

Human Dimensions of Rebounding Seal and Shark Populations on Cape Cod

Summary Report April 11, 2022

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Human Dimensions of Rebounding Seal and Shark Populations on Cape Cod

EXECUTIVE SUMMARY

Funding from Woods Hole Sea Grant supported a team from Salem State University, University of Massachusetts-Boston, Center for Coastal Studies, Center for Animals and Public Policy at Cummings School of Veterinary Medicine at Tufts University, Cape Cod Commercial Fishermen's Alliance, and Atlantic White Shark Conservancy to conduct a mixed mode (mail and Qualtrics) social science survey of residents, tourists and commercial fishers on Cape Cod about their views of seals and sharks. Representative samples of Cape Cod voters (n=547), commercial fishers (n=564), and tourists (n=699) completed surveys between June and September 2021. The methodology is detailed in Appendix A.

Differences in attitudes towards seals among stakeholder groups on Cape Cod are notable. Voters and especially tourists view seals favorably. They hope to see them on Cape Cod. They largely perceive seals as beneficial, positive, and enjoyable. They believe that seals are an important part of the marine ecosystem and a sign of a healthy environment. Commercial fishers hold different views and are more negative in their perceptions of seals and their ecological, economic, and fishery impacts. Commercial fishers blame seals for reducing and suppressing fish stocks, hurting the economy, and creating public safety risks by attracting sharks to the area. Most commercial fishers report interactions with seals. Interactions are most frequent in mid-water (bluefish, striped bass, and tuna), bait-like (herring/menhaden, mackerel, squid), and benthic (skate/monkfish, multi-species/groundfish, and dogfish) fisheries.

The results also indicate that voter and commercial fisher stakeholder groups are not monolithic. About one-fourth of voters share commercial fishers' critiques of seals, whereas some one-third of commercial fishers have more positive views of seals, especially around their ecosystem role. Tourists are largely unified in their positive evaluations of seals.

Little support is found for lethal management of seals in any of the groups. Voters and tourists are strongly opposed to lethal management under all circumstances. Commercial fishers are more divided, resulting in more neutral views when averaged. All three stakeholder groups prefer non-lethal management approaches to lethal management. In addition, almost two-thirds of tourists and half of voters believe seals should be left alone; only one-fifth of commercial fishers believe seals should be left alone. Support for the goals of the Marine Mammal Protection Act (MMPA) is at near consensus levels among voters and tourists; although more conflicted, two-thirds of commercial fishers also support MMPA goals.

Tourists and voters are more likely than commercial fishers to perceive sharks as having aesthetic, ecological, and economic benefits. Commercial fishers hold less favorable views of sharks than tourists and voters on almost every measure, although differences in views are less than in regard to seals. Commercial fishers view sharks more favorably than seals.

While sharks generate fear and are viewed as a threat to people by the majority of voters, tourists, and commercial fishers, the perceived benefits of sharks appear to outweigh the risks. Respondents in all three stakeholder groups view sharks as important to the marine ecosystem. By large margins, respondents in all groups agree with the statement “I am willing to accept some inconvenience and risk in order to have oceans where marine wildlife can thrive.” Very few respondents indicated that they had reduced beach visits to avoid sharks. Moreover, some two-thirds of voters and tourists, and more than half of commercial fishers feel that they have control over whether they encounter a shark.

Tourists are the most likely of the three groups to take actions to avoid encounters with sharks, such as checking and obeying signage and warning systems, following lifeguard instructions, avoiding seals, and using patrolled beaches. Commercial fishers are less likely than tourists and voters to take actions to avoid encounters with sharks. Although the majority of commercial fishers support shark encounter prevention policies such as increased public education, improved signage at beaches, and increased shark patrols, they are less supportive than tourists and voters, who favor these measures at near-consensus levels. Views of restrictions on deep water activities during peak shark season are more mixed, with some support among voters and tourists and virtually no support among commercial fishers.

All three stakeholder groups reject the lethal management of sharks. Over two-thirds of voters, tourists and commercial fishers support leaving sharks alone. Support for non-lethal management of sharks is also high.

While the surveys found differences in attitudes among the three stakeholder groups toward seals, sharks, and their management, shared commitments to coexistence with marine wildlife and ecosystem health are also apparent. Over two-thirds of respondents in all three groups indicate a desire to “learn to share the ocean with the animals that live there.” Management for the ecosystem is the top priority for tourists and voters, and is second only to the fisheries in the management priorities of commercial fishers.

The surveys also reveal that many respondents lack knowledge about the history of seals and sharks in Cape Cod waters and the impacts of public policies on their populations. Only about half of voters, fishers, and tourists are aware that state-funded bounty hunting resulted in the near extinction of seals on Cape Cod by 1960, and only about a third of each sample are aware that fishing activities depleted shark populations. Respondents in all three stakeholder groups are more aware of the role of laws in seal population recovery than in the recovery of shark populations. Commercial fishers are more knowledgeable about the role of laws in population recovery, seal behavior and shark biology.

Signs at the beaches and the news media are the primary sources of information on seals and sharks for all respondent categories. The majority of tourists also rely on lifeguards for information. One third of respondents in each stakeholder group use apps such as Sharktivity, and about one-third of tourists and commercial fishers and almost half of voters rely on social media for information on seals and sharks.

Human Dimensions of Rebounding Seal and Shark Populations on Cape Cod

Introduction

State-sanctioned bounty hunting in the 19th and 20th century led to the local extinction of seals from Massachusetts coastal waters by the 1950s (Andrews and Mott 1962, Lelli et al. 2009, Lotze et al., 2004, Wood et al. 2011). In 1962, Massachusetts outlawed the killing of gray seals and, at the federal level, in 1972, the Marine Mammal Protection Act (MMPA) made it illegal to harass, hunt, capture, or kill any marine mammal. Under these protections, seal populations began to rebound, enhanced by emigration from Canada. In 1991, researchers determined that gray seals had re-established a historic breeding colony at Muskeget Island (MA) (Wood et al. 2020). The most recent population estimate in U.S. waters based on pups born at U.S. breeding sites is 27,131 (95% CI: 22,162 – 33,215) animals (Hayes et al. 2018).

Similarly, Northwest Atlantic shark abundances experienced population declines as a result of commercial fisheries bycatch and recreational fishing. The white shark population suffered population reductions estimated to be as high as 73% in the 1970s and 1980s (Baum et al. 2003, Curtis et al. 2014, Winton et al. 2021). Fishery management plans for coastal shark species, including white sharks, were not put into place until 1993 (NMFS 1993). White sharks were designated as prohibited species for fisheries in federal waters in the Atlantic in 1997 (NMFS 1997, US Department of Commerce 1997). In the past decade, increases in white shark sightings and catch records in the broader Northwest Atlantic have increased, which suggests some level of population recovery, but stock status remains uncertain (Curtis et al. 2014). The increased presence of white sharks off of Cape Cod has been tied to increases in seal populations (Skomal et al. 2012).

Increases in the local abundance of seals and sharks are considered conservation success stories. Re-established seal and shark populations have generated new tourist industries and constituencies with an interest in seals and sharks. Seal cruises, seal walks and shark viewing expeditions increasingly have become popular activities for both tourists and residents. However, conflicts related to seal and shark populations threaten continued conservation of both species. In September 2018, the first shark fatality in Massachusetts since 1936 escalated public safety concerns.

Seals occupy a contentious space in public discourse on Cape Cod. An expanding seal population in the region is a boon to the environment in many respects. Marine mammals are known to act as nutrient pumps, effectively transferring energy from deep water and offshore areas to surface waters and nearshore areas, and may suppress other predators of valued fish (Lavery et al. 2012, Roman and McCarthy 2010). However, while this has not been shown to occur in the U.S. at this time, the movement of energy via fecal deposition may increase the prevalence of certain parasites in fishes (Bamford 2015, Buchmann and Kania 2012, Haarder et al. 2014, Hauksson 2011).

While they can provide benefits to the local economy in terms of eco-tourism (DiGiovanni and Sabrosky 2010), seals may compete with commercial and recreational fisheries targeting some of the same stocks of fish (Benoît et al. 2011, Cook et al. 2015, Moksness et al. 2011). There are also concerns that large seal populations (relative to recent historic lows) may reduce the capacity of overfished stocks to recover (Cook et al. 2015, Swain et al. 2011). At the same time, some argue that seals are being scapegoated for problems caused by overfishing (Morissette and Pauly 2012, Roman et al. 2013).

Seals also come into conflict with fisheries by damaging and depredating gear (Cosgrove et al. 2015, Königson et al. 2010, Königson et al. 2013, Nichols et al. 2012, Nichols et al. 2014). In addition to the fishery consequences, such interactions put seals at risk for becoming entangled in fishing gear, ingesting debris, or being struck by fishing vessels. These occurrences are believed to directly cause 45% of gray seal stranding deaths in Southeastern MA (Bogomolni et al. 2010), and an estimated 1-2,000 seals are killed in fisheries interactions each year off the coast of Massachusetts (ASRG 2021, Hatch and Orphanides 2015, Northeast Fisheries Science Center 2021). This is the highest level of bycatch of any marine mammal species in the United States. Moreover, a recent study on the prevalence of entanglement indicates that current methods and data sources used for estimating fishery interactions may grossly underestimate instances of serious seal injuries and mortalities in the region as a welfare issue (Martins et al. 2019).

Human behavior often contributes to human-wildlife conflict (Barduch-Mordo et al. 2009). Seal-fishery and human-shark conflicts are no exception. On Cape Cod, the provisioning of seals in harbors incidentally when decks are cleaned and intentionally when fishers toss fish to seals has been documented (Gilbert et al. 2015). Instances of crew on charter boats “chumming” seals with fish for the entertainment of passengers also have been reported. Similarly, swimming in close proximity to seals, wearing wetsuits that mimic seals, and swimming in deep water can contribute to human-shark encounters.

To develop and target messaging that advances wildlife conservation and responsible stewardship of the interfacing human and marine ecosystems, researchers, policy makers, and organizations concerned with the marine environment need an understanding of the values, perceptions, and knowledge of key stakeholders (Bogomoloni et al. 2021, Treves et al. 2009). Building on a pilot study of attitudes toward seals on Nantucket among voters, tourists, and recreational anglers (Jackman et al. 2018), Salem State University, University of Massachusetts-Boston, Center for Coastal Studies, Center for Animals and Public Policy at Cummings School of Veterinary Medicine at Tufts University, Cape Cod Commercial Fishermen’s Alliance, and Atlantic White Shark Conservancy undertook a collaborative research project to survey residents, tourists and commercial fishers on their views of seals and sharks with the goal of fostering coexistence, enhancing public safety, and mitigating conflicts. The project was funded by Woods Hole Sea Grant with additional support from the Elizabeth A. Lawrence Endowed Fund of the Center for Animals and Public Policy at Cummings School of Veterinary Medicine at Tufts University and Salem State University’s Department of Politics, Policy and International Relations, Faculty Scholarship Support Program, and Frederick E. Berry Institute of Politics.

Respondents

Administered through mail surveys and Qualtrics, surveys were completed by representative samples of Cape Cod voters (n=547), commercial fishers (n=564), and tourists (n=699) between June and September 2021.

In the voter sample, the proportions of female (53.2%) and male (46%) respondents mirrored the 2020 U.S. Census gender balance for >18 year olds in Barnstable County. Of voters, 0.7% identified as Gender X. Non-response bias checks between respondents and non-respondents found that voters older than 65 years old ($X^2 = 55.107$, $df=3$, $p < .001$) and voters in the Lower Cape Region ($X^2 = 14.692$, $df=2$, $p < .001$) were over-represented. To correct for this over-representation, voter data were weighted by Barnstable County voter population age and regional distribution (Jackman et al. 2018, Jackman and Rutberg 2015). No significant differences in findings between weighted and unweighted data were found.

In the commercial fisher sample, non-response bias checks of respondent and non-respondents found no differences in regional distribution on Cape Cod (Table 1) ($X^2 = 5.578$, $df=2$, $p = .061$). Similar distribution of the types of commercial fishery endorsements were held among the population of 1761 Barnstable County commercial fishery permit holders and respondents (Table 1). Of commercial fishers, 92.5% were male, 6% female, and 1.5% Gender X.

Table 1. Barnstable County commercial fishery permit holder population and respondents by endorsement (%)

	Population	Respondents
Bait-like (Herring, Squid, Eel)	3.8	3.5
Fish pots (Sea Bass, Conch, Scup)	2.7	1.2
Midwater (Striped Bass, Whiting)	33.0	41.4
Benthic (Groundfish, Dogfish, Tautog)	25.8	19.7
Shellfish (Sea Scallop, Bay Scallop, Quahog, Urchin)	34.6	34.2

In the tourist sample, the distribution of respondents by the beach at which they were recruited was very similar to the distribution of Cape Cod National Seashore beach visitors during June and July 2021 as reported by the National Park Service (2021) (Table 2).

Table 2. Cape Cod National Sea Shore Tourist visitation population and respondents by beach (%)

Beach	Visitation (NPS 2021)	Respondents
Coast Guard	22.1	20.8
Head of the Meadow	7.0	5.8
Herring Cove	18.8	21.4
Marconi	17.9	17.6
Nauset Light	14.7	12.6
Race Point	19.5	21.9

Of tourist respondents, 61.3% were female, 37.2% male, and 1.5% Gender X. Over half of tourists (52.2%) were visitors from elsewhere in New England. Another one-third (31.5%) were from the Mid-Atlantic Region. Additional visitors hailed from the South (7.2%), Mid-west (3.7%), and West (5.4%).

To allow segmentation by participation in recreational fishing and surfing, respondents in all three samples were asked if they identified as recreational anglers an/or surfers. Over one-third of commercial fishers (39.9%) identified as recreational anglers, compared with 27.9% of voters and 12.1% of tourists. Of the commercial fishers, 14.5% (82) identified as for-hire fishers. Of commercial fishers, 8.9% (50) identified as surfers. Only 3.9% of voters (20) and 3.7% of tourists (26) identified as surfers.

Appendix A includes detailed descriptions of methodology, variables, and data analysis. Appendix B includes ANOVA tables to supplement the findings presented below. Appendix C includes ANOVA tables that measure differences in scale variables for value orientation, seal attitude, shark attitude, seal lethal management, Marine Mammal Protection Act, and shark lethal management segmented by gender and recreational anglers within the three stakeholder groups. Because of the small number of Gender X and surfer respondents in each stakeholder group, only descriptive data are provided in Appendix C for comparisons within stakeholder groups.

Findings

1. Marine Wildlife Value Orientations

Respondents were asked a series of questions about the beliefs they hold related to oceans and marine wildlife. In human dimensions of wildlife research, these beliefs together form value orientations, which range on a continuum from utilitarian or use value orientation to protection or mutualistic value orientation (Fulton et al. 1996). Value orientations are especially important since they drive attitudes and behavior (Engel et al. 2021, Vaske and Donnelly 1999, Vaske and Manfredo 2012).

The values of all three stakeholder groups toward marine wildlife in this study are more oriented toward protection than use (Figure 1). However, significant differences among the three groups were detected on scale and item variables (Appendix B Table B1). Tourists consistently score highest on the marine values orientation protection scale and items, followed by voters, and lowest on the marine values orientation use scale and items, followed by voters. Commercial fishers are more likely than voters and tourists to prioritize the use of marine wildlife, but, even for fishers, protection values are higher than use values.

Of particular importance, super-majorities of tourists (97%), voters (93%), and commercial fishers (74%) indicate that they believe “we should learn to share the ocean with animals that live there.” Similarly, 94% of tourists, 86% of voters, and 66% of fishers are “willing to accept some inconvenience and risk in order to have oceans where marine wildlife can thrive.”

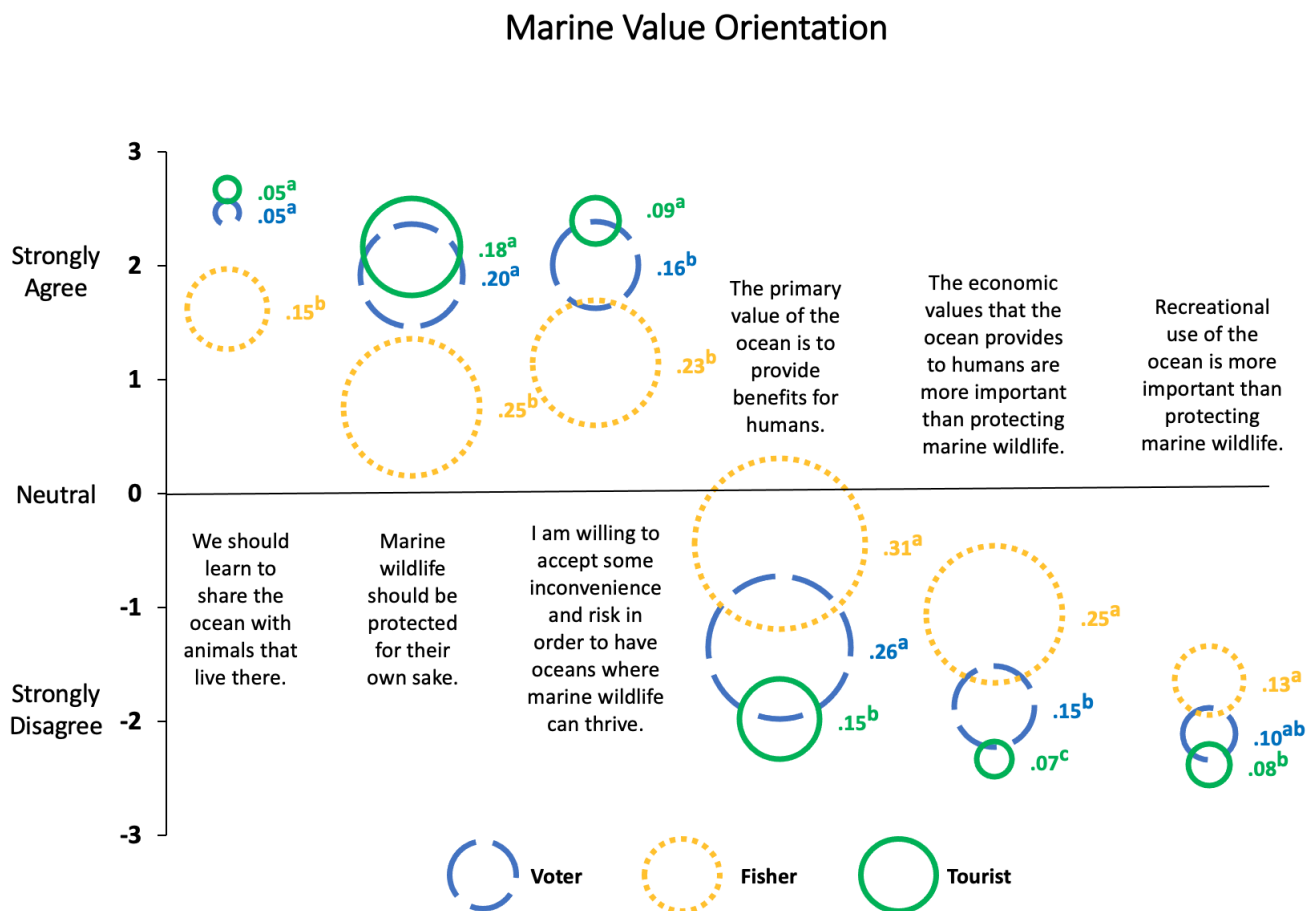


Figure 1. Mean and PCI_2 values for marine value orientation protection and use scale items by stakeholder. PCI_2 values are represented by bubble size, with lower values associated with more consensus (smaller bubbles) and higher values associated with more conflict (larger bubbles). The different superscript letters (a, b, c) on the PCI_2 indicate differences in PCI_2 scores for the three groups.

The Potential for Conflict Index (PCI_2), which measures levels of consensus and conflict within stakeholder groups, revealed consensus among voters ($PCI_2 = 0.10$), commercial fishers ($PCI_2 = 0.13$), and tourists ($PCI_2 = 0.08$) in rejecting the statement “recreational use of the ocean is more important than protecting marine wildlife.” (A detailed description of the Potential for Conflict Index is provided in Appendix A.). For the other use value orientation items, consensus remains high among tourists who reject the view that the economic value of the ocean is more important than protecting marine wildlife ($PCI_2 = 0.07$), while conflict is greater among voters ($PCI_2 = 0.15$) and commercial fishers ($PCI_2 = 0.25$). Conflict is highest within all stakeholder groups in response to the statement “the primary value of the ocean is to provide benefit for humans,” with the most consensus among tourists ($PCI_2 = 0.15$).

Of the protection value orientation items, consensus among tourists ($PCI_2 = 0.05$), voters ($PCI_2 = 0.05$), and commercial fishers ($PCI_2 = 0.15$) is highest for the coexistence statement. Consensus is also high among tourists ($PCI_2 = 0.09$) for willingness to accept some inconvenience and risk in order to have oceans where marine wildlife can thrive, while responses to this statement are more polarized among voters ($PCI_2 = 0.16$) and commercial fishers ($PCI_2 = 0.23$). The statement “marine wildlife should be protected for their own sake” is the most controversial among commercial fishers ($PCI_2 = 0.25$), but is less controversial among voters ($PCI_2 = 0.20$) and tourists ($PCI_2 = 0.18$).

Analysis of results by gender and recreational angler identity reveals differences within segments of each stakeholder group. Within voter (Appendix C Table C1) and commercial fisher (Appendix C Table C2) stakeholder groups, females are significantly more likely than males to display wildlife value orientations focused on protection of marine wildlife rather than use. A gender gap among tourists also is present, but not statistically significant (Appendix C Table C3). Descriptive data on attitudinal scales for Gender X are provided in Appendix C Tables C4, C5, and C6).

Among voters (Appendix C Table C7) and tourists (Appendix Table C9), recreational anglers are significantly more likely to hold marine use values than non-anglers. Voters who identify as recreational anglers are also less likely to hold protection values than non-anglers, while differences based on recreational angler status among tourists are not statistically significant. Differences in marine value orientations between commercial fishers who identified as recreational anglers and those who did not are not statistically significant (Appendix C Table C8).

2. Attitudes toward Seals on Cape Cod

Significant differences are found in the attitudes of the three stakeholder groups toward seals (Appendix Table B2). Consistently, tourists hold the most favorable views of seals, followed by voters. Both tourists and voters view seals as beneficial, positive, and enjoyable. Commercial fishers largely perceive seals as harmful, negative, and not enjoyable. Of tourists, 64% take pride in seals. Pride in seals on Cape Cod is lower for voters (45%) and very low for fishers (10%).

