NOAA Technical Memorandum CRCP 43

National Coral Reef Monitoring Program Socioeconomic Monitoring Component

Summary Findings for Hawai‘i, 2020

NOAA Coral Reef Conservation Program
Silver Spring, MD

January 2022

United States Department of Commerce	National Oceanic and Atmospheric Administration	National Ocean Service
Gina Raimondo Secretary	Richard Spinrad Under Secretary	Nicole LeBoeuf Assistant Administrator

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M.E. Allen, C.S. Fleming, B.M. Zito, S.B. Gonyo, S.D. Regan, and E.K. Towle
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Executive Summary

The Socioeconomic Component of the National Coral Reef Monitoring Program (NCRMP) collects socioeconomic data across all United States (U.S.) coral reef territories and jurisdictions to inform human connections indicators. These indicators fall under the broad categories of demographics of these populations, human use of coral reef resources, and knowledge, attitudes, and perceptions of coral reefs and coral reef management. The overall goal of this endeavor is to track relevant information regarding each jurisdiction's population, social and economic structure, human interactions with coral reef resources, and the responses of local communities to coral management. These data are used to develop and update indicators that describe the state of each jurisdiction relative to other U.S. jurisdictions. The National Oceanic and Atmospheric Administration's (NOAA) Coral Reef Conservation Program (CRCP) uses this information to protect coral reefs at local, regional, and national levels, as well as to inform continuing research and communication products. CRCP staff, along with educators and managers in the jurisdictions, use this information to monitor changes in coral reef dependent communities and jurisdictions, and ensure education programs are designed to achieve their goals.

This report presents primary data collected from the second monitoring cycle in Hawai‘i (the first monitoring cycle was completed in 2015). The survey was conducted from April to June 2020, and results are representative of the population of the State of Hawai‘i as a whole, as well as the islands of Hawai‘i (further stratified by East and West), Kaua‘i, Maui, and O‘ahu. The following are key highlights from the results (where "Hawai‘i" refers to the entire state unless otherwise noted):

- **Activity Participation:** Beach recreation, swimming/wading, and snorkeling were primary activities for Hawai‘i residents in both 2015 and 2020. Since 2015, there was a decrease in resident participation in boating, waterside or beach camping, recreational diving, and gathering of marine resources. Resident participation in snorkeling remained relatively high.
- **Importance of Coral Reefs:** Residents recognized that Hawai‘i's coral reefs provide a variety of ecosystem services. There was a general consensus that coral reefs are important to Hawaiian culture, offer protection from erosion and natural disasters, attract tourists to the region, and provide economic opportunities and food for coastal communities.
- **Seafood:** The majority of resident households consumed seafood at least once a week in both 2015 and 2020, and in 2020, nearly one-fourth of all residents in Hawai‘i consumed locally caught seafood harvested from local coral reefs at least once a month.
- **Perceived Resource Conditions:** Residents believed that the quality of marine resources in general had become worse over the past ten years, and that conditions are likely to worsen in the future. In 2020, crowding of beaches was a particular concern.

- **Threats to Coral Reefs:** Residents were familiar with all included threats to coral reefs, but were most familiar with pollution and sunscreen with chemicals toxic to corals, and least familiar with ocean acidification.
- **Conservation Behaviors:** The majority of residents recycled at least once a month, and 73% used reef-safe sunscreen at some frequency. Residents on West Hawai‘i (island), Kaua‘i, and Maui were more likely to participate in conservation activities.
- **Management Strategies:**
    - **30 by 30 Initiative:** Familiarity with Hawai‘i’s 30 by 30 Initiative was low, but support for a measure to manage 30% of Hawai‘i’s nearshore waters by 2030 to build and maintain healthy reefs and fisheries was high.
    - **Marine Managed Areas:** The majority of residents were familiar with Marine Managed Areas (MMAs) in Hawai‘i, and generally agreed that MMAs help protect coral reefs and increase the number of fish. Despite resident support for initiatives to build and maintain healthy and abundant reefs and fisheries, there was less agreement on whether there should be more MMAs.
    - **Support for Management Strategies:** There is strong support (positive attitudes) for coral restoration efforts and stricter control of pollution sources to preserve water quality. There is less support for the establishment of a non-commercial fishing license. From 2015 to 2020, support for a non-commercial fishing license declined by over 17%.
- In general, results suggest that current management efforts in the region are responding to residents’ needs and desires for healthy reef resources; however, results also suggest that some management strategies for fishing activities need careful consideration. For example, while residents supported limits per person for certain fish species, there was less support for the establishment of a non-commercial fishing license.

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List of Acronyms

ACS	American Community Survey
C-CAP	Coastal Change Analysis Program
COVID-19	Disease caused by SARS-CoV-2 coronavirus
CNMI	Commonwealth of the Northern Mariana Islands
CRCP	Coral Reef Conservation Program
DLNR	Hawai‘i Department of Land and Natural Resources
GDP	Gross Domestic Product
H.B.	House Bill
MLCD	Marine Life Conservation District
MMA	Marine Managed Area
NCCOS	National Centers for Coastal Ocean Science
NCEI	National Center for Environmental Information
NCRMP	National Coral Reef Monitoring Program
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
OMB	Office of Management and Budget
RR	Response Rate
S.B.	Senate Bill
SCUBA	Self Contained Underwater Breathing Apparatus
U.S.	United States

1. Introduction

Coral reefs are among the most valuable ecosystems on Earth, providing food, protection from storms, and recreational opportunities to adjacent coastal communities (e.g., Storlazzi et al. 2019). These assets are also tied to economic benefits including tourism, fishing, the aquarium trade and other ornamental resources, and biomedical products. When coral reefs are threatened by climate change, fishing impacts, and land-based sources of pollution, nearby human communities are also threatened. In 2013, the National Oceanic and Atmospheric Administration's (NOAA) Coral Reef Conservation Program (CRCP) created the National Coral Reef Monitoring Program (NCRMP) to establish an integrated and focused long-term monitoring program for all United States (U.S.) coral reef ecosystems. Since 2014, the program has been conducting sustained observations of biological, climatic, and socioeconomic indicators in U.S. states and territories where coral reefs are present. More information about all components of the NCRMP can be explored in the "NOAA Coral Reef Conservation Program: National Coral Reef Monitoring Plan" (NOAA CRCP 2021).[1]

The novel inclusion of a socioeconomic monitoring component to the NCRMP represents a progressive, interdisciplinary approach for the CRCP, which has recognized the need to integrate socioeconomic information with biophysical indictors relevant to the conservation of coral reef resources.

1.1 Socioeconomic component of NCRMP

The Socioeconomic Component of the NCRMP collects and monitors socioeconomic information, including human use of coral reef resources, knowledge, attitudes, and perceptions of coral reefs and coral reef management, and demographics of the populations living in coral reef areas. The overall goal of the socioeconomic monitoring component is to track relevant information regarding each jurisdiction's population, social and economic structure, the benefits of coral reefs and related habitats, the perceived impacts of society on coral reefs, and the impacts of coral management on communities. NOAA's CRCP uses the information to improve programs designed to protect coral reefs at local, regional, and national levels, as well as to inform continuing research and communication products. Survey indicators were developed in consultation with local stakeholders, partners, and other scientists. Composite indicators allow researchers to measure the complex two-way relationship between the environment and humans. Researchers are then able to track the various facets of this relationship over time by breaking down an intellectually complex and immeasurable concept into its various smaller and more measurable parts to improve communication and policy (Schirnding 2002).

In 2012, an indicator development workshop produced a suite of 13 socioeconomic indicators to track the relationship between coral reefs and coral reef adjacent communities (Table 1)

[1] https://www.coris.noaa.gov/activities/NCRMP_Plan_2021/welcome.html.

(Lovelace and Dillard 2012).[2] Primary and secondary data streams inform the indicators for each of the seven inhabited U.S. coral reef jurisdictions: South Florida, the U.S. Virgin Islands, Puerto Rico, Hawai‘i, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands (CNMI) (Table 2).

Table 1: Thirteen socioeconomic indicators for the NCRMP socioeconomic surveys.

	Indicators	
1	Participation in coral reef activities (including snorkeling, diving, fishing, harvesting)	Measuring participation in coral reef activities enhances coral reefs to local residents as well as the level of extractive and non-extractive pressures on reefs
2	Perceived resource condition	Assessment of perceived conditions is a complement to biophysical information and is key to evaluating differences in levels of support for various management strategies
3	Attitudes towards coral reef management strategies	Monitoring this information over time will be valuable to decision makers, as it will provide insight into possible changes in public perception concerning coral reef management strategies
4	Awareness and knowledge of coral reefs	Monitoring this information over time is key to tracking whether CRCP constituents understand threats to coral reefs and will help inform management strategies (and education/outreach efforts)
5	Human population trends (change) near coral reefs	Monitoring human population trends is important for understanding increasing pressure on coral reefs, as well as reef-adjacent populations
6	Economic impact of coral reef fishing to jurisdiction	Tracking the economic contributions of coral reefs can help justify funds allocated for coral reef protection
7	Economic impact of dive/snorkel tourism to jurisdiction	Tracking the economic contributions of coral reefs can help justify funds allocated for coral reef protection
8	Community well-being	Tracking changes in health, basic needs, and economic security enhances understanding of links between social conditions and coral reefs
9	Cultural importance of coral reefs	Measuring cultural importance improves understanding of traditional and cultural significance of coral reefs to jurisdictional residents, and whether this is changing over time
10	Participation in behaviors that may improve coral reef health (*e.g.*, beach cleanups, sustainable seafood choices)	Measuring participation improves understanding of positive impacts to coral reefs as well as negative impacts
11	Physical Infrastructure	Assessment of coastal development footprint, physical access to coastal resources, and waste and water management infrastructure provides an understanding of human impacts on the coast
12	Knowledge of coral reef rules and regulations	Tracking this information over time at the jurisdictional/national level will inform investment in education and outreach
13	Governance	Measurement of governance provides information on the current status of local institutions involved in coral reef conservation, number of functioning management strategies, and percent area of coral reefs under protection

[2] https://data.nodc.noaa.gov/coris/library/NOAA/CRCP/project/626_Loper/Social_and_Economic_Indicators_for_Monitoring_the_U.S._Coral_Reef_Jurisdictions_Workshop_Report_2012.pdf.

From 2014-2018, the NCRMP Socioeconomic team completed its first round of monitoring via a random sample of resident households in each jurisdiction (Gorstein et al. 2019a; Gorstein et al. 2019b; Gorstein et al. 2018a; Gorstein et al. 2018b; Gorstein et al. 2017; Gorstein et al. 2016; Levine et al. 2016). The survey instrument was composed of one consistent set of questions for all U.S. coral reef jurisdictions, as well as a subset of jurisdiction-specific questions relevant to local management needs. NCRMP socioeconomic data are collected using a variety of modes as appropriate to the context in each jurisdiction with methodology that generally follows Dillman's Tailored Design Method (Dillman et al. 2014). For all jurisdictions, the aim is a representative sample of the population that meets a 95% confidence level with a minimum of a +/-5% margin of error. All survey questions are periodically approved for use by the Office of Management and Budget (OMB) under OMB#0648-0646. Surveys are planned to be repeated in each U.S. coral reef jurisdiction approximately once every five to seven years, and the second round of monitoring began in 2019.

Table 2: Geographic scope of current NCRMP Socioeconomic Monitoring.

Location	Inhabited Islands/Counties
American Samoa	Islands of Tutuila, Ta'u, Olosega, Ofu, Aunu'u
Florida	Martin, Palm Beach, Broward, Miami-Dade, and Monroe Counties
Hawai'i	Islands of Kaua'i, Maui, Moloka'i, O'ahu, Hawai'i, Lāna'i
Puerto Rico	Islands of Puerto Rico, Vieques, and Culebra
Commonwealth of the Northern Mariana Islands	Islands of Saipan, Tinian, and Rota
Guam	Entire island of Guam
US Virgin Islands	Islands of St. Croix, St. Thomas, and St. John

Following the first round of monitoring (2014-2018), the NCRMP Socioeconomic team coordinated a series of expert panels and workshops to determine how each of the 13 socioeconomic indicators would be measured using primary data collected through the NCRMP resident surveys and existing secondary data. In 2019, the team published an indicator development report (Abt Associates, Inc. 2019) that presented guiding methodology for each monitoring cycle's indicator score development, as well as the calculated indicator scores for the first round of monitoring. Following the completion of each monitoring cycle, the 13 socioeconomic indicator scores will be recalculated using the 2019 foundational methodology. Tracking indicator scores over time will allow CRCP to monitor trends in human connections to U.S. coral reef ecosystems.

More information on indicator development, secondary data, as well as summary findings and methods can be found at the project website: www.coris.noaa.gov/monitoring/socioeconomic.html.

1.2 Purpose of this report

This technical memorandum presents the findings from the second Hawai‘i NCRMP socioeconomic primary data collection, which inform the following indicators:

- Participation in coral reef activities (including snorkeling, diving, fishing, harvesting)
- Cultural importance of coral reefs
- Perceived resource condition
- Awareness and knowledge of coral reefs
- Attitudes towards coral reef management strategies
- Awareness of coral reef rules and regulations
- Participation in behaviors that may improve coral health

While additional secondary data collection efforts will support the remaining six indicators (Human population change near coral reefs, Community well-being, Physical infrastructure, Economic impact of coral reef fishing to jurisdiction, Economic impact of dive/snorkel tourism to jurisdiction, and Governance), the present report focuses solely on data collected through the Hawai‘i NCRMP survey. As demonstrated in Abt Associates, Inc. (2019), the data presented in this report as well as additional secondary data will be synthesized and published at the completion of the current monitoring cycle.

This report is organized into five remaining sections. Section 2 briefly describes the current jurisdiction (Hawai‘i), Section 3 details the methodology used in data collection and analysis, Section 4 provides descriptive statistics for the current (2020) round of monitoring, and Section 5 provides trend analysis between the first (2015) and second (2020) rounds of monitoring. Section 6 provides discussion and ideas for future monitoring.

2. Jurisdiction Description

The Hawaiian Islands comprise the southernmost and westernmost state in the United States, with the Main Hawaiian Islands positioned between 19- and 22-degrees north latitude and the Northwestern Hawaiian Islands located between 23- and 29-degrees north latitude (Figure 1). The entire archipelago is considered the longest, oldest, and perhaps best-studied archipelago on earth, and is comprised of islands, islets, atolls, reefs, submerged banks, and seamounts (Grigg et al. 2008). It was formed millions of years ago almost entirely by volcanic activity (Macdonald, Abbott, and Peterson 1983), and younger islands within the chain are still volcanically active and growing in size. Since the Hawaiian Archipelago is located far offshore from the mainland U.S., its coral reefs are exposed to large open ocean swells and strong trade winds that have major impacts on the structure of the coral reefs, and result in distinctive communities that are sculpted by these dynamic natural processes (Friedlander et al. 2008). The geographic isolation of these

islands has resulted in some of the highest endemism of any tropical marine ecosystem on earth (Kay and Palumbi 1987; Jokiel 1987; Randall 1998). Some of these endemics are dominant components of the coral reef community, resulting in a unique ecosystem that has extremely high conservation value (DeMartini and Friedlander 2004; Maragos et al. 2004).

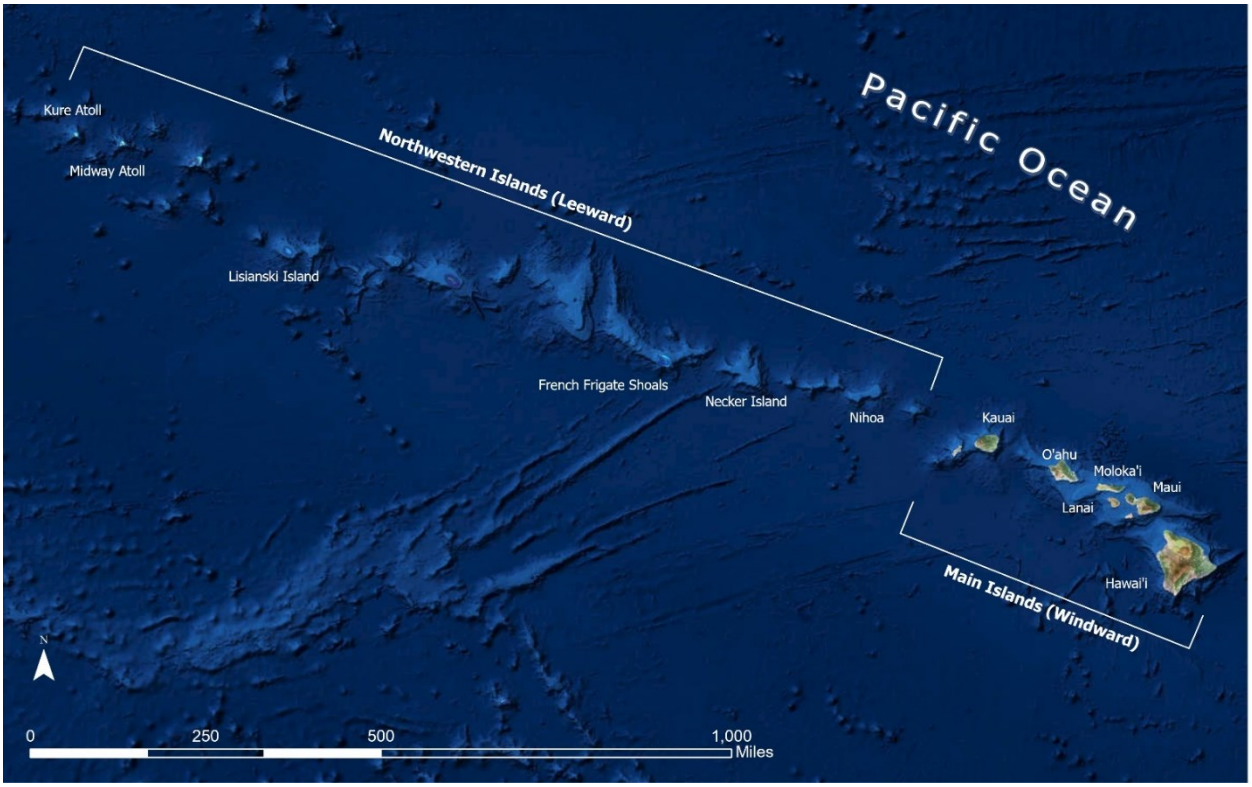


Figure 1: Map of the Hawaiian Archipelago, including Northwestern Hawaiian Islands and Main Hawaiian Islands.

