

# Museum Guest Perceptions of Florida's Coral Reef and Its Conservation



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# Key Messages

Florida's Coral Reef (FCR), a vital ecosystem for South Florida's biodiversity, economy, and culture is experiencing multiple conservation threats, including climate change, disease, overfishing, and pollution. Conservation efforts depend on human action, so it is important to understand what the public knows about the status of the reef.

Adult museum guests appear to have a superficial understanding of FCR, but in many cases lack deeper knowledge. They demonstrate an understanding that their actions and life connect with the reef, but some lacked confidence in their ability to assist in the protection of the reef. This highlights the need for more adult outreach and education in South Florida about FCR and actions that individuals can take to protect it.

Museum guests believe that protecting the reef is a collaborative effort between many different stakeholders such as recreational and commercial users, government entities, community groups, scientists, and institutions. They also lack confidence that the reef is being protected by these entities.

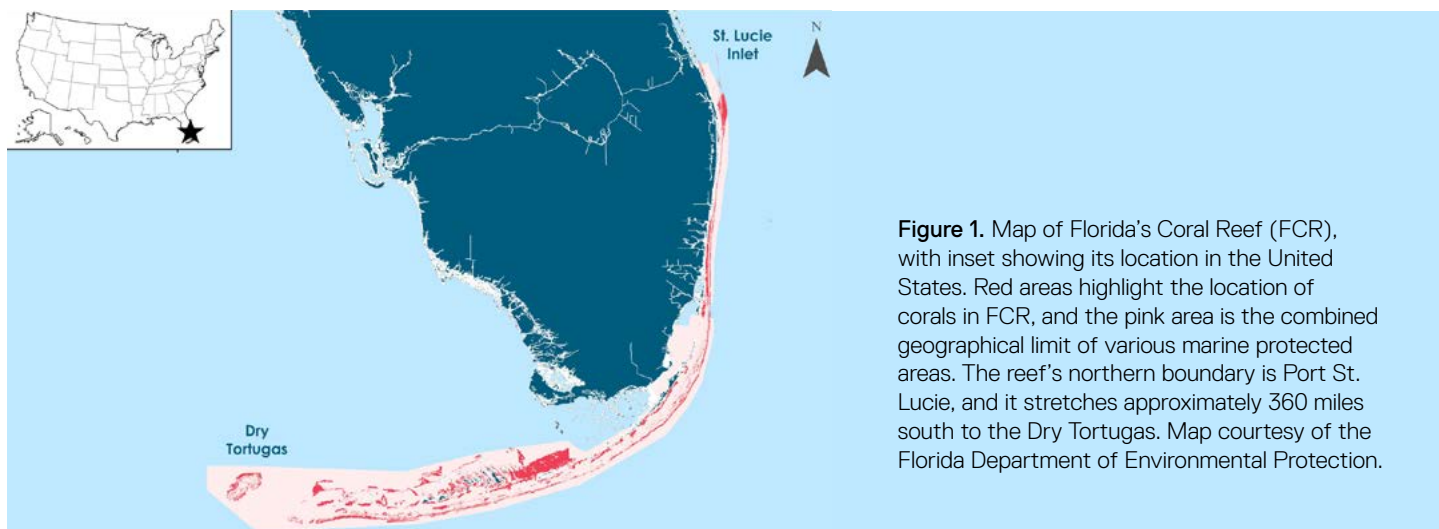
Guest outlooks for the future of FCR appear dependent on residency status, with residents feeling more negative about the future of the reef and tourists feeling more positive.



# Background Information

Florida's Coral Reef (hereafter FCR), stretching about 360 miles from St. Lucie Inlet to the Dry Tortugas off the east coast of Florida (Figure 1), provides a myriad of ecological, economic and cultural benefits and services. It is essential habitat for thousands of species of fish and other marine life,<sup>1-3</sup> many of which are commercially and recreationally important. It is also a valuable recreational and tourism resource that contributes over \$529 million per year to Florida's GDP through diving, snorkeling, and recreational fishing<sup>4-6</sup>. For Florida residents, the reef provides over \$650 million in coastline protection benefits by acting as a barrier to wave energy, especially during strong storms.<sup>2-4,7</sup>

FCR is also in danger. Coastline development, ocean acidification, temperature stress, overfishing, and disease all negatively impact the health of a reef.<sup>8</sup> It is estimated that over the last 40 years FCR has lost over 90% of its stony coral coverage.<sup>9</sup> More recently, record hot water temperatures have significantly affected reef health and coral cover, causing mass bleaching and mortality, particularly in the southern portion of FCR.<sup>10,11</sup> Concerted marine conservation efforts have become critical to protect this valuable Florida resource. Because marine conservation is driven by human efforts,<sup>12</sup> understanding the public's perception of and attitudes toward the reef is crucial.



**Figure 1.** Map of Florida's Coral Reef (FCR), with inset showing its location in the United States. Red areas highlight the location of corals in FCR, and the pink area is the combined geographical limit of various marine protected areas. The reef's northern boundary is Port St. Lucie, and it stretches approximately 360 miles south to the Dry Tortugas. Map courtesy of the Florida Department of Environmental Protection.