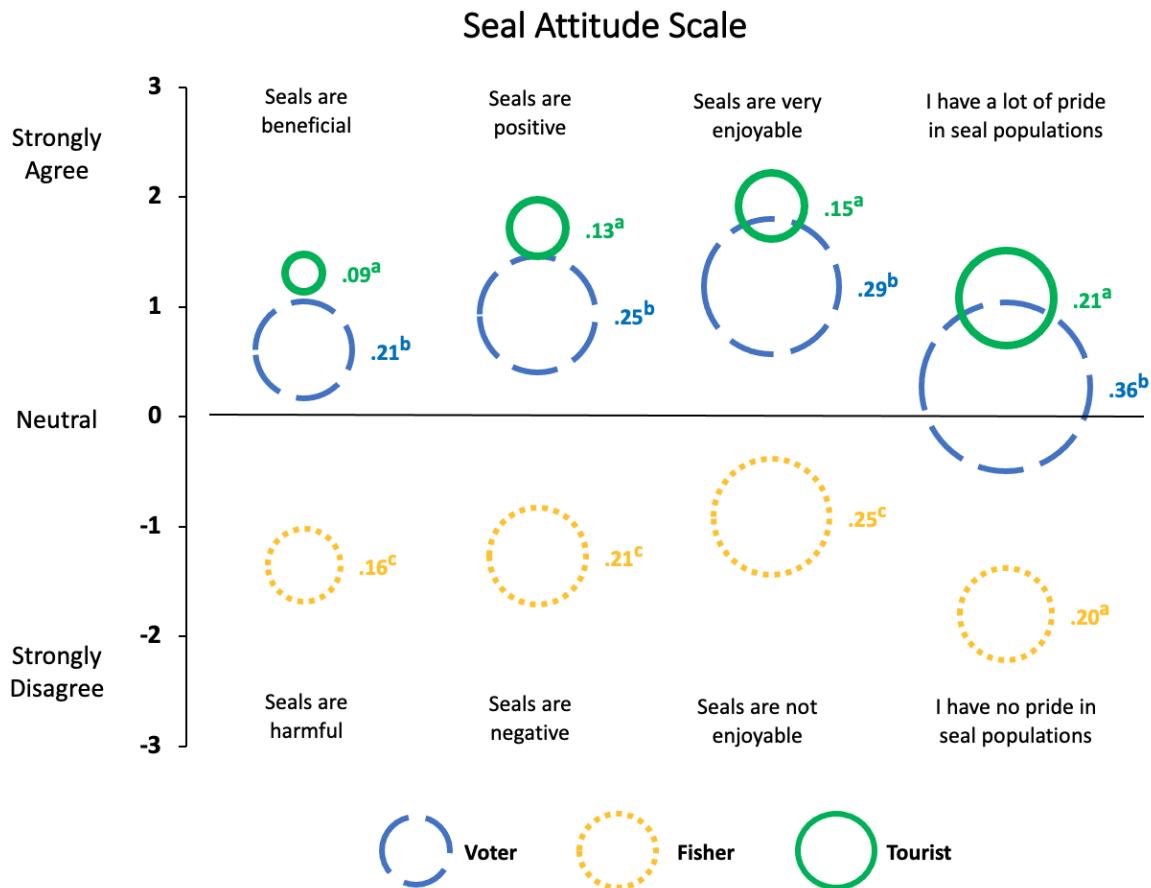


Figure 2. Mean and PCI_2 values for seal attitude scale items by stakeholder. PCI_2 values are represented by bubble size, with lower values associated with more consensus (smaller bubbles) and higher values associated with more conflict (larger bubbles). The different superscript letters (a, b, c) on the PCI_2 indicate differences in PCI_2 scores for the three groups.

For all scale items, tourists display more consensus than voters or commercial fishers in their favorable views of seals. Consensus is greatest among tourists ($PCI_2 = 0.09$) for “seals are beneficial.” Commercial fishers also have high levels of consensus in their perception of “seals are harmful” ($PCI_2 = 0.16$). Response to “seals are positive” and “seals are very enjoyable” followed the same pattern, with the most consensus among tourists ($PCI_2 = 0.13$, $PCI_2 = 0.15$) in their favorable views of seals and fishers ($PCI_2 = 0.21$, $PCI_2 = 0.25$) in their unfavorable views. The levels of consensus are similar among commercial fishers in their lack of pride for seal populations ($PCI_2 = 0.20$) and tourists in their pride in seals ($PCI_2 = 0.21$), while voters are more conflicted ($PCI_2 = 0.36$).

Gender-based differences are statistically significant within each stakeholder group, with females consistently more favorable toward seals than males (Figure 3, Appendix C Table C1). Descriptive data on attitudinal scales for Gender X are provided in Appendix C Tables C4, C5, and C6). Among both voters (Figure 4, Appendix C Table C7) and tourists (Figure 5, Appendix Table C9), recreational anglers hold more negative views of seals than non-anglers. Differences between

recreational anglers and non-anglers among commercial fishers are not statistically significant. (Appendix C Table C8).

Voter – Seal Attitude Scale by Gender

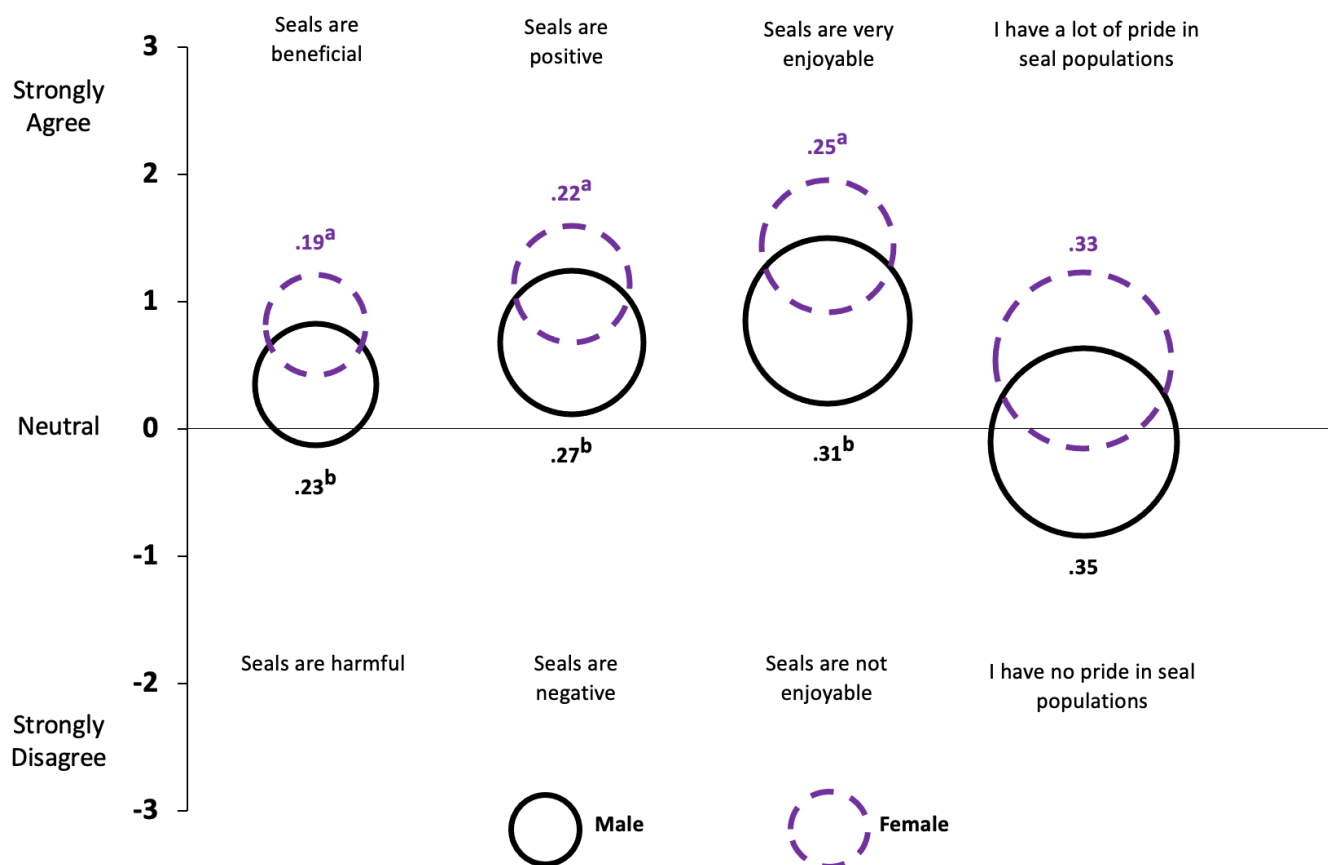


Figure 3. Mean and PCI₂ values for seal attitude scale items by gender for voters. PCI₂ values are represented by bubble size, with lower values associated with more consensus (smaller bubbles) and higher values associated with more conflict (larger bubbles). The different superscript letters (a, b, c) on the PCI₂ indicate differences in PCI₂ scores for the three groups.

Commercial Fisher – Seal Attitude Scale by Gender

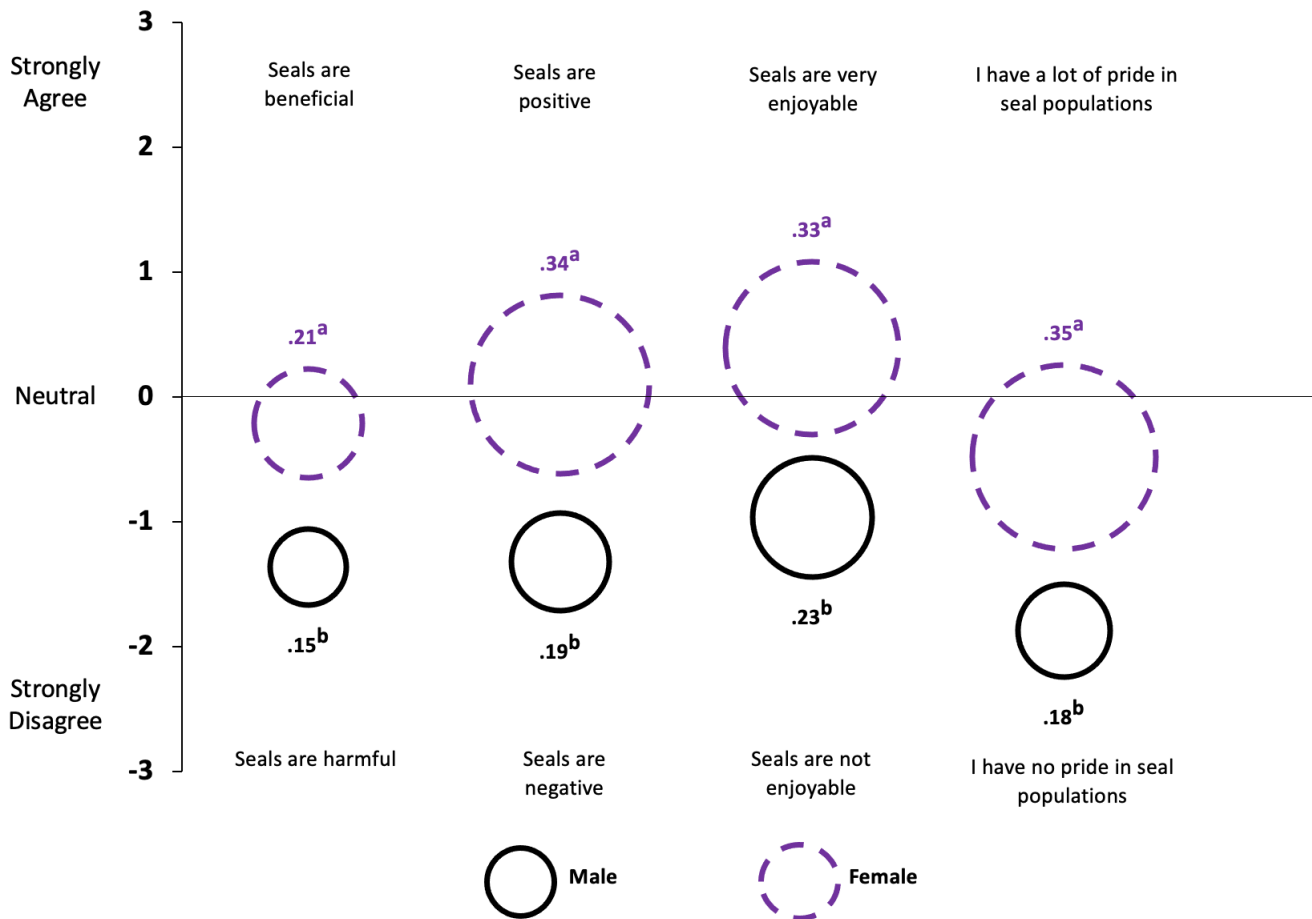


Figure 4. Mean and PCI₂ values for seal attitude scale items by gender for commercial fishers. PCI₂ values are represented by bubble size, with lower values associated with more consensus (smaller bubbles) and higher values associated with more conflict (larger bubbles). The different superscript letters (a, b, c) on the PCI₂ indicate differences in PCI₂ scores for the three groups.

Tourist – Seal Attitude Scale by Gender

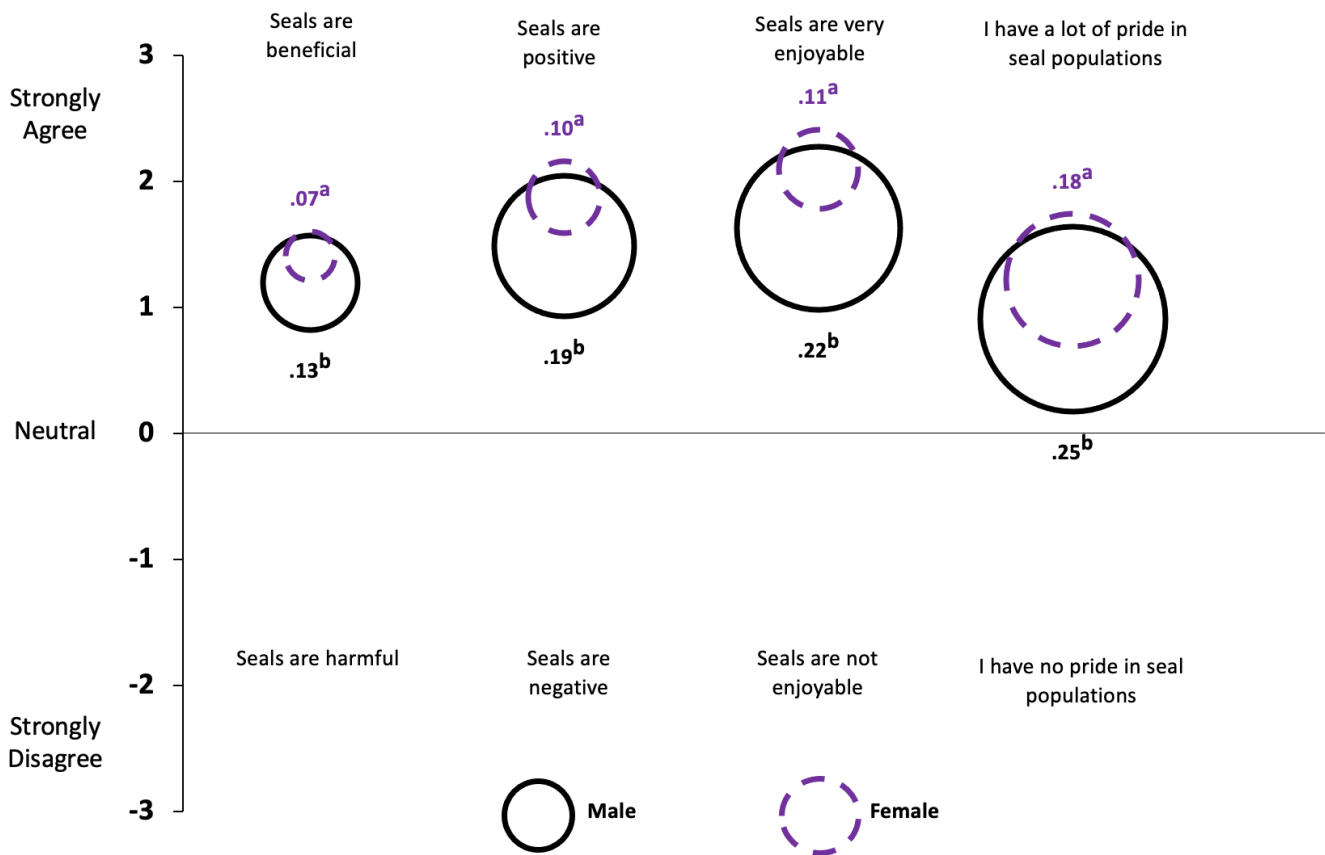


Figure 5. Mean and PCI₂ values for seal attitude scale items by gender for tourists. PCI₂ values are represented by bubble size, with lower values associated with more consensus (smaller bubbles) and higher values associated with more conflict (larger bubbles). The different superscript letters (a, b, c) on the PCI₂ indicate differences in PCI₂ scores for the three groups.

3. Attitudes toward Sharks on Cape Cod

Differences in attitudes toward sharks among the three stakeholder groups are less pronounced than their views of seals (Appendix B Table B3), with the mean views of sharks as beneficial/harmful, positive/negative, enjoyable/not enjoyable, and pride/no pride hovering around neutral for all three groups (Figure 6). Tourists perceive sharks to be more positive and beneficial than voters and commercial fishers, but they also are more frightened of the sharks than the other two groups. Nonetheless, tourists (40%) and voters (42%) have higher levels of pride in sharks than commercial fishers (34%).

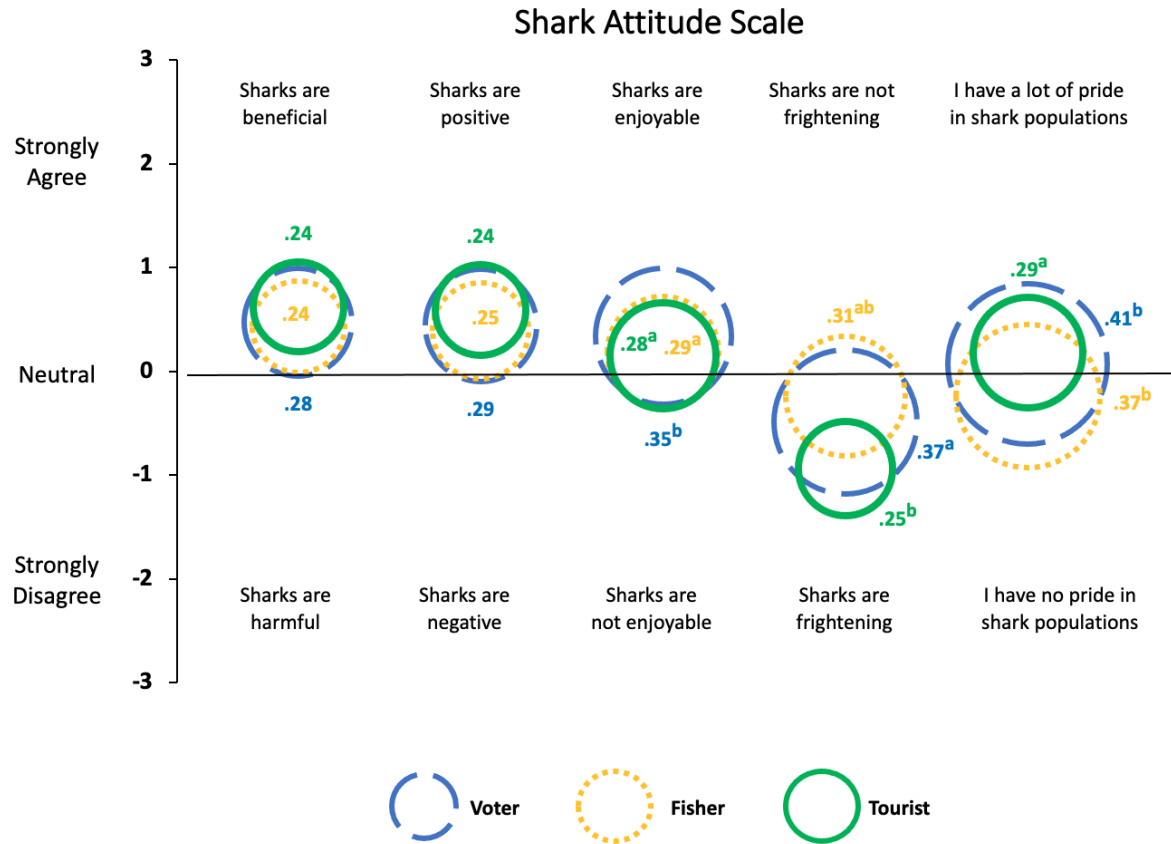


Figure 6. Mean and PCI_2 values for shark attitude scale items by stakeholder. PCI_2 values are represented by bubble size, with lower values associated with more consensus (smaller bubbles) and higher values associated with more conflict (larger bubbles). The different superscript letters (a, b, c) on the PCI_2 indicate differences in PCI_2 scores for the three groups.

The views of voters are most polarized for all five shark attitude statements, with PCI_2 values ranging from 0.28 (“Sharks are beneficial”) to 0.41 (“I have a lot of pride in shark populations”), although differences in levels of conflict between stakeholder groups are only statistically significant for the statements related to fright and pride. Tourists and commercial fishers have similar levels of consensus for the first three statements, with PCI_2 values of 0.24 for both samples in response to “sharks are beneficial,” values of 0.24 (tourist) and 0.25 (commercial fisher) for “sharks are positive,” and 0.28 (tourist) and 0.29 (commercial fisher) for “sharks are enjoyable.” Tourists are the most united in agreement that sharks are frightening ($PCI_2 = 0.25$), while fishers ($PCI_2 = 0.31$) and voters ($PCI_2 = 0.37$) are less frightened of sharks and more conflicted within samples than tourists. Tourists also display the most consensus around “I have a lot of pride in shark populations” ($PCI_2 = 0.29$), while commercial fishers disagree with the statement and are more conflicted ($PCI_2 = 0.37$).

Only among tourists is the gender gap in attitudes towards sharks statistically significant, with female tourists more favorable toward sharks than male tourists (Appendix C Tables C1, C2, C3). Descriptive data on attitudinal scales for Gender X are provided in Appendix C Tables C4, C5, and C6). Differences in attitudes among voters (Appendix C Table C7), commercial fishers (Appendix C Table C8),

and tourists (Appendix C Table C9) towards sharks based on recreational angler status are not significant.

Pride in Cape Cod shark populations is lower than for seals among tourists and voters (Figure 4). Unlike tourists and voters, commercial fishers have greater pride in shark than seal populations.

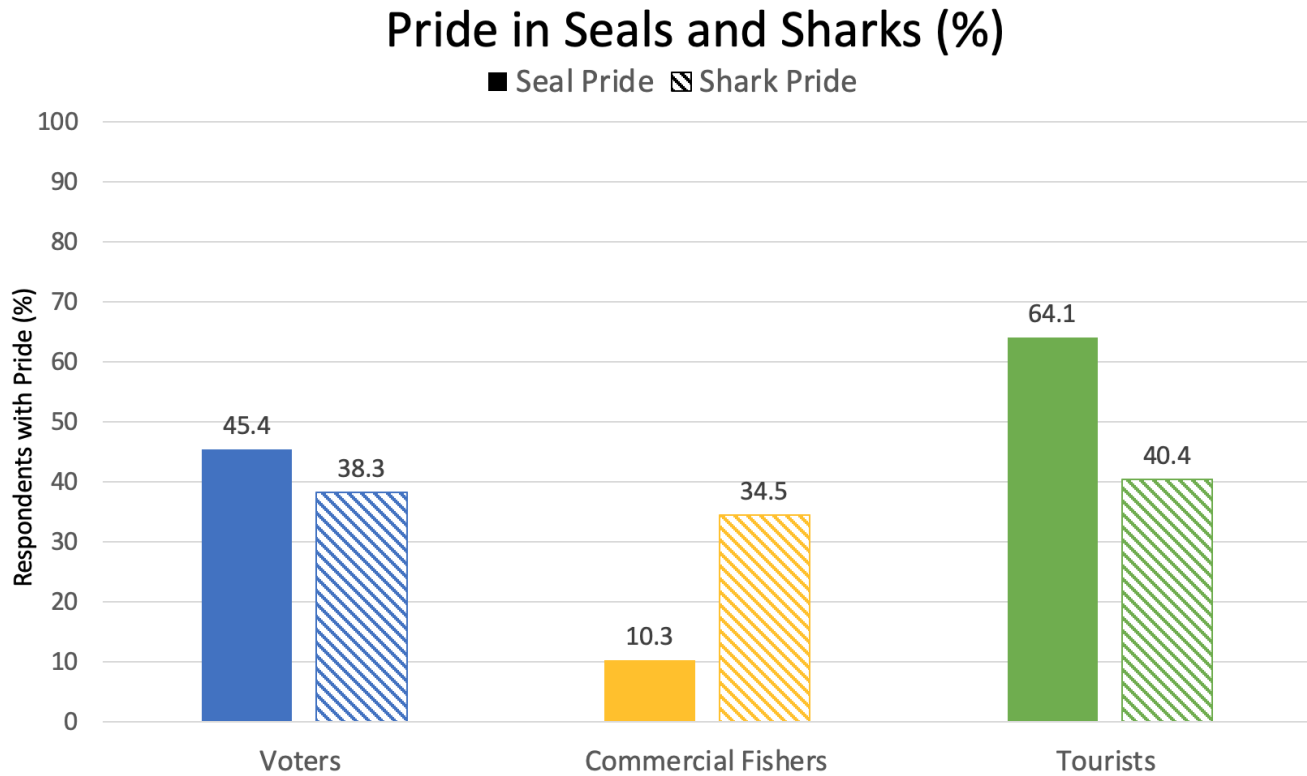


Figure 7. Pride in seals and sharks by stakeholder group (% agree).