From east to west, the Northwestern Hawaiian Islands stretch approximately 1,500 miles from the Kure Atoll to Nihoa, and the Main Hawaiian Islands (commonly called Hawai‘i) include Ni‘ihau, Kaua‘i, O‘ahu, Moloka‘i, Lāna‘i, Maui, Kaho‘olawe, and Hawai‘i (or “the Big Island”). All but Kaho‘olawe are permanently inhabited. Polynesians first settled in the Hawaiian Islands sometime during the 3rd to 6th century AD during the age of transpacific migrations. The socioeconomic connection between Hawaiians and the surrounding ocean environment is imperative for understanding community life in Hawai‘i. The islands are relatively small and most cities, towns, and villages are located within the coastal zone. As such, various aspects of local and indigenous history, culture, and society are closely related to the surrounding ocean and use of its resources. As a result, modern culture in Hawai‘i is based on a mix of both ancient and newer practices (Jokiel et al. 2011).

The 2020 NCRMP socioeconomic monitoring effort included residents from the islands of O‘ahu, Maui, Hawai‘i (additionally stratified by East and West), and Kaua‘i (Figure 2).[3] O‘ahu is the most populous island in Hawai‘i. It is home to the state’s capital (Honolulu) as well as almost 70% of the state’s population (U.S. Census Bureau 2018). Of the state’s 1.4 million population, 99% reside in the study area’s islands. In addition to O‘ahu, 13.9%, 11.6%, and 5.0% of residents live on the islands of Hawai‘i, Maui, and Kaua‘i, respectively (U.S. Census Bureau 2018). While Hawai‘i is the 41st most populous state in the U.S., it ranks 15th in terms of population density (U.S. Census Bureau 2021). The state’s population identifies as 37.8% Asian, 25.0% White, 10.2% Native Hawaiian and Other Pacific Islander, and 27.2% as Other races (including two or more races). An additional 10.4% of Hawai‘i’s population also identifies with Hispanic/Latino origins (U.S. Census Bureau, 2018). English is the predominantly spoken language in Hawai‘i (66.1% of households only speak English), but 33.9% of households speak languages other than English in the home.

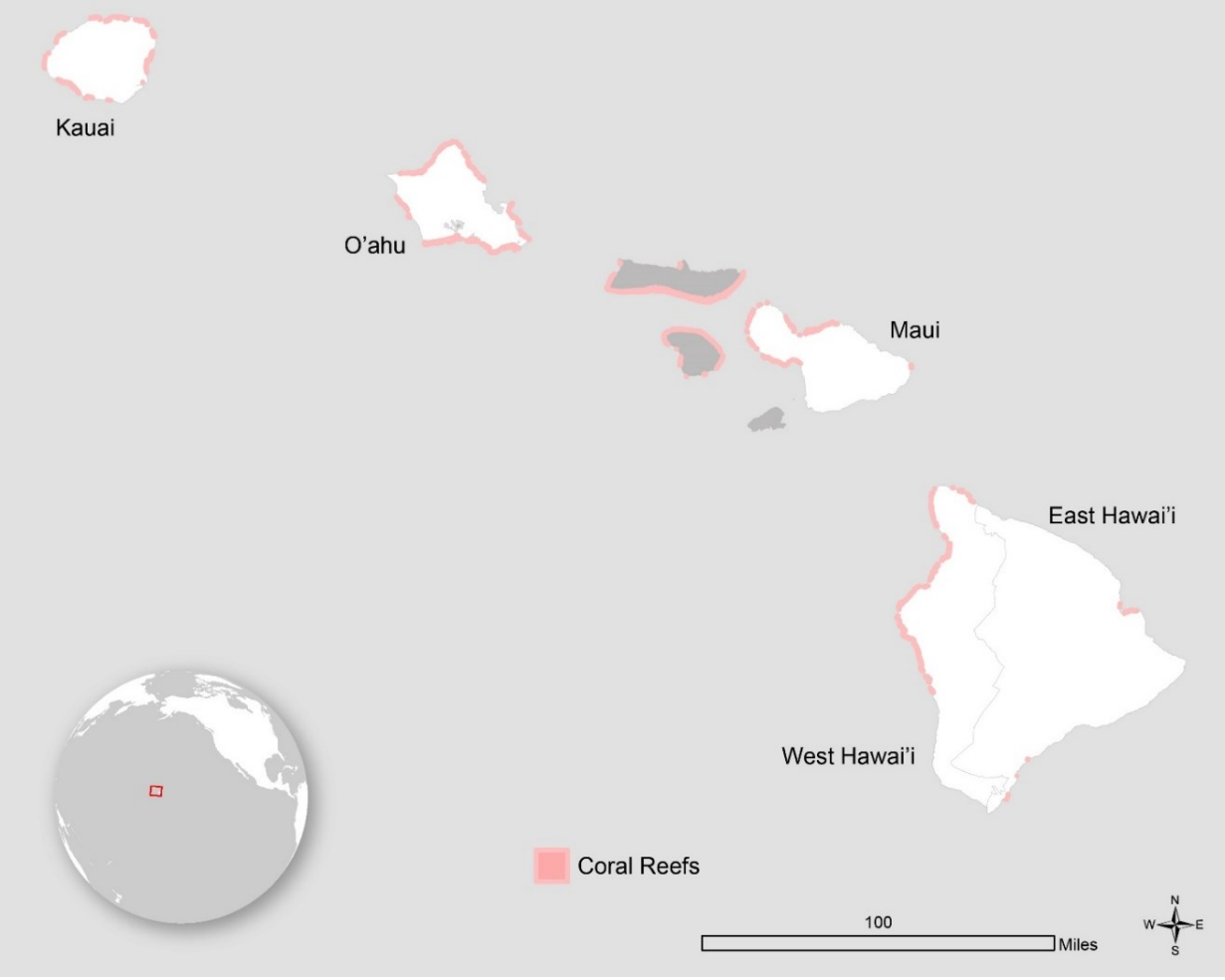


Figure 2: Map of sampling areas in Hawai‘i in relation to total coral cover.

[3] Moloka'i and Lāna'i were omitted from the sampling design due to budgetary constraints and tradeoff decisions made with jurisdictional partner feedback.

Hawai‘i has a total land area of approximately 6,423 square miles and its land cover varies considerably by island. For example, the island of Hawai‘i is about 4,028 square miles but has only around 1.2 percent impervious surface. In contrast, the island of O‘ahu is 597 square miles but 12.7 percent of its total land is covered by impervious surfaces, including the city of Honolulu (C-CAP 2010). Many of the developed areas in Hawai‘i occur along coastal areas and in close proximity to coral reef ecosystems (Figure 2).

Tourism is an integral part of the Hawaiian economy, accounting for roughly 16% of the state's GDP in 2019 (Tian 2020). Due to Hawai‘i's favorable climate and unique cultural and ecological features, the state is a frequently visited tourist destination for domestic and foreign travelers alike. These high rates of tourism, coupled with high population density near the coast, bring even more humans in contact with coral reef ecosystems in the region; thereby creating more opportunities for humans to derive ecosystem services from reefs, but also more opportunities for human-induced stressors to impact reefs.

A red algal bloom off the coast of Hawai‘i. Photo credit: Michelle Johnston, NOAA.

In 1967, the first Marine Life Conservation District (MLCD), which limits or prevents certain human activities, was established in Hawai‘i with the creation of Hanauma Bay on O‘ahu. Since then, ten other MLCDs have been created to help protect Hawai‘i's coral reefs and fish populations (DLNR 2021a). In 2006, the Papahānaumokuākea Marine National Monument was established in the islands and atolls of the Northwestern Hawaiian Islands. This monument was

expanded in 2016 to approximately 583,000 square miles, making it one of the world's largest protected areas. In 2018, the Hawai‘i Senate expanded the state's conservation efforts by passing legislation banning the sale of sunscreen that contains oxybenzone and/or octinoxate, chemicals toxic to coral reefs and humans, through Senate Bill 2571 (S.B. 2571 2018).

These conservation efforts are important because the climate is changing and under environmental stress, corals can undergo a bleaching response in which they expel the symbiotic algae that they depend on for food and energy. Bleaching events often result in increased coral mortality; though, corals are able to recover from bleaching if local stressors, such as human impacts, pollution, and overfishing, are reduced near the affected corals (West and Salm, 2003). In 2014 and 2015, coral bleaching events resulted in 50% coral mortality in West Hawai‘i and 20-30% in Maui (Bahr et al. 2017; Eakin et al. 2019; Kramer et al. 2016; Rodgers et al. 2017). Another major bleaching event occurred in autumn 2019, affecting coral colonies throughout the Main Hawaiian Islands (DLNR 2021b; Jones et al. 2021). This pattern of events in the past six years suggests that bleaching is becoming more frequent in Hawaiian waters (NMFS 2019). Local stressors have also resulted in the loss of certain types of coral colonies near the West Hawai‘i, Maui, and O‘ahu coasts, and species that can better adapt to the local environmental conditions are overtaking the local nearshore coral populations. The overall reduction in the coral populations' genetic diversity, however, could possibly compromise the long-term resilience of the reefs (Tisthammer et al. 2020). Invasive species are yet another threat to Hawai‘i's coral reef ecosystems (Sherwood et al. 2019).

3. Methodology

A telephone and online web survey of residents aged eighteen and older within the islands of Hawai‘i (further stratified by East and West), Kaua‘i, Maui, and O‘ahu was conducted from March to June 2020. The survey instrument is included in Appendix A. Figure 1 (Section 2) shows the surveyed areas in relation to total coral cover.

Respondents were invited to take an online web survey through mailed invitational letters and reminder post cards with telephone follow up calls. Respondents could also choose to complete the survey via telephone. All surveys were offered to respondents in English. Of the 23,501 individuals contacted, a total of 2,700 surveys were completed (293 completed telephone surveys and 2,407 completed online web surveys), yielding an overall response rate of 11.5%. For more information on data collection procedures, please see Appendix B.1. Data were weighted to resident populations with slight differences caused by weight trimming. For more details on data weighting and trimming protocols, please see Appendix B.2.

Table 3 provides weighted estimates of key demographic variables for Hawai‘i residents. Most people lived on O‘ahu, and most were White, Asian, or other. Most residents had below a college degree, and most had an annual household income under $100,000. Additionally, residential tenure of residents was high. A slight majority of residents were employed full-time or part-time,

and about one quarter were retired. A majority of residents did not have a marine occupation, but some common marine occupations included ecological research, education, and marina/boat operations.

Table 3: Weighted estimates of key demographics for Hawai‘i residents (percent).

Demographic Variables		Study area residents
Location of Residence	East Hawai‘i Island	9.5
	West Hawai‘i Island	6.6
	Kaua‘i	6.0
	Mau‘i	13.0
	O‘ahu	65.1
Gender	Female	50.1
Race	White	27.7
	Asian	35.4
	Native Hawaiian / Pacific Islander	8.9
	Other	28.0
Age	18-34	20.9
	35-44	15.3
	45-54	15.7
	55-64	17.7
	65+	30.4
Education	Some college or less	65.3
	College degree or higher	34.7
Household Income	Under $50,000	30.3
	$50,000-$99,999	29.6
	$100,000-$149,999	20.5
	$150,000 or higher	19.6
Residential Tenure	1 year or less	3.7
	2-5 years	11.2
	6-10 years	7.3
	More than 10 years	28.3
	All my life	49.5
Employment Status	Employed full time	50.4
	Employed part time	7.6
	Unemployed	8.9
	Retired	24.9
	Homemaker	3.6
	Student	4.6
Employment in marine occupation	Yes	10.5

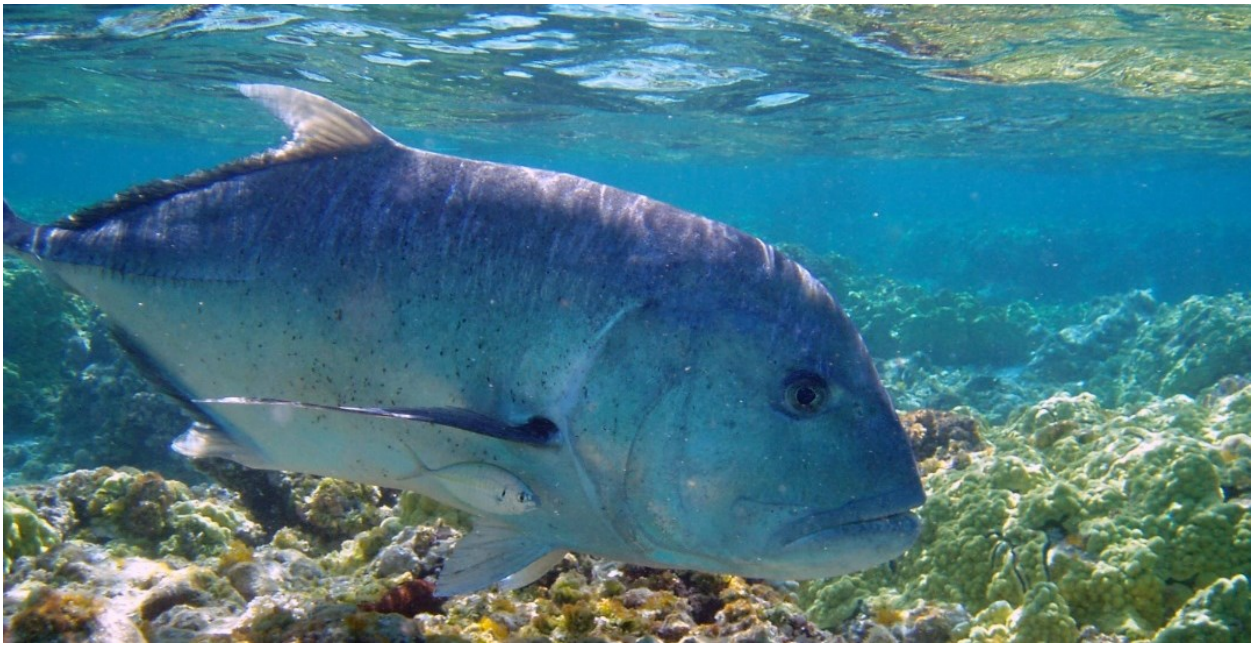
Data analysis of all monitoring cycles includes descriptive statistics, as well as examinations of statistical relationships between variables (e.g., cross tabulations, mean comparisons). All data were publicly archived with the National Center for Environmental Information (NCEI), and the authors are available to assist with data requests as needed.

4. Results: Summary Findings

Survey results are organized into the following subsections: 4.1 Participation in coral reef activities, 4.2 Cultural importance of reefs and reef reliance, 4.3 Perceived resource conditions, 4.4 Awareness and knowledge of coral reefs, 4.5 Attitudes towards coral reef management strategies, 4.6 Participation in behaviors that may improve coral reef health, and 4.7 Sources of coral reef information. The majority of these data support measurement of the seven NCRMP indicators reliant upon primary data; however, other data of jurisdictional importance from the 2020 survey are incorporated here as well. All data presented are weighted to the resident population of the State of Hawai‘i. Interesting findings by island and/or sub-island are also summarized and presented following “By island”. All “By island” tables are provided in Appendix C, and these tables are referenced throughout this section. Lastly, all usage of “Hawai‘i” refers to the entire state unless otherwise stated.

4.1 Participation in coral reef activities

The most popular marine-related activities included in the survey were beach recreation and swimming or wading, with varied monthly participation rates (Figure 3). Snorkeling was another activity of interest, but diving participation rates were comparatively lower. The least popular activities were gathering of marine resources and spearfishing. By island, residents of East Hawai‘i (island) and O‘ahu participated in boating much less often than the other island/sub-island populations (Table C1). Residents of West Hawai‘i (island) were more likely to participate in snorkeling, and residents of O‘ahu were less likely to participate in gathering of marine resources or fishing from boat or shore using a pole, line, or net.



Ulua fish, also known as Giant Trevally (*Caranx ignobilis*), in Hawai‘i. Photo credit: Claire Fackler, NOAA.

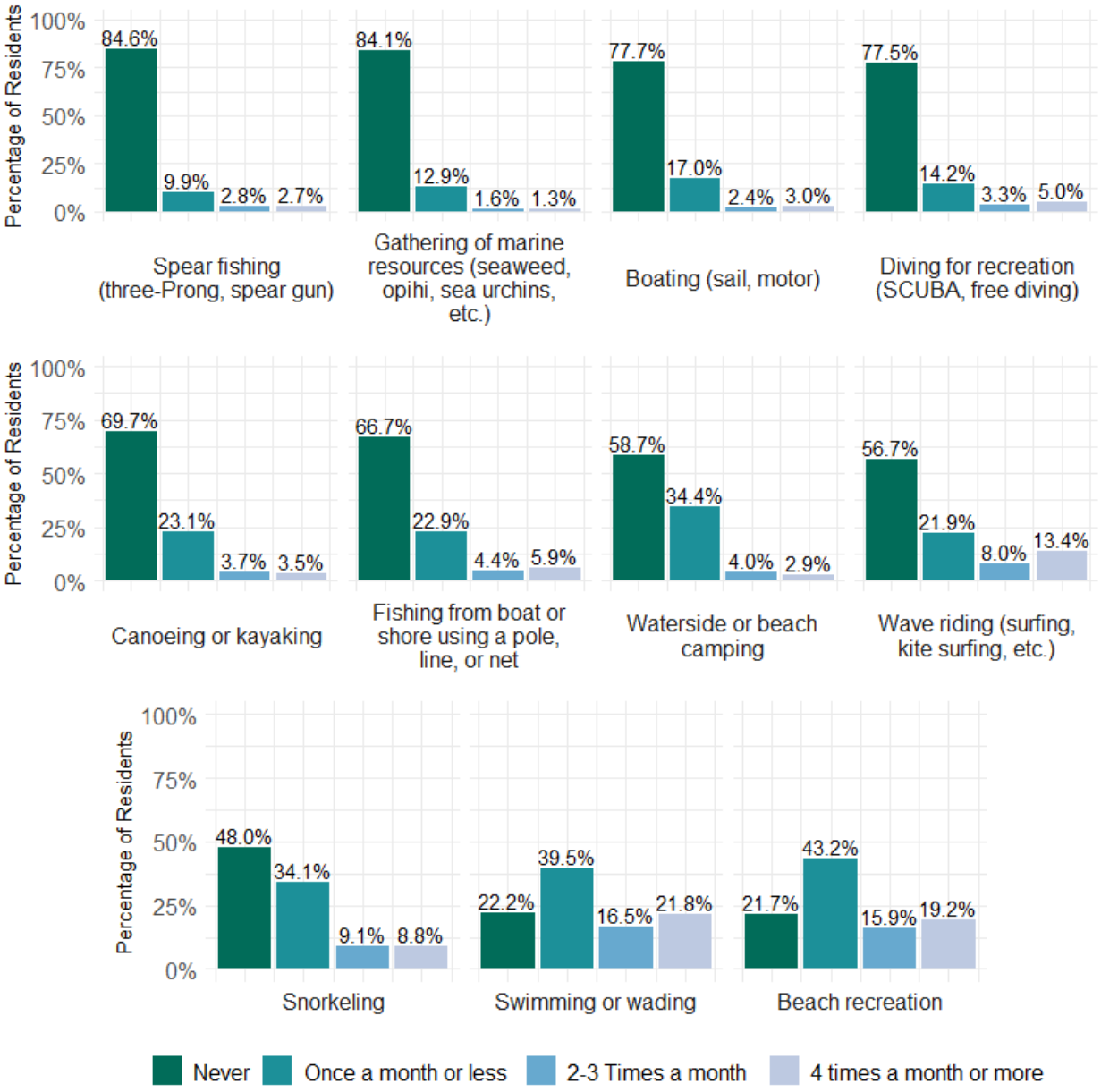


Figure 3: Frequency of participation in various reef activities.