Science museums and similar institutions are uniquely poised to explore how people relate to their environments. As trusted sources of science information and informal education, museums, zoos, and aquariums play a critical role in environmental conservation<sup>13</sup>. The Phillip and Patricia Frost Museum of Science (hereafter Frost Science) is a combination science museum, aquarium, and planetarium in Miami, Florida USA. Frost Science sees more than 700,000 guests annually. It features a three-story "Living Core" that is home to marine species including sharks, a loggerhead turtle, Goliath grouper, and many corals. Guests can also learn about coral care and conservation in our Marine Conservation WetLab, an active research space open to the public. The museum has an active conservation department, which focuses on protecting local marine and coastal habitats, as well as wide-ranging education and outreach programs.

Frost Science's latest coral conservation initiative is the National Oceanic and Atmospheric Administration-funded National Coral Reef Conservancy at Frost Science, referred to more succinctly as ReeFLorida. ReeFLorida is Frost Science's response to the myriad of threats facing FCR. It continues the work of our dedicated staff and partners, who are actively involved in cutting-edge coral reef restoration efforts as part of the Southeast Florida Coral Reef Restoration Hub. Our conservation work involves establishing a new coral nursery, removing non-native marine species from the wild, and caring for and studying rare corals in our Marine Conservation WetLab. To support this work and raise knowledge and awareness among our guests, we are also undertaking a renovation of one level of the Living Core to highlight FCR. Before this exhibit renovation, we surveyed about 360 museum guests to gather information about their knowledge and perceptions of the reef.

# Survey and Data Analysis Methods

Survey data were collected by Frost Science volunteers from a randomly selected sample of 364 museum guests. Respondents were offered a coupon to our onsite Science Store or a reusable silverware kit in exchange for their time. The survey consisted of 17 questions and was reviewed by a museum education expert outside of our institution prior to its administration. It was deemed exempt by the Florida International University Institutional Review Board (IRB-23-0406). Most questions asked respondents to rate their agreement with a statement on a five-point Likert scale; one asked them to estimate the length of FCR and another asked them to provide a one-word answer. Data were checked for duplicates and cleaned to omit non-numeric responses to the question about the reef's length (e.g., "I don't know") and unusable responses to the question asking for one word describing a respondent's outlook for the reef.

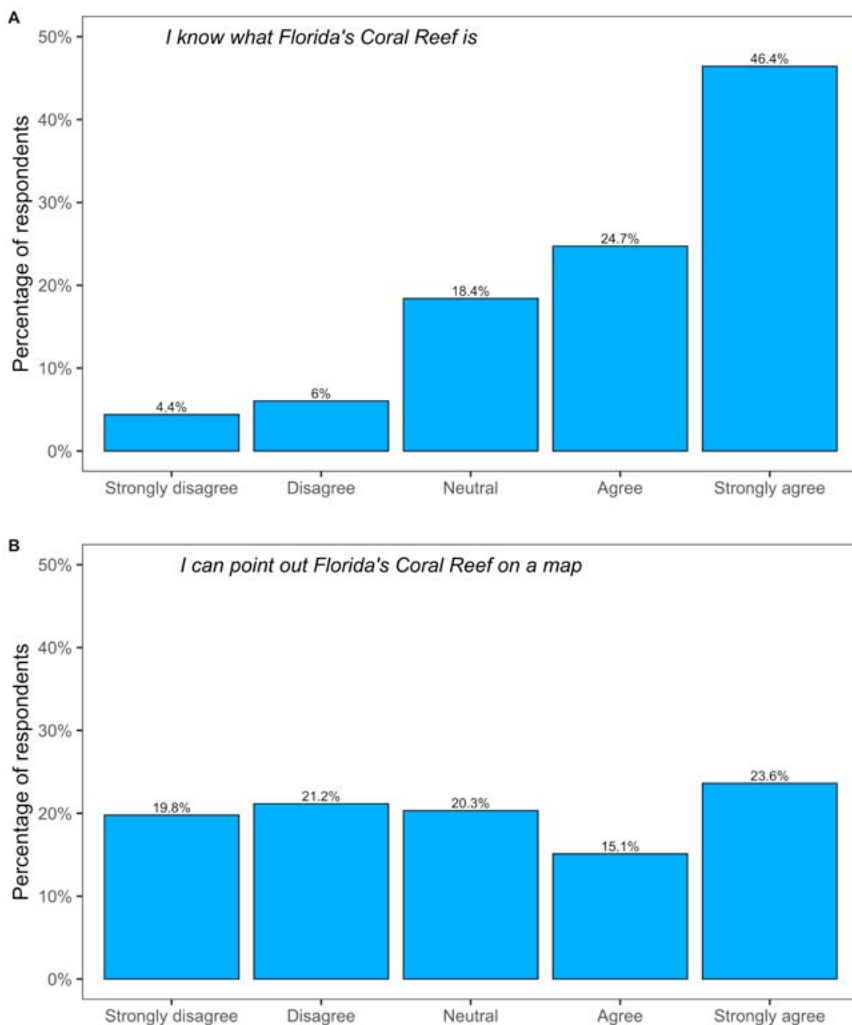
Here we present our findings and analysis in four sections (Table 1). These cover guests' knowledge about FCR, how they conceptualize their relationships to FCR, their perceptions of the reef's status and conservation, and their opinions about who is responsible for protecting it.