4. Beliefs about Seals

Tourists and voters hold more favorable beliefs about seals than commercial fishers (Appendix B Table B4). Majorities of both stakeholder groups believe that seals symbolize the beauty of Cape Cod (70% tourists, 51% voters), are important to the ecosystem (87% tourists, 74% voters), are a sign of a healthy environment (77% tourists, 65% voters), and help balance food webs (77% tourists, 64% voters). Of commercial fishers, only 15% believe that seals symbolize beauty on Cape Cod, 38% believe that seals are important to the ecosystem, and 33% believe seals are a sign of a healthy environment.

Few tourists and voters agree with the statements that seals are nuisance animals (8% tourists, 22% voters), cause the decline of fish stocks (9% tourists, 23% voters), hurt the economy because they compete with fishermen (10% tourists, 24% voters), and suppress the recovery of fish stocks (13% tourists, 29% voters). Conversely, almost two-thirds (62%) of commercial fishers view seals as a

nuisance, 57% blame seals for fish stock declines, 62% believe seals hurt the economy because they compete with fishermen, and 77% believe seals suppress fish stock recovery. Most tourists (77%), voters (75%) and even commercial fishers (56%) agree that overfishing is a cause of fish stock decline.

Majorities of both voters (54%) and commercial fishers (70%) believe seals are a threat because they draw sharks. Only 38% of tourists view seals drawing sharks as a threat. Still, over two-thirds of voters (90%), fishers (65%), and tourists (97%) believe that seals have the right to exist. Voters (60%) and tourists (77%) believe that climate change impacts the presence of seals along Cape Cod; only 28% of commercial fishers hold this belief.

Voters and tourists have vastly different views than commercial fishers of the role seals play in the ecosystem (Figure 8, Appendix B Table AB). The seal ecological benefits scale and item variables reveal that tourists, followed by voters, have the most positive perceptions of seal contributions to the environment, whereas fishers are more likely to believe that seals cause ecological harm.

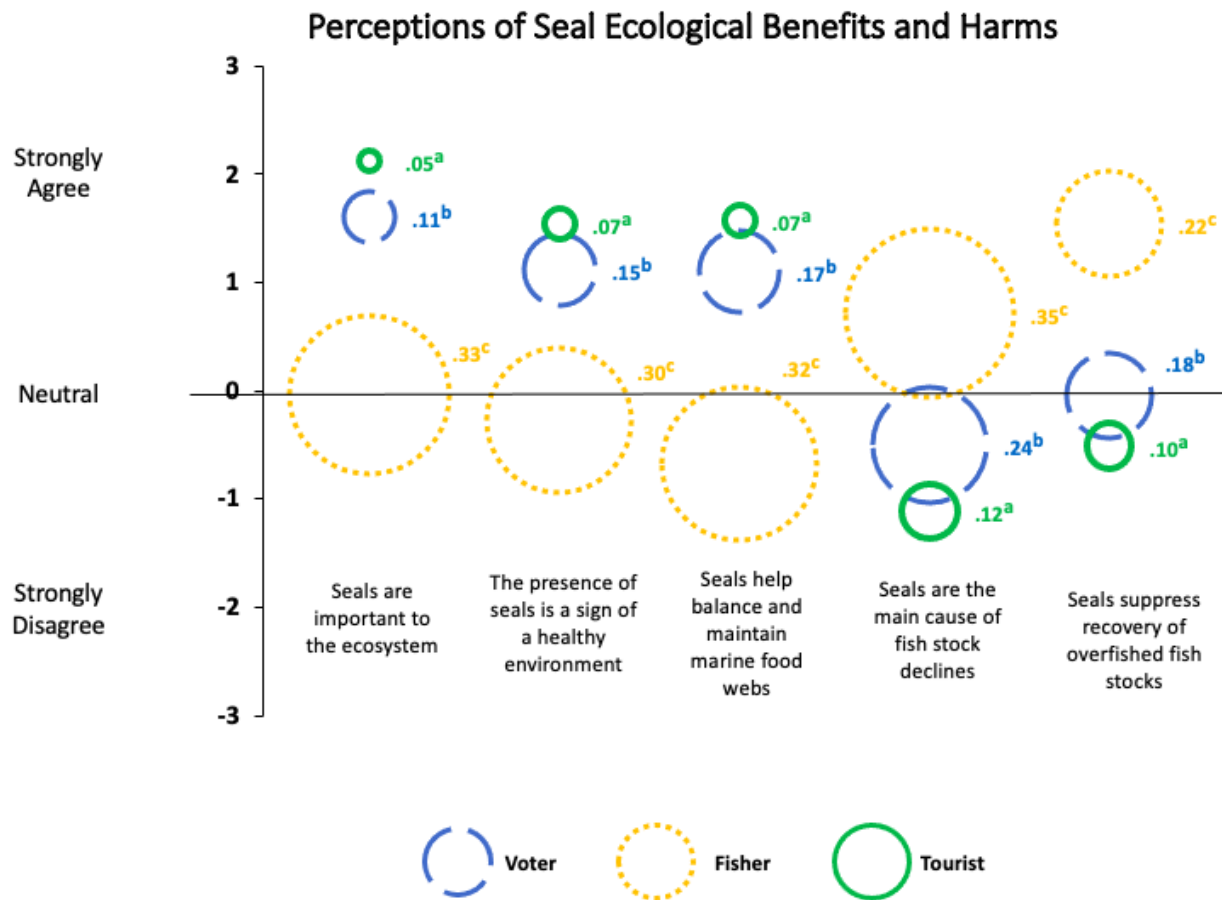


Figure 8. Mean and PCI_2 values for seal ecological benefit and harm items by stakeholder. PCI_2 values are represented by bubble size, with lower values associated with more consensus (smaller bubbles) and higher values associated with more conflict (larger bubbles). The different superscript letters (a, b, c) on the PCI_2 indicate differences in PCI_2 scores for the three groups.

The broader seal benefits scale, which includes beliefs about aesthetic, economic, and ecological benefits of seals, finds that tourists and voters are more likely than commercial fishers to believe that seals are environmentally beneficial and help the economy because they draw tourists (Appendix Table A5). Commercial fishers largely reject these views. Conversely, commercial fishers are more likely to adhere to beliefs in the aesthetic, ecological, economic, and public safety damage that seals cause, as shown by the seal harms scale.

5. Beliefs about Sharks

As with seals, tourists consistently hold more favorable beliefs about sharks than either voters or commercial fishers (Appendix B Table B6). Tourists (56%), followed by voters (50%) and commercial fishers (35%), believe that sharks symbolize the beauty of Cape Cod, are important to the ecosystem (89% tourists, 81% voters, 77% commercial fishers), are a sign of a healthy environment (74% tourists, 67% voters, 59% commercial fishers), and help balance marine food webs (81% tourists, 74% voters,

72% commercial fishers). Similarly, tourists are more likely, followed by voters, to reject the views that sharks are nuisance animals and deter tourists. No significant differences are found among stakeholder groups about whether sharks help the economy by drawing tourists, where only about one-third of each group agree. All three groups agree by wide margins that sharks pose a threat to people and that they control seal populations.

Differences in views of the impact of climate change on shark presence in Cape Cod waters were detected. Tourists (78%) and voters (64%) perceive climate change as a factor in shark presence; only 36% of fishers hold this view.

The shark ecological benefits scale and scale item results reveal the largely positive views of the role of sharks in the ecosystem among all three stakeholder groups (Figure 9). Still, tourists, followed by voters, held significantly more favorable views of the ecological contributions of sharks (Appendix B Table B6).

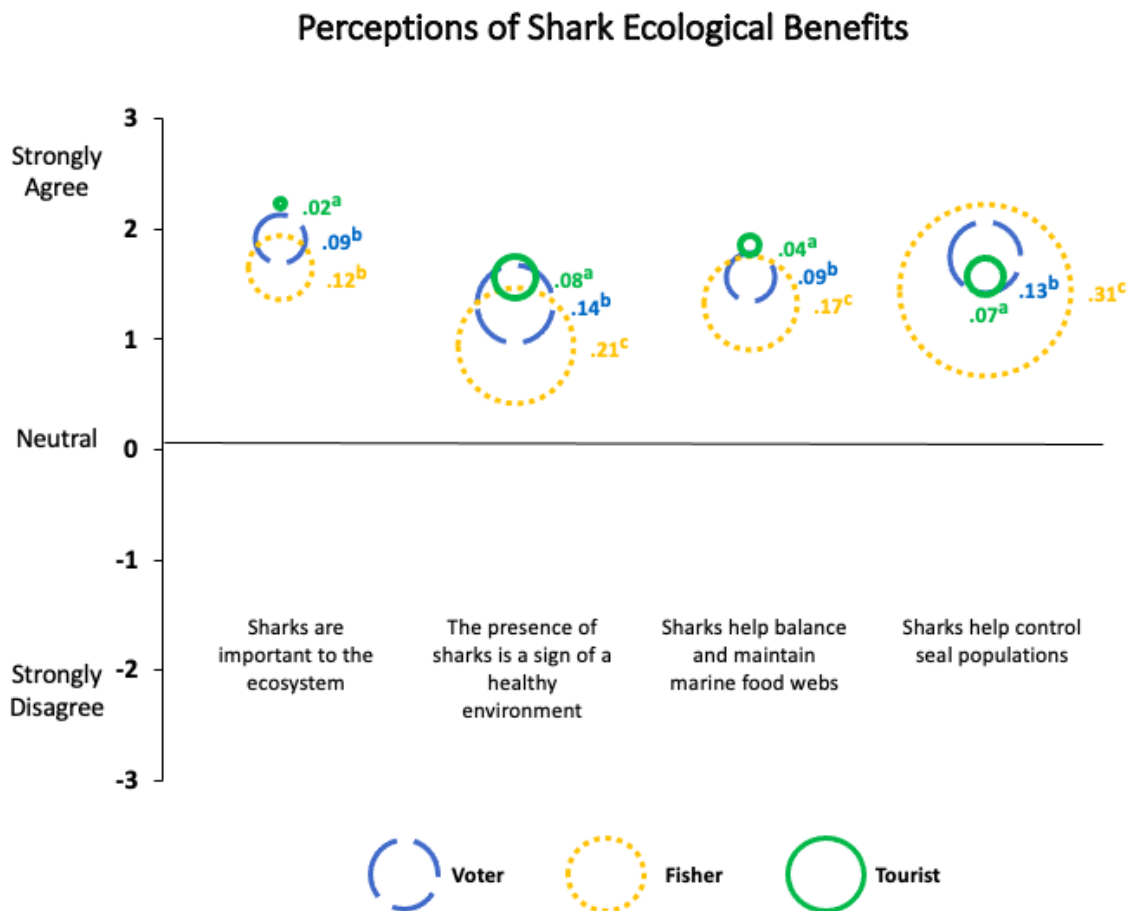
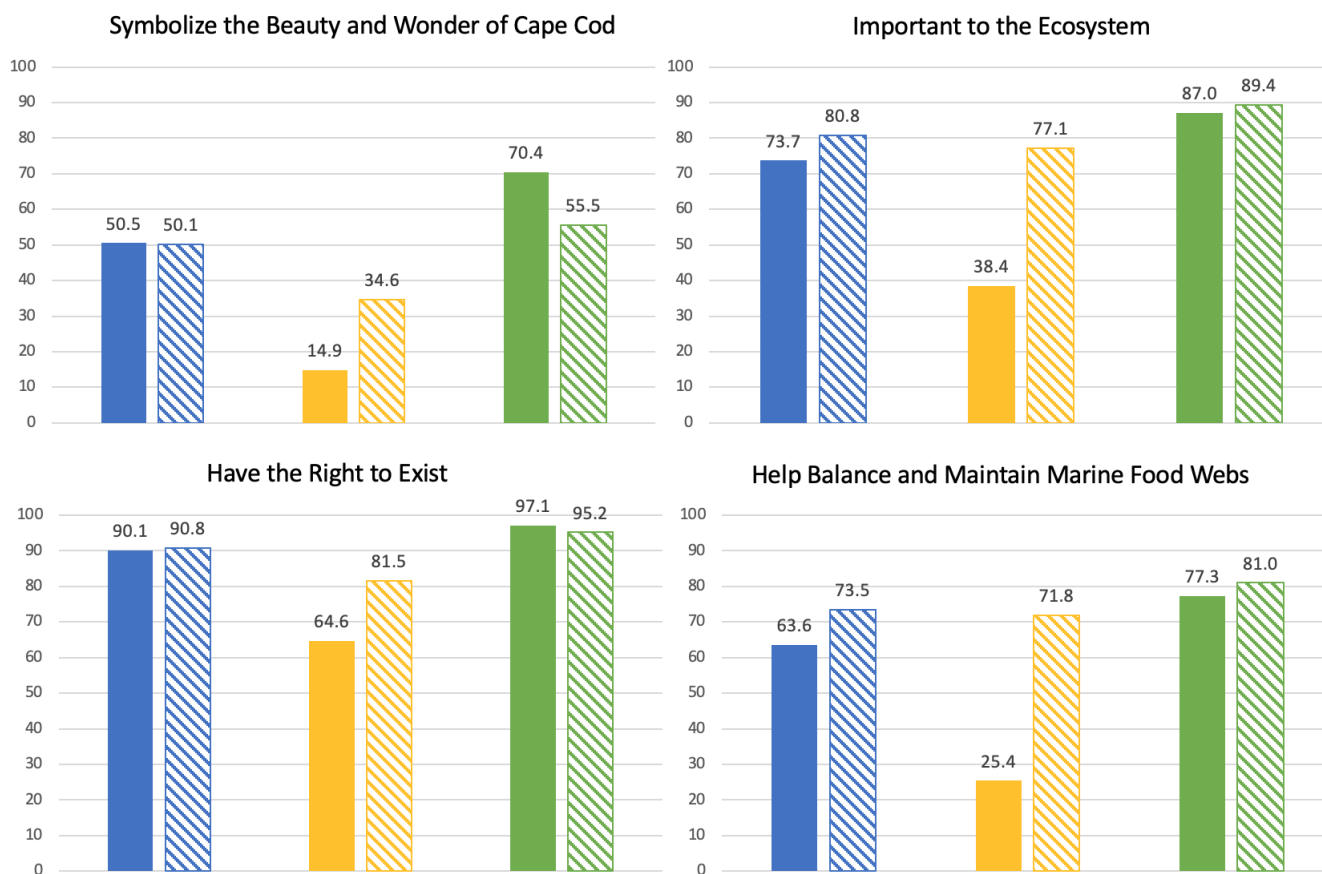


Figure 9. Mean and PCI₂ values for shark ecological benefit scale items by stakeholder. PCI₂ values are represented by bubble size, with lower values associated with more consensus (smaller bubbles) and higher values associated with more conflict (larger bubbles). The different superscript letters (a, b, c) on the PCI₂ indicate differences in PCI₂ scores for the three groups.

On the broader shark benefit scale, which measures aesthetic, economic, and ecological benefits, tourists and voters also perceive sharks more positively than commercial fishers (Appendix B Table B7).

6. Comparisons of Beliefs about Seals and Sharks

On almost all ecological and aesthetic measures, tourists and voters rate seals more positively than or as positively as sharks (Figure 10). However, both tourists and voters give sharks an edge over seals for their contributions to marine food webs. Fishers are consistently more negative in their views of seals than sharks.



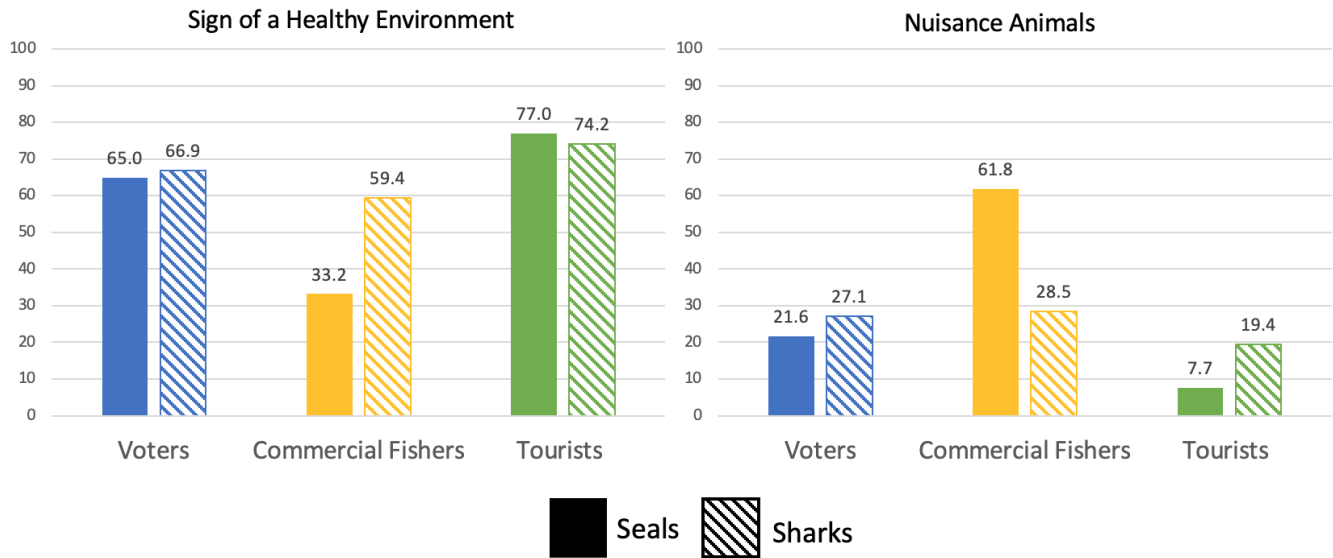


Figure 10. Beliefs about seals and sharks by stakeholder group (% agree).

7. Knowledge and Information Sources

Many respondents lack knowledge of the history of seals and sharks in Cape Cod waters (Table 3). While almost all respondents in each sample know that seals live in the waters around Cape Cod, only slightly more than half of voters (57%), commercial fishers (59%), and tourists (53%) are aware that state-funded bounty hunting in the nineteenth and twentieth centuries resulted in the near extinction of seals on Cape Cod. Similarly, most respondents are aware that sharks are present on Cape Cod, but relatively few (34% of voters, 33% of commercial fishers, and 42% of tourists) know that fishing activities depleted shark populations.

Respondents in each group are more aware of the role laws played in the recovery of seal populations than the recovery of great white shark populations. Over two-thirds of voters (75%) and tourists (67%) know that laws helped seal populations recover, while fewer (40% of voters and 33% of tourists) are aware that laws also helped great white shark populations recover. Commercial fishers are more knowledgeable than voters and tourists about the role laws had in the recovery of both species, with 85% aware that laws helped seal populations recover and 59% aware that laws helped great white shark populations.

Table 3. Respondent knowledge about seals and sharks on Cape Cod by stakeholder (%)

	Voters % Correct	Commercial Fishers % Correct	Tourists % Correct
Seals live in the waters around Cape Cod (T)	97.9	99.4	97.0
Seals only rest on land if they are sick or unhealthy (F)	86.9	92.0	73.6
Bounty-hunting resulted in the near extinction of seals on Cape Cod by 1960 (T)	57.3	59.0	53.2
Laws helped seal populations recover in their historic ranges (T)	72.9	84.6	66.8
Great white sharks live in the waters around Cape Cod (T)	93.0	95.6	90.8
Great white sharks breed quickly and produce many young (F)	45.9	66.0	44.0
Fishing activities resulted in large declines in great white shark populations (T)	33.5	32.8	41.7
Laws helped great white shark populations recover in their historic ranges (T)	39.8	58.8	32.7

Signs at the beaches and the news media are the primary sources of information on seals and sharks for all respondent categories (Table 4). However, the reliance of voters (81%) and tourists (94.8%) on beach signage is far greater than that of commercial fishers (51%). Voters (81%) are more likely than commercial fishers (54%) and tourists (56%) to rely on the news media. The majority of tourists (57%) also obtain information on seals and sharks from lifeguards, while one in five tourists obtain information from information tables. Approximately one-third of respondents in each category use apps such as Sharktivity, which is operated by the Atlantic White Shark Conservancy (AWSC). Multiple respondents also mention AWSC and the “Chatham Shark Museum” as additional sources of information in qualitative responses. People on the beach are a source of information for 28% of voters, 25% of commercial fishers, and 32% of tourists. In their qualitative comments, multiple commercial fishers indicate that their own observations and other fishermen are their main sources of information.

Table 4. Seal and shark information source use on Cape Cod by stakeholder (%)

	Voters	Commercial Fishers	Tourists
Signs at Beaches	81	51	95
News Media	81	54	56
Social Media	47	38	31
Lifeguards	37	20	57
Apps such as Sharktivity	31	40	36
Other People on Beach	28	25	32
Information tables	11	11	19

8. Experiences with Seals and Sharks on Cape Cod

Tourist and voter enthusiasm for seeing seals is high, with 67% of tourists and 56% of voters indicating that they hope to see seals when they are on Cape Cod (Table 5). Very few commercial fishers (13%) share this desire. For tourists, seals are second only to whales in their popularity, with dolphins and porpoises a close third. While voters and tourists are less enthusiastic about seeing sharks than seals, commercial fishers hoped to see sharks more than seals.

Table 5. Respondent hopes to see marine wildlife species on Cape Cod by stakeholder (%)¹

	Voters	Commercial Fishers	Tourists
Whales	85%	77%	80%
Dolphins and Porpoises	77%	62%	65%
Fish	73%	92%	51%
Seals	56%	13%	67%
Sharks	39%	29%	28%

¹ Percentage includes “somewhat” and “very much” responses.

Almost all voters (92%), commercial fishers (99%) and tourists (93%) have seen seals on Cape Cod either swimming or resting on rocks or a beach. Fewer respondents report having seen sharks swimming in the ocean on Cape Cod (53% of voters, 91% of commercial fishers, and 31% of tourists).

Respondents have observed several human behaviors that contribute to problematic interactions with seals and sharks. Large majorities of voters (65%), commercial fishers (79%), and tourists (61%) observed people coming too close to seals. Half of commercial fishers (50%) and almost

a third of voters (29%) observed people feeding seals; one in ten tourists observed this behavior (11%). Almost half of commercial fishers (48%) observed people coming too close to sharks; fewer voters (25%) and tourists (8%) had this experience. Of commercial fishers, 16% indicate that they have seen people feeding sharks, compared with only 6% of voters and 2% of tourists.

Most commercial fishers (88%) report that they have seen seals interfere with fishing. One-quarter of voters (27%) and several tourists (9%) also observed seal interference with fishing.