The most common reasons for fishing, spearfishing, and/or gathering of resources (of those who participated) were to feed themselves and/or their families or for fun; most residents never fished to sell their catch (Figure 4). By island, Kaua‘i and Maui residents were more likely to fish to give their catch to extended family members and more likely to fish for special occasions and cultural events, and East Hawai‘i (island) and O‘ahu residents were less likely to fish to feed themselves or their families (Table C2).

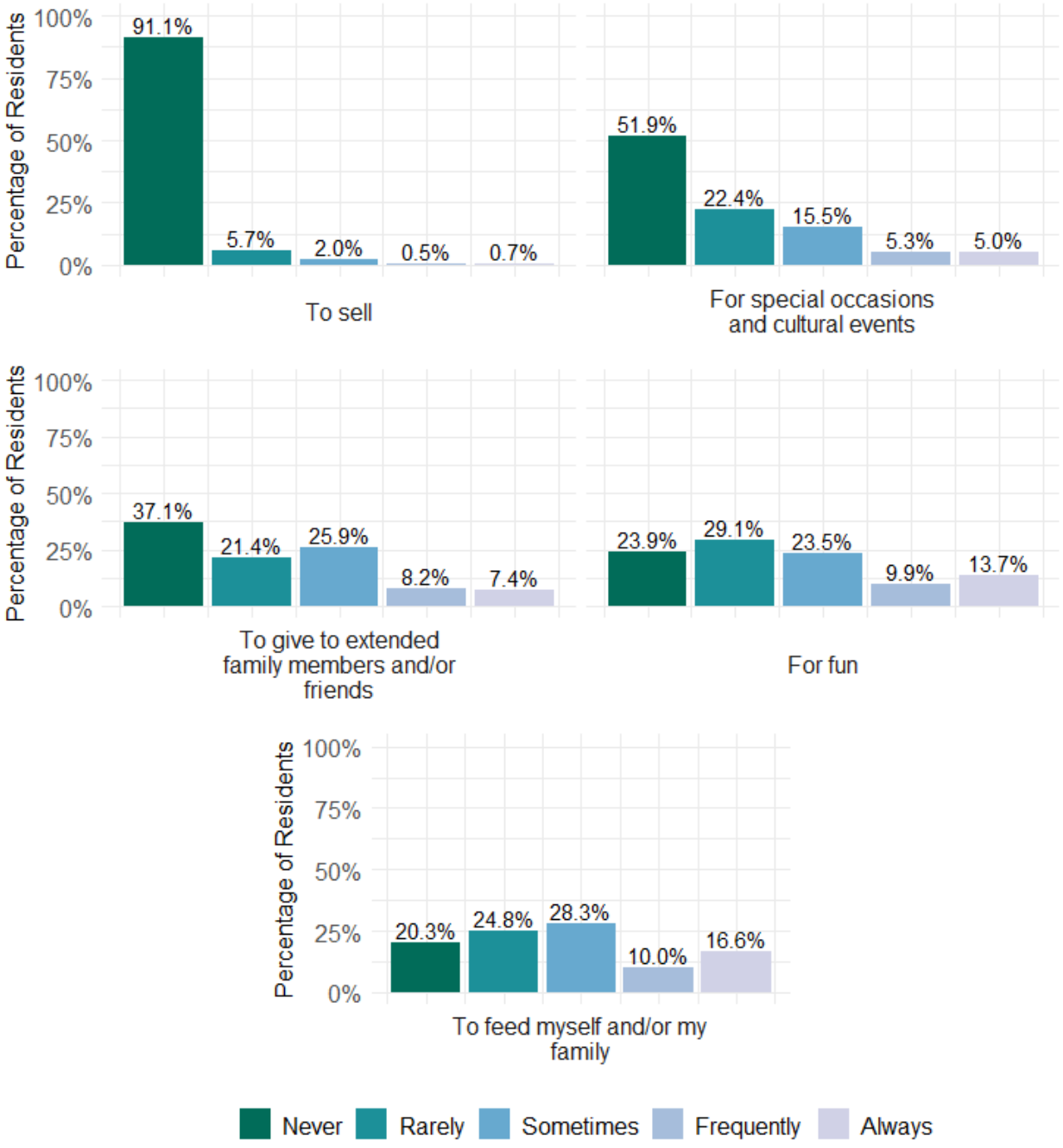


Figure 4: Frequency of fishing and gathering by reason.

The top two targeted species groups were jacks (e.g., papio, ulua) and surgeonfish (e.g., manini, palani, kala) (Figure 5). By island, Kauaʻi and Maui residents gathered limpets (opihi) more frequently, and Maui residents more frequently fished for or harvested octopus (tako) (Table C3).

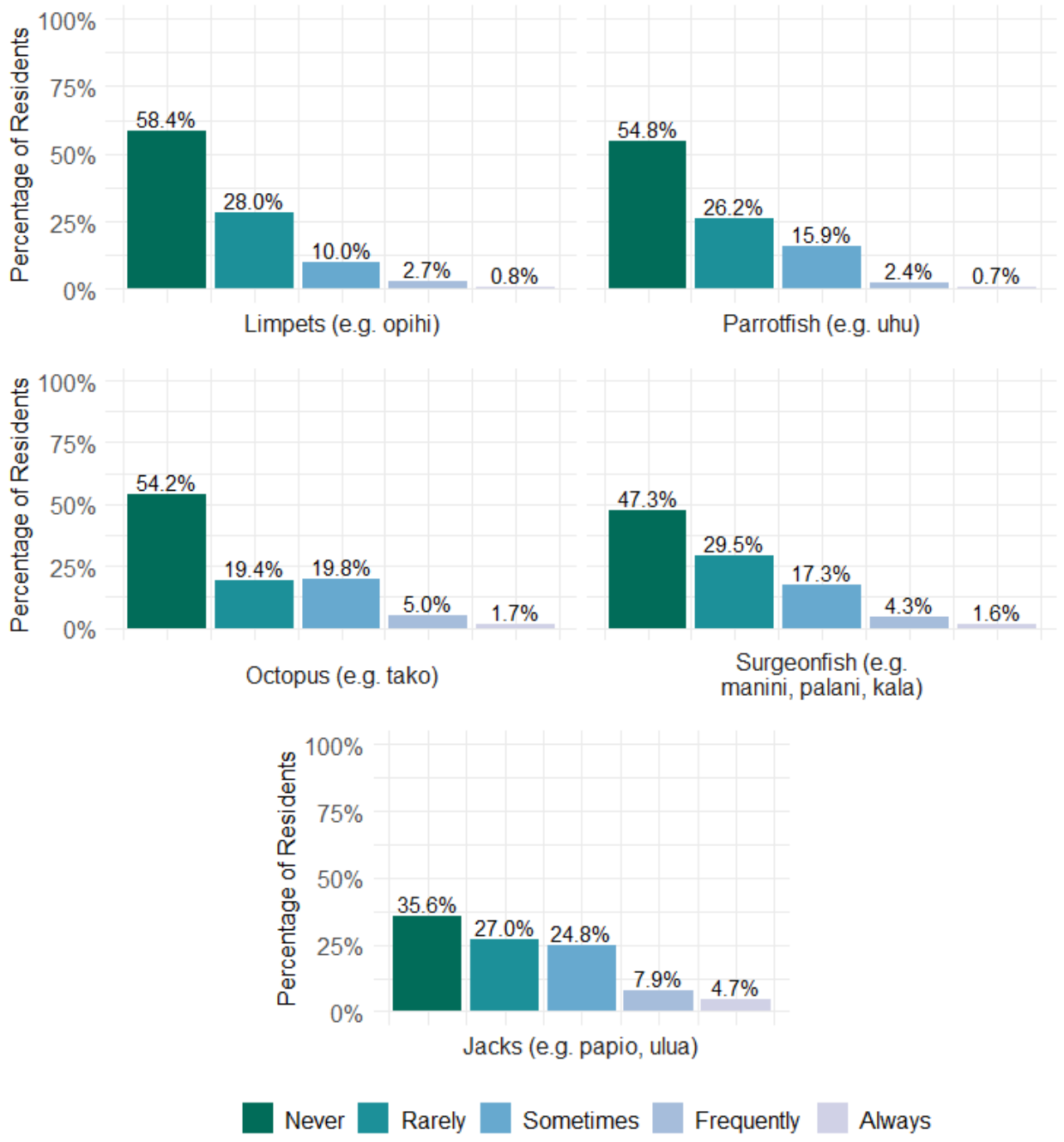


Figure 5: Frequency of fishing for groups of fishery species.

4.2 Cultural importance of reefs and reef reliance

The majority of residents believed that coral reefs are important to their family's cultural beliefs and practices (Figure 6). By island, residents of East and West Hawai'i (island) were slightly more likely to indicate lack of cultural importance, and O'ahu residents were more likely to indicate neither importance nor unimportance (Table C4).

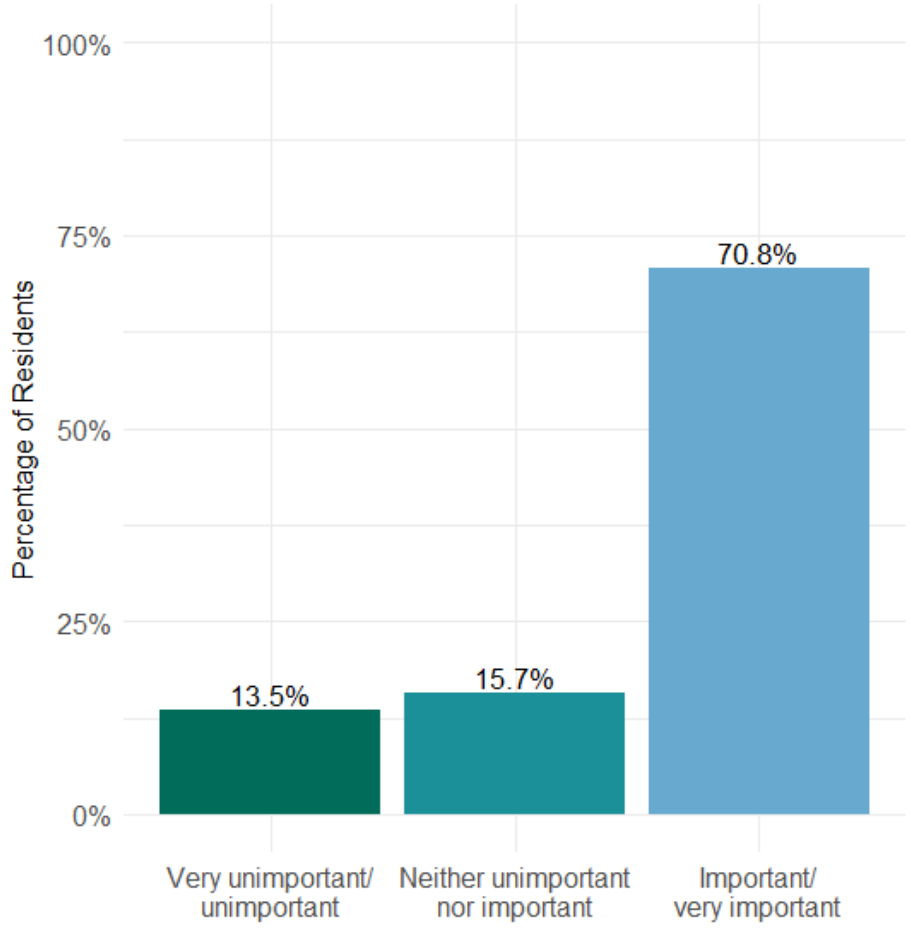


Figure 6: Cultural importance of coral reef environments.

4.2.1 Seafood consumption

Most resident families[4] consumed seafood at least once a month to a few times a week (Figure 7). By island, Kauaʻi residents were more likely to consume seafood at least a few times a week (Table C5).

Of residents who consumed seafood, most ate local seafood from coral reefs less than once a month or never (Figure 7). Though not shown in the figure, 8.7% of respondents were unsure how often they ate local seafood from coral reefs (bars in blue sum to 91.2% as a result). By island, Maui residents were more likely to eat seafood from local coral reefs one to three times per month (Table C6). Residents of West Hawaiʻi (island) had less uncertainty about whether or not they consumed seafood from coral reefs, and Oʻahu residents had greater uncertainty.

[4] "Family" was defined as all persons living under the same roof.

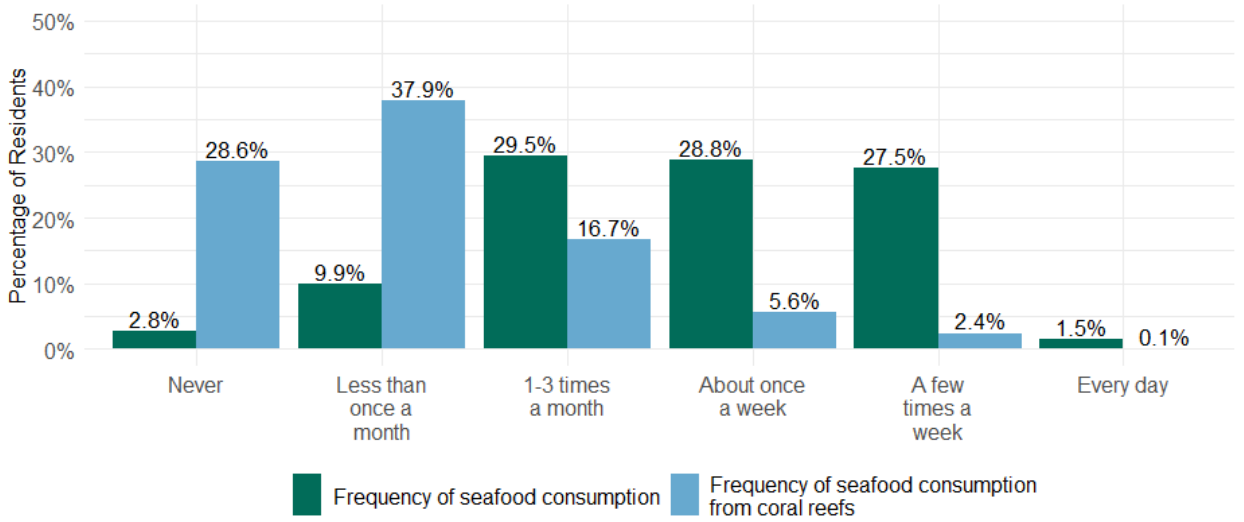
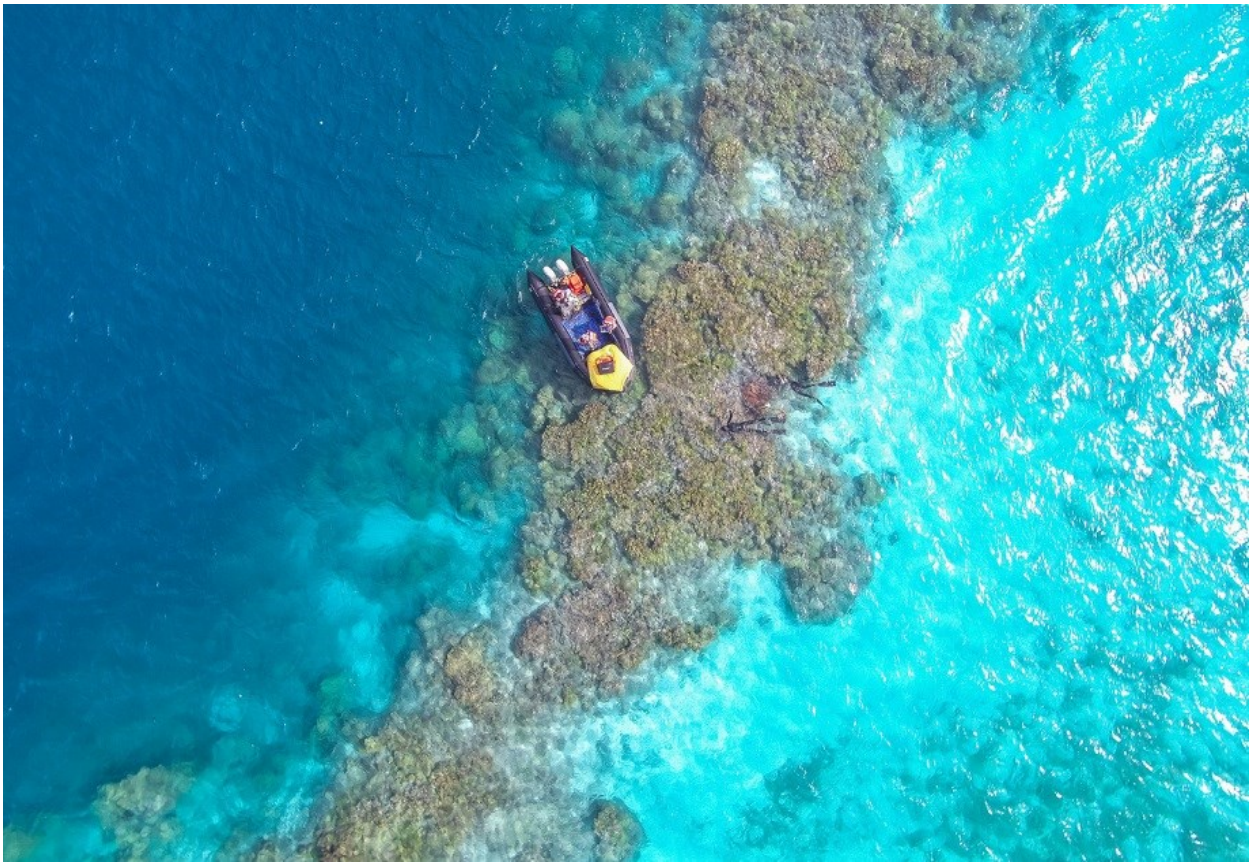


Figure 7: Frequency of seafood consumption (asked of all residents) and frequency of seafood consumption from local coral reefs (asked only of those who eat seafood).