# Survey Results and Discussion

## KNOWLEDGE OF FCR

Nearly three-quarters of guests surveyed responded that they know what FCR is, with 24.7% agreeing and 46.4% strongly agreeing (Figure 2A). They were less confident that they could point it out on a map—while strongly agree was the most frequent response to this question (23.6%), it was closely followed by disagree, neutral, and strongly disagree (Figure 2B). We also found that museum guests consistently and substantially underestimated the spatial extent of FCR, which spans approximately 360 linear miles. Approximately 80% of guest estimates were less than 360 miles, with the median being 80 miles. A smaller portion vastly overestimated the reef's length, with the top 2.5% of guesses above 10,000 miles (Figure 3).

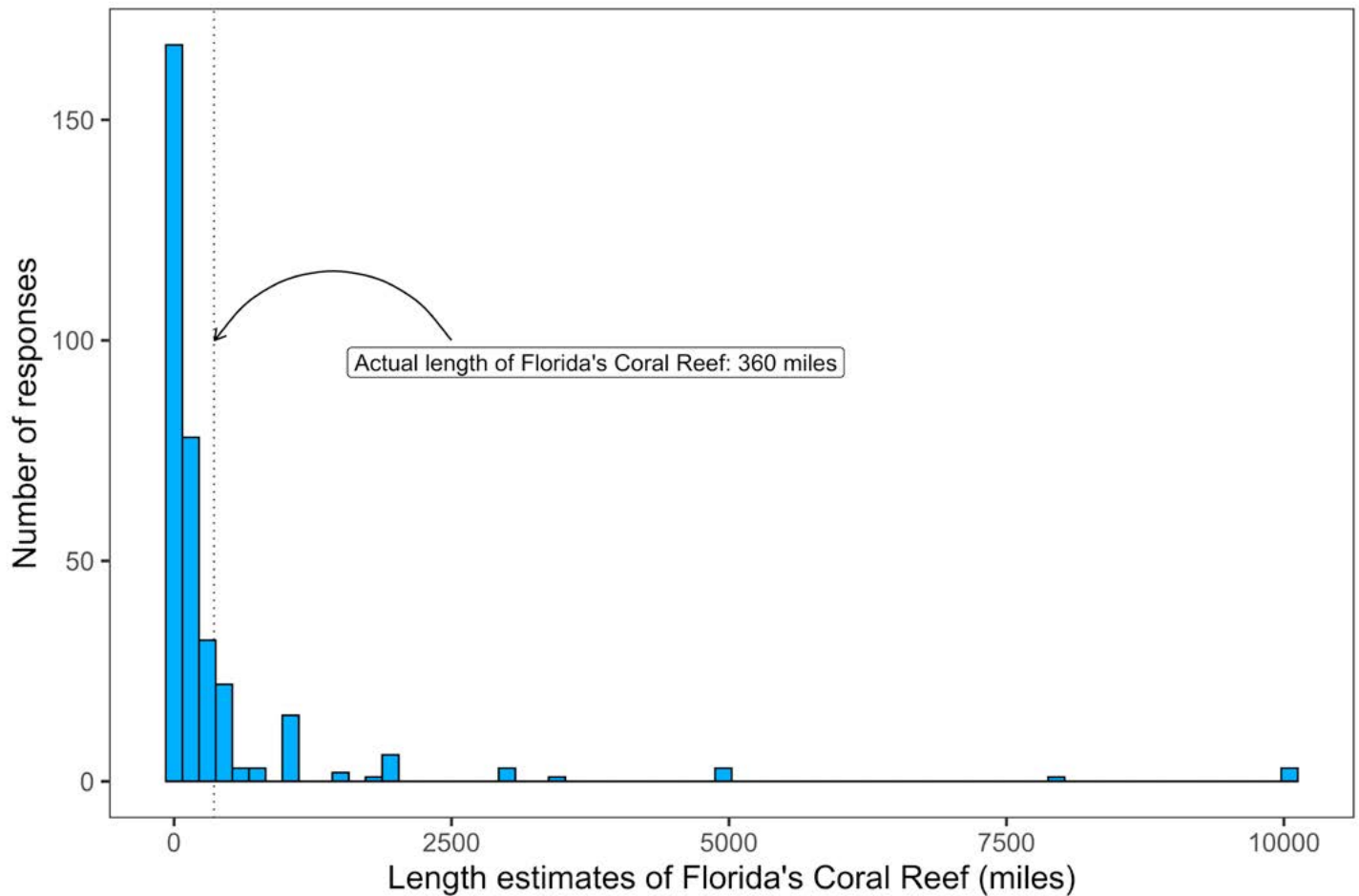


**Figure 2.** Survey respondents' levels of agreement with the statements (A) "I know what Florida's Coral Reef is" and (B) "I can point out Florida's Coral Reef on a map". In general, about three-quarters of respondents agreed that they know what FCR is, but the sample had mixed levels of agreement about whether they could point it out on a map.

# Survey Results and Discussion

## KNOWLEDGE OF FCR

Together, these results suggest that there is a need for education and awareness-raising efforts about FCR—particularly those targeting adults. Many environmental education efforts are geared toward children with the goal of inspiring a lifelong desire to care for the environment. This is important and valuable work. However, our oceans face imminent and urgent conservation threats that need action today. This is especially true for FCR, which is in danger from disease, warming temperatures, invasive species, and pollution, among other conservation challenges. Efforts to educate today's decision-makers and voters about the reef can make a difference now and preserve the reef for future generations.

