as conservation solutions. These include communication and media studies, public perceptions, and stakeholder engagement. One possible direction would be to continue exploring environmental media associated with the NARW and other threatened species to understand how they reflect science and influence public perceptions and policy actions related to wildlife and biodiversity conservation, especially in the marine environment. Another would be to continue tracking national level US news coverage of NARW science and conservation to understand how the IAC unfolded after the sample period of this study concluded, or looking at historic coverage to explore if there were previous IACs that played out prior to 2010. There are also opportunities to explore other news reporting related to the NARW, either in more localized coverage or internationally.

Conclusion

This study examined how US news media covered the NARW over a recent period of more than 12 years. A total of 356 articles and op-eds published by six publications were analyzed using content analysis and critical discourse analysis. With a majority of the sampled news coverage published from 2017 on ($n = 267$), by *The Boston Globe* ($n = 209$) and *Globe* reporter David Abel ($n = 50$), set in New England ($n = 229$), and focused on issues related to fishing gear and whale entanglement ($n = 162$), the topic of NARW science and conservation appears to have been largely one of local and regional focus. This did not appear to be an instance of news traveling down to a regional paper from more elite national publications, but the opposite.

Six key themes were identified as part of the sampled media coverage. Fishing gear and whale entanglement represented nearly half of all articles ($n = 162$, 45.5%), reflecting and facilitating an escalating conservation conflict between human actor groups. Three central actor groups were featured in the coverage related to this theme: whale experts and advocates, governmental organizations, and commercial lobstermen and their allies. Each group used distinct discursive strategies in an attempt to shape the discourse and public opinion related to new or stricter regulations for the commercial lobster fishery that were designed to reduce the risk of entanglement for the NARW. Findings suggest that the IAC related to NARW science and conservation has already moved through at least three of five key stages and will inevitably fall out of public view as other issues arise, with the expectation that there will be occasional recurrences in public interest as time goes on. Overall, this case study demonstrates the continued importance of journalists and news media to conservation – as public forums for discussion, essential components of organizational strategies for change, and as an externality that can directly

influence the outcomes of decision making. Efforts to support communication research and practice are vital to successful conservation now and into the future.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

MR: Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. CM: Conceptualization, Formal analysis, Supervision, Writing – original draft, Writing – review & editing. JW: Methodology, Supervision, Writing – original draft, Writing – review & editing. RF: Supervision, Writing – original draft, Writing – review & editing. MS-R: Conceptualization, Supervision, Writing – original draft, Writing – review & editing.

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Conflict of interest

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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Supplementary material

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