A derelict fishing net found by SCUBA divers was carefully removed from the reef at Pearl and Hermes Atoll in the Northwestern Hawaiian Islands. Photo credit: Steven Gnam, NOAA Fisheries.

Among residents who consumed (local or non-local) seafood, the most common source was a store or restaurant (Figure 8). The least common source was caught by the resident or family members. By island, Kaua‘i residents were more likely to source seafood caught by themselves, their family members, extended family members, friends and neighbors (Table C7).

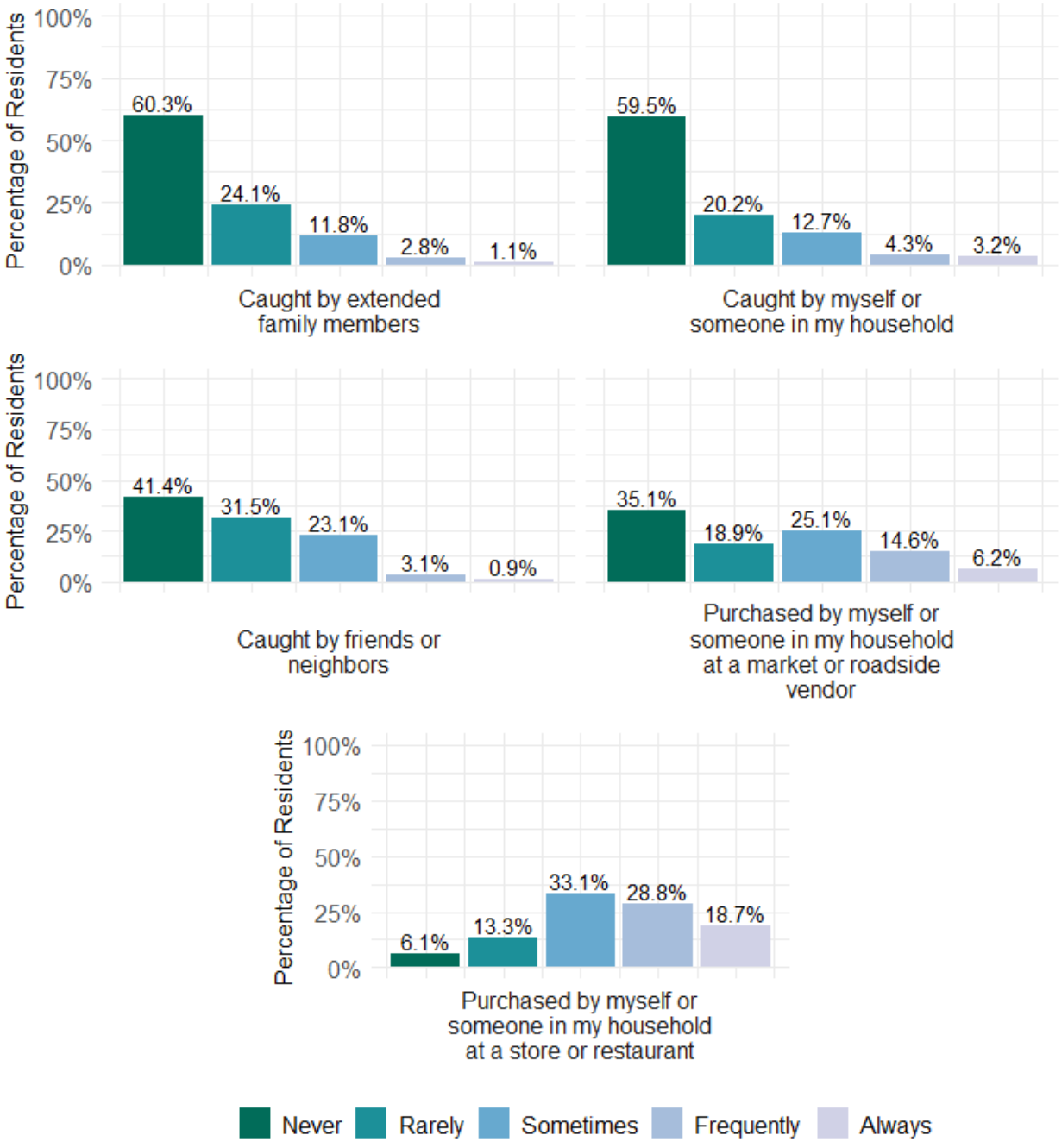


Figure 8: Primary sources of seafood for household residents.

4.3 Perceived resource conditions

Crowding of beaches and amount of live coral were most likely to be rated poorly, and ocean water quality was most likely to be considered good (Figure 9). By island, residents of West Hawai‘i (island) had more positive perceptions and less uncertainty of all resource conditions, whereas residents of East Hawai‘i (island) had more uncertainty (Table C8).

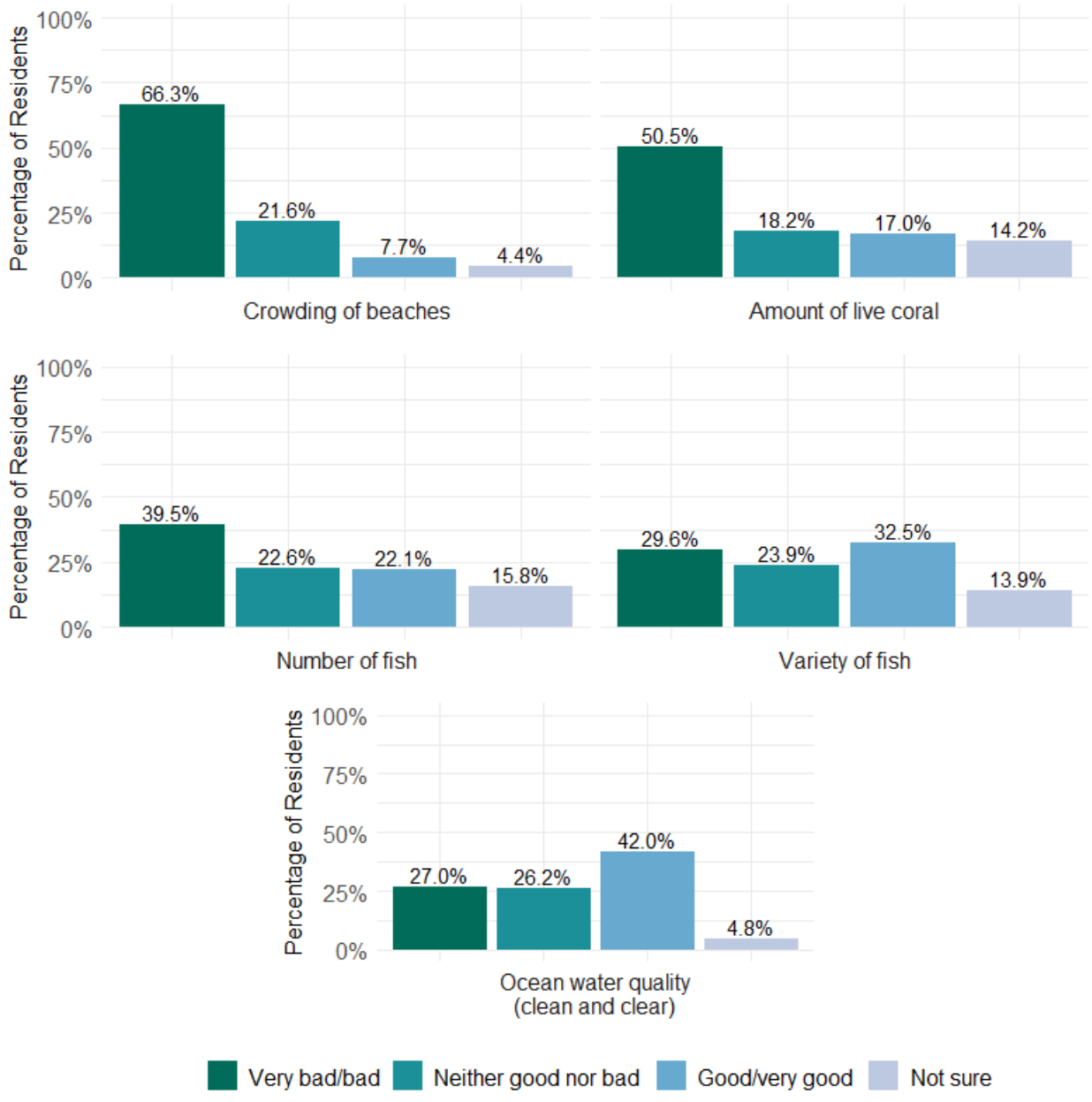


Figure 9: Perceptions of current marine resource conditions.

Most residents believed that resource conditions had worsened over the past ten years (Figure 10). Uncertainty about change in condition was greater than uncertainty about current conditions overall, and uncertainty increased for underwater resources (i.e., amount of live coral, number of fish, and variety of fish). By island, Kaua‘i residents were more positive, perceiving slight improvements for all resources (Table C9). Residents of East Hawai‘i (island) were still generally the least certain, and Maui residents tended to be most certain.

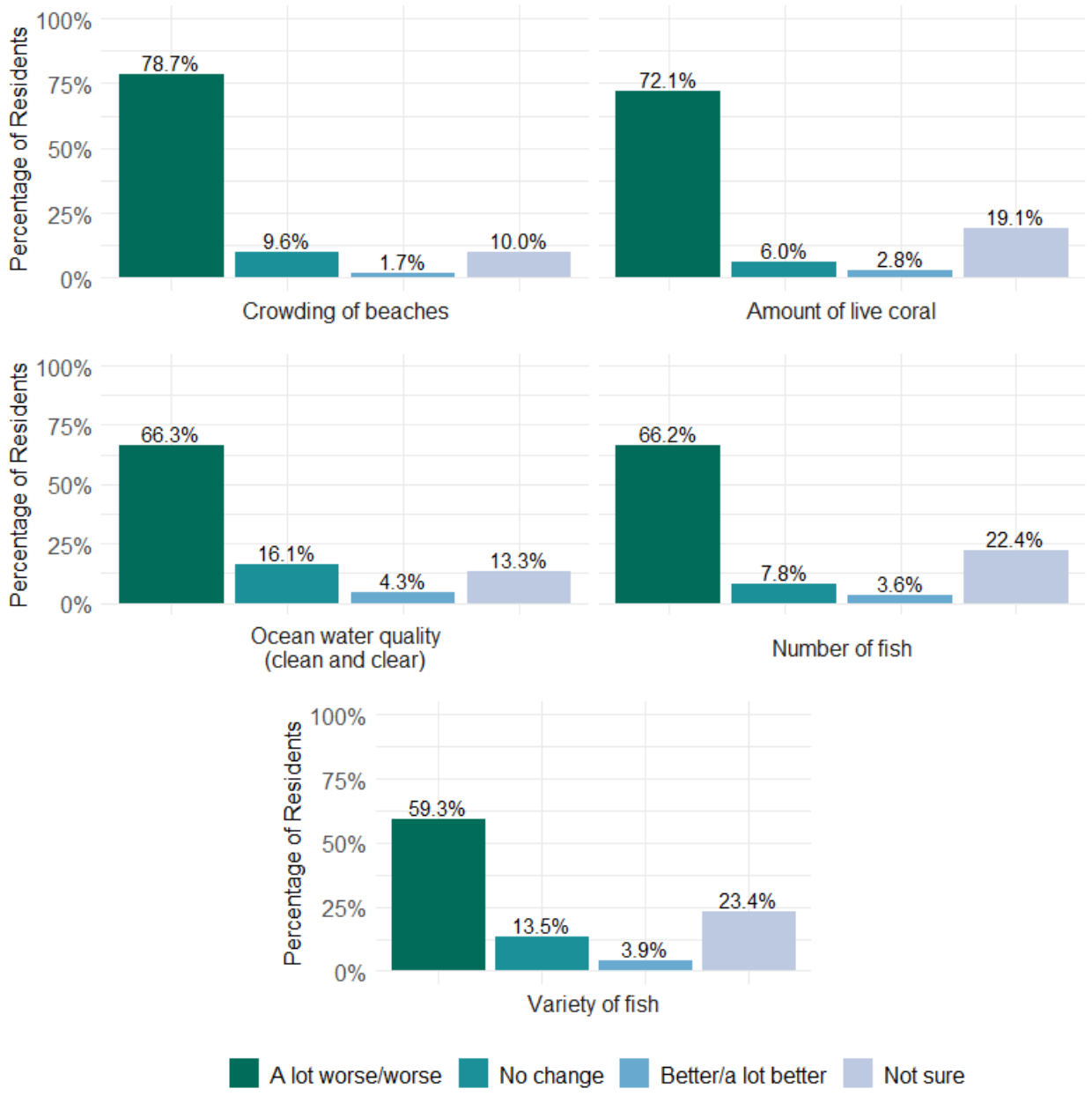


Figure 10: Perceived change in resource conditions over the past ten years.

The majority of residents also believed resource conditions will continue to get worse over the next ten years (Figure 11). By island, Kaua‘i and Maui residents were slightly more optimistic (Table C10). Residents of East Hawai‘i (island) were again less certain, though Maui residents were also less certain.

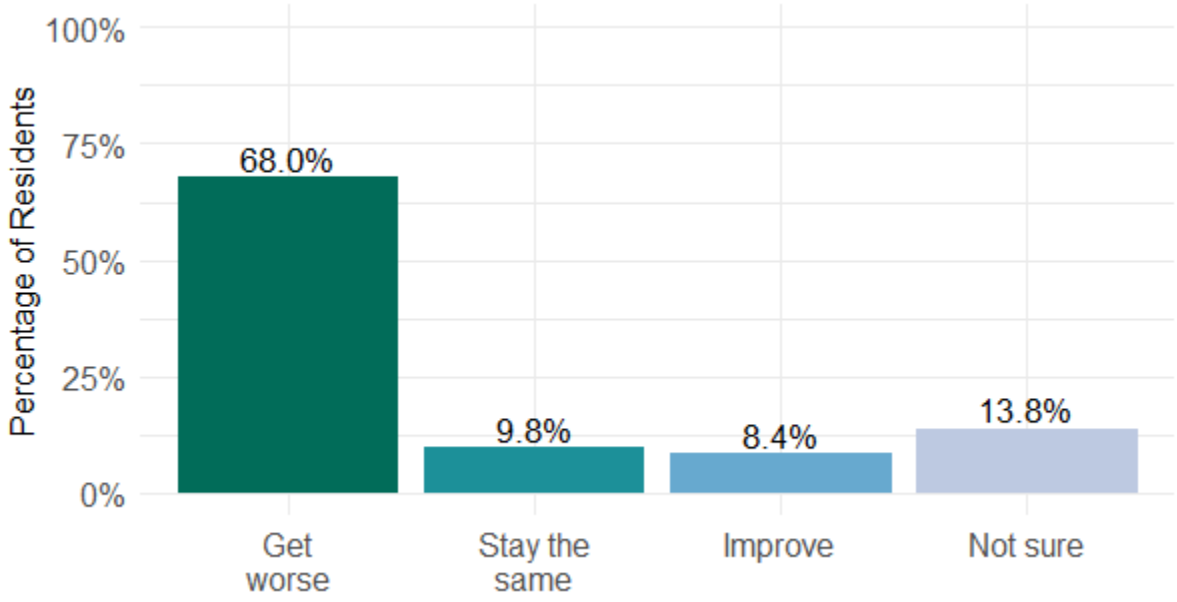


Figure 11: Perceived overall marine resource change over the next ten years.

A shark swims over a coral reef in that was heavily damaged by Hurricane Walaka in 2018. Photo credit: Kailey Pascoe, NOAA.

4.4 Awareness and knowledge of coral reefs

Residents generally agreed with all statements regarding the various ecosystem services provided by coral reefs, with the exception of coral reefs' singular importance to fishermen, snorkelers, and divers (Figure 12). Residents were most likely to agree that coral reefs are important to Hawai'i's culture. By island, despite high overall agreement levels, West Hawai'i (island) residents had slightly less agreement with the importance of coral reefs for the provision of food and economic opportunities, and residents of East Hawai'i (island) and Kaua'i had slightly less agreement with the importance of coral reefs for mitigating natural disasters and attracting tourists (Table C11).

Residents had high levels of familiarity with all threats (Figure 13). Familiarity levels were highest for pollution and sunscreen with chemicals toxic to corals and familiarity levels were lowest for ocean acidification. By island, residents of West Hawai'i (island) were generally more likely to have higher familiarity levels overall (Table C12).

Sign in Maui that lists sunscreen chemicals to avoid using. Photo credit: The Hawai`i Vacation Guide.