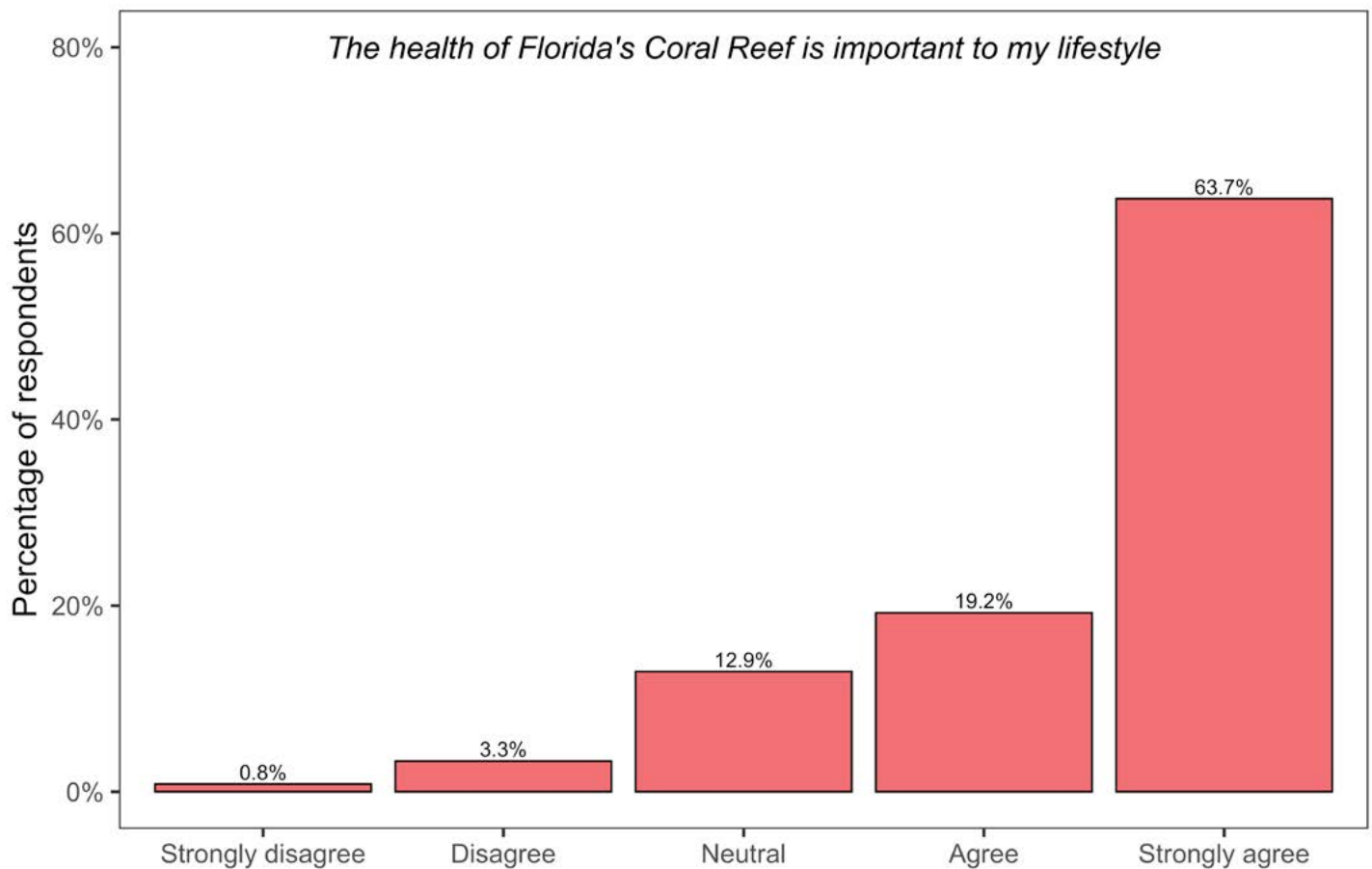


**Figure 3.** A histogram showing the middle 95% of survey respondents' estimates of the length of FCR, spanning between 4 miles and 10,000 miles. The dashed horizontal line marks the actual length of the reef, 360 miles. Approximately 80% of respondents estimated FCR to be shorter than this value.

# Survey Results and Discussion

## RELATIONSHIPS WITH FCR

Most survey respondents agreed (19.2%) or strongly agreed (63.7%) that the health of FCR is important to their lifestyle (Figure 4). While we didn't ask them for specifics on why they agreed with this statement, outdoor recreation like snorkeling and diving, kayaking and paddleboarding, swimming, boating, and fishing are very popular activities here in South Florida. Healthy marine ecosystems with vibrant fish and coral communities encourage people to participate in those activities, propelling the tourism and recreation economy that supports the livelihoods of many South Floridians. For example, about 34% of guests we surveyed were tourists to Florida, who previous research has shown visit the state in part to see healthy coral reefs.<sup>4</sup>