Large majorities of each stakeholder group indicate that they have seen people told to stay out of water because of shark sightings (79% of voters, 83% of commercial fishers, and 68% of tourists). Some respondents also report that they have seen people told to stay out of the water because of seal sightings (37% of voters, 49% of commercial fishers, and 26% of tourists).

Some respondents report having witnessed harm to seals, with 13% of voters, 13% of commercial fishers, and 7% of tourists indicating that they have seen people harassing, harming, or killing seals. Seals entangled in fishing gear or other debris have been observed by 17% of voters, 23% of fishers, and 5% of tourists, while fewer respondents (17% of commercial fishers, 9% of voters, and 3% of tourists) report having observed entanglement of sharks.

9. Cape Cod Beach Activities and Shark Avoidance Actions

For voters and commercial fishers, beach use tracks with the regional distribution of where respondents live on Cape Cod. Voters use Cape Cod Bay (70%) and Nantucket Sound (69%) beaches most heavily, although 61% visit Outer Cape beaches. Commercial fishers indicate that they used Outer Cape beaches (72%) most frequently, followed by Cape Cod Bay (64%) and Nantucket Sound (55%) beaches. For tourists, Outer Cape beaches (90%) and Cape Cod Bay beaches (60%) are most popular, with only 27% visiting Nantucket Sound beaches.

The patterns of beach recreational uses for voters and tourists are similar (Table 6). Beach use for voters and tourists focuses on on-beach activities such as walking, sunbathing, and volleyball (90% of voters, 91% of tourists); swimming (74% of voters, 79% of tourists); and watching marine wildlife (60% of voters, 78% of tourists). Not surprisingly, the largest proportion of commercial fishers engage in fishing by boat at the beach (79%) and shellfishing (67%), followed by on-beach activities (52%), swimming (52%), surfcasting (47%), and watching marine wildlife (42%).

Table 6. Cape Cod beach activities by stakeholder (%)

	Voters	Commercial Fishers	Tourists
On-beach activities (e.g. walking, sunbathing, volley ball)	90	52	91
Swimming	74	52	79
Watching marine wildlife (e.g., seals, whales, sharks, dolphins)	60	42	78
Bird watching	41	25	40
Paddle sports (e.g., kayak, paddle boarding)	33	27	23
Fishing by boat	31	79	11
Shell fishing	25	67	7
Board sports (e.g., surfing, body-boarding)	18	22	23
Surfcasting	16	47	7
Snorkeling	12	17	5
Scuba Diving	3	12	.7
I don't go to the beach	3	4	0

When they are at Cape Cod beaches, voters and tourists take multiple actions to avoid encounters with sharks, with tourists especially vigilant (Table 7). These actions include checking and obeying signage and warning systems (66% of voters, 77% of tourists), avoiding areas where sharks have been reported (63% of voters, 55% of tourists), following lifeguard instructions (54% of voters, 74% of tourists), and avoiding seals (57% of voters, 51% of tourists).

Consistently, fewer commercial fishers than voters and tourists take actions to avoid encounters with sharks. Pluralities of commercial fishers report that they try to avoid seals (49%) and areas where sharks have been reported (43%), but only 33% stay in shallow water, 32% check and obey signage and warning systems, and 24% follow lifeguard instructions.

Tourists (40%) are more likely than voters (21%) or commercial fishers (10%) to visit patrolled beaches to reduce the risk of shark encounters. Few respondents in any category limit splashing, use shark repellent devices, or indicate that they had reduced the frequency of their beach visits.

Table 7. Shark avoidance behavior by stakeholder (%)

	Voters	Commercial Fishers	Tourists
Check and obey signage and warning systems	66	32	77
Avoid areas where sharks have been reported	63	43	55
Avoid seals	57	49	51
Follow lifeguard instructions	54	24	74
Stay in shallow water	51	33	64
Stay on beach	40	28	46
Avoid low visibility water	37	29	32
Use patrolled beaches	22	10	41
Avoid suits and gear likely to attract sharks	17	15	14
Limit splashing	13	12	11
None	10	19	5
Reduce frequency of beach visits	8	12	3
Wear or use shark repellent device	1	3	1

10. Allocation of Blame for Shark Bites

Only 16% of voters, 19% of commercial fishers, and 11% of tourists believe shark bites are intentional. Over half of voters (54%), commercial fishers (58%), and tourists (56%) characterize shark bites as accidental.

Sharks are held largely blameless for shark bites (Appendix B Table B8). Only 27% of voters, 29% of commercial fishers, and 24% of tourists hold sharks responsible for shark bites. Both voters (54%) and tourists (48%) place the most blame for shark bites on people in the water. While commercial fishers (51%) also blame people in the water, 76% hold seals responsible. Of voters, 50% also hold seals responsible whereas only 37% of tourists blame seals. Few voters (13%), commercial fishers (34%), and tourists (7%) blame the government. Over one-third of voters (39%), commercial fishers (35%), and tourists (41%) said no one is to blame for shark bites.

The three groups have similar opinions and consensus levels in blaming no one ($PCI_2 = 0.25$ for voters and commercial fishers, 0.22 for tourists) and people in the water ($PCI_2 = 0.29$ for voters, 0.28 for commercial fishers, 0.23 for tourists) for shark bites (Figure 11). All groups reject blaming the shark, with less consensus ($PCI_2 = 0.38$ for commercial fishers, 0.34 for voters, and 0.30 for tourists). There is more consensus among fishers blaming seals ($PCI_2 = 0.27$) than among voters ($PCI_2 = 0.42$) or tourists, who reject this statement ($PCI_2 = 0.35$). Consensus is strong among tourists against blaming the government ($PCI_2 = 0.15$), while voters ($PCI_2 = 0.25$) and commercial fishers ($PCI_2 = 0.45$) are more divided.

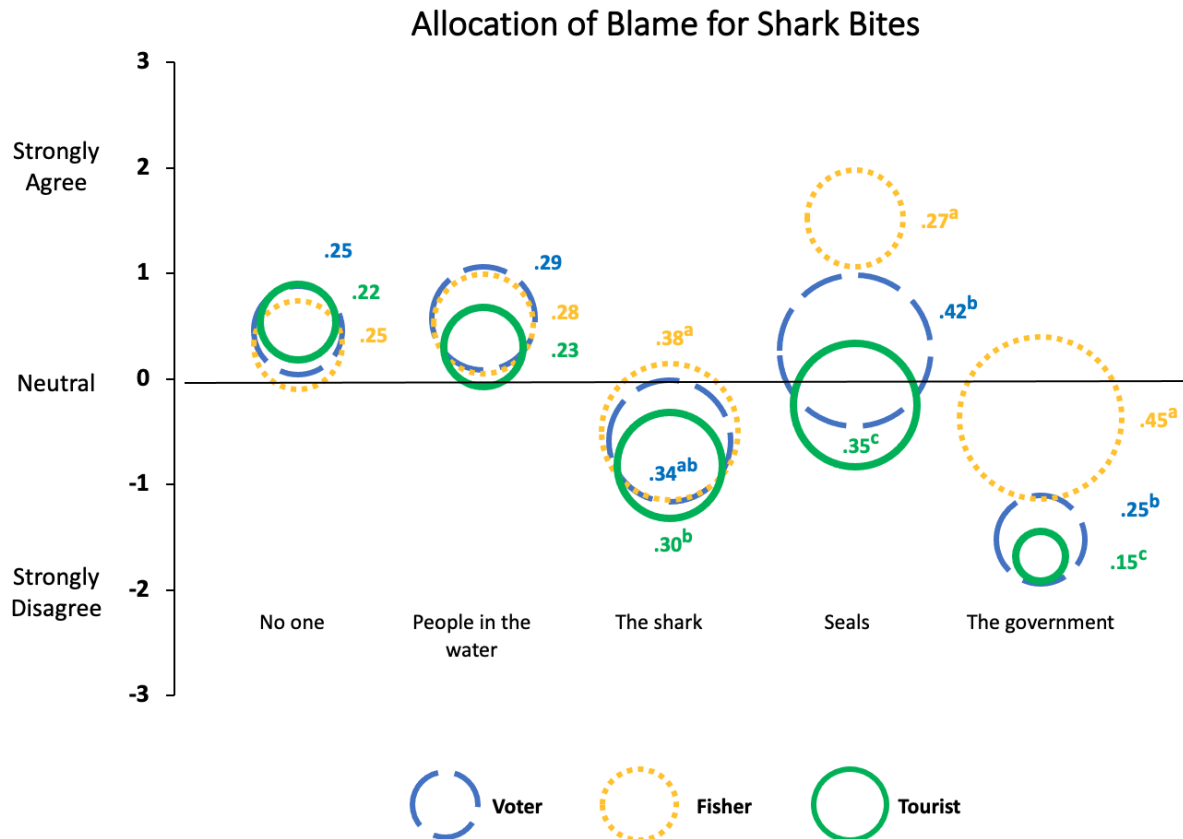


Figure 11. Mean and PCI_2 values for shark bite blame allocation for each stakeholder. PCI_2 values are represented by bubble size, with lower values associated with more consensus (smaller bubbles) and higher values associated with more conflict (larger bubbles). The different superscript letters (a, b, c) on the PCI_2 indicate differences in PCI_2 scores for the three groups.

Respondents in all three groups feel that they have control over whether or not they encounter sharks. Of voters, 68% indicate that they have control, followed by 60% of commercial fishers and 65% of tourists.

11. Management of the Ocean, Seals, and Sharks

11.1 Management Priorities

The ocean management priorities of voters, fishers, and tourists differ (Appendix B Table B9). For voters (87%) and tourists (95%), management in the best interests of the ecosystem is the top priority (Figure 10). For voters, the next highest priorities are fisheries (74%), local communities (67%), seals (64%), and sharks (64%). After the ecosystem, tourists rate the best interests of the seals (81%), sharks (79%), and local communities (73%) most highly. The top management priorities for commercial fishers are fisheries (84%), the ecosystem (75%), and local communities (63%).

Consensus is highest among tourists that management should prioritize the best interests of seals ($PCI_2 = 0.12$), the ecosystem ($PCI_2 = 0.02$), and local communities ($PCI_2 = 0.06$), while tourists are more conflicted than voters and commercial fishers about the best interests of fisheries ($PCI_2 = 0.21$) (Figure 12). Commercial fishers are in agreement that the best interests of fisheries should be the top priority ($PCI_2 = 0.13$), while voters fall between fishers and tourists in both level of agreement and level of consensus ($PCI_2 = 0.17$). The best interests of sharks are most strongly supported by tourists ($PCI_2 = 0.16$), with greater consensus than among voters ($PCI_2 = 0.26$) or fishers ($PCI_2 = 0.25$). Commercial fishers ($PCI_2 = 0.48$) are more conflicted than tourists ($PCI_2 = 0.32$) and voters ($PCI_2 = 0.12$) about the best interests of seals. Tourists ($PCI_2 = 0.02$) have the highest level of consensus about management for the ecosystem, while voters ($PCI_2 = 0.09$) and commercial fishers ($PCI_2 = 0.09$) are more conflicted. Tourists are more divided about how much priority should be put on tourism ($PCI_2 = 0.22$) than the other considerations, but still less conflicted than voters ($PCI_2 = 0.27$) and fishers ($PCI_2 = 0.23$). The best interests of local communities generate similar levels of agreement and consensus among commercial fishers ($PCI_2 = 0.16$) and voters ($PCI_2 = 0.18$).

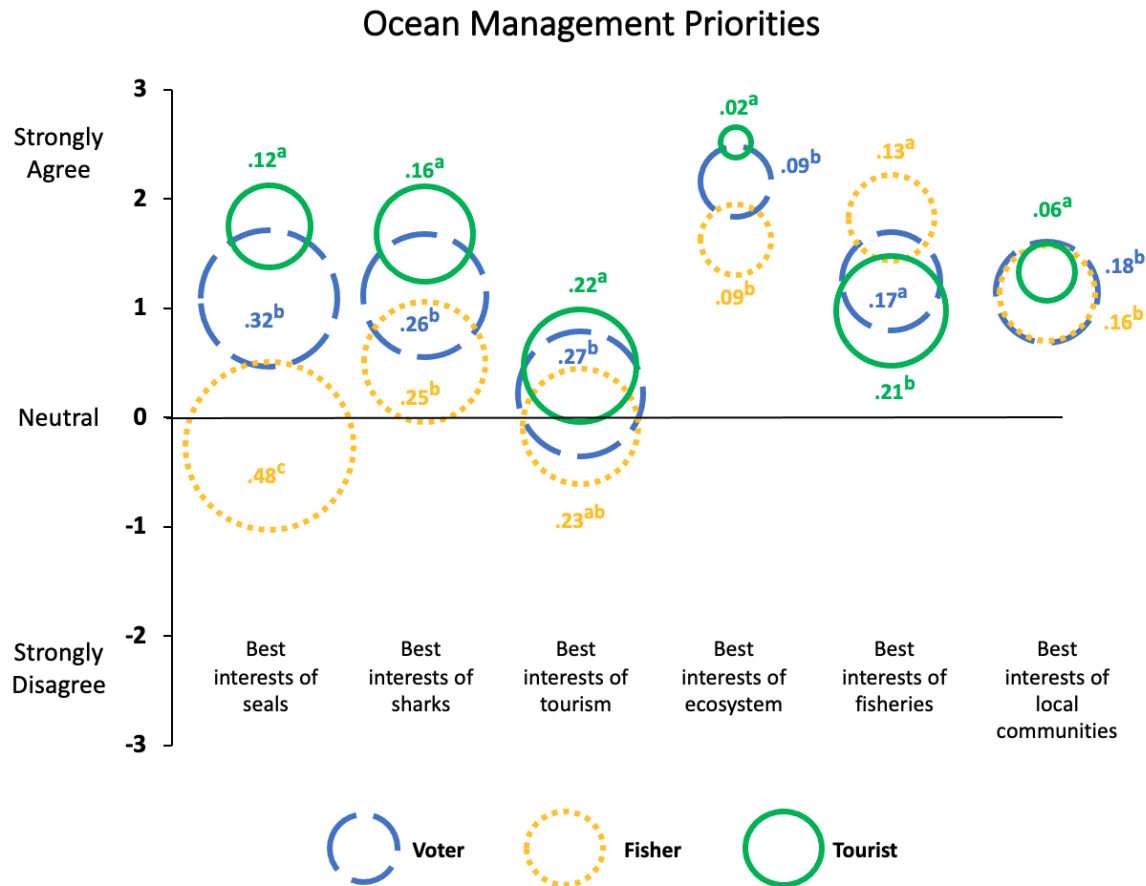


Figure 12. Mean and PCI_2 values for ocean management priorities by stakeholder. PCI_2 values are represented by bubble size, with lower values associated with more consensus (smaller bubbles) and higher values associated with more conflict (larger bubbles). The different superscript letters (a, b, c) on the PCI_2 indicate differences in PCI_2 scores for the three groups.

11.2 Seal Management

Although voters, commercial fishers, and tourists differ in their management attitudes, little support is found for lethal management of seals (Appendix B Table B10). On the lethal management scale, the means of all three samples are below or at the neutral level, with tourists, followed by voters, strongly opposed to lethal management. While voters and tourists reject lethal management in all situations (Figure 13), commercial fishers are more supportive of lethal management to control populations and in response to interference with fishing. However, the levels of support among commercial fishers for lethal management under these circumstances are only slightly above the neutral level.

Tourists are largely united against killing seals that lay on beaches or rocks ($PCI_2 = 0.06$), swim in harbors ($PCI_2 = 0.07$), interfere with fishing ($PCI_2 = 0.12$), and to reduce population levels ($PCI_2 = 0.17$) (Figure 9). Voters are similarly united in rejecting killing seals that lay on beaches or rocks ($PCI_2 = 0.14$) or swim in harbors ($PCI_2 = 0.17$), but more divided over killing seals that interfere with fishing ($PCI_2 =$

0.28) and killing seals to reduce population levels ($PCI_2 = 0.41$). Commercial fishers also reject killing seals if they lay on beaches or rocks ($PCI_2 = 0.39$) or swim in harbors ($PCI_2 = 0.38$). The polarization of respondents within the commercial fisher sample is greater in terms of lethal management of seals that interfere with fishing ($PCI_2 = 0.44$) and to reduce population levels ($PCI_2 = 0.54$), resulting in more neutral views when averaged.

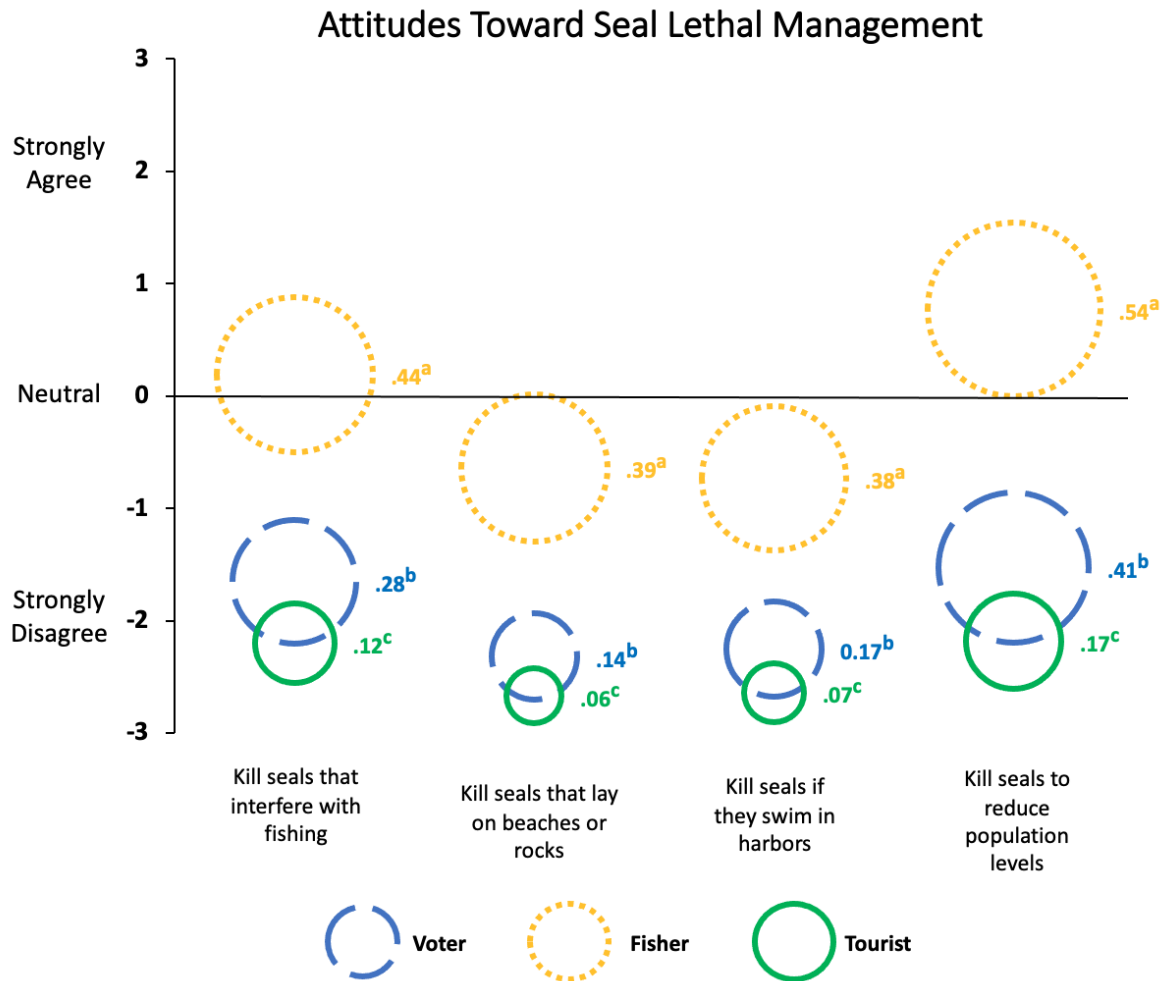


Figure 13. Mean and PCI_2 values of attitudes toward seal lethal management by stakeholder. PCI_2 values are represented by bubble size, with lower values associated with more consensus (smaller bubbles) and higher values associated with more conflict (larger bubbles). The different superscript letters (a, b, c) on the PCI_2 indicate differences in PCI_2 scores for the three groups.

In all three stakeholder groups, female respondents are significantly more likely than male respondents to oppose lethal management (Appendix C Table C1, Table C2, Table C3). Descriptive data on attitudinal scales for Gender X are provided in Appendix C Tables C4, C5, and C6). Among both voters (Appendix C Table C7) and tourists (Appendix C Table C9), non-recreational anglers are more likely to oppose lethal management than recreational anglers. Differences between recreational anglers and non-anglers among commercial fishers are not statistically significant (Appendix C Table C8).

Support for non-lethal management of seals is higher than lethal management for all stakeholder groups. While there are differences in attitudes towards non-lethal management of seals (Appendix B Table B11), they are less pronounced. Commercial fishers are marginally supportive of non-lethal management under all circumstances. Tourists are the least supportive of non-lethal management in response to seals laying on beaches and rocks, seals swimming in harbors, and to reduce populations, but support non-lethal management to prevent conflicts with fishing. Voters also support non-lethal management to prevent conflicts with fishing and are somewhat supportive of non-lethal management to reduce seal population levels.

All three stakeholder groups display similar levels of conflict within groups about non-lethal management (Figure 14). The use of non-lethal methods to reduce seal population levels generates the most controversy among all three groups, with PCI_2 values of 0.50 for tourists, 0.51 for voters, and 0.46 for fishers. Consensus was highest among each of the three groups in agreement with the use of non-lethal methods to prevent conflict with fishing (PCI_2 = 0.30 for tourists, 0.33 for fishers, and 0.37 for voters).

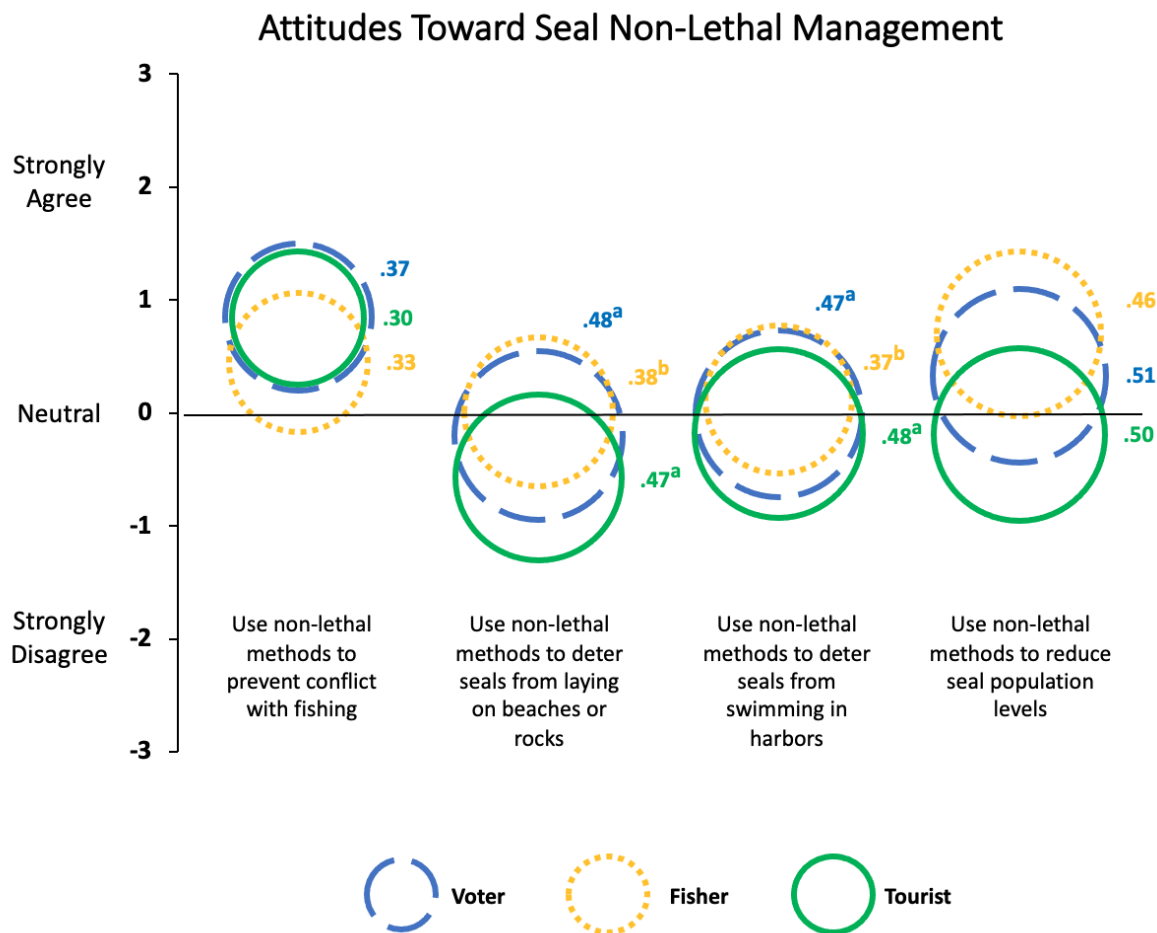


Figure 14. Mean and PCI_2 values of attitudes toward seal non-lethal management by stakeholder. PCI_2 values are represented by bubble size, with lower values associated with more consensus (smaller bubbles) and higher values associated with more conflict (larger bubbles). The different superscript letters (a, b, c) on the PCI_2 indicate differences in PCI_2 scores for the three groups.