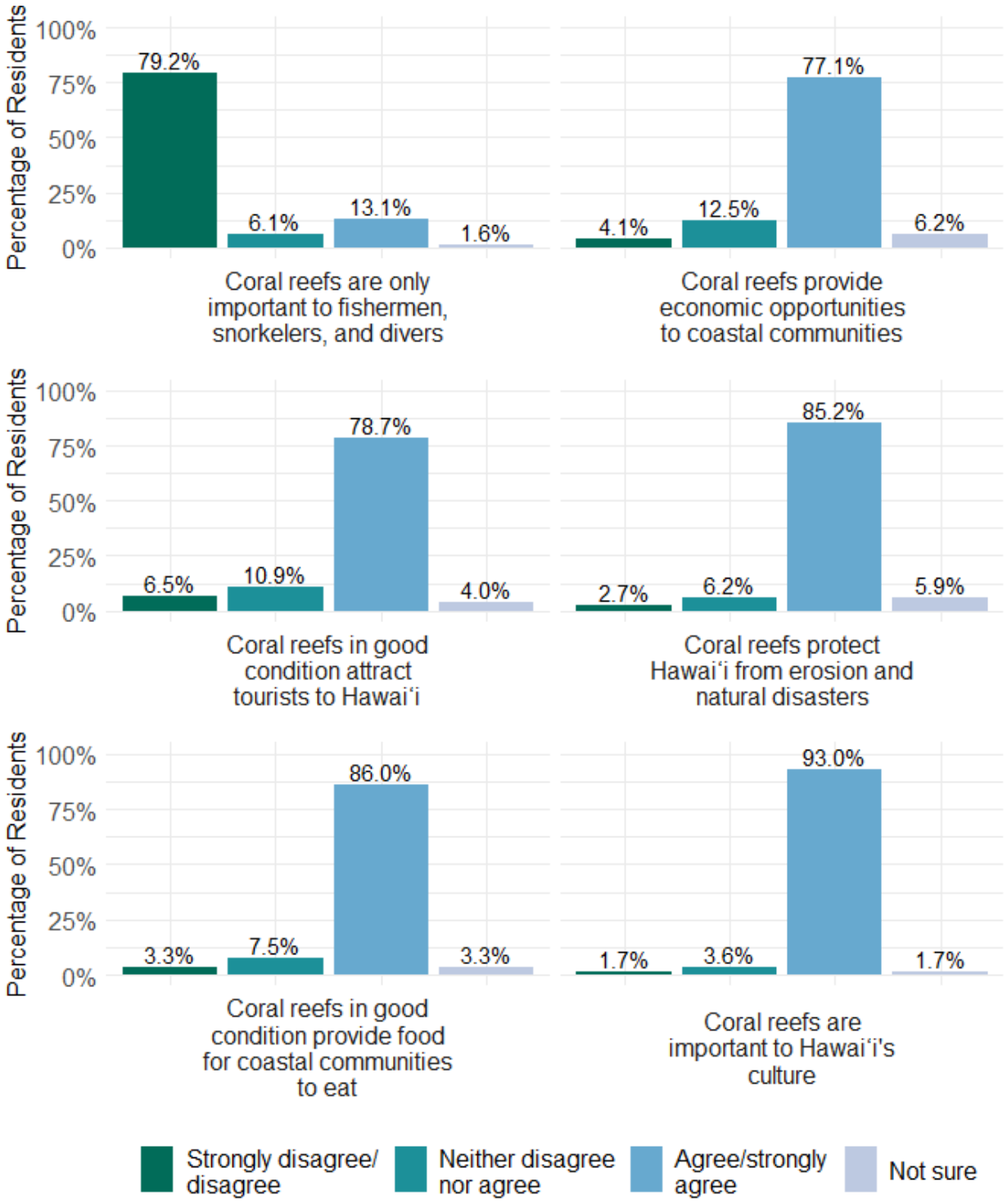


Figure 12: Perceptions of coral reef ecosystem services.

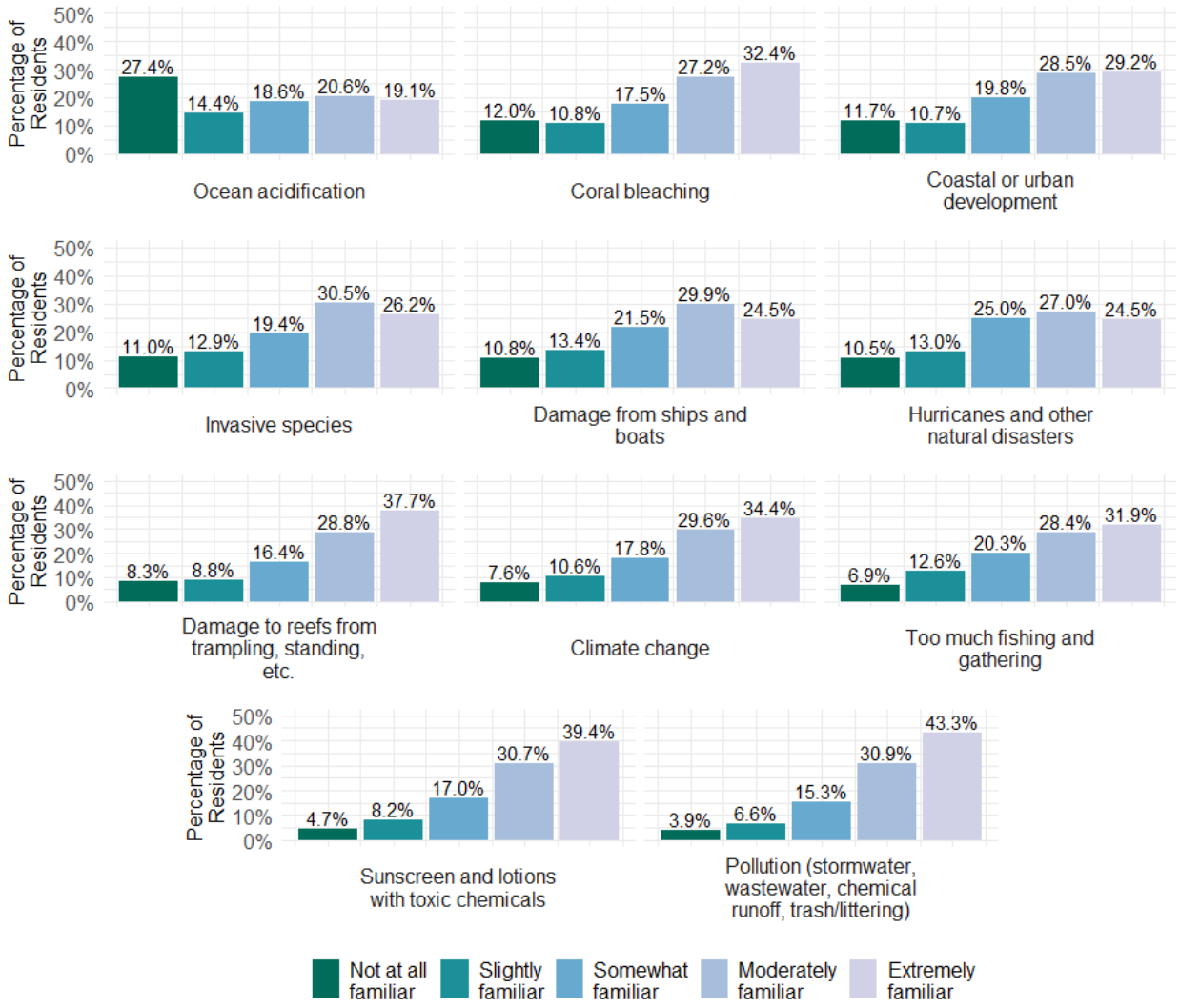


Figure 13: Familiarity with threats to coral reefs.

4.5 Attitudes towards coral reef management strategies

Residents were familiar with marine managed areas (MMAs) in Hawai‘i (Figure 14). The survey defined a MMA as “an area of the ocean where human activity is typically restricted to protect living, non-living, cultural, and/or historic resources, such as Marine Life Conservation Districts and Community-Based Subsistence Fishing Areas.” By island, residents on West Hawai‘i (island) and Maui were more familiar with MMAs (Table C13).

Overall, the majority of residents supported the establishment of MMAs in Hawai‘i and believed there should be more MMAs (Figure 15).

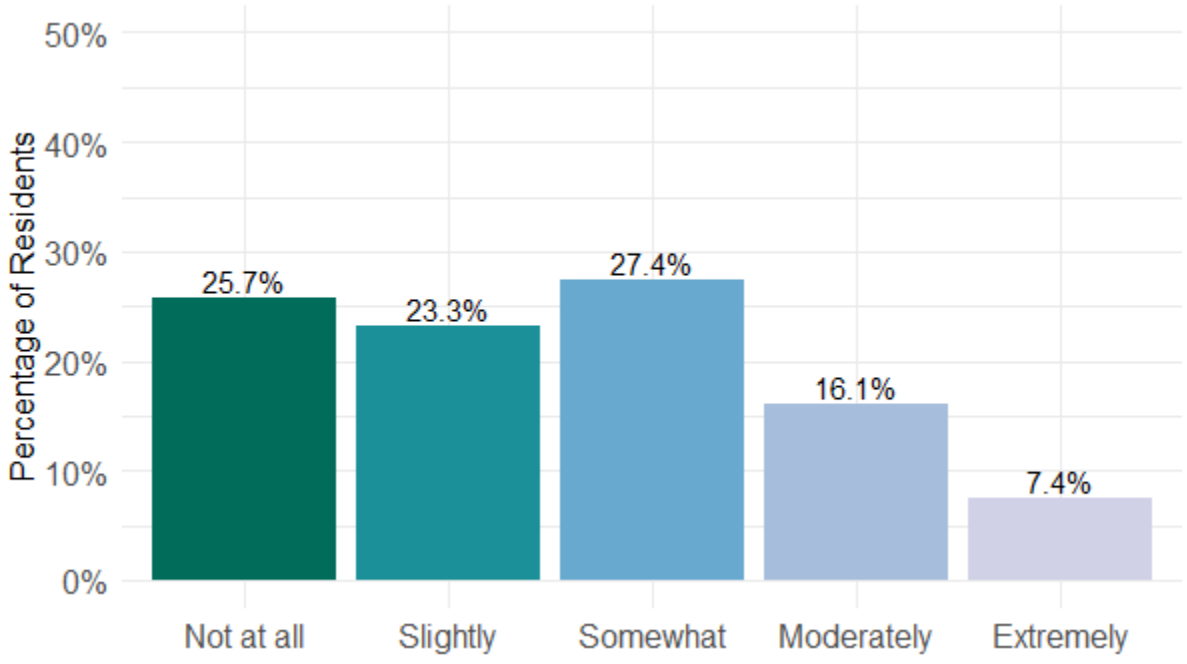


Figure 14: Familiarity with Marine Managed Areas.

4.5.1 Impacts of Marine Managed Areas

Most residents agreed that MMAs benefit coral reefs and coastal communities; however, residents agreed less often that MMAs increase tourism or have economic benefits (Figure 15). By island, while still mostly supportive, Kauaʻi residents generally had less agreement with supportive MMA statements and were more likely to agree that MMAs negatively impacted fishermen's livelihoods (Table C14). Residents of East Hawaiʻi (island) were also more likely to agree that fishermen's livelihoods had been negatively impacted.

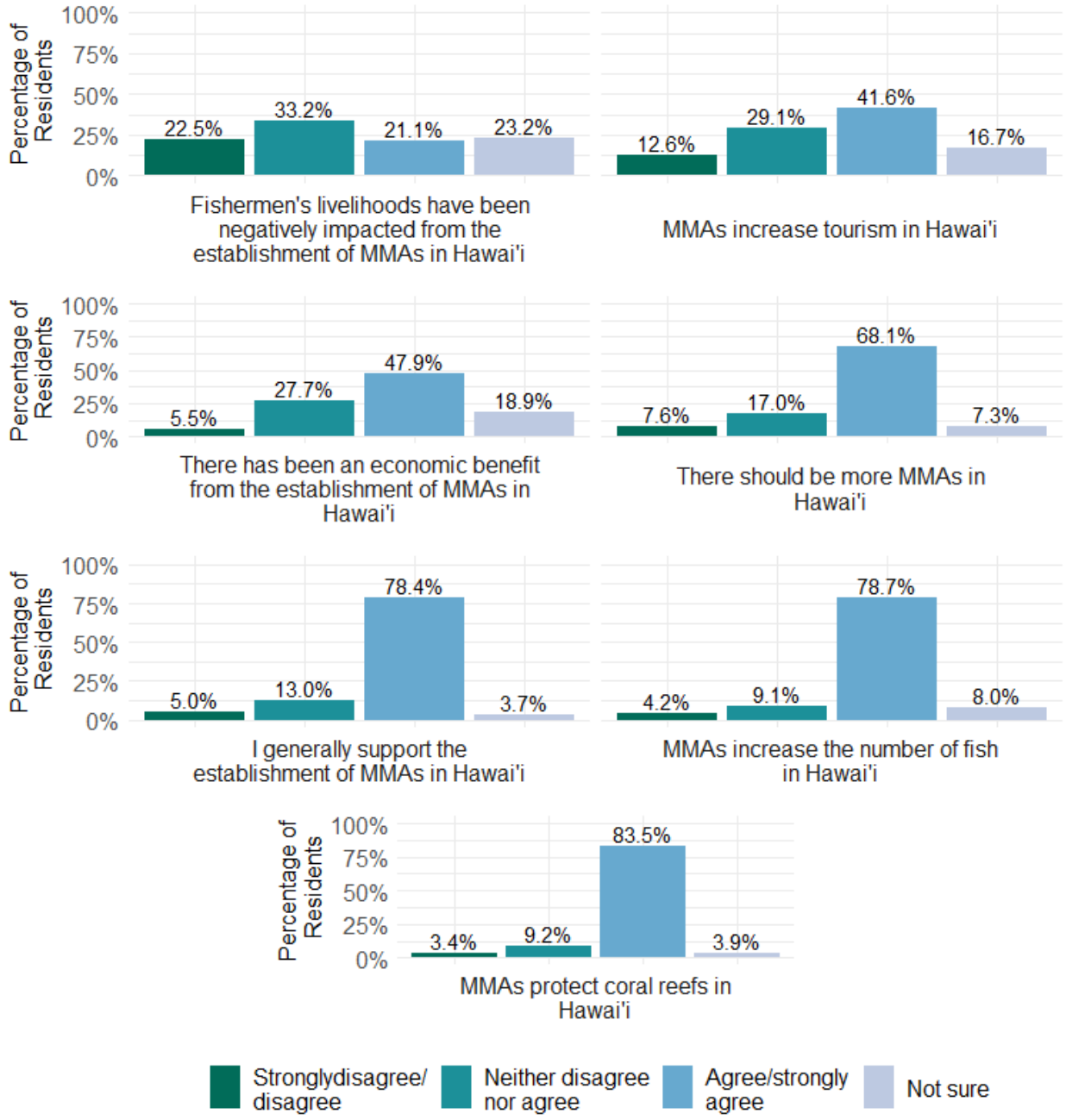


Figure 15: Agreement with statements about Marine Managed Areas.

4.5.2 Hawai‘i 30 by 30 Initiative

Most residents were not familiar with Hawai‘i’s 30 by 30 Initiative to improve management of nearshore marine waters by 2030,[5] but residents then supported this type of initiative when described as a “statewide effort led by the Division of Aquatic Resources in consultation with

[5] To learn more about this effort, please visit: https://dlnr.hawaii.gov/marine30x30/.

local communities to effectively manage 30% of Hawai‘i’s nearshore waters by 2030 to build and maintain healthy and abundant reefs and fisheries” (Figure 16). By island, West Hawai‘i (island) residents were more likely to be aware of the 30 by 30 Initiative (Table C15, Table C16). Residents of Maui were most supportive of this type of initiative, and residents of Kaua‘i were least supportive.

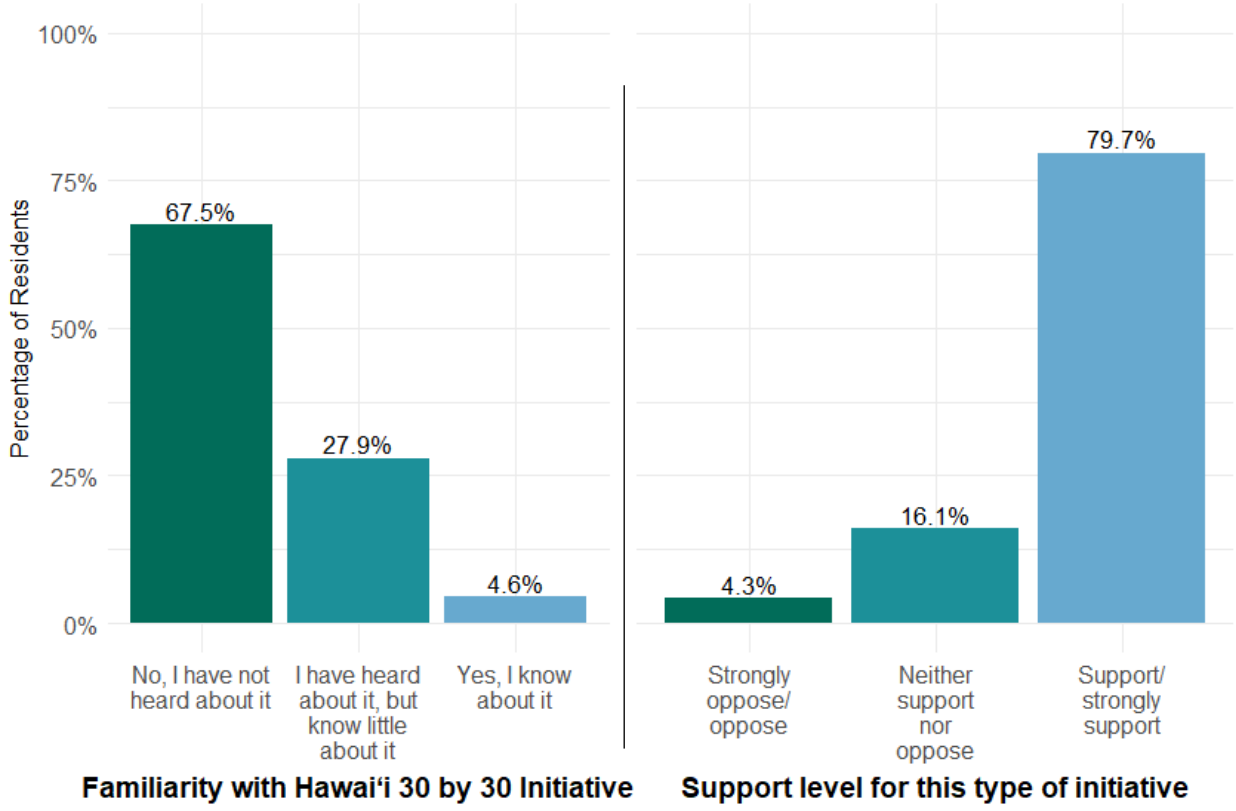


Figure 16: Familiarity with Hawai‘i 30 by 30 Initiative and support level for this type of state-wide conservation initiative.