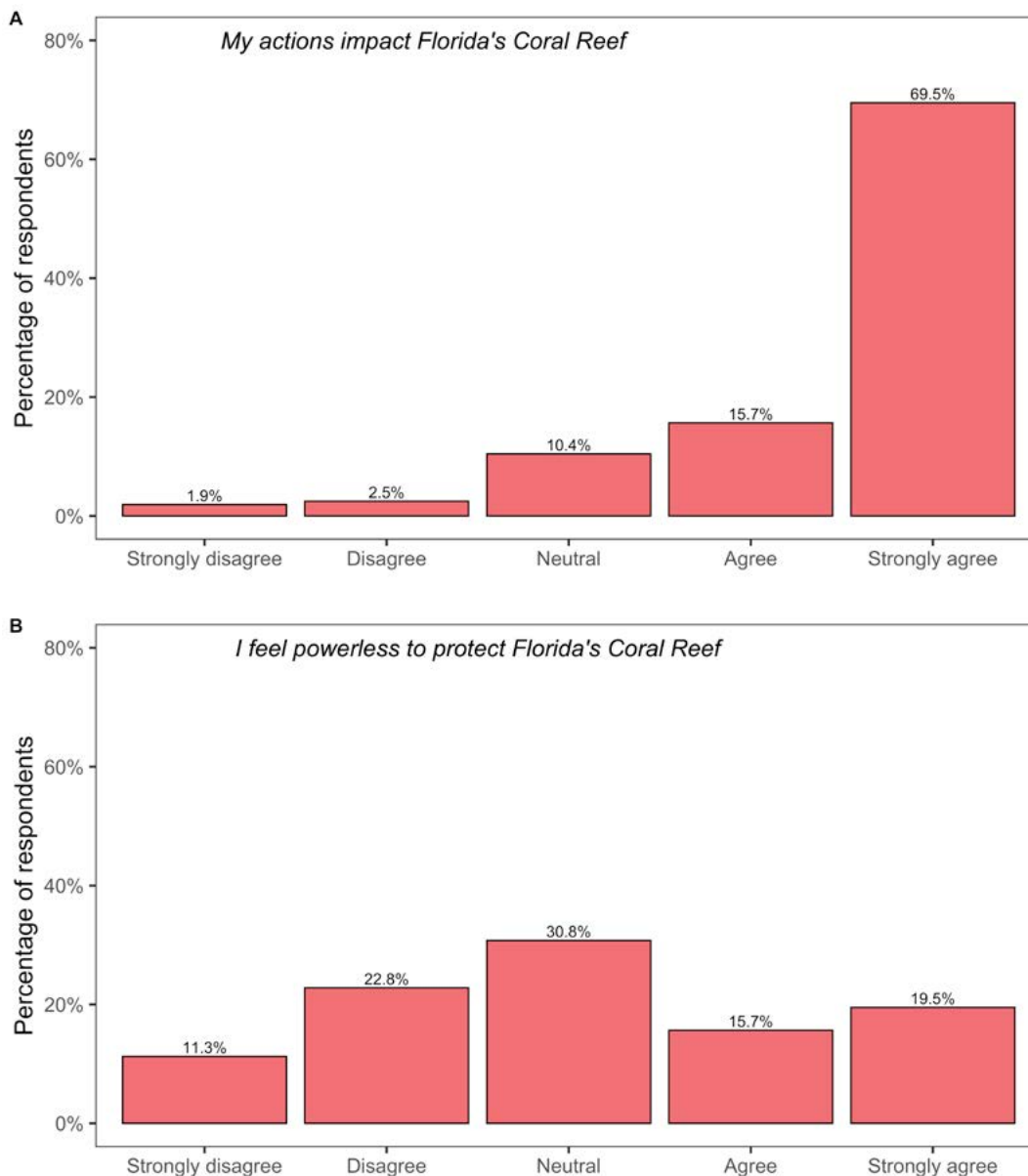


**Figure 4.** Survey respondents' levels of agreement with the statement, "The health of Florida's Coral Reef is important to my lifestyle". The majority strongly agreed with this statement, with less than 20% of total respondents feeling neutrally or disagreeing.

# Survey Results and Discussion

## RELATIONSHIPS WITH FCR

Further, our survey showed that respondents are aware that their actions impact FCR (Figure 5A). Nearly 70% of those surveyed strongly agreed with this statement, and another 15.7% agreed. A valuable follow up question that we did not ask, but can pursue in the future, is whether they perceive their actions as having negative impact by damaging or endangering the reef, or as having positive impact, by promoting its conservation. The very mixed response to our question about whether respondents feel powerless to protect FCR (Figure 5B) suggests it is probably a combination of the two; roughly equal proportions of guests agreed or strongly agreed (35.2%), were neutral (30.8%), and disagreed or strongly disagreed (34.1%) with this statement.



**Figure 5.** Survey respondents' levels of agreement with the statements, (A) "My actions impact Florida's Coral Reef" and (B) "I feel powerless to protect Florida's Coral Reef." In general, respondents agreed that their impacts affect the reef, but they feel much more mixed about their ability to protect it.