Increases in public education on seals and improved signage to reduce encounters with seals are advocated by overwhelming majorities of voters and tourists. While half of commercial fishers (56%) agree with increasing public education on seals, only one-third (36%) support improved signage. Both voters (78%) and tourists (91%) support rescuing seals that become stranded or entangled. Only 35% of commercial fishers support seal rescue.

The goals of the Marine Mammal Protection Act are viewed favorably by all three groups of respondents. However, MMPA support is significantly higher among voters and tourists, with tourists the most supportive (Appendix B Table B12). Over 94% of tourists and 86% of voters agree with each of the MMPA goals. Among commercial fishers, 67% or more support each of the MMPA goals.

Among the Marine Mammal Protection Act goals, consensus is highest among tourists (Figure 15), followed by voters and then commercial fishers in support of preventing marine mammals from going extinct ($PCI_2 = 0.02$ for tourists, 0.08 for voters, and 0.12 for fishers); maintaining or restoring marine mammal populations ($PCI_2 = 0.02$ for tourists, 0.12 for voters, and 0.15 for commercial fishers); minimizing harm and suffering of marine mammals ($PCI_2 = 0.02$ for tourists, 0.13 for voters, and 0.20 for commercial fishers); and protecting areas of the ocean important for marine mammal feeding and breeding, which is the most controversial item among commercial fishers ($PCI_2 = 0.02$ for tourists, 0.10 for voters, and 0.25 for commercial fishers) (Figure 11). Minimizing conflict between marine mammals and commercial fishing was the most controversial item among tourists ($PCI_2 = 0.07$).

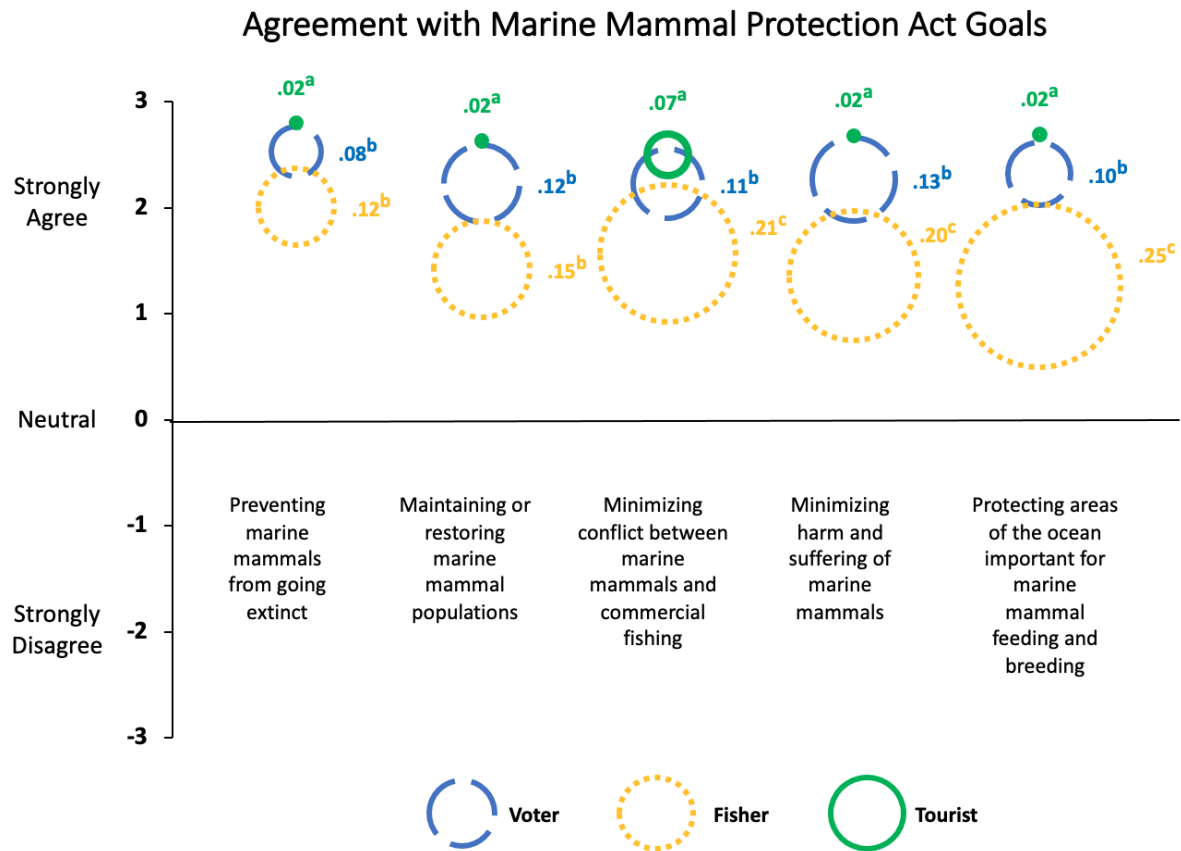


Figure 15. Mean and PCI_2 values for agreement with Marine Mammal Protection Act goals for each sample. PCI_2 values are represented by bubble size, with lower values associated with more consensus (smaller bubbles) and higher values associated with more conflict (larger bubbles). The different superscript letters (a, b, c) on the PCI_2 indicate differences in PCI_2 scores for the three groups.

Support for the goals of the Marine Mammal Protection Act is significantly higher among females in all three stakeholder groups (Appendix C Tables C1, C2 and C3). Descriptive data on attitudinal scales for Gender X are provided in Appendix C Tables C4, C5, and C6). Among voters (Appendix C Table C7) and tourists (Appendix C Table C9), non-recreational anglers are more supportive of MMPA goals than recreational anglers; differences in recreational angler status among commercial fishers are not statistically significant (Appendix C Table C8).

11.3 Shark Management

Lethal management of sharks is strongly opposed by all three groups (Figure 16). Under all circumstances, tourists are the most opposed to lethal management of sharks, followed by voters (Appendix B13). Voters and tourists are more opposed to lethal management of seals than of sharks, while commercial fishers are far more opposed to lethal management of sharks than seals.

Consensus is highest among tourists against killing sharks that swim near the beach ($PCI_2 = 0.17$), after a bite occurs ($PCI_2 = .27$) or to reduce population levels ($PCI_2 = 0.13$) (Figure 12). Consensus is greater among tourists and voters against killing sharks that interfere with fishing. Killing sharks after a bite occurs is the most controversial item for each group ($PCI_2 = 0.39$ for fishers, 0.36 for voters, and 0.27 for tourists), but all groups oppose lethal management in this situation.

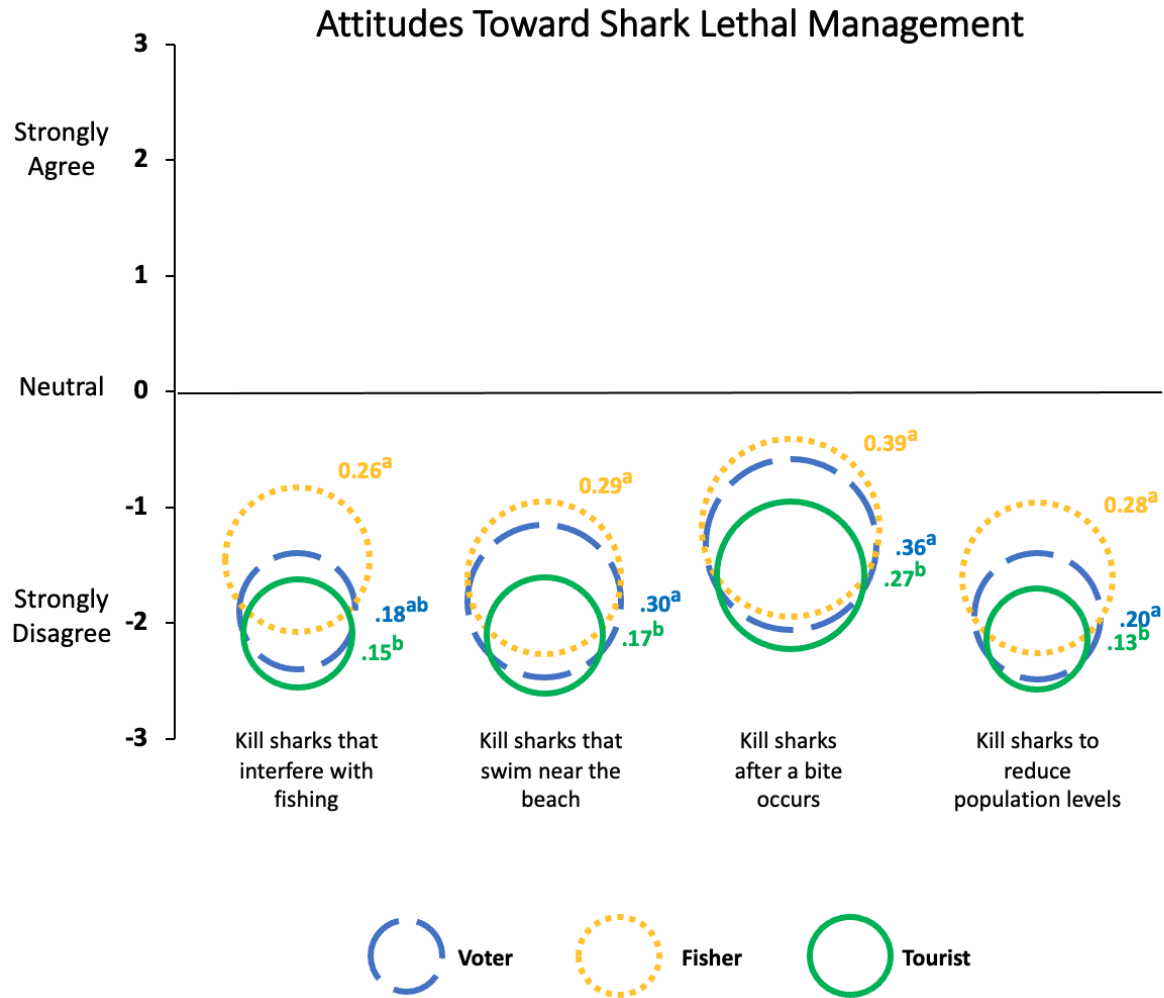


Figure 16. Mean and PCI_2 values of attitudes toward shark lethal management by stakeholder. PCI_2 values are represented by bubble size, with lower values associated with more consensus (smaller bubbles) and higher values associated with more conflict (larger bubbles). The different superscript letters (a, b, c) on the PCI_2 indicate differences in PCI_2 scores for the three groups.

While female and male voters (Appendix C Table C1) and commercial fishers (Appendix C Table C2) do not hold significantly different views of lethal shark management, female tourists are far more opposed to lethal management than male tourists (Appendix C Table C3). Descriptive data on attitudinal scales for Gender X are provided in Appendix C Tables C4, C5, and C6). No significant differences based on recreational angler status are found in attitudes toward shark lethal management in any of the three stakeholder groups (Appendix C Tables C7, C8, C9).

Support for non-lethal management of sharks is greater among all groups than for non-lethal management of seals. Support for non-lethal management of sharks around beaches and in response to shark bites is particularly high. Commercial fishers have lower levels of support for non-lethal management than voters and tourists, whose levels of support for non-lethal management are similar (Appendix B Table B14).

Levels of consensus are similar among all groups regarding shark non-lethal management responses (Figure 17). The most controversial item for all groups is using non-lethal methods to reduce shark population levels ($PCI_2 = 0.52$ for tourists, 0.53 for voters, 0.41 for commercial fishers), while the most consensus was observed in support of the use of non-lethal methods to prevent shark bites ($PCI_2 = 0.26$ for tourists, 0.32 for commercial fishers, and 0.33 for voters). The use of non-lethal methods to prevent conflicts with fishing is more controversial among voters ($PCI_2 = 0.46$) than tourists ($PCI_2 = 0.35$) or commercial fishers ($PCI_2 = 0.34$), as is the use of non-lethal methods to prevent sharks from swimming near beaches ($PCI_2 = 0.41$ for voters, 0.35 for commercial fishers, and 0.34 for tourists).

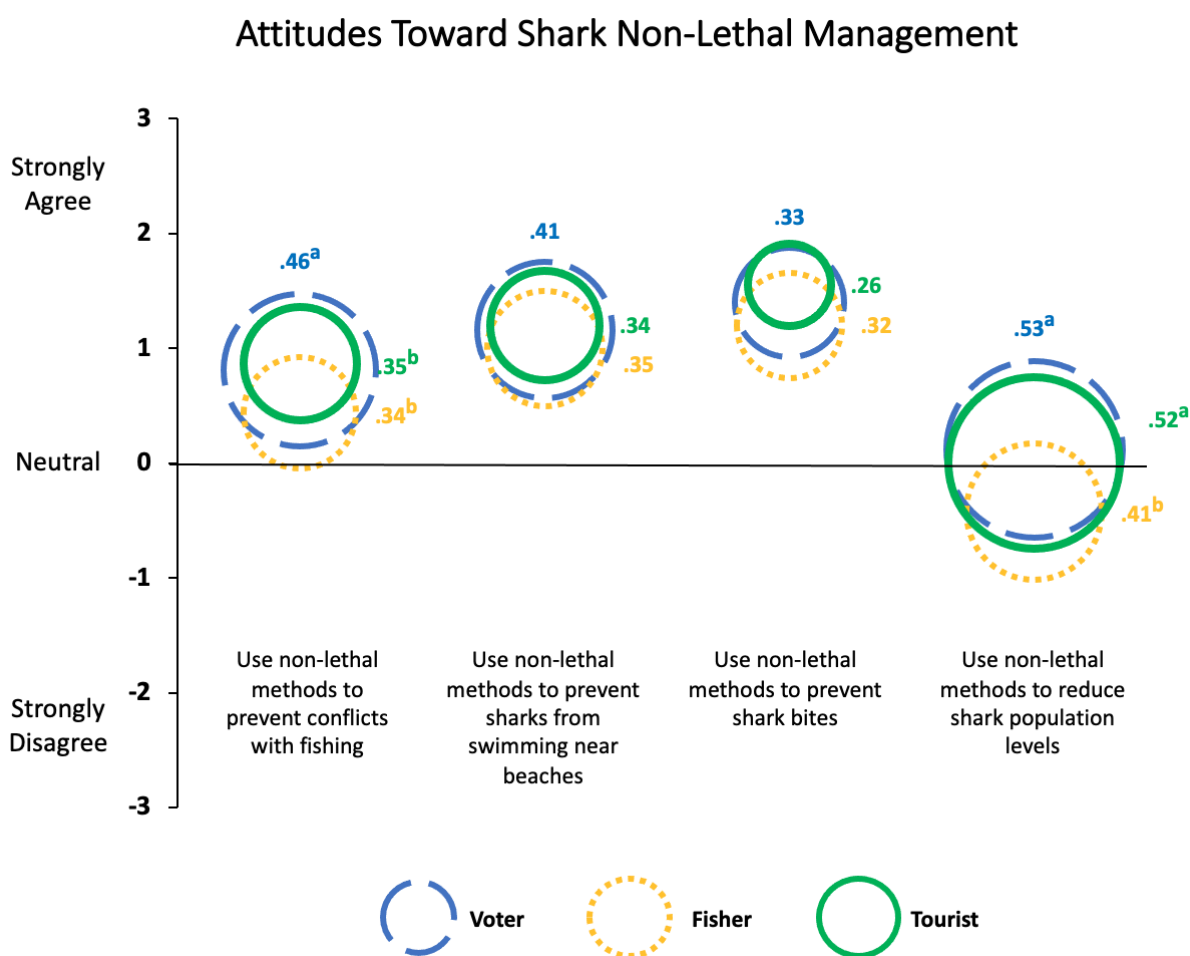


Figure 17. Mean and PCI_2 values of attitudes toward shark non-lethal management by stakeholder. PCI_2 values are represented by bubble size, with lower values associated with more consensus (smaller bubbles) and higher values associated with more conflict (larger bubbles). The different superscript letters (a, b, c) on the PCI_2 indicate differences in PCI_2 scores for the three groups.

The majority of voters (58.7%) and tourists (74.5%) support leaving seals alone (Figure 18). The overwhelming majority of commercial fishers (65.7%) reject this approach. In contrast, voters (69.8%), commercial fishers (69.4%), and tourists (77.8%) agree that sharks should be left alone.

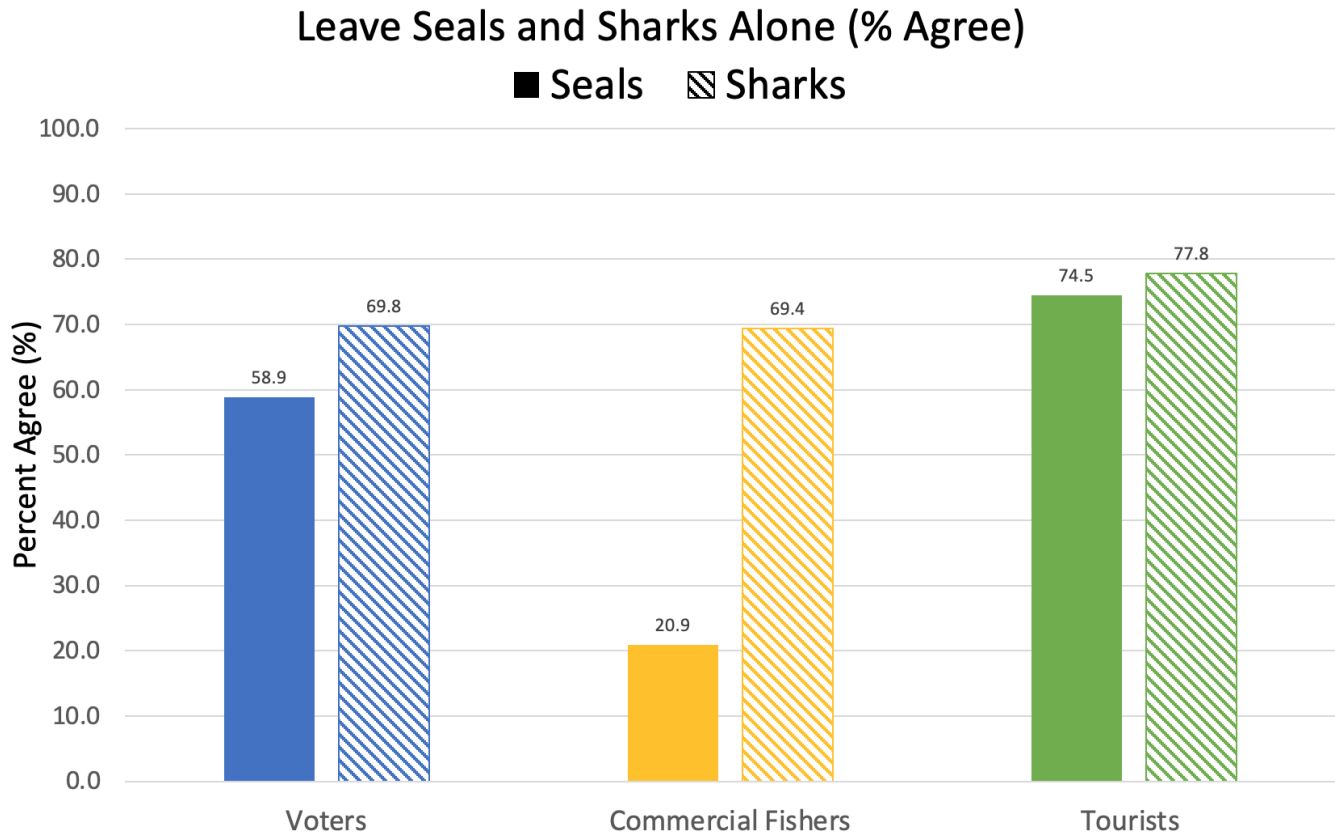


Figure 18. Support for leaving seals and sharks alone by stakeholder (%).

11.4 Shark Conflict Prevention Policies

Large majorities of respondents in each group support policies to prevent human-shark interactions, including increasing public education about sharks, improving signage at beaches, and establishing more patrols as a part of shark warning systems. However, commercial fishers consistently are less favorable toward these measures (Appendix B Table B15). Over three-quarters of voters and tourists support increased public education (87% of voters, 94% of tourists), improved signage (86% of voters, 90% of tourists), and increased patrols (84% of voters, 90% of tourists). Among commercial fishers, 69% favor increased shark public education, 61% favor improved signage, and 63% favor increased patrols. The majority of tourists (59%) and slightly less than half of voters (48%) support restrictions on deep water activities during peak shark seasons; commercial fishers soundly reject restrictive measures, with only 20% in support.

There is high consensus among tourists in acceptance of shark conflict prevention strategies, as demonstrated by the small PCI_2 values (Figure 19) for increasing public education on sharks ($PCI_2 = 0.02$), improving signage at beaches ($PCI_2 = 0.06$), and increasing beach patrols/shark spotters/aerial patrols ($PCI_2 = 0.03$). Among voters, there is less consensus with slightly higher PCI_2 values ($PCI_2 = 0.13$ for increasing public education, 0.13 for improving signage at beaches, and 0.15 for increasing beach patrols/shark spotters/aerial patrols). Commercial fishers demonstrate the most conflict, having the largest PCI_2 scores for increasing public education ($PCI_2 = 0.23$), improving signage at beaches ($PCI_2 = 0.23$), and increasing beach patrols/shark spotters/aerial patrols ($PCI_2 = 0.24$). Restricting deep water activities such as surfing during peak shark season is the least popular and most controversial strategy for each group ($PCI_2 = 0.40$ for voters, 0.29 for tourists, and 0.31 for commercial fishers).