4.5.3 Support for Management Strategies

Residents were generally supportive of all proposed management strategies to protect coral reefs, with the exception of a establishing a non-commercial fishing license (Figure 17). Residents were most supportive of controlling pollution and restoring damaged coral reefs. Though the establishment of a non-commercial fishing license had the least support, it also had the most uncertainty. By island, Kaua‘i residents were the least supportive of catch limits, improved law enforcement, and cooler inspections, and were most supportive of incorporating traditional Hawaiian practices into coral reef management (Table C17).

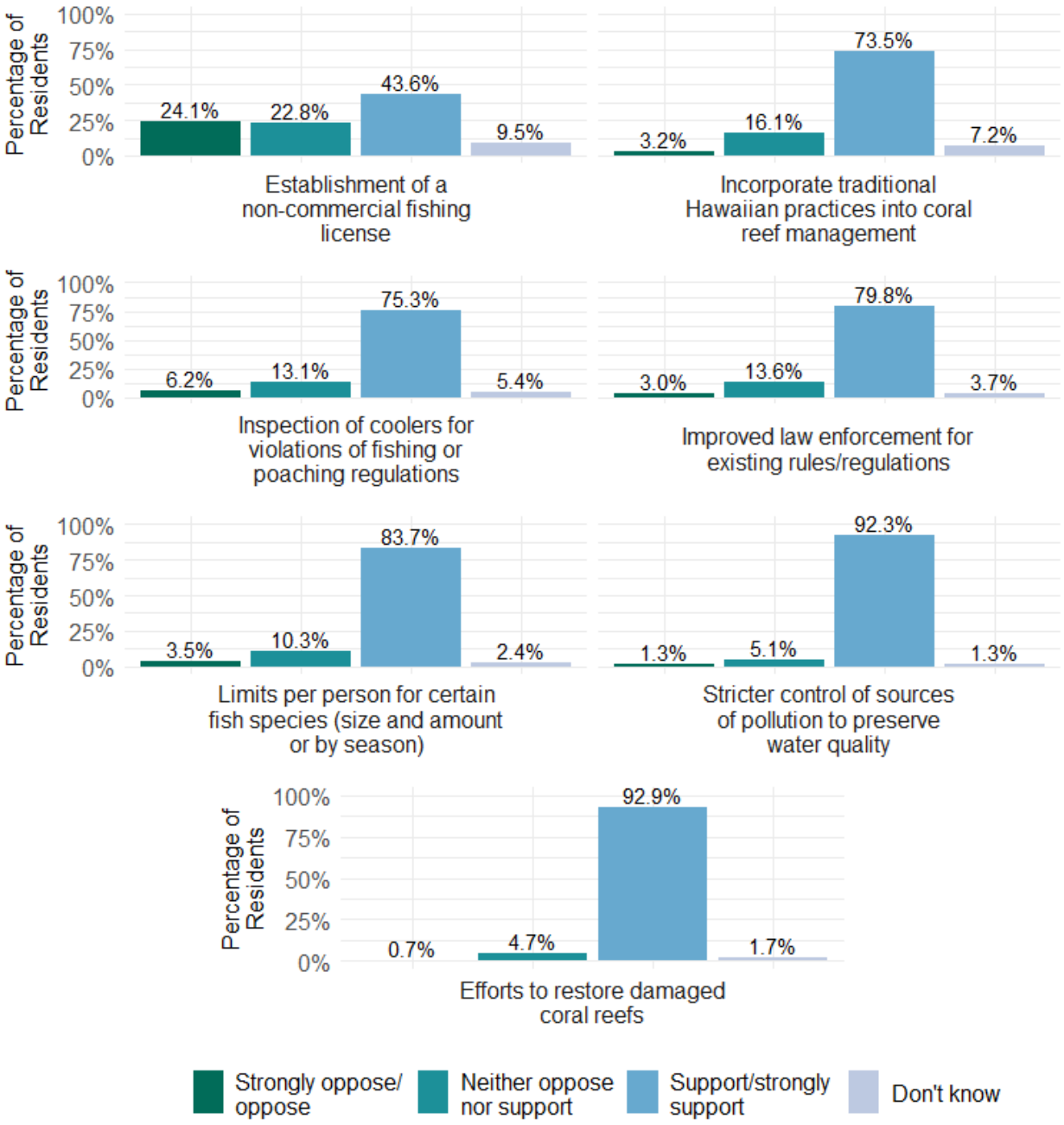


Figure 17: Support for coral reef management strategies.

4.6 Participation in behaviors that may improve coral reef health

Residents were most likely to recycle and use reef-safe forms of sun protection, but were least likely to teach responsible fishing behavior to the next generation or volunteer with environmental groups (Figure 18). By island, residents of East Hawai‘i (island) were least likely

to use reef-safe forms of sun protection, volunteer with environmental groups, or donate to environmental causes (Table C18).

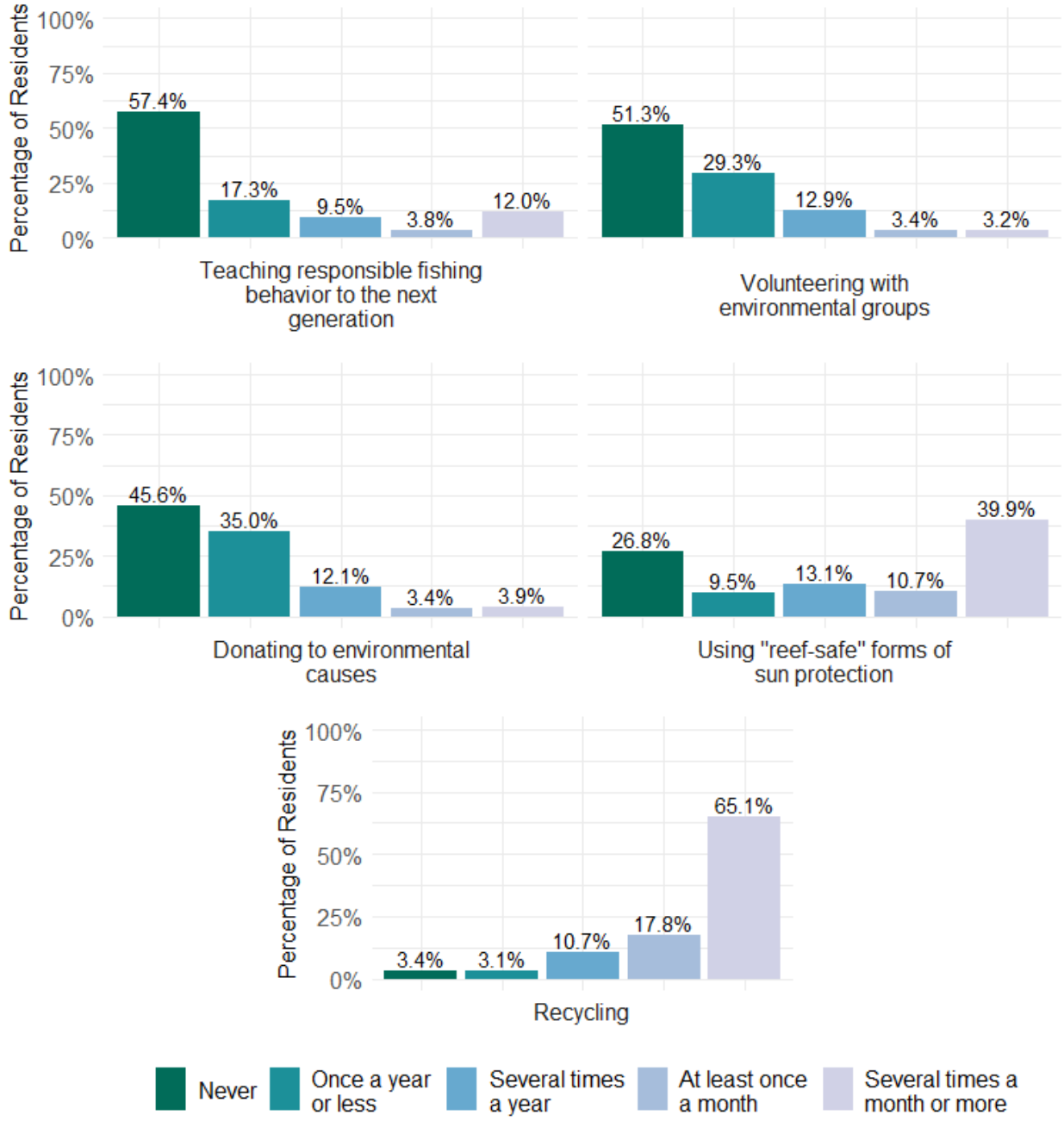


Figure 18: Frequency of participation in pro-environmental behaviors.

4.7 Sources of coral reef information

Radio and community leaders were the least frequently used sources for obtaining coral reef information, and online news sources were most common (Figure 19). By island, O‘ahu residents

were less likely to use community leaders, the Hawai‘i State government, and non-profit organizations (Table C19).

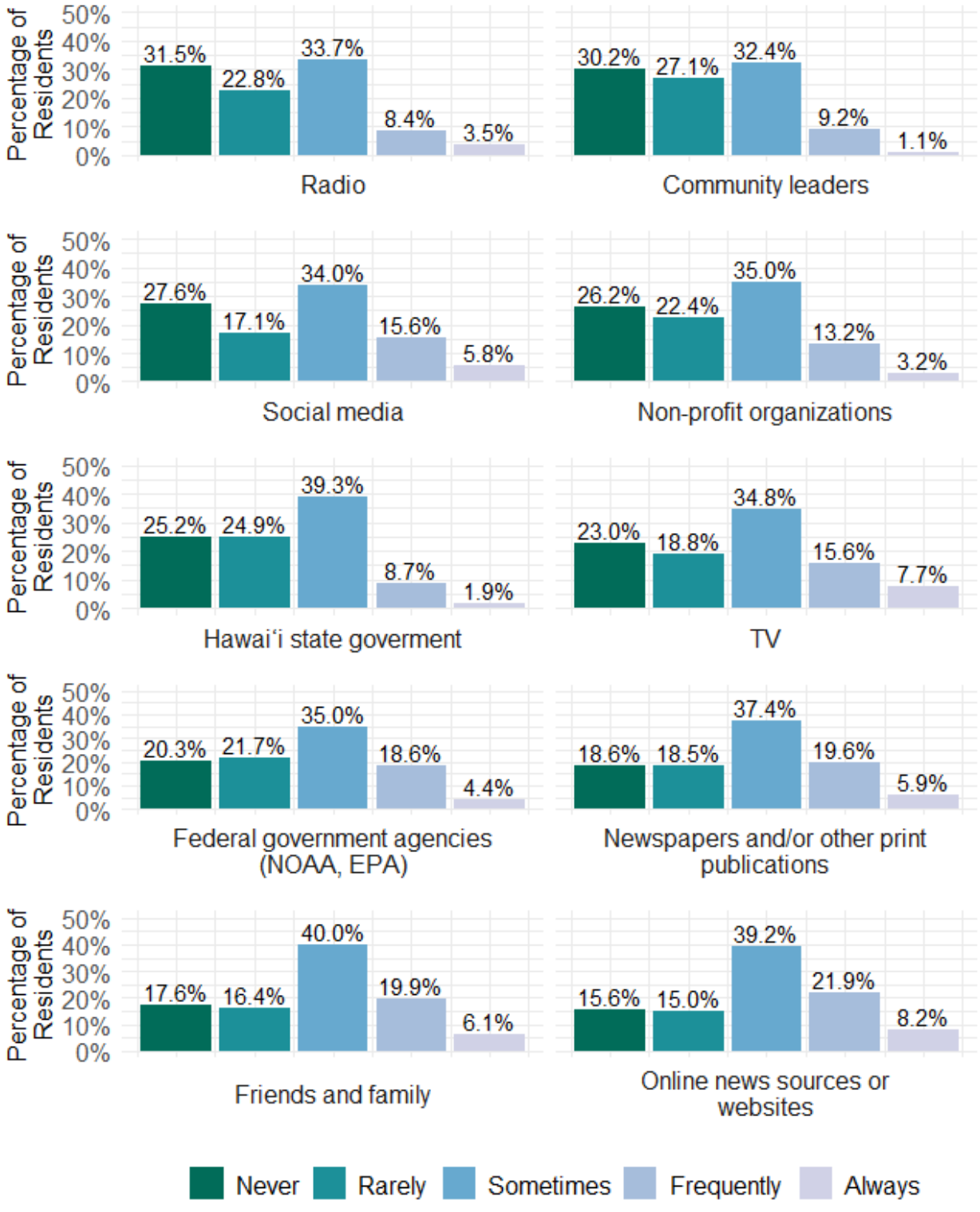


Figure 19: Usage of sources for coral reef-related information.

5. Results: Trend Analysis for 2015 to 2020

With two cycles of survey data from 2015 and 2020, NCRMP is able to track changes in socioeconomic conditions in Hawai‘i over time. While the Hawai‘i survey (Appendix B) underwent some improvements from its first implementation in 2015 to its most recent implementation in 2020, the same indicators are being measured in the survey to allow for data comparisons. Trend analyses of interest are presented below. T-tests were performed to test for statistically significant differences in mean percentages of responses between residents in 2015 and residents in 2020 (*p*-values are indicated in the figures below). Please see Gorstein et al. (2018b) for 2015 monitoring methodology and weighting protocols.

5.1 Participation in coral reef activities

Between 2015 and 2020, resident participation rates in beach recreation, canoeing or kayaking, fishing, snorkeling, swimming or wading, and wave riding were relatively the same (Figure 20). In both survey years, residents most frequently participated in beach recreation and swimming/wading. Since 2015, there was a statistically significant decrease in resident participation in boating (-7.6%), waterside or beach camping (-6.9%), diving for recreation (-5.9%), and gathering of marine resources (-5.9%).[6]

Fishing from shore in Hawai‘i. Photo credit: Keith Kamikawa, NOAA.

[6] “Fishing from boat or shore using a pole, line, or net” and “spear fishing (three-prong, spear gun)” were combined in the 2020 data to be comparable to “fishing for finfish” measured in the 2015 data.

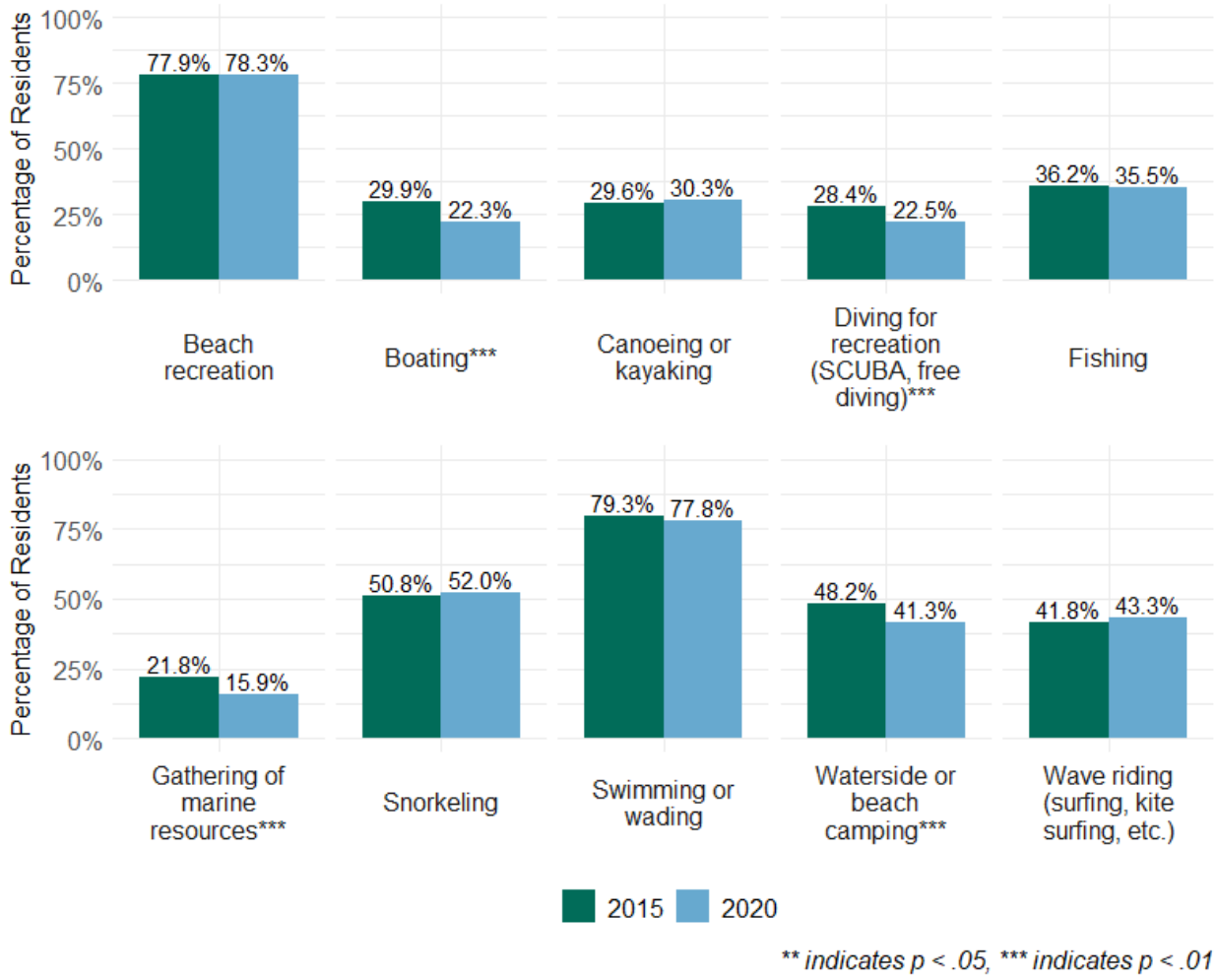


Figure 20: Resident participation in activities during 2015 and 2020.