# Survey Results and Discussion

## RELATIONSHIPS WITH FCR

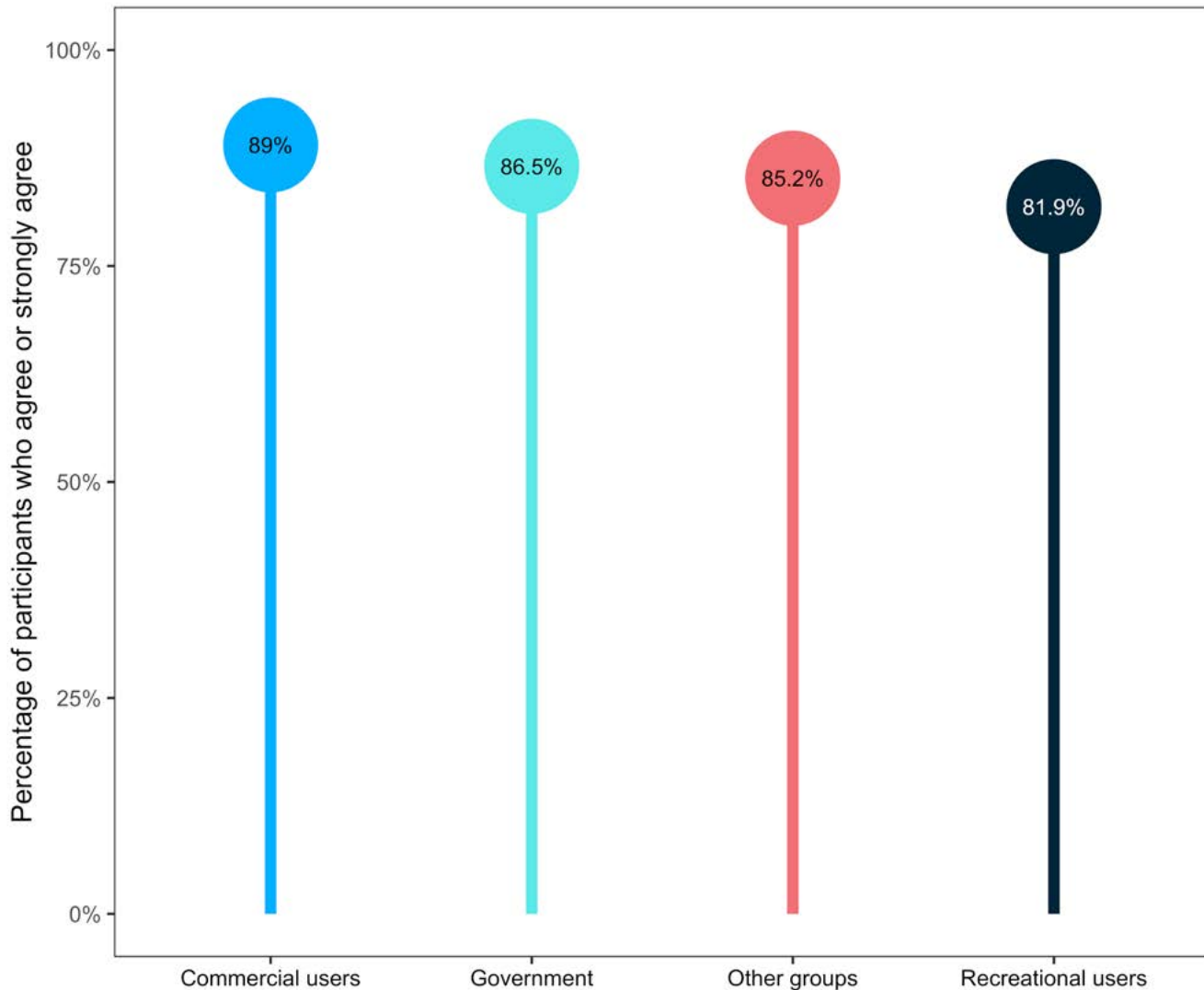
While it is encouraging that more than one-third of respondents felt they have at least some power to protect the reef, there is a clear need for increased efforts to genuinely empower the public on this issue. Often, solutions for large-scale conservation issues like coral reef protection presented to the public are focused on easy individual behavioral changes (e.g., recycling, conserving water) that have small positive impacts yet cannot bring about the systemic change needed to achieve the goal. However, there are higher-impact things people can do. For coral reef conservation, these actions include contacting their local, state, and federal government representatives to support conservation policies; seeking out reliable information about environmental issues to share with their networks; and behaving responsibly when snorkeling or scuba diving. People who live in South Florida or other areas near coral reefs can also attend public government meetings for infrastructure and environmental projects that may affect FCR and volunteer with coral reef restoration and coastal clean-up organizations.



# Survey Results and Discussion

## RESPONSIBILITY FOR CONSERVING FCR

Respondents were asked to respond to a series of statements about which types of stakeholders are responsible for conserving FCR: state and/or federal government; recreational users of marine resources; commercial users of marine resources; and community groups, scientists and institutions. Most guests agreed or strongly agreed that all these stakeholders are responsible for the reef, with commercial users attracting the most agreement (89%) and recreational users the least (81.9%; Figure 6). According to the Florida Department of Environmental Protection, in 2019 the commercial fishing industry brought in an estimated revenue of \$166 million for the economies of the five counties that border FCR (Monroe, Miami-Dade, Broward, Palm Beach, and Martin). At the same time, there remains a need for improved fishing policies and regulations. Research by a large group of South Florida-based fisheries scientists has found that 85% of prized grouper and snapper species, which play important roles in coral reef food webs, have been overfished.<sup>14</sup>