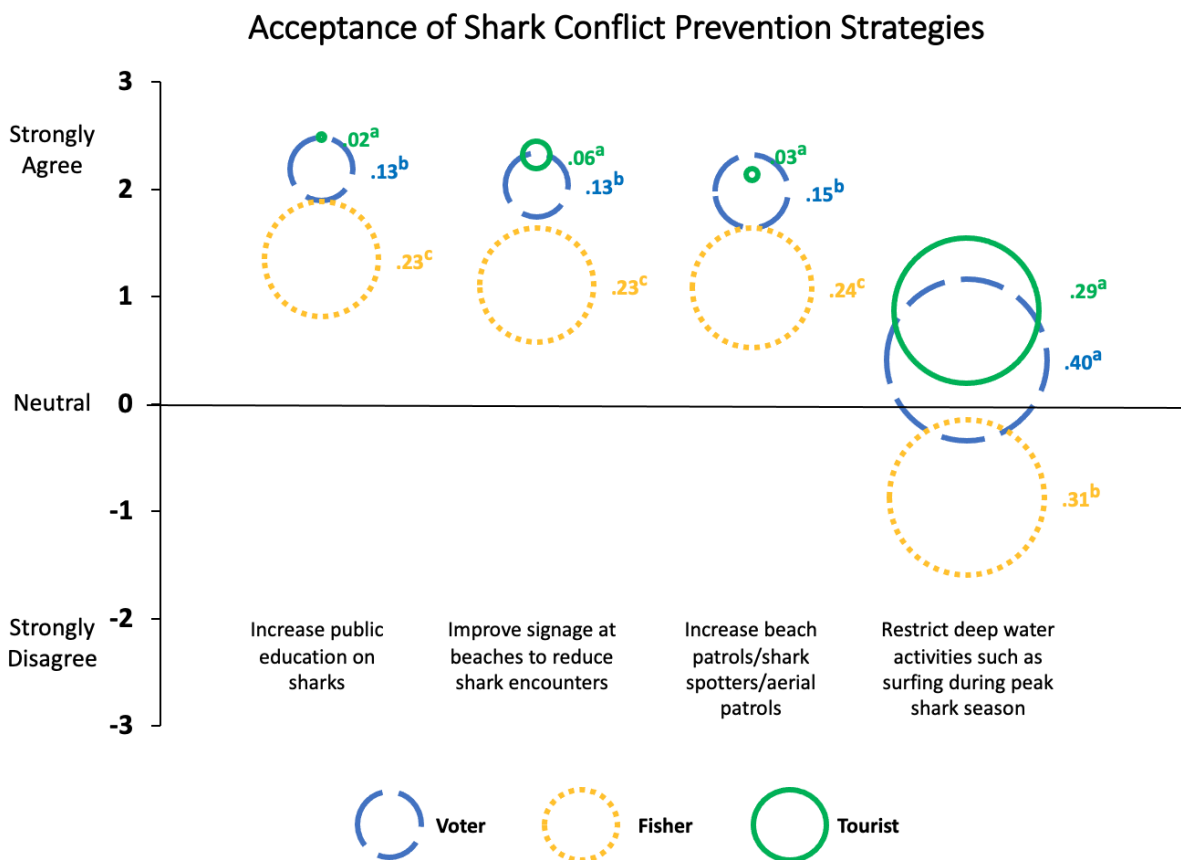


Figure 19. Mean and PCI_2 values for acceptance of shark conflict prevention strategies by stakeholder. PCI_2 values are represented by bubble size, with lower values associated with more consensus (smaller bubbles) and higher values associated with more conflict (larger bubbles). The different superscript letters (a, b, c) on the PCI_2 indicate differences in PCI_2 scores for the three groups.

12. Interest Group Identification

Interest group preferences of the three groups of respondents reflect their attitudinal differences toward marine wildlife and their management (Table 8). Tourists most strongly identify with

environmental (74%) and animal protection (67%) groups. Voters also affiliate themselves with environmental and animal protection groups, but by smaller margins (49% and 49%, respectively). Not surprisingly, commercial fishers most strongly identify with commercial fisher groups (73%) and recreational angler groups (51%). Few voters and tourists identify with commercial fisher (18% of voters, 20% of tourists), recreational angler (18% of voters, 20% of tourists), or hunter groups (12% of voters, 10% of tourists). Among commercial fishers, almost a third (39%) identify with hunter groups, 22% identify with environmental groups, and only 15% identify with animal protection groups.

Table 8. Interest group identification by stakeholder¹

Interest Group Identity	Voters % Strong Identification	Commercial Fishers % Strong Identification	Tourists % Strong Identification
Environmental Groups	49%	22%	74%
Animal Protection Groups	49%	15%	67%
Commercial Fisher Groups	18%	73%	20%
Recreational Angler Groups	18%	51%	20%
Hunter Groups	12%	40%	10%

¹Strong identification = % Strongly Agree + % Very Strongly Agree

13. Commercial Fisher Supplemental Findings

The commercial fisher supplement was completed by 83% (467) of commercial fisher respondents. The mean number of endorsements held by respondents is 2.79, with 53% of respondents working from commercial fishing vessels; 21% working from other vessel types including private/personal boats, skiffs, or from shore; 15% working from charter boats; and 2% working from head boats.

A plurality of commercial fishers (33%) derive less than 5% of their annual household income from commercial fishing, followed by 22% who depend on fishing for 5-25% of their annual household income (Table 9). The next largest subgroup (16%) earns more than 95% of their annual income from commercial fishing.

Table 9. Percent of income derived from commercial fishing annually (%)

	Commercial Fishers (%)
<5%	33
5% - 25%	22
26% - 50%	15
51% - 75%	9
76% - 95%	6
>95%	16

The mean length of a typical fishing trip reported is 7.85 hours, with most respondents fishing 31-90 days annually (24%), followed by 91-180 days (23%), 10-30 days (19%), more than 270 days (12%), and 181-270 days (11%). Eleven percent of respondents fish less than 10 days annually.

Fisheries, Gear Types, and Fishing Grounds

The most important fisheries for respondents are midwater (41.3% very important and 35.7% somewhat important), shellfish (45.4% very important and 14.8% somewhat important), and bait-like (21.4% very important and 34.8% somewhat important). (Table 10).

Table 10. Fisheries by importance to commercial fishers (%)

	Not important	Somewhat important	Very important
Bait-like (Herring/Menhaden, Mackerel, Squid)	44	35	21
Pot (Conch, Lobster/Crab, Black Sea Bass)	44	45	11
Midwater (Bluefish, Striped Bass, Tuna)	23	36	41
Benthic (Skate/Monkfish, Multispecies/groundfish, Dogfish)	58	31	12
Shellfish (Quahog/Surf Clam/Mussel/Scallop/Oyster)	40	15	45
Other (aquaculture, fluke, sand eel)	87	5	9

The gear types most often used by respondents are handline/rod and reel/jigging machine (64%), rakes and tongs (33%), trap/pot (17%), and 'other' gear including aquaculture, cast nets, harpoon, and racks/bags (15%) (Table 11). Rakes and tongs are important sometimes to 25% of respondents, followed by handline/rod and reel/jigging machine (20%), trap/pot (18%), and dredge

gear (14%). Purse seine, midwater trawl, otter trawl, gillnet, and benthic longline/tub trawl gear are never important to greater than 89.6% of respondents.

Table 11. Gear types by importance to commercial fishers (%)

	Never	Sometimes	Often
Handline, Rod and Reel, Jigging Machine	16	20	63.6
Benthic Longline, Tub-trawl	90	7.8	2.7
Gillnet	92	5.8	2
Trap / Pot	65	17.5	17
Otter Trawl	97	2	0
Midwater Trawl	98	1	0
Purse Seine	99	1	0.0
Dredge (Scallop, Mussel, Hydraulic)	76	14	10
Rakes / Tongs	41	25	33
Other (Aquaculture, cast nets, harpoon, racks/bags)	83	2	15

When asked about the importance of fishing grounds, Cape Cod Bay was ranked as somewhat or very important by 84% of respondents, followed by the Backside (72%), and Southern New England inshore (71%) (Table 12). Less important were Southern New England offshore, ranked as somewhat or very important by 46% of respondents, the Gulf of Maine (40%), and the Great South Channel (38%). 'Other' fishing grounds were not at all important to 92% of respondents.

Table 12. Importance of Fishing Grounds to commercial fishers (%).

	Not at all important	Somewhat important	Very important
Southern New England inshore (Vineyard Sound, Nantucket Sound, Block Island Sound, Nantucket Shoals, Buzzards Bay)	29	17	54
Southern New England offshore	54	19	27
Great South Channel	62	18	20
Cape Cod Bay	16	16	68
The Backside	28	18	54
Gulf of Maine	60	18	22
Other	92	1	7

Commercial Fisher Interactions with Seals

Of commercial fishers, 84% of respondents have experienced interactions with seals. Interactions are reported most often in midwater (58% often and 41% sometimes), bait-like (41% often and 45% sometimes), benthic (35% often and 36% sometimes), and shellfish (28% often and 37% sometimes) fisheries (Table 13).

Table 13. Interactions with seals by fishery (%)

	Never	Sometimes	Often
Bait-like (Herring/Menhaden, Mackerel, Squid)	14	45	41
Pot (Conch, Lobster/Crab, Black Sea Bass)	28	56	16
Midwater (Bluefish, Striped Bass, Tuna)	2	41	58
Benthic (Skate/Monkfish, Multispecies/groundfish, Dogfish)	29	36	35
Shellfish (Quahog/Surf Clam/Mussel/Scallop/Oyster)	35	37	28
Other	41	33	26

The most commonly reported impacts of interactions with seals are seals taking bait (38%), lost catch (38%), damaged catch (33%), having to stop fishing (31%), stress to fish (25%), and damaged gear (21%). Other interactions experienced were seals feeding on discards (16%), seals being playful (8%),

and seals boarding the boat (5%). Some respondents (9%) reported no impacts of interactions with seals.

The most common actions taken to minimize seal interactions are to work around seals (42%), stop fishing (31%), and change fishing practices (17%). Some fishers (17%) did not take any actions to minimize seal interactions, while other actions such as changing fishing gear (6%), sounds (5%), and physical barriers (1%) were less common. Write-in responses for 'other' actions (5%) included moving locations, bashing seals with equipment, and throwing rocks.

Discussion

Differences in attitudes towards seals among voter, commercial fisher, and tourist stakeholder groups on Cape Cod are notable and largely consistent with 2016 survey findings in Nantucket (Jackman et al. 2018). Voters and especially tourists view seals favorably. They largely perceive seals as beneficial, positive, and enjoyable. They believe that seals are an important part of the marine ecosystem and a sign of a healthy environment. Commercial fishers hold different views and blame seals for reducing and suppressing fish stock, hurting the economy, and creating public safety risks from sharks.

Most commercial fishers report interactions with seals. Some one-third of commercial fishers who completed the supplemental questions reported seals taking bait and lost and damaged catch; another one-fifth report damaged fishing gear. Interactions are most frequent in mid-water (bluefish, striped bass, and tuna), bait-like (herring/menhaden, mackerel, squid), and benthic (skate/monkfish, multi-species/groundfish, and dogfish) fisheries. In response, almost half of fishers work around seals, and some stop fishing. Fewer take actions such as changing gear or using sounds or physical barriers.

Since the 2018 death on Cape Cod as a result of a shark encounter, controversies around seals and sharks have intensified. Heated public forums have been held and local officials are facing mounting political pressure to implement shark mitigation (Pollock 2019). Proposed measures range from relatively non-invasive shark-spotting programs (Kock et al. 2012), to barrier systems that exclude or entangle sharks (Green et al. 2009), to culls of both sharks (Wetherbee et al. 1994) and seals (Morissette et al. 2012). Lethal management of seals and sharks have been found to be costly; ineffective for reducing conflict between humans, sharks, and seals; ecologically damaging (Bowen and Lidgard 2013, Lavigne 2003); unacceptable to the public (Gibbs and Warren 2015, Gray and Gray 2017; Jackman et al. 2018, Garcia-Quijano 2018); and a threat to tourism (Parsons 2003). Lethal management of sharks, in particular, has been found to increase fear and weaken support for shark conservation (Neff 2014) in addition to being ineffective in reducing shark bites (Gibbs and Warren 2015, Wetherbee et al. 1994).

Our survey confirmed that lethal management is strongly opposed by Cape Cod voters and tourists and finds little support even within the commercial fisher stakeholder group. A clear preference among all stakeholder groups was indicated for non-lethal management approaches over lethal management of both seals and sharks. While higher than support for lethal management,

enthusiasm for non-lethal management is limited by large portions of respondents who believe one or both species should be left alone. The majority of voters and three-quarters of tourists believe that seals should be left alone, an approach supported by only one-fifth of commercial fishers. Some two-thirds of each of the three stakeholder groups support leaving sharks alone.

Despite the differences among voters, commercial fishers and tourists in their views of seals, sharks and their management, the survey reveals the shared commitment of all three stakeholder groups to coexistence with marine wildlife and ecosystem health. Management for the ecosystem is the top priority for tourists and voters, and is second only to the fisheries in the management priorities of commercial fishers. In an earlier case study of Cape Cod commercial fishermen, Gruber (2014) also found that the top priority for commercial fishers were fisheries, followed by the ecosystem. Jackman et al. (2018) found the ecosystem was the top priority for Nantucket voters, recreational anglers and tourists. In our study, the goals of the Marine Mammal Protection Act retained the same high levels of support as found in Kellert's (1999) national survey two decades earlier. This support includes over two-thirds of voters and tourists as well as the majority of commercial fishers.

Although all three stakeholder groups place a high value on the importance of the ecosystem to ocean management, there is substantial disagreement over the role of seals in the ecosystem. Tourists and voters see seals as beneficial to the ecosystem, an important sign of a healthy environment, and an integral part of marine food webs. Commercial fishers view seals as damaging to the ecosystem and a threat to fish stocks. The results also indicate that voter and commercial fisher stakeholder groups are not monolithic. About one-fourth of voters share commercial fishers' critiques of seals, whereas some one third of commercial fishers have more positive views of seals, especially around their ecosystem role. These differences within stakeholder groups are reflected in the Potential for Conflict Index scores, which detect higher levels of conflict within voter and commercial fisher samples. Tourists are largely unified in their positive evaluations of seals.

Additional differences within each stakeholder group are also apparent. Substantial gender gaps are found in all three stakeholder groups, with female respondents more opposed to lethal management of both seals and sharks and more supportive of Marine Mammal Protection Act goals. This finding is consistent with prior research, which has found gender-based differences in views of wildlife management (Jackman and Rutberg 2015). Uniquely, this study also finds gender differences in attitudes toward seals, with females in each stakeholder group more favorable toward seals. Gender differences in attitudes towards sharks, however, are not significant. In voter and tourist stakeholder groups, recreational anglers hold more negative attitudes toward seals, are less likely to oppose lethal management of seals, and are less supportive of Marine Mammal Protection Act goals than non-anglers (Cook et al. 2015, Schakner et al. 2019). Within the commercial fisher stakeholder group, no differences are found between recreational anglers and non-anglers in views of lethal management and Marine Mammal Protection Act goals. In all three stakeholder groups, the relationship between recreational angler identity and attitudes towards sharks and shark management is not detected on these measures.

While tourist and voter enthusiasm for seals is greater than for sharks on most measures, sharks were perceived by larger margins of all three stakeholder groups as important to the marine ecosystem.

Recent studies also have found attitudes toward sharks becoming more favorable in the U.S. over the past three and a half decades (George et al. 2016), and this survey finds some support for this trend on Cape Cod (Garcia-Quijano 2018).

Our results suggest that seals and sharks are an especially important part of the Cape Cod experience for tourists and voters. Tourists, especially, hope to see seals when they are on Cape Cod, second only to their enthusiasm for seeing whales. Tourists, followed by voters, consistently hold the most favorable views of both seals and sharks. According to our findings, shark fears and concerns are muted by a desire for coexistence, a belief in the ecological importance of sharks, a willingness to accept inconvenience and risk in order to allow marine wildlife to thrive and a sense of control over whether shark encounters occur. Gibbs and Warren (2015) found that most ocean users adapt their behavior to reduce personal risk of shark encounters and support research and education on shark behavior and deterrents. Tourists on Cape Cod are taking multiple actions to avoid shark encounters, including staying in shallow water and checking and obeying signage and warning systems, which is an important measure of governmental and non-governmental success in communicating shark encounter prevention methods. The survey results suggest that tourists, in particular, are heavily using the public safety information systems available to them, particularly signage and lifeguards. Perhaps because of their increased familiarity with both species and the region, those who live on Cape Cod – voters and especially commercial fishers – are less likely than tourists to engage in behaviors to reduce their encounters with sharks.

Controversies related to seals and sharks may in part derive from a phenomenon known as “shifting baseline syndrome.” This concept, first coined by Canadian fisheries scientist Daniel Pauly (Pauly 1995), describes how each generation gauges the level of the fishery compared to when they first became fishers, or perhaps when they were children. In this case, the baseline on Cape Cod until the last two decades, has been an ecosystem largely devoid of both seals and sharks. The challenge is how to “lift the baseline” (Roman et al. 2015).

Support for increased public education, research, and signage on both seals and sharks and beach patrols among all three stakeholder groups is very high. The survey results also point to a need to enhance education on the history of seals and sharks in Cape Cod waters and shark avoidance strategies. The need for additional research and communication from scientists of the role of seals in the ecosystem is a clear take away from our study. In the absence of education about the benefits of seals and sharks, media coverage on seals as competition for fisheries or an attractant for sharks and sharks as a threat to human safety likely will continue to foster polarization (Bruskotter and Wilson 2014, Muter et al. 2012).

The present report seeks to provide a summary of key survey findings. In an effort to further understanding of the views of Cape Cod voters, tourists, and commercial fishers, to develop effective messaging, and to contribute to management deliberations and human dimensions of wildlife research, future analyses will examine in more depth the contributions of a variety of factors to attitudes toward seals and sharks and their management and to shark avoidance behavior.

Works Cited

Andrews, J C., and P. Rhoades Mott. (1967). Gray Seals at Nantucket, Massachusetts. *Journal of Marine Mammalogy* 48, 4: 657.

Atlantic Scientific Review Group. (2021). Letter to Dr. Paul Doremus, National Marine Fishery Services.

Bamford, L.A. (2015). A parasite-pinniped-fisheries interaction: Codworm (*Pseudoterranova*) in Atlantic Cod (*Gadus Morhua*) in the Gulf of Maine, University of New England.

Baruch-Mordo, S., Breck, S. W., Wilson, K. R., and Broderick, J. (2009). A tool box half full: how social science can help solve human–wildlife conflict. *Human Dimensions of Wildlife*, 14(3), 219-223.

Baum, J.K., Myers, R.A., Kehler, D.G., Worm, B., Harley, S.J. and Doherty, P.A. (2003). Collapse and conservation of shark populations in the Northwest Atlantic. *Science*, 299(5605), pp.389-392.

Benoît, H., D. Swain, W. Bowen, G. Breed, M. Hammill, and V. Harvey. (2011). Evaluating the potential for gray seal predation to explain elevated natural mortality in three fish species in the southern Gulf of St. Lawrence. *Marine Ecology Progress Series* 442:149–167.

Bogomolni, A.L., Pugliares, K.R., Sharp, S.M., Patchett, K., Harry, C.T., LaRocque, J.M., Touhey, K.M., Moore, M. (2010). Mortality trends of stranded marine mammals on Cape Cod and southeastern Massachusetts, USA, 2000 to 2006. *Diseases of Aquatic Organisms*. 88: 143-155.

Bogomolni, A., Nichols, O.C. and Allen, D. (2021). A Community Science Approach to Conservation Challenges Posed by Rebounding Marine Mammal Populations: Seal-Fishery Interactions in New England. *Frontiers in Conservation Science*, p.34.

Bowen, W. D., and Lidgard, D. (2013). Marine mammal culling programs: review of effects on predator and prey populations. *Mammal Review*, 43(3), 207-220.

Buchmann, K., and P. Kania. (2012). Emerging *Pseudoterranova decipiens* (Krabbe, 1878) problems in Baltic cod, *Gadus morhua* L., associated with gray seal colonization of spawning grounds. *Journal of Fish Diseases* 35:861–866.

Bruskotter, J. T., & Wilson, R. S. (2014). Determining where the wild things will be: using psychological theory to find tolerance for large carnivores. *Conservation Letters*, 7(3), 158-165.

Cohen, J. (2013). *Statistical power analysis for the behavioral sciences*. Routledge.

Cook, R. M., S. J. Holmes, and R. J. Fryer. (2015). Gray seal predation impairs recovery of an over-exploited fish stock. *Journal of Applied Ecology* 52(4):969–979.

Cook, T. C., James, K., and Bearzi, M. (2015). Angler perceptions of California sea lion (*Zalophus californianus*) depredation and marine policy in Southern California. *Marine Policy*, 51, 573-583.

Cosgrove, R., M. Gosch, D. Reid, M. Sheridan, N. Chopin, M. Jessopp, and M. Cronin. (2015). Seal depredation in bottom-set gillnet and entangling net fisheries in Irish waters. *Fisheries Research* 172:335–344.

Crossley, R., Collins, C. M., Sutton, S. G., and Huveneers, C. (2014). Public perception and understanding of shark attack mitigation measures in Australia. *Human dimensions of wildlife*, 19(2), 154-165.

Curtis TH, McCandless CT, Carlson JK, Skomal GB, Kohler NE, Natanson LJ, et al. (2014) Seasonal Distribution and Historic Trends in Abundance of White Sharks, *Carcharodon carcharias*, in the Western North Atlantic Ocean. *PLoS ONE* 9(6): e99240.

de Bernardo, D. H., and Curtis, A. (2013). Using online and paper surveys: the effectiveness of mixed-mode methodology for populations over 50. *Research on Aging*, 35(2), 220-240.

DiGiovanni, R. A. Jr., and A. M. Sabrosky. (2010). A note on seal watching in the Northeast United States. *North Atlantic Marine Mammal Commission Scientific Publications* 8.

Dillman, D., Smyth, J. D., and Christian, L. M. (2014). *Internet, phone, mail, and mixed-mode surveys: The tailored design method*. Hoboken, New Jersey: John Wiley and Sons, Inc.

Engel, M. T., Vaske, J. J., & Bath, A. J. (2021). Seal hunting in Newfoundland from the perspective of local people. *Marine Policy*, 128, 104491.

Fulton, D. C., Manfredo, M. J., & Lipscomb, J. (1996). Wildlife value orientations: A conceptual and measurement approach. *Human dimensions of wildlife*, 1(2), 24-47.

Garcia-Quijano, C. (2018). After a fatal shark attack on Cape Cod, will the reaction be coexistence or killing. *The Conversation*. Retrieved from <https://theconversation.com/after-a-fatal-shark-attack-on-cape-cod-will-the-reaction-be-coexistence-or-culling-102702> .

George, K. A., Slagle, K. M., Wilson, R. S., Moeller, S. J., and Bruskotter, J. T. (2016). Changes in attitudes toward animals in the United States from 1978 to 2014. *Biological Conservation*, 201, 237–242.

Gibbs, L. and Warren, A. (2015). Transforming shark hazard policy: Learning from ocean-users and shark encounter in Western Australia. *Marine Policy*, 58, pp.116-124.

Gilbert, K., Harry, C.T., Rose, K., Niemeyer, M., Patchett, K., Sharp, B., Hoppe, J. O'Reilly, M., Hunter, N., Madden, M., Johnson, T., Brennan, B. and DiMartino, N. (2015) Gray seal occurrence and human interaction observations at the Chatham Fish Pier. In *Seals and ecosystem health: meeting report of the Northwest Atlantic Seal Research Consortium*, eds. Bass, A. L., Bogomolni, A. L., Early, G. A., Nichols, O. C., and Patchett, K., 14-15. Woods Hole Oceanographic Institution.