In order to make comparisons between motivations for participation in fishing and/or gathering in 2015 and 2020 (Figure 21), the five-point frequency scale used in the 2020 survey was recoded into a four-point scale consistent with the 2015 measure ("frequently" and "always" were combined into "frequently or always"). Recoding is a common practice as long as the meaning of the scales is maintained.

Between 2015 and 2020, there were statistically significant differences in four out of five fishing motives (Figure 21). Among those who fished at any frequency, there was a decrease in the percentage of residents who fished to sell their catch (-9.2%) or for special occasions and cultural events (-11.4%). The percentage of residents who fished/gathered for fun, at any frequency, increased by 6.6%. In both survey years, residents generally fished most often to feed themselves and their family or household.

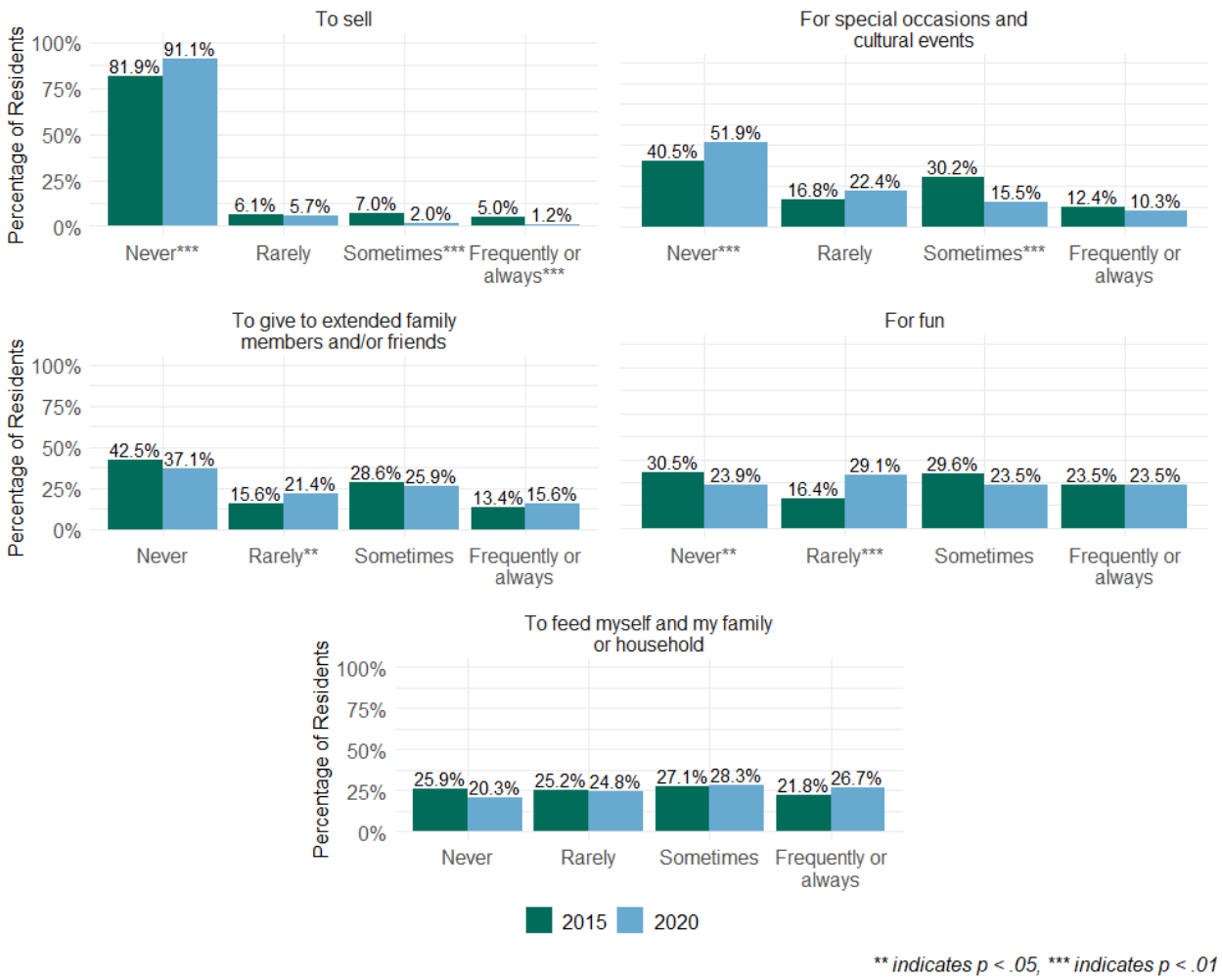


Figure 21: Reasons for resident participation in fishing in 2015 and 2020.

5.2 Reef reliance (seafood consumption)

Overall, there was a decreasing trend in seafood consumption among resident households between 2015 and 2020 (Figure 22). There was a statistically significant decrease in the percent of residents who consumed seafood every day (-2.7%) or a few times a week (-7.1%), but a 7.4% increase in residents who consumed seafood 1-3 times a month. In both 2015 and 2020, nearly one-third of residents ate seafood about once a week, and only 3% never consumed seafood.

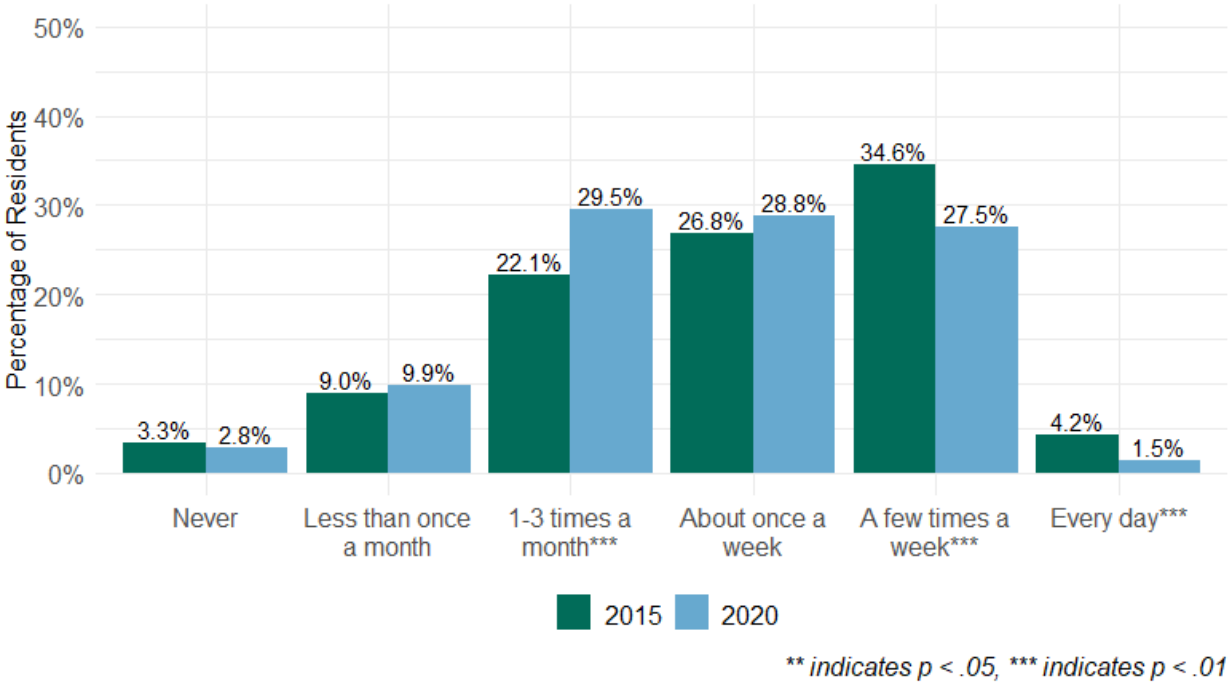


Figure 22: Frequency of resident seafood consumption in 2015 and 2020.

5.3 Perceived resource conditions

Perceptions of current resource conditions in 2015 and 2020, perceptions of change in resource conditions over 10-year intervals, and resident beliefs about how those conditions will change in the future were compared.

5.3.1 2015 and 2020 perceived resource conditions

The current condition of four marine resources were asked about in both the 2015 and 2020 surveys: ocean water quality, amount of coral, number of fish, and variety of fish. In general, residents' perceptions of all four resource conditions became more negative in 2020 (Figure 23). The percentage of residents who were "not sure" about these conditions remained the same in 2020, but overall, residents were most confident in their perception of ocean water quality (only 4-5% were "not sure" in both survey years).

Ocean water quality was perceived as being in the best condition (relative to other resources), but perceptions became worse in 2020, as indicated by a 22.4% decrease in the percent of residents who thought this resource was in good or very good condition. This decline was the largest change in perceptions of a resource condition. The amount of live coral was perceived as being in relatively the worst condition, and this perception became more negative in 2020, as indicated by a 15.5% increase in bad or very bad perceptions.

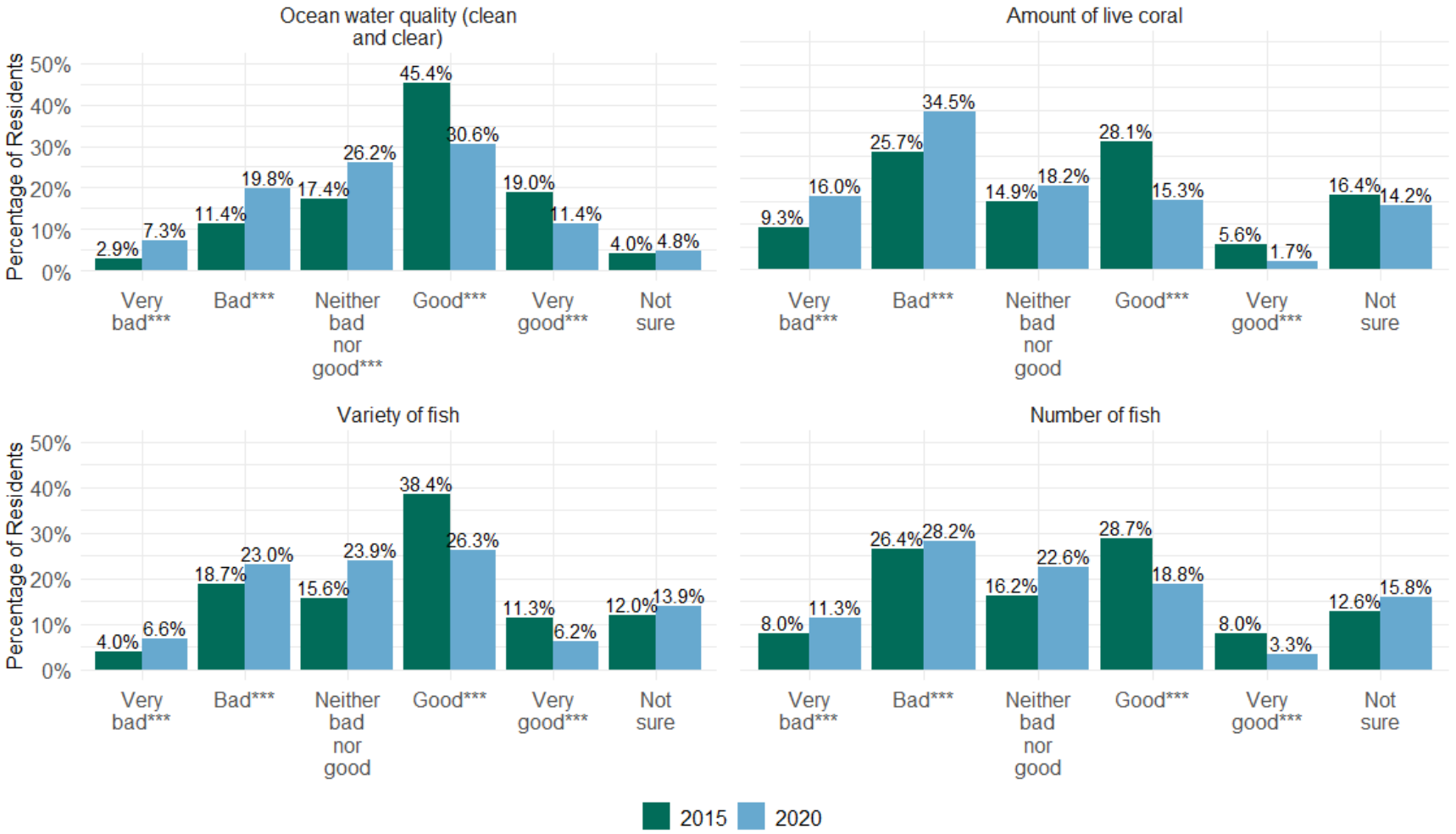


Figure 23: Resident perceptions of current resource conditions in 2015 and 2020.

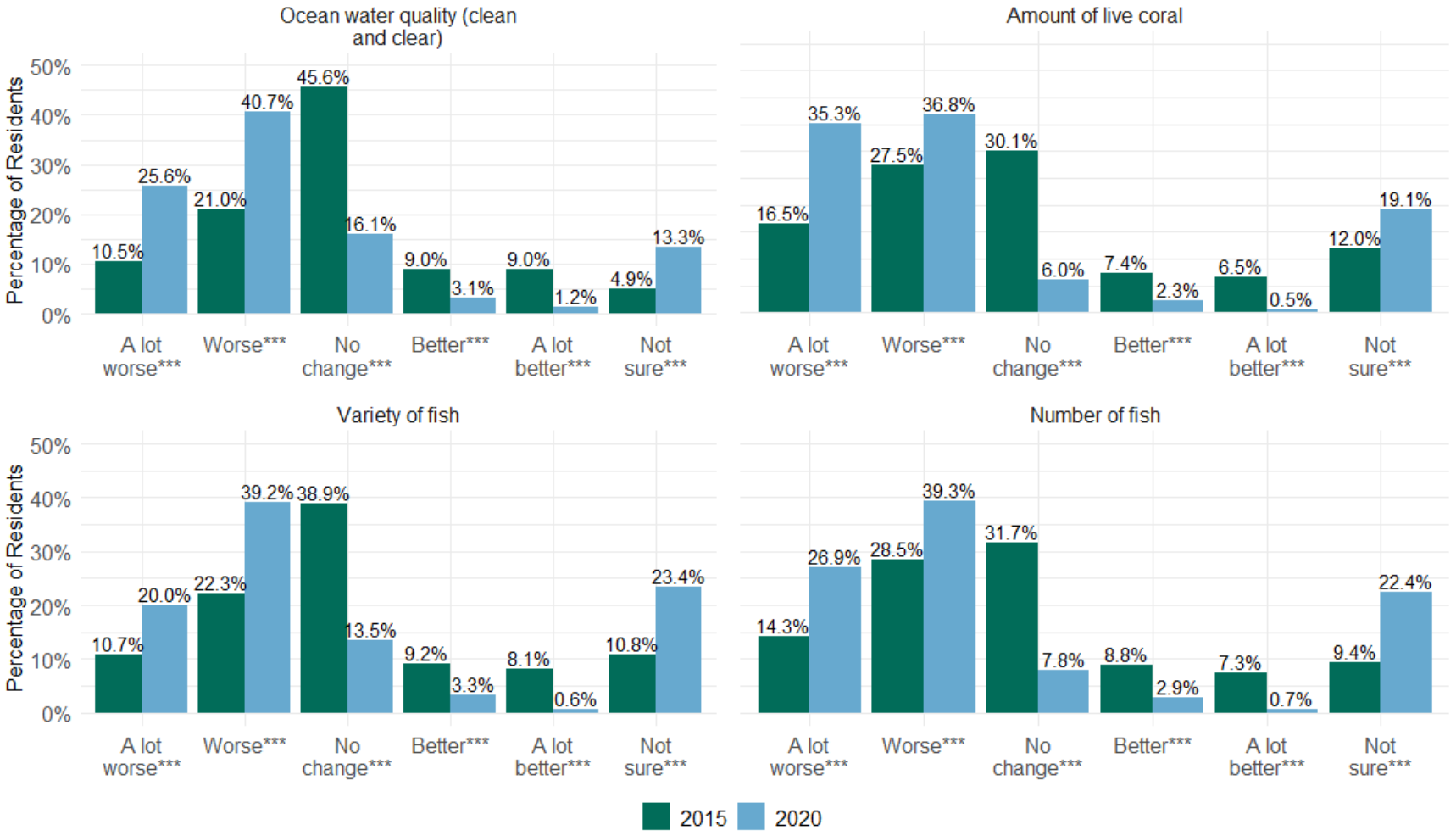
5.3.2 Changes in perceived resource conditions in 10-year intervals

In the 2015 and 2020 surveys, residents were asked how much resource conditions had changed over the past ten years (over 10-year intervals). These perceptions reflected perceived changes during the ten-year periods of 2005-2015 and 2010-2020.

Generally, in 2020, more residents believed that resource conditions had become worse over the past ten years (2010-2020), compared to resident perceptions of change in 2015 (2005-2015) (Figure 24).

The largest difference between the 2015 and 2020 evaluations was a 34.8% increase in residents who thought the condition of ocean water quality had become worse or a lot worse over the past ten years (2010-2020). Residents in 2020 were also less sure about how resource conditions had changed over the past ten years, especially for the number and variety of fish.

School of Convict Tang or Convict Surgeonfish (*Acanthurus triostegus sandvicensis*) in the Northwestern Hawaiian Islands, Papahānaumokuākea Marine National Monument. Credit: NOAA



*** indicates p < .05, *** indicates p < .01*

Figure 24: Resident perceptions of changes in resource conditions over the past 10-year interval (2005-2015 and 2010-2020).

5.3.3 Change in overall resource quality in the next 10-year interval

In the 2015 and 2020 surveys, residents were asked how much they believe the overall quality of resources will change in the next ten years (in 10-year intervals). These beliefs reflected future changes over the ten-year periods of 2015-2025 and 2020-2030.

In both survey years, the highest percent of respondents believed that resources will get worse in the next 10-year interval, and this percent increased by 10.8% in 2020 (Figure 25). In 2020, the percent of "not sure" responses increased by 9.6%, indicating that residents were less confident in 2020 compared to in 2015 regarding their beliefs about how resources will change in the future.