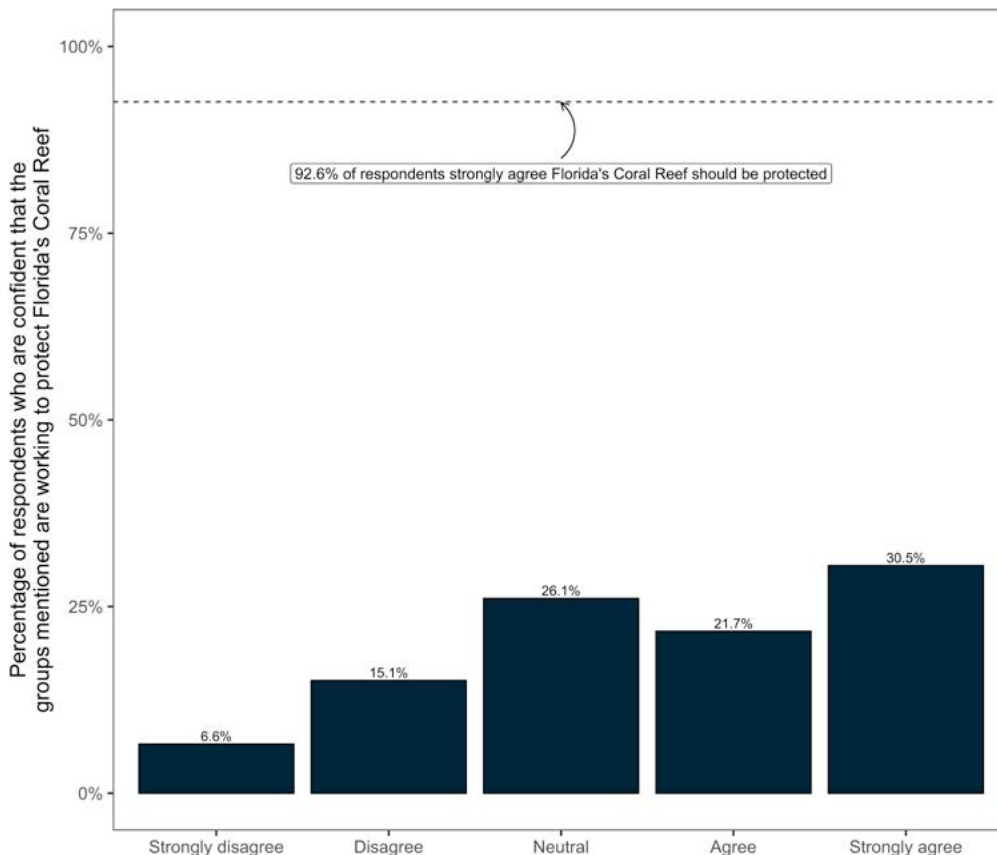
**Figure 6.** Survey respondents' opinions of which stakeholder groups they hold responsible for conserving FCR. This information indicates that respondents believe many stakeholders are responsible for protecting the reef.

# Survey Results and Discussion

## RESPONSIBILITY FOR CONSERVING FCR

About 85% of guests hold community groups, scientists, non-profit organizations, museums, and similar institutions responsible for protecting FCR. While this may be due largely to the visibility of such institutions as opposed to their true legal power, this statistic points to the immense opportunity these groups have to drive the conversation around coral conservation. In particular, science museums are trusted institutions in the communities they serve and can play an important role as convening partners for coalitions of all stakeholders. Frost Science's annual ReefFlorida Symposium is an example of how this can work. The Symposium brings together representatives of conservation non-profits, scientists, educators, protected area managers, and elected officials for a three-day meeting about the health of the reef in a neutral setting. It has spurred productive conversations and new partnerships, and strengthened our own ties to local and state conservation agencies.

No matter who guests hold most responsible, nearly all of them (92.6%) strongly agreed that FCR should be protected. However, they had much more mixed opinions about whether the groups identified in Figure 6 were doing so. In total, about half agreed (21.7%) or strongly agreed (30.5%) that this is the case, with 21.6% responding neutrally (Figure 7). This mix of findings illustrates the complicated reality of the conservation of FCR. Many stakeholders, including scientists, non-profit organizations, and large institutions are working to protect the reef in various ways and in some cases are making local progress. However, this small-scale success is overshadowed by the number, severity, and—in the case of climate change—global nature of the threats FCR faces. Whether the reef is being conserved is thus a question with two contradictory answers: many groups are working tirelessly toward this goal (including Frost Science), and yet the reef's overall health continues to decline.



**Figure 7.** Survey respondents reported confidence in whether stakeholders are working to protect FCR. While over 92% strongly agree that the reef should be protected, their levels of agreement as to whether it is happening were mixed.

# Survey Results and Discussion

## RESPONDENTS' OUTLOOKS FOR FCR

Survey respondents submitted more than 100 different words in response to the prompt asking them to provide one word describing how they feel about the outlook for FCR (Figure 8). Hope/hopeful and sad/sadden/sadness were the two most common responses, with 30 and 24 people submitting these responses, respectively. Five other words were submitted more than 10 times: worry/worried (17 times), important (16), beautiful (15), good (13), and concerned/concerning (12). These words covered a wide range of emotions, so to better understand guests' views we manually classified each word into one of three emotional categories: positive, neutral, or negative. Just 18.2% of words submitted were neutral; the majority (42.8%) were negative and the remaining 39.0% were positive.