- Gray, G. M., and Gray, C. A. (2017). Beach-User Attitudes to Shark Bite Mitigation Strategies on Coastal Beaches; Sydney, Australia. *Human Dimensions of Wildlife*, 22(3), 282-290.
- Green, M., Ganassin, C. and Reid, D.D. (2009). Report into the NSW shark meshing (bather protection) program. *NSW DPI Fisheries Conservation and Aquaculture Branch*.
- Gruber, C. (2014). Social, economic, and spatial perceptions of gray seal (*Halichoerus grypus*) interactions with commercial fisheries in Cape Cod, MA.
- Haarder, S., P. W. Kania, A. Galatius, and K. Buchmann. (2014). Increased *Contracaecum osculatum* infection in Baltic cod (*Gadus Morhua*) livers (1982–2012) associated with increasing gray seal (*Halichoerus Gryphus*) populations. *Journal of Wildlife Diseases* 50(3):537–543.
- Hatch, J. M., and Orphanides, C. (2015). Estimates of cetacean and pinniped bycatch in the 2013 New England sink and mid-Atlantic gillnet fisheries.
- Hauksson, E. (2011). The prevalence, abundance, and density of *Pseudoterranova* sp. (p) larvae in the flesh of cod (*Gadus morhua*) relative to proximity of gray seal (*Halichoerus grypus*) colonies on the coast off Drangar, Northwest Iceland. *Journal of Marine Biology* 2011:1–8.
- Hayes SA, Josephson E, Maze-Foley K, Rosel PE, Byrd B, Chavez-Rosales S, Col TVN, Engleby L, Garrison LP, Hatch J, Henry A, Horstman SC, Litz J, Lyssikatos MC, Mullin KD, Orphanides C, Pace RM, Palka DL, Soldevilla M, Wenzel FW. 2018. TM 245 US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2017. NOAA Tech Memo NMFS NE-245; 371 p.
- Jackman, J., Bettencourt, L., Vaske, J., Sweeney, M., Bloom, K., Rutberg, A., and Brook, B. (2018). Conflict and consensus in stakeholder views of seal management on Nantucket Island, MA, USA. *Marine Policy* 95, 166-173.
- Jackman, J. L., and Rutberg, A. T. (2015). Shifts in attitudes toward coyotes on the urbanized East Coast: The Cape Cod experience, 2005–2012. *Human Dimensions of Wildlife*, 20(4), 333-348.
- Kellert, S.R. (1999). *American perceptions of marine mammals and their management*. Washington, D.C.: Humane Society of the United States.
- Kock, A., Titley, S., Petersen, W., Sikweyiya, M., Tsotsobe, S., Colenbrander, D., Gold, H. and Oelofse, G. (2012). A pioneering shark safety program in cape town, South Africa. *Global Perspectives on the Biology and Life History of the White Shark*. Edited by Michael L. Domeier, CRC Press, pp.447-466.
- Königson, S., A. Fjälling, M. Berglind, and S.-G. Lunneryd. (2013). Male gray seals specialize in raiding salmon traps. *Fisheries Research* 148:117–123.
- Königson, S., S.-G. Lunneryd, H. Stridh, and F. Sundqvist. (2010). Gray Seal Predation in Cod Gillnet Fisheries in the Central Baltic Sea. *Journal of Northwest Atlantic Fishery Science* 42:41–47.

- Lavery, T. J., B. Roudnew, J. Seymour, J. G. Mitchell, and T. Jeffries. (2012). High nutrient transport and cycling potential revealed in the microbial metagenome of Australian sea lion (*Neophoca cinerea*) Faeces. *PLoS ONE* 7(5):e36478.
- Lavigne, D. M. (2003). Marine mammals and fisheries: the role of science in the culling debate. *Marine mammals: Fisheries, tourism and management issues*, eds. N. Gales, M. Hindell, and R. Kirkwood, 31-47. Csiro Publishing.
- Lelli, B., Harris, D. E., and Aboueissa, A. M. (2009). Seal bounties in Maine and Massachusetts, 1888 to 1962. *Northeastern Naturalist*, 16(2), 239-254.
- Lotze, H. K., and I. Milewski. (2004). Two centuries of multiple human impacts and successive changes in a North Atlantic food web. *Ecological Applications* 14(5):1428–1447.
- Martins, M. C. I., Sette, L., Josephson, E., Bogomolni, A., Rose, K., Sharp, S. M., Niemeyer, M. and Moore, M. (2019). Unoccupied aerial system assessment of entanglement in Northwest Atlantic gray seals (*Halichoerus grypus*). *Marine Mammal Science*.
- Moksness, E., J. Gjøsæter, G. Lagailarde, E. Mikkelsen, E. M. Olsen, H. T. Sandersen, and J. H. Vølstad. (2011). Effects of Fishing Tourism in a Coastal Municipality: a Case Study from Risør, Norway. *Ecology and Society* 16(3):art11.
- Morissette, L., Christensen, V., and Pauly, D. (2012). Marine mammal impacts in exploited ecosystems: would large scale culling benefit fisheries? *PLoS One*, 7(9), e43966.
- Muter, B. A., Gore, M. L., Gledhill, K. S., Lamont, C., and Huveneers, C. (2013). Australian and US news media portrayal of sharks and their conservation. *Conservation Biology*, 27(1), 187-196.
- National Park Service (2021). Year to Date Report: Cape Cod National Seashore Report Dates June and July 2021. Retrieved at <https://irma.nps.gov/STATS/SSRSReports/Park%20Specific%20Reports/Park%20YTD%20Version%201?Park=CACO> .
- NMFS. (1993). Fishery management plan for sharks of the Atlantic Ocean. Silver Spring, MD.
- NMFS. (1997) Framework seasonal adjustment of management measures under the fishery management plan for sharks, final environmental assessment and regulatory impact review/final regulatory flexibility analysis. United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Sustainable Fisheries, Silver Spring, Maryland.
- Northeast Fisheries Science Center. (2021). State of the Ecosystem 2021: New England Revised. Woods Hole, MA.

- Neff, C. (2014). Human perceptions and attitudes towards sharks. *Sharks: Conservation, Governance and Management*, eds. E. J. and Klein, N., 107-132. NY: Routledge.
- Nichols, O.C., A. Bogomolni, E. Bradfield, G. Early, L. Sette, and S. Wood. (2012). Gulf of Maine seals-fisheries interactions and integrated research. *Woods Hole Oceanographic Institution Technical Report* 2012-06.
- Nichols, O. C., E. Eldredge, and S. X. Cadrin. (2014). Gray seal behavior in a fish weir observed using Dual-Frequency Identification Sonar. *Marine Technology Society Journal* 48(4):72–78.
- Parsons, E. C. M. (2003). Seal management in Scotland: Tourist perceptions and the possible impacts on the Scottish tourism industry. *Current Issues in Tourism*, 5(6), 540-546.
- Pauly, D. (1995). Anecdotes and the shifting baseline syndrome of fisheries. *Trends in Ecology and Evolution*. 10, 10:430.
- Pollock, A. (2019). Surfers push for better shark safety. Cape Cod Chronicle. Retrieved at <https://capecodchronicle.com/en/5406/chatham/4079/Surfers-Push-For-Better-Shark-Safety-Sharks.htm>
- Roman, J., Altman, I., Dunphy-Daly, M. M., Campbell, C., Jasny, M., and Read, A. J. (2013). The Marine Mammal Protection Act at 40: status, recovery, and future of US marine mammals. *Annals of the New York Academy of Sciences*, 1286(1), 29-49.
- Roman, J., and J. J. McCarthy. (2010). The whale pump: marine mammals enhance primary productivity in a coastal basin. *PLoS ONE* 5(10):e13255.
- Roman, J., Dunphy-Daly, M.M., Johnston, D.W. and A. J. Read. Lifting baselines to address the consequences of conservation success. *Trends in Ecology and Evolution* 30, no. 6 (2015): 299-302.
- Schakner, Z., Purdy, C., & Blumstein, D. T. (2019). Contrasting attitudes and perceptions of California sea lions by recreational anglers and the media. *Marine Policy*, 109, 103710.
- Sexton, N. R., Miller, H. M., and Dietsch, A. M. (2011). Appropriate uses and considerations for online surveying in human dimensions research. *Human Dimensions of Wildlife*, 16(3), 154-163.
- Skomal, G. B., Chisholm, J., and Correia, S. J. (2012). Implications of increasing pinniped populations on the diet and abundance of white sharks off the coast of Massachusetts. *Global Perspectives on the Biology and Life History of the White Shark*. (Ed. M. Domeier.) pp, 405-418.
- Soga, M. and Gaston, K.J., 2018. Shifting baseline syndrome: causes, consequences, and implications. *Frontiers in Ecology and the Environment*, 16(4), pp.222-230.

- Sponarski, C. C., Vaske, J. J., and Bath, A. J. (2015). Differences in management action acceptability for coyotes in a national park. *Wildlife Society Bulletin*, 39, 239–247
- Swain, D. P., H. P. Benoît, M. O. Hammill, G. McClelland, and É. Aubry. (2011). Alternative hypotheses for causes of the elevated natural mortality of cod (*Gadus morhua*) in the southern Gulf of St. Lawrence: the weight of evidence. Pages 1-37. Gulf Fisheries Centre, *Research Document 2011/036*, Moncton, NB.
- Treves, A., R. B. Wallace, and S. White. (2009). Participatory planning of interventions to mitigate human–wildlife conflicts. *Conservation Biology* 23(6):1577–1587.
- US Department of Commerce (1997) Atlantic Shark Fisheries; Quotas, Bag Limits, Prohibitions, and Requirements. Federal Register 62(66): 16648-16656.
- Vaske, J. J. (2019). *Survey research and analysis*. Sagamore-Venture. Urbana, IL 61801.
- Vaske, J. J., Beaman, J., Barreto, H., and Shelby, L. B. (2010). An extension and further validation of the potential for conflict index. *Leisure Sciences*, 32(3), 240-254.
<https://doi.org/10.1080/01490401003712648>
- Vaske, J. J., & Donnelly, M. P. (1999). A value-attitude-behavior model predicting wildland preservation voting intentions. *Society & Natural Resources*, 12(6), 523-537.
- Vaske, J. J., & Manfredo, M. J. (2012). Social psychological considerations in wildlife management. *Human dimensions of wildlife management*, 43-57.
- Wetherbee, B. M., Lowe, C. G., and Crow, G. L. (1994). A review of shark control in Hawaii with recommendations for future research.
- Winton, M. V., Sulikowski, J., & Skomal, G. B. (2021). Fine-scale vertical habitat use of white sharks at an emerging aggregation site and implications for public safety. *Wildlife Research*, 48(4), 345-360.
- Wood, S. A., Frasier, T. R., McLeod, B. A., Gilbert, J. R., White, B. N., Bowen, W. D., and Brault, S. (2011). The genetics of recolonization: an analysis of the stock structure of gray seals (*Halichoerus grypus*) in the northwest Atlantic. *Canadian Journal of Zoology*, 89(6), 490-497.
- Wood, S. A., Murray, K. T., Josephson, E., & Gilbert, J. (2020). Rates of increase in gray seal (*Halichoerus grypus atlantica*) pupping at recolonized sites in the United States, 1988–2019. *Journal of Mammalogy*, 101(1), 121-128.

Appendix A

Methodology

Data Collection

Lists of registered voters, which were obtained from town clerks in each of the 15 municipal counties in Barnstable County (referred to hereafter as Cape Cod), were used as a sampling frame for residents (Jackman and Rutberg 2015; Jackman et al. 2018). A systematic random sample, stratified by town, was drawn from voter lists (April 2021). The survey was sent to 1793 voters.

To obtain a sample of commercial fishers, one person per household and per email address was randomly selected from a list of the population of Barnstable County commercial fishery permit holders (N=1761) obtained from the Massachusetts Division of Marine Fisheries (April 2021). Voter and commercial fisher samples were cross-checked for duplicates, and names occurring on both lists were removed from the voter list. The survey was sent to 1456 commercial fisher permit holders. The list included email addresses for 85% of permit holders.

A sample of 1074 non-resident visitors to Cape Cod was recruited at the six Cape Cod National Seashore Beaches (Nauset Light, Coast Guard, Marconi, Head of the Meadows, Herring Cove, and Race Point) in June and July 2021. Sampling time blocks (n=20) were identified using a multi-stage sampling design (Vaske 2019) based on visitor use data from 2019 (available at <https://irma.nps.gov/STATS/>). Beach visitors were intercepted by team members, wearing T-shirts identifying the project, and invited to sign-up to receive the survey to complete at a later date (Sexton et al. 2011; Sponarski et al. 2015). Interested participants were asked a series of screening questions, disqualifying residents of Cape Cod and individuals under 18 years of age. International visitors (very few due to COVID-19) were excluded from the sample. Eligible participants completed a card with their name, email, and mailing addresses and were given a pen with the study logo to incentivize response. Of the tourists who were asked to participate in the survey, 80% agreed to participate and provided contact information.

The surveys were distributed to the three samples following the Dillman (2014) 5-contact methodology, with participants able to complete the survey by mail or online. The online option, implemented using the survey platform Qualtrics, was provided with each contact. Participation of people < 49 years old in mail surveys has been found to be lower (Jackman et al. 2018, Jackman and Rutberg 2015). A mixed-mode survey design (mail and online) has been found to increase response rates (Sexton et al. 2011) among both younger respondents and older respondents (de Bernardo and Curtis 2012).

All voters and commercial fishers for whom email addresses were unavailable first received a pre-notice letter containing a unique link to complete the survey online. One week after the first contact, non-respondents received a mailed packet containing a cover letter, survey questionnaire, and pre-stamped return envelope. Three additional contact attempts were made at two-week intervals by mail (reminder, replacement packet, and final reminder). Tourists and commercial fishers with email addresses received an initial email invitation to complete the survey online, followed by reminder

emails scheduled 7, 21, and 28 days later. Non-respondents after the 3rd email contact were mailed a packet containing a cover letter, survey questionnaire, and pre-stamped return envelope. All respondents were assigned a permanent identification number, to preserve anonymity and prevent multiple responses.

Of voters, 87.2% completed the surveys by mail and 12.6% via Qualtrics. Of the commercial fishers, 36.4% completed the survey by mail and 63.6% via Qualtrics. Thirteen percent of tourists completed the survey by mail and 87% on Qualtrics.

The survey was completed by Cape Cod voters (n=547), commercial fishers (n=564), and tourists (n=699) between June and September 2021. Response rates were 32.4% for voters, with 106 undeliverable surveys; 39% for commercial fishers, with 9 undeliverable surveys; and 68.3% for tourists, with 50 undeliverable surveys.

Variables

The Cape Cod survey instrument replicated and extended the 2016 questionnaire used in the survey of views of the public, tourists, and recreational anglers on Nantucket (Jackman et al. 2018). The common survey instrument for all three samples was made up of seven sections, followed by a supplement of 12 questions administered to the commercial fisher sample only. Below we describe variables. The scale descriptions are presented in more detail in the body of this report.

Section A, Time on Cape Cod, asked participants if Cape Cod is the location of their primary residence (yes/no) and to enter the number of years they have been residing (year-round or seasonally) on or visiting Cape Cod.

Section B, Views of the Ocean and Its Inhabitants, contained three series of questions pertaining to wildlife appreciation, marine value orientation, and knowledge of seals and great white sharks on Cape Cod. The first series, containing five items, asked participants to rate how much they hope to see various marine animals (dolphins and porpoises, fish, seals, sharks, and whales) on Cape Cod on a 5-point scale ranging from not at all (-2) to very much (2). In the next series, respondents were asked the extent to which they agreed with three statements prioritizing ocean use by humans and three statements prioritizing protection of marine wildlife. Responses to these 7-point scale items ranged from strongly disagree (-3) to strongly agree (3). Two scales were constructed based on these items: marine value use orientation (3 items) and marine value protection orientation (3 items). Lastly, a series of knowledge items included a series of 8 questions (true, false, don't know) about the biology, history and public policy related to seals and sharks on Cape Cod.

Section C, Views of Seals, measured attitudes toward and beliefs about seals. First, participants reported their feelings about seals on 7-point valence scales from extremely harmful (-3) to extremely beneficial (3); negative (-3) to positive (3); not enjoyable at all (-3) to extremely enjoyable (3); and no pride (-3) to a lot of pride (3). A seal attitude scale was constructed based on these four items. Participants also rated their agreement with a series of belief statements about the aesthetic, economic, and ecological benefits and harms of seals (12 items) and threats to seals (2 items).

Responses for all 14 items ranged from strongly agree (3) to strongly disagree (-3). Seal ecological benefits (3 items), seal ecological harm (2 items), seal benefits (5 items), and seal harms (5 items) scales were constructed based on the belief variables.

Section D, Views of Great White Sharks, asked a parallel series of questions examining attitudes toward and beliefs about sharks. First, participants rated their feelings about sharks on 7-point valence scales from extremely harmful (-3) to extremely beneficial (3); negative (-3) to positive (3); not enjoyable at all (-3) to extremely enjoyable (3); extremely frightening (-3) to not frightening at all (3); and no pride (-3) to a lot of pride (3). These five items were averaged to form the shark attitude scale. Next, participants responded to a series of statements about the aesthetic, economic, and ecological benefits and harms of sharks (11 items) and threats to sharks (1 item). Responses for all 14 items ranged from strongly agree (3) to strongly disagree (-3). Shark ecosystem benefits (4 items), shark benefits (6 items), and shark harms (4 items) scales were constructed from these belief variables.

Section E, Experiences on Cape Cod, asked participants about their experiences with seals and sharks on Cape Cod (13 items), including whether they had observed (never, sometimes, many times) seals, sharks, and human and species behavior likely to exacerbate conflicts. Respondents also were asked to indicate their sources of information about seals and sharks on Cape Cod (8 items), preferred beaches and beach activities (13 items), and shark avoidance strategies (14 items) as categorical variables. In addition, respondents were asked whether they blamed people in the water, sharks, seals, government, or no one for shark bite incidents on a 7-point scale ranging from strongly disagree (-3) to strongly agree (3) and how much control (1 item) they felt they have in preventing a shark encounter on a 7-point scale ranging from no control (-3) to a lot of control (3).

Section F, Views of Ocean Management, contained four series of questions about ocean management priorities. First, respondents rated their levels of agreement on a series of interests, including seals, sharks, tourism, the ecosystem, fisheries, and local communities (6 items). Next, respondents were asked whether they agreed with lethal and non-lethal management responses to a series of situation-based scenarios related to seals and sharks (12 items). Respondents also indicated their level of agreement with five goals of the Marine Mammal Protection Act. For all items, a 7-point scale ranged from strongly disagree (-3) to strongly agree (3). Based on relevant items, the following scales were constructed: seal lethal management (4 items), seal non-lethal management (4 items), shark lethal management (4 items), shark non-lethal management (4 items), Marine Mammal Protection Act (5 items), and shark encounter prevention scale (3 items).

The last section, Section G, asked respondents to indicate their level of identification with environmental, animal protection, commercial fisher, recreational angler, and hunter interest groups on a 5-point scale ranging from not at all (-2) to very strongly (2). Respondents also provided their gender, age, zip code, education level, and personal identification as an angler, fisher, or surfer.

Commercial fishers were asked to complete supplemental questions regarding their fishing activity and interactions with seals. Respondents were asked to report the percentage of income derived from commercial fishing and days spent fishing annually, the length of an average fishing trip in hours, the number of Massachusetts commercial endorsements held, and types of vessels worked on.

On a 3-point scale ranging from never (1) to often (3), fishers were asked to report the importance of gear types (10 items), seal interactions by fishery (14 items), the importance of individual fisheries to business (14 items), and the importance of regional fishing grounds (6 items). Fishers were also asked about the impacts of seal interactions (10 items) and actions taken to minimize seal interactions (8 items). Fisheries were grouped into 6 categories for analysis (bait-like, pot, midwater, benthic, shellfish, and other).

Data Analysis

Cronbach's alpha was used to examine the internal reliability of the scales. The statistic ranges from 0 to 1, with .65 to .70 considered as sufficiently reliable (Vaske 2019). All scales used in this report had Cronbach's alpha statistics between .72 and .94.

Differences in scale and item means for the three types of public were evaluated using one-way analysis of variance (ANOVA) with post hoc tests, LSD where equal variances could be assumed and Games-Howell where equal variances could not be assumed. Means with different superscripts are significantly different at $p < .001$. Effect size (i.e., η) was calculated, with .10 as a minimal, .243 as a typical and .371 as a substantial relationship (Cohen, 1988; Vaske, 2019). Independent-Sample T-tests were used to evaluate differences in views between males and females and between recreational anglers and non-anglers within stakeholder groups.

The Potential for Conflict Index₂ (PCI₂) was used to determine differences in the levels of conflict and consensus among stakeholder groups in their attitudes toward and beliefs about seals and sharks and attitudes toward management priorities, lethal and non-lethal management actions, and MMPA goals (Vaske, Beaman, Bareto, & Shelby, 2010). The PCI₂ integrates central tendency, dispersion and distribution shape into a single measure, and generates a statistic, which ranges from 0 to 1. Complete consensus within a stakeholder group is represented by 0, which is indicated graphically by small bubbles; 1 represents complete polarization, which is indicated by larger bubbles. The PCI₂ and statistical differences (d) tests for comparing two PCI₂ values were calculated using software at <https://sites.warnercnr.colostate.edu/jerryv/calculating-pci2-excel/>.