Figure 8. A word cloud containing respondents' submissions of one word indicating their outlook for the future of FCR. The size of the word correlates to the frequency, with larger words indicating a more common response. The three colors indicate the words' sentiments.

The contrast of positive and negative words was intriguing, so we looked deeper into the demographic data that survey respondents supplied to understand who answered positively and who answered negatively. We discovered a link between residence status (i.e., guests who reported they were Florida residents for at least part of the year versus those who were tourists) and the emotional tone of their outlook for Florida's Coral Reef. Generally, tourists were more likely to respond to the prompt with positive words, whereas Florida residents more often responded with negative words. Over half (52.5%) of words submitted by tourists were positive, and 31.0% were negative. Conversely, 31.7% of words submitted by residents were positive, and 49.3% were negative.

The reason behind this difference in outlook is most likely rooted in the amount of first-hand experience tourists and Florida residents have of FCR. While tourists may view the reef as a novelty and something they see on vacation, Florida residents are likely more informed about the current state of the reef and may have even directly observed its deterioration over time. This information is useful not only for Frost Science, but all institutions that interact with the public about FCR so that we can better tailor our messages to the specific audience they are meant for.

# Conclusion

As trusted institutions, science museums are uniquely poised to engage the public on important environmental issues, such as coral reef conservation. To encourage productive dialogue, it is useful to understand the audience's point of view. While previous research had shown that people seem to be aware that the health of FCR is declining and support its protection and restoration,<sup>5,12,15</sup> our survey provides important detail on the perspectives of the general public about the reef and their outlook for its future.

Moving forward, we will apply the information we learned as we design new educational and outreach programming about Florida's Coral Reef for guests of all ages. The survey will also be repeated after the exhibition renovation, which will bring content about Florida's Coral Reef and the museum's ReefFlorida initiative into *The Dive* exhibition. This will allow us to evaluate the impact of that exhibition renovation and, more broadly, of the scientific content we present, to ensure that the museum is meeting the informational needs of our guests and achieving its conservation goals.



# References

1. Graham, N. A. J. & Nash, K. L. The importance of structural complexity in coral reef ecosystems. *Coral Reefs* 32, 315–326 (2013).
2. Moberg, F. & Folke, C. Ecological goods and services of coral reef ecosystems. *Ecol. Econ.* 29, 215–233 (1999).
3. Rivera, H., Chan, A. & Luu, V. Coral reefs are critical for our food supply, tourism, and ocean health. We can protect them from climate change. *MIT Sci. Policy Rev.* 1, 18–33 (2020).
4. Atzori, R., Fyall, A. & Miller, G. Tourist responses to climate change: Potential impacts and adaptation in Florida's coastal destinations. *Tour. Manag.* 69, 12–22 (2018).
5. Allen, M. E. et al. National Coral Reef Monitoring Program Socioeconomic Monitoring Component: Summary Findings for South Florida, 2019. (2021).
6. Wallmo, K., Edwards, P., Steinback, S., Wusinich-Mendez, D. & Allen, M. Economic Impact Analysis of Snorkeling and SCUBA Diving on Florida Reefs. (2021) doi:<https://doi.org/10.25923/g8ex-r982>.
7. Storlazzi, Curt D. et al. Rigorously Valuing the Role of U.S. Coral Reefs in Coastal Hazard Risk Reduction. (2019).
8. Towle, Erica et al. Coral Reef Condition: A Status Report for Florida's Coral Reef. <https://doi.org/10.25923/rxd1-d467> (2020).
9. McClenachan, L., Connor, G., Neal, B. P., Pandolfi, J. M. & Jackson, J. B. C. Ghost reefs: Nautical charts document large spatial scale of coral reef loss over 240 years. *Sci. Adv.* (2017) doi:10.1126/sciadv.1603155.
10. Florida Fish And Wildlife Conservation Commission. Coral Bleaching. Florida Fish And Wildlife Conservation Commission <https://myfwc.com/research/habitat/coral/news-information/bleaching/> (2024).
11. National Oceanic and Atmospheric Administration. NOAA confirms 4th global coral bleaching event. <https://www.noaa.gov/news-release/noaa-confirms-4th-global-coral-bleaching-event> (2024).
12. Hein, M. Y. et al. Coral restoration: Socio-ecological perspectives of benefits and limitations. *Biol. Conserv.* 229, 14–25 (2019).
13. Fraser, J. & Sickler, J. Why Zoos and Aquariums Matter: Handbook of Research Key Findings and Results from National Audience Surveys. 87 [https://wzam.org/wp-content/uploads/Fraser.Sickler.2008\\_Why-Zoos-and-Aquariums-Matter-Handbook.pdf](https://wzam.org/wp-content/uploads/Fraser.Sickler.2008_Why-Zoos-and-Aquariums-Matter-Handbook.pdf) (2009).
14. Ault, J. S. et al. Length-based risk analysis of management options for the southern Florida USA multispecies coral reef fish fishery. *Fish. Res.* 249, 106210 (2022).
15. Hesley, D., Burdeno, D., Drury, C., Schopmeyer, S. & Lirman, D. Citizen science benefits coral reef restoration activities. *J. Nat. Conserv.* 40, 94–99 (2017).