Appendix B

ANOVA tables for values, beliefs and attitudinal scales and variables by stakeholder group

Table B1. Marine wildlife value orientations scale and items by stakeholder (means)¹

	Voters	Commercial Fishers	Tourists	F	η
Marine Value Orientation Use Scale²	-1.78 ^a	-1.04 ^b	-2.23 ^c	155.970***	0.390
Marine Value Orientation Use Scale Items					
The primary value of the ocean is to provide benefits for humans.	-1.35 ^a	-.44 ^b	-1.98 ^c	119.116***	0.346
The economic values that the ocean provides to humans are more important than protecting marine wildlife.	-1.87 ^a	-1.06 ^b	-2.33 ^c	119.507***	0.346
Recreational use of the ocean is more important than protecting marine wildlife.	-2.11 ^a	-1.64 ^b	-2.38 ^c	51.591***	0.236
Marine Value Orientation Protection Scale³	2.14 ^a	1.17 ^b	2.41 ^c	202.636***	0.434
Marine Value Orientation Protection Scale Items					
We should learn to share the ocean with animals that live there.	2.47 ^a	1.62 ^b	2.67 ^c	137.205***	0.367
Marine wildlife should be protected for their own sake.	1.92 ^a	.76 ^b	2.17 ^a	132.724***	0.363
I am willing to accept some inconvenience and risk in order to have oceans where marine wildlife can thrive.	2.01 ^a	1.15 ^b	2.40 ^c	121.366***	0.349

***p<.001

¹Means with different superscripts are different at p<.05. ²Cronbach Alpha .723 ³Cronbach Alpha .760

Table B2. Attitudes toward seals by stakeholder (means)¹

	Voters	Commercial Fishers	Tourists	F	η
Seal Attitude Scale²	1.74 ^a	-.35 ^b	2.51 ^c	592.002***	0.643
Seal Attitude Scale Items					
Seals are beneficial	.61 ^a	-1.35 ^b	1.31 ^c	462.644***	0.589
Seals are positive	.93 ^a	-1.27 ^b	1.72 ^c	506.431***	0.610
Seals are very enjoyable	1.18 ^a	-.91 ^b	1.92 ^c	453.120***	0.587
I have a lot of pride in seal populations	.27 ^a	-1.80 ^b	1.08 ^c	417.455***	0.570

***p<.001

¹Means with different superscripts are different at p<.05. ²Cronbach Alpha .938**Table B3. Attitudes towards sharks by stakeholder (means)¹**

	Voters	Commercial Fishers	Tourists	F	η
Shark Attitude Scale²	.18	.11	.13	.300	0.019
Shark Attitude Scale Items					
Sharks are beneficial	.47	.43	.62	2.060	0.049
Sharks are positive	.44	.39	.59	2.052	0.049
Sharks are enjoyable	.34	.18	.15	1.886	0.047
Sharks are not frightening	-.49 ^a	-.24 ^b	-.94 ^a	23.783***	0.164
I have a lot of pride in shark populations	.07 ^a	-.24 ^b	.18 ^a	6.792**	0.088

p<.01, *p<.001

¹Means with different superscripts are different at p<.05. ²Cronbach's Alpha .882

Table B4. Perceptions of seal ecological benefits and harms by stakeholder (means)¹

	Voters	Commercial Fishers	Tourists	F	η
Seal Ecological Benefits Scale²	1.28 ^a	-.33 ^b	1.74 ^c	377.022***	0.551
Seal Ecological Benefits Scale Items					
Seals are important to the ecosystem.	1.61 ^a	-.04 ^b	2.13 ^c	323.584***	0.520
The presence of seals is a sign of a healthy environment.	1.12 ^a	-.27 ^b	1.55 ^c	224.005***	0.452
Seals help balance and maintain marine food webs.	1.10 ^a	-.67 ^b	1.57 ^c	326.114***	0.521
Seal Ecological Harm Scale³	-.28 ^a	1.13 ^b	-.81 ^c	275.733***	0.491
Seal Ecological Harm Scale Items					
Seals are the main cause of fish stock declines.	-.50 ^a	.72 ^b	-1.11 ^c	168.126***	0.402
Seals suppress recovery of overfished fish stocks.	-.04 ^a	1.54 ^b	-.51 ^c	274.209***	0.489

***p<.001

¹Means with different superscripts are different at p<.05. ²Cronbach's Alpha .890 ³Cronbach's Alpha .776

Table B5. Perceptions of seal aesthetic, ecological and economic benefits and harms by stakeholder (means)¹

Seal Benefits Scale (aesthetic, ecological, economic) ²	.92 ^a	-.59 ^b	1.43 ^c	420.162***	0.572
Seal Benefits Scale Items					
Seals symbolize the beauty and wonder of Cape Cod	.58 ^a	-1.34 ^b	1.35 ^c	397.685***	0.559
Seals are important to the ecosystem	1.61 ^a	-.04 ^b	2.12 ^c	323.454***	0.520
Seals help the economy because they draw tourists	.13 ^a	-.66 ^b	.59 ^c	86.289***	0.300
The presence of seals is a sign of a healthy environment	1.12 ^a	-.26 ^b	1.54 ^c	223.896***	0.452
Seals help balance and maintain marine food webs	1.10 ^a	-.67 ^b			0.521
Seal Harms Scale (nuisance, ecological, economic, safety) ³	-.35 ^a	1.05 ^b	-1.02 ^c	375.508***	0.550
Seal Harms Scale Items					
Seals are nuisance animals	-1.0 ^a	.86 ^b	-1.85 ^c	348.556***	0.534
Seals are the main cause of fish stock declines	-.50 ^a	.71 ^b	-1.12 ^c	168.063***	0.402
Seals pose a threat to people because they draw sharks	.47 ^a	1.21 ^b	-.15 ^c	79.076***	0.288
Seals hurt the economy because they compete with fishermen	-.62 ^a	.91 ^b	-1.45 ^c	281.199***	0.493
Seals suppress recovery of overfished fish stocks	-.04 ^a	1.55 ^b	-.52 ^c	274.100***	0.489

***p<.001

¹ Means with different superscripts are different at p<.05. ² Cronbach's Alpha .885 ³ Cronbach's Alpha .864

Table B6. Perceptions of shark ecological benefits by stakeholder (means)¹

	Voter	Commercial Fisher	Tourist	F	η
Shark Ecosystem Benefits Scale²	1.65 ^a	1.35 ^b	1.81 ^c	23.296***	0.163
Shark Ecosystem Benefits Scale Items					
Sharks are important to the ecosystem	1.91 ^a	1.65 ^b	2.23 ^c	30.323***	0.184
The presence of sharks is a sign of a healthy environment	1.32 ^a	.94 ^b	1.57 ^c	26.207***	0.171
Sharks help balance and maintain marine food webs	1.56 ^a	1.33 ^b	1.85 ^c	20.777***	0.153
Sharks help control seal populations	1.75 ^a	1.44 ^b	1.57 ^{ab}	5.473**	0.079

p< .01, *p<.001

¹ Means with different superscripts are different at p<.05. ² Cronbach's Alpha .829

Table B7. Perceptions of shark aesthetic, ecological, and economic benefits and harms by stakeholder (means)¹

Shark Benefits Scale²	1.22 ^a	.92 ^b	1.36 ^a	21.981***	0.158
Shark Benefits Scale Items					
Sharks symbolize the beauty and wonder of Cape Cod	.46 ^a	-.13 ^b	.74 ^c	32.542***	0.190
Sharks are important to the ecosystem	1.91 ^a	1.65 ^b	2.23 ^c	30.323***	0.184
Sharks help the economy because they draw tourists	.23 ^a	.21 ^a	-.02 ^b	4.572*	0.072
The presence of sharks is a sign of a healthy environment	1.32 ^a	.94 ^b	1.57 ^c	26.207***	0.171
Sharks help balance and maintain marine food webs	1.56 ^a	1.33 ^b	1.85 ^c	20.777***	0.153
Sharks help control seal populations	1.75 ^a	1.44 ^b	1.57 ^{ab}	5.473**	0.079
Shark Harms Scale³	-.42 ^a	-.18 ^b	-.58 ^c	13.947***	0.126
Shark Harm Scale Items					
Sharks are nuisance animals	-.67 ^a	-.39 ^b	-.88 ^c	10.680***	0.110
Sharks pose a threat to people	.66 ^a	1.01 ^b	.72 ^a	6.225**	0.084
Sharks hurt the economy because they deter tourists	-.63	-.58	-.76	1.661	0.044
Sharks hurt the economy because they compete with fishermen	-1.01 ^a	-.73 ^b	-1.39 ^c	23.982***	0.164

*p< .05, **p<.01, ***p<.001

¹Means with different superscripts are different at p<.05. ²Cronbach's Alpha .873 ³Cronbach's Alpha .712**Table B8. Allocation of blame for shark bites by stakeholder (means) ¹**

	Voter	Fisher	Tourist	F	η
Blame no one	.46 ^{ab}	.32 ^a	.54 ^b	2.071	0.050
Blame People in Water	.57 ^a	.52 ^{ab}	.30 ^b	4.037*	0.069
Blame the shark	-.59 ^{ab}	-.50 ^a	-.82 ^b	4.387*	0.072
Blame the seals	.27 ^a	1.52 ^b	-.25 ^c	119.905***	0.351
Blame the government	-1.52 ^a	-.37 ^b	-1.68 ^a	74.089***	0.284

*p< .05, ***p<.001

¹ Means with different superscripts are different at p<.05.

Table B9. Attitudes toward management priorities by stakeholder (means)¹

	Voters	Commercial Fishers	Tourists	F	η
Best interests of ...					
The seals	1.09 ^a	-.26 ^b	1.75 ^c	176.257***	0.415
The sharks	1.12 ^a	.51 ^b	1.68 ^c	68.680***	0.274
Tourism	.22 ^a	-.08 ^b	.48 ^c	16.037***	0.136
The ecosystem	2.16 ^a	1.63 ^b	2.52 ^c	79.468***	0.294
Fisheries	1.25 ^a	1.84 ^b	.98 ^c	45.274***	0.225
Local Communities	1.15	1.14	1.33	3.334*	0.063

*p<.05, *** p < .001

¹ Means with different superscripts are different at p<.001.

Table B10. Attitudes toward lethal management of seals by stakeholder (means)¹

	Voters	Commercial Fishers	Tourists	F	η
Attitudes toward Seal Lethal Management Scale²	-1.95 ^a	-.11 ^b	-2.42 ^c	376.566***	0.559
Attitudes toward Lethal Management Scale Items					
Kill seals that interfere with fishing	-1.65 ^a	.19 ^b	-2.20 ^c	273.372***	0.495
Kill seals that lay on beaches or rocks	-2.32 ^a	-.64 ^b	-2.67 ^c	274.878***	0.496
Kill seals if they swim in harbors	-2.25 ^a	-.73 ^b	-2.64 ^c	226.092***	0.461
Kill seals to reduce population levels	-1.53 ^a	.77 ^b	-2.18 ^c	347.614***	0.540

***p<.001

¹ Means with different superscripts are different at p<.001. ² Cronbach's Alpha .913

Table B11. Attitudes toward non-lethal management of seals by stakeholder (means)¹

	Voters	Commercial Fishers	Tourists	F	η
Attitudes toward Seal Non-Lethal Management Scale²	.25 ^a	.32 ^a	-.03 ^b	6.161**	0.086
Attitudes toward Non-Lethal Management Scale Items					
Use non-lethal methods to prevent conflict with fishing	.85 ^a	.45 ^b	.84 ^a	6.920**	0.090
Use non-lethal methods to deter seals from laying on beaches or rocks	-.20 ^a	.01 ^a	-.57 ^b	10.461***	0.111
Use non-lethal methods to deter seals from swimming in harbors	-.01 ^{ab}	.12 ^a	-.18 ^b	2.733	0.057
Use non-lethal methods to reduce seal population levels	.33 ^a	.70 ^b	-.19 ^c	23.046***	0.163

p<.01, * p <.001

¹ Means with different superscripts are different at p<.05. ² Cronbach's Alpha .858

Table B12. Attitudes toward Marine Mammal Protection Act by stakeholder (means)¹

	Voters	Commercial Fishers	Tourists	F	η
Attitudes toward MMPA Scale²	2.32 ^a	1.53 ^b	2.66 ^c	186.799***	0.426
Attitudes toward MMPA Scale Items					
Preventing marine mammals from going extinct	2.53 ^a	2.01 ^b	2.80 ^c	77.312***	0.289
Maintaining or restoring marine mammal populations	2.23 ^a	1.42 ^b	2.63 ^c	135.980***	0.372
Minimizing conflict between marine mammals and commercial fishing	2.23 ^a	1.57 ^b	2.50 ^c	75.871***	0.287
Minimizing harm and suffering of marine mammals	2.28 ^a	1.36 ^b	2.68 ^c	155.682***	0.394
Protecting areas of the ocean important for marine mammal feeding and breeding	2.33 ^a	1.26 ^b	2.69 ^c	181.370***	0.420

*** p < .001

¹ Means with different superscripts are different at p<.05. ² Cronbach's Alpha .887

Table B13. Attitudes toward lethal management of sharks by stakeholder (means)¹

	Voters	Commercial Fishers	Tourists	F	η
Attitudes toward Shark Lethal Management Scale²	-1.76 ^a	-1.47 ^b	-1.98 ^c	17.113***	0.142
Attitudes toward Shark Lethal Management Scale Items					
Kill sharks that interfere with fishing	-1.90 ^a	-1.45 ^b	-2.09 ^a	22.700***	0.162
Kill sharks that swim near the beach	-1.81 ^a	-1.61 ^a	-2.11 ^b	12.554***	0.121
Kill sharks after a bite occurs	-1.32 ^a	-1.18 ^a	-1.59 ^b	6.619**	0.088
Kill sharks to reduce population levels	-1.94 ^a	-1.61 ^b	-2.14 ^c	15.415***	0.134

p<.01, * p < .001

¹ Means with different superscripts are different at p < .001. ² Cronbach's Alpha .884

Table B14. Attitudes toward non-lethal management of sharks by stakeholder (means)¹

	Voters	Commercial Fishers	Tourists	F	η
Attitudes toward Non-Lethal Management Scale²	.86 ^a	.56 ^b	.90 ^a	6.079**	0.085
Attitudes toward non-Lethal Management Scale Items					
Use non-lethal methods to prevent conflicts with fishing	.81 ^a	.44 ^b	.87 ^a	6.805**	0.089
Use non-lethal methods to prevent sharks from swimming near beaches	1.16	1.00	1.20	1.421	0.041
Use non-lethal methods to prevent shark bites	1.40 ^{ab}	1.20 ^a	1.55 ^b	4.711**	0.074
Use non-lethal methods to reduce shark population levels	.12 ^a	-.42 ^b	.00 ^a	7.636***	0.095

p<.01, *p < .001

¹ Means with different superscripts are significantly different at p<.05. ² Cronbach's Alpha .861

Table B15. Attitudes toward shark conflict prevention policies by stakeholder (means)¹

	Voters	Commercial Fishers	Tourists	F	η
Attitudes toward Shark Prevention Scale²	2.07 ^a	1.18 ^b	2.32 ^c	139.952***	0.377
Attitudes toward Shark Prevention Scale Items					
Increase public education on sharks	2.19 ^a	1.35 ^b	2.49 ^c	104.822***	0.332
Improve signage at beaches to reduce shark encounters	2.04 ^a	1.11 ^b	2.32 ^c	103.483***	0.330
Increase beach patrols/shark spotters/aerial patrols	1.98 ^a	1.08 ^b	2.14 ^a	82.541***	0.298

***p < .001

¹ Means with different superscripts are significantly different at p<.05. ² Cronbach's Alpha .806**Table B16. Attitudes toward shark encounter prevention policies by stakeholder (means)¹**

	Voters	Commercial Fishers	Tourists	F	η
Attitudes toward Shark Prevention Scale²	2.07 ^a	1.18 ^b	2.32 ^c	139.952***	0.377
Attitudes toward Shark Prevention Scale Items					
Increase public education on sharks	2.19 ^a	1.35 ^b	2.49 ^c	104.822***	0.332
Improve signage at beaches to reduce shark encounters	2.04 ^a	1.11 ^b	2.32 ^c	103.483***	0.330
Increase beach patrols/shark spotters/aerial patrols	1.98 ^a	1.08 ^b	2.14 ^a	82.541***	0.298

***p < .001

¹ Means with different superscripts are significantly different at p<.05. ² Cronbach's Alpha .806

Appendix C

Views of gender, recreational angler, and surfer subgroups on value orientation and attitudinal scales

For this summary report, we segmented the data by gender (Tables C1, C2, C3), recreational angler (Tables C7, C8, C9), and surfer (Tables C10, C11, and C12) identification within each subgroup to evaluate views as measured by the Marine Value Orientation Use Scale, Marine Value Orientation Protection Scale, Seal Attitude Scale, Shark Attitude Scale, Seal Lethal Management Scale, Marine Mammal Protection Act Scale, and Shark Lethal Management Scale. Differences between males and females and between the means for recreational anglers and non-anglers in each stakeholder group were analyzed using Independent-Sample T-tests. Because of the small numbers of respondents identifying as Gender X in each stakeholder group, Gender X had to be excluded from statistical analyses. To allow some descriptive comparisons, the means of all three gender subgroups are included in Tables C4, C5, and C6. Reflecting the small number of surfers in the overall population, respondents for each stakeholder group included fewer surfers than would be needed for statistical analysis. As a result, difference tests within each stakeholder group were not conducted for surfer identity. To allow some descriptive comparisons, the means of surfer and non-surfer subgroups are included in Tables C10, C11, and C12. Additional research is needed to assess the views of representative samples of surfers.

Table C1. Differences in value orientation, seal attitude, shark attitude, seal lethal management, Marine Mammal Protection Act, and shark lethal management scale variables by gender within voter stakeholder group (Means)

	Female	Male	t
Marine Value Orientation Use Scale	-1.9387	-1.5766	-3.477***
Marine Value Orientation Protection Scale	2.2830	1.9537	3.605***
Seal Attitude Scale	1.9954	1.4345	4.183***
Shark Attitude Scale	.1064	.2560	-1.068
Attitudes toward Seal Lethal Management Scale	-2.1412	-1.7150	-3.445***
Attitudes toward MMPA Scale	2.5035	2.1117	4.267***
Attitudes toward Shark Lethal Management Scale	-1.8300	-1.6453	-1.393

p<.01, *p<.001

Table C2. Differences in value orientation, seal attitude, shark attitude, seal lethal management, Marine Mammal Protection Act, and shark lethal management scale variables by gender within commercial fisher stakeholder group (Means)

	Female	Male	t
Marine Value Orientation Use Scale	-1.7381	-1.0177	-2.842**
Marine Value Orientation Protection Scale	1.9048	1.1560	3.720***
Seal Attitude Scale	.9464	-.3888	4.786***
Shark Attitude Scale	.4552	.1042	1.255
Attitudes toward Seal Lethal Management Scale	-1.5268	-.0266	-4.27***
Attitudes toward MMPA Scale	2.3714	1.4822	5.192***
Attitudes toward Shark Lethal Management Scale	-1.7054	-1.4709	-.739

p<.01, *p<.001

Table C3. Differences in value orientation, seal attitude, shark attitude, seal lethal management, Marine Mammal Protection Act, and shark lethal management scale variables by gender within tourist stakeholder group (Means)

	Female	Male	t
Marine Value Orientation Use Scale	-2.4081	-1.9331	-5.745***
Marine Value Orientation Protection Scale	2.4727	2.3293	2.046*
Seal Attitude Scale	2.6525	2.2941	3.290***
Shark Attitude Scale	.0789	.1975	-1.031
Attitudes toward Seal Lethal Management Scale	-2.5436	2.2255	-3.799***
Attitudes toward MMPA Scale	2.7579	2.5024	4.545***
Attitudes toward Shark Lethal Management Scale	-2.1462	-1.7115	-3.920***

*p< .05, **p<.01, ***p<.001

Table C4. Means for value orientation, seal attitude, shark attitude, seal lethal management, Marine Mammal Protection Act, and shark lethal management scale variables by gender within voter stakeholder group, including Gender X

	Female	Male	Gender X
Marine Value Orientation Use Scale	-1.9387	-1.5766	-3.00
Marine Value Orientation Protection Scale	2.2830	1.9537	2.5855
Seal Attitude Scale	1.9954	1.4345	1.2947
Shark Attitude Scale	.1064	.2560	.3533
Attitudes toward Seal Lethal Management Scale	-2.1412	-1.7150	-1.9718
Attitudes toward MMPA Scale	2.5035	2.1117	2.2497
Attitudes toward Shark Lethal Management Scale	-1.8300	-1.6453	-2.3692

Table C5. Means for value orientation, seal attitude, shark attitude, seal lethal management, Marine Mammal Protection Act, and shark lethal management scale variables by gender within commercial fisher stakeholder group, including Gender X

	Female	Male	Gender X
Marine Value Orientation Use Scale	-1.7381	-1.0177	-.2857
Marine Value Orientation Protection Scale	1.9048		-.8095
Seal Attitude Scale	.9464	-.3888	-1.2500
Shark Attitude Scale	.4552	.1042	.0000
Attitudes toward Seal Lethal Management Scale	-1.5268	-.0266	1.9583
Attitudes toward MMPA Scale	2.3714	1.4822	.1333
Attitudes toward Shark Lethal Management Scale	-1.7054	-1.4709	-.4167

Table C6. Means for value orientation, seal attitude, shark attitude, seal lethal management, Marine Mammal Protection Act, and shark lethal management scale variables by gender within tourist stakeholder group, including Gender X

	Female	Male	Gender X
Marine Value Orientation Use Scale	-2.4081	-1.9331	-2.5333
Marine Value Orientation Protection Scale	2.4727	2.3293	2.6333
Seal Attitude Scale	2.6525	2.2941	2.7000
Shark Attitude Scale	.0789	.1975	1.2000
Attitudes toward Seal Lethal Management Scale	-2.5436	2.2255	-2.7000
Attitudes toward MMPA Scale	2.7579	2.5024	-2.7000
Attitudes toward Shark Lethal Management Scale	-2.1462	-1.7115	2.7800

Table C7. Differences in value orientation, seal attitude, shark attitude, seal lethal management, Marine Mammal Protection Act, and shark lethal management scale variables by recreational angler identity within voter stakeholder group (Means)

	No	Yes	t
Marine Value Orientation Use Scale	-1.8535	-1.5094	-2.737**
Marine Value Orientation Protection Scale	2.2187	1.8559	3.341***
Seal Attitude Scale	1.8647	1.3201	3.395***
Shark Attitude Scale	.1299	.3316	-1.216
Attitudes toward Seal Lethal Management Scale	-2.0879	-1.4611	-4.306***
Attitudes toward MMPA Scale	2.3718	2.1524	2.021*
Attitudes toward Shark Lethal Management Scale	-1.7730	-1.6952	-.489

*p< .05, **p<.01, ***p<.001

Table C8. Differences in value orientation, seal attitude, shark attitude, seal lethal management, Marine Mammal Protection Act, and shark lethal management scale variables by recreational angler identity within commercial fisher stakeholder group (Means)

	No	Yes	t
Marine Value Orientation Use Scale	-.9550	-1.1622	1.770
Marine Value Orientation Protection Scale	1.1174	1.2485	-1.084
Seal Attitude Scale	-.4105	-.2642	-1.105
Shark Attitude Scale	.0848	.1534	-.507
Attitudes toward Seal Lethal Management Scale	.0549	-.2888	1.904
Attitudes toward MMPA Scale	1.4219	1.6502	-1.948
Attitudes toward Shark Lethal Management Scale	-1.3323	-1.62161	1.927

Table C9. Differences in value orientation, seal attitude, shark attitude, seal lethal management, Marine Mammal Protection Act, and shark lethal management scale variables by recreational angler identity within tourist stakeholder group (Means)

	No	Yes	t
Marine Value Orientation Use Scale	-2.2856	-1.8492	-3.876***
Marine Value Orientation Protection Scale	2.4309	2.2937	1.342
Seal Attitude Scale	2.5920	1.9207	4.462***
Shark Attitude Scale	.1031	.3383	-1.403
Attitudes toward Seal Lethal Management Scale	-2.483	-2.3029	-5.399***
Attitudes toward MMPA Scale	2.6948	2.4024	3.945***
Attitudes toward Shark Lethal Management Scale	-2.0128	-1.7771	-1.533

***p<.001

Table C10. Means for value orientation, seal attitude, shark attitude, seal lethal management, Marine Mammal Protection Act, and shark lethal management scale variables by surfer identity within voter stakeholder group

	Non-Surfer	Surfer
Marine Value Orientation Use Scale	-1.7974	-1.2871
Marine Value Orientation Protection Scale	2.1424	2.0903
Seal Attitude Scale	1.7416	1.7737
Shark Attitude Scale	.1740	.3776
Attitudes toward Seal Lethal Management Scale	-1.9657	-1.5583
Attitudes toward MMPA Scale	2.3217	2.3771
Attitudes toward Shark Lethal Management Scale	-1.7626	-1.5909

Table C11. Means for value orientation, seal attitude, shark attitude, seal lethal management, Marine Mammal Protection Act, and shark lethal management scale variables by surfer identity within commercial fisher stakeholder group

	Non-Surfer	Surfer
Marine Value Orientation Use Scale	-1.0014	-1.440
Marine Value Orientation Protection Scale	1.1871	1.0340
Seal Attitude Scale	-.3283	-.5200
Shark Attitude Scale	.1435	-.1400
Attitudes toward Seal Lethal Management Scale	-.1199	.0190
Attitudes toward MMPA Scale	1.5047	1.7347
Attitudes toward Shark Lethal Management Scale	-1.4689	-1.411

Table C12. Means for value orientation, seal attitude, shark attitude, seal lethal management, Marine Mammal Protection Act, and shark lethal management scale variables by surfer identity within commercial fisher stakeholder group

	Non-Surfer	Surfer
Marine Value Orientation Use Scale	-1.4689	-1.411
Marine Value Orientation Protection Scale	2.4384	1.7949
Seal Attitude Scale	2.5315	1.9712
Shark Attitude Scale	.1415	-.2385
Attitudes toward Seal Lethal Management Scale	-2.4464	-1.8558
Attitudes toward MMPA Scale	2.6690	2.3923
Attitudes toward Shark Lethal Management Scale	-2.0163	-1.1731