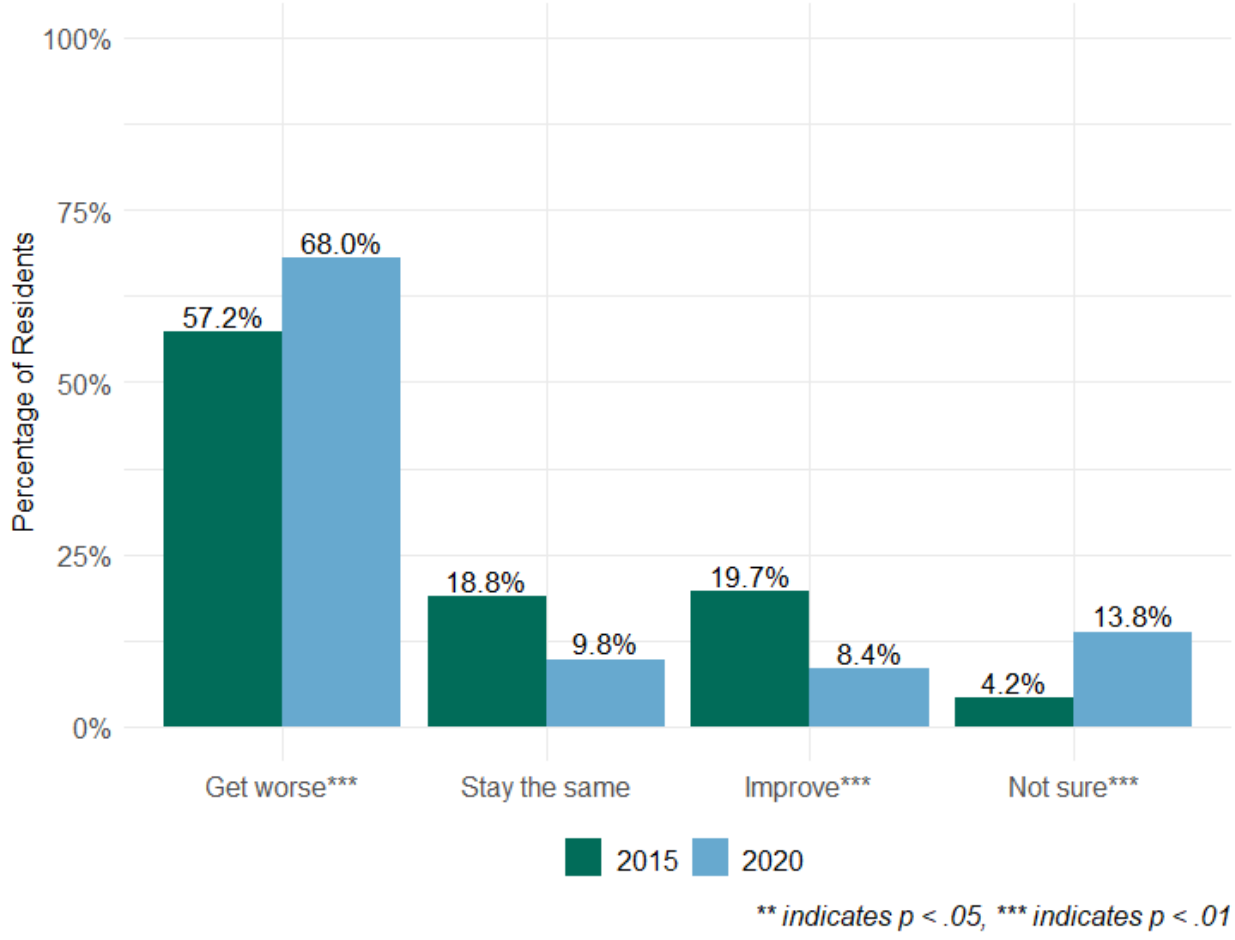


Figure 25: Residents' beliefs in 2015 and 2020 about how the overall quality of resources will change over the next 10-year interval (2015-2025 and 2020-2030).

5.4 Importance of coral reefs

Four statements rated by residents in 2015 and 2020 on the importance of corals reefs were compared (Figure 26). In both survey years, the majority of residents agreed with the three statements that coral reefs are important to Hawai‘i’s culture, protect Hawai‘i from erosion and disasters, and attract tourists, and disagreed with the statement that coral reefs are only important to fishermen, divers, and snorkelers. From 2015 to 2020, there was an increase in the percent of residents who strongly agreed with each of the first three statements, and an increase in the percent of residents who strongly disagreed with the latter statement. The largest change between 2015 and 2020 was an increase in agreement about the importance of coral reefs to Hawai‘i’s culture. Finally, residents were less certain in 2020 about coral reef protection from erosion and natural disasters (more residents were “not sure” about this statement).

Sailing past Mokumanamana, an island known for its numerous religious sites and artifacts. Photo credit: Brad Ka‘aleleo Wong, Office of Hawaiian Affairs.

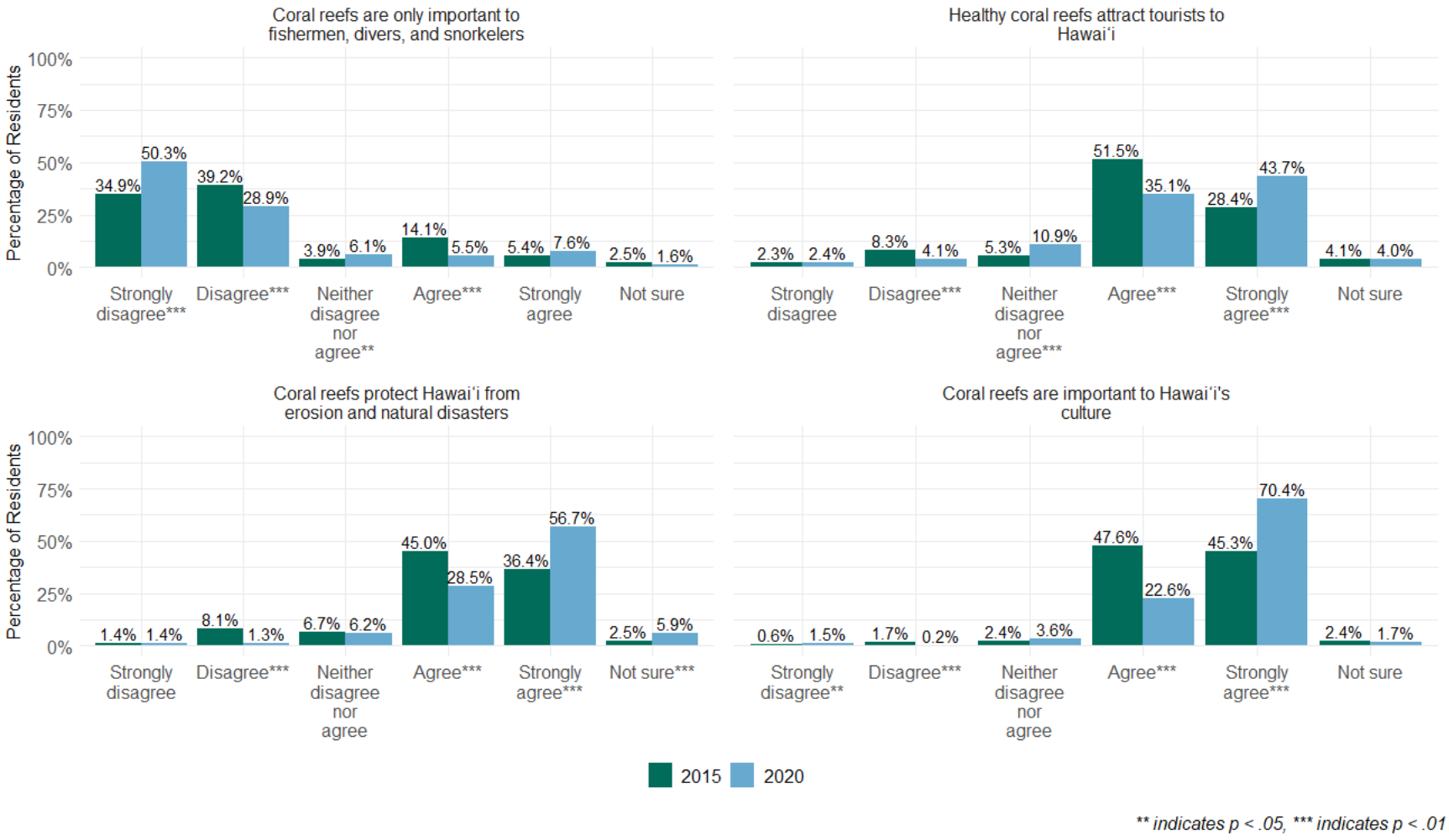


Figure 26: Residents' perceived importance of coral reefs in 2015 and 2020.

5.5 Attitudes toward coral reef management strategies

There were three questions about attitudes toward management strategies that were included in both the 2015 and 2020 survey, and all three had significant differences in the results (Figure 27). In 2015 and 2020, the majority of residents supported limits per person for certain fish species (such as size or quantity limits) and improved law enforcement for existing rules/regulations. However, there were more residents who were indifferent (neither opposed nor supported) about these management strategies in 2020 than in 2015.

The largest change in 2020 was a 17.6% decrease in support for establishment of a non-commercial fishing license. Nearly 25% of residents opposed or strongly opposed this strategy, the least popular of the three, and strong opposition increased from 2015 to 2020. This management strategy also had the largest increase in the percentage of residents who were indifferent in 2020 compared to in 2015. Of the three coral reef management strategies, there were more residents who did not know whether they opposed or supported non-commercial fishing licenses.

Young fishers who caught and safely released a papio. Photo credit: Michael Lameier, NOAA Fisheries.

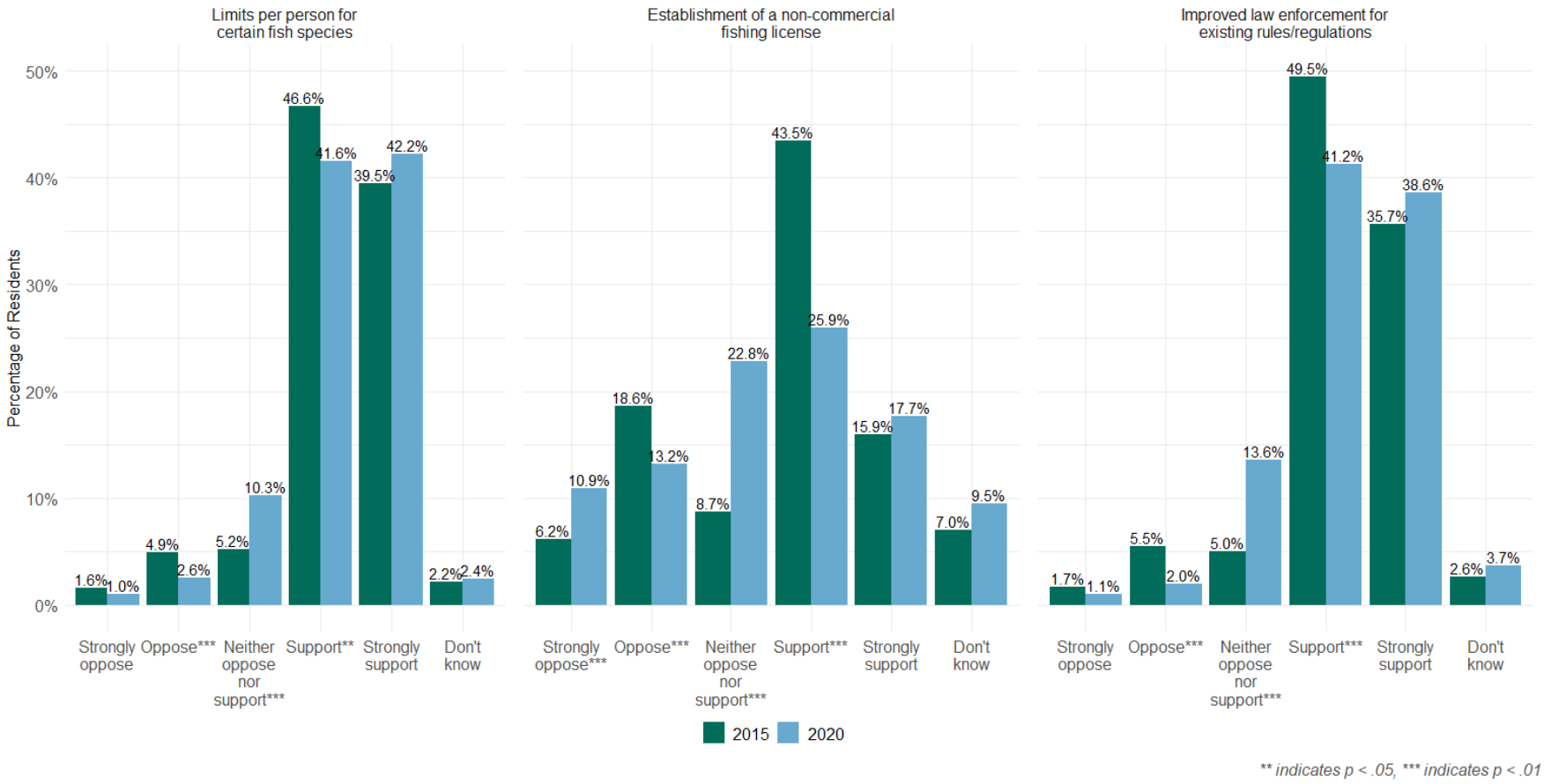


Figure 27: Residents' support for management strategies in 2015 and 2020.

6. Discussion

The interactions between human use and the condition of coral reef ecosystems are important from a management perspective. The results from the 2020 NCRMP socioeconomic survey can inform management on residents' coral reef behaviors and how their actions may be linked to their perceptions, beliefs, and attitudes toward coral reef management strategies in Hawai‘i. Based on the survey findings, some general conclusions about the population of Hawai‘i in 2020 and their interactions with coral reefs are evident. Notable changes or similarities between 2015 and 2020 are also reported. We conclude this section by discussing directions for future research.

6.1 Participation in coral reef activities

Beach recreation, swimming/wading, and snorkeling were primary activities for Hawai`i residents in both 2015 and 2020. While residents most often participated in these three activities, residents also participated in wave riding, waterside or beach camping, fishing, and other activities. As such, it is important for residents to have sufficient access to beaches and coastal areas to use for a variety of purposes. The 2020 survey results indicated a decline in participation in boating, diving for recreation, waterside/beach camping, and the gathering of marine resources. However, the survey data were collected between March and June of 2020, a time which coincided with the onset of the COVID-19 pandemic in the U.S. Thus, it is possible that COVID-19 social distancing and stay-at-home measures influenced decreases in activity participation rates. COVID-19 may have also biased recall of average participation levels, where respondents may have inadvertently provided skewed estimates of their activity participation given recent memory of early pandemic activity patterns.

Some differences in activity participation may also be influenced by geography or differences in the physical coastline. On West Hawai‘i (island), for example, there was higher participation in snorkeling compared to on East Hawai‘i (island) or the other four islands and sub-island. This finding may be due to differences in coastline and ocean conditions. For instance, ocean conditions off the coast of West Hawai‘i (island) are generally calm, creating an ease of access to coral reefs; whereas ocean conditions off the eastern shore are generally rougher and more turbid, creating more difficult access and poorer water visibility.

The popularity of activities among residents has social, environmental, and management implications. High participation in coral reef activities may indicate important benefits being provided by the ecosystem. At the same time, increases in activity participation can also result in higher densities of people in one area, which can further impact the quality of resource conditions, recreational experiences or other social conditions, such as overcrowding or conflict between different activity groups (Manning 1999). Sustained access to activities and the quality of recreational experiences are linked to ecosystem conditions. Beach recreation, for instance, is most directly linked to coral reefs through the protection of beaches from erosion due to storm events (Shivlani, Letson, and Theis 2003). Additionally, reefs provide material for natural beach

replenishment (NOAA CRCP 2015). Swimming/wading and snorkeling depend on ocean water quality for public health and safety, aesthetics, and other benefits, but can also impact the health of corals by introducing toxic sunscreen residues and other transferable chemicals. When feasible, future surveys will incorporate a question on where residents engage in outdoor activities, which could be correlated to habitat and resource conditions.

6.2 Cultural importance of coral reefs

Ecosystem services and culture. *The majority of residents recognized that coral reefs provide a variety of ecosystem services to Hawai'i.* There was a general consensus that coral reefs are important to Hawaiian culture, offer protection from erosion and natural disasters, attract tourists to the region, and provide economic opportunities and food for coastal communities.

Coral reefs have always held a special place in Hawaiian culture and the lives of local communities (Gregg et al., 2015). Residents overwhelmingly believed that *coral reefs are important to their family's cultural beliefs and practices*. While the 2020 survey did not ask about specific types of cultural beliefs and practices, the results suggest that fishing and providing local seafood towards household food self-sufficiency and security is of high cultural and nutritional value in Hawai'i (Grafeld et al., 2017). The large majority of resident households consumed seafood at least once a week in both 2015 and 2020, indicating that residents continued to rely on seafood as a regular food source. Nearly 40% of residents engaged in at least one type of fishing or gathering activity for various reasons, but the primary motivation was to feed themselves or their family. By island, Kaua'i and Maui residents were more likely to fish to give their catch to extended family members and to fish for special occasions and cultural events compared to residents residing on Hawai'i (island) and O'ahu. These findings underscore the need for sustainable management of cultural fishing practices and seafood (Teneva, Schemmel, and Kittinger 2018).

Seafood sourced from local coral reefs. Nearly one-fourth of all residents in Hawai'i consumed locally caught seafood harvested from local coral reefs at least once a month, but nearly three-fourths consumed locally caught seafood from coral reefs annually. One possible explanation is that people who eat seafood may not have known where that seafood came from, and therefore, may not have known how to respond to this survey question. Most residents purchased their seafood at a store or restaurant, where the "sources" may not always be apparent to consumers. Residents who did not fish or gather marine resources were much more likely to get their seafood from a store or restaurant compared to those who did fish or gather.

Residents who fished were likely to be more familiar with the types of species local to reefs (including jacks and surgeonfish that were frequently targeted by residents) and where their seafood came from. Fishers and gatherers often ate seafood that was caught by themselves or someone in their household, their extended family members, and friends or neighbors. This

demonstrates the importance of social exchange and sharing of fish within communities (Leong et al. 2020).

Residents who fished most often targeted jacks, such as Ulua/Papio, or surgeonfish, such as Manini, Palani, or Kala. Jacks have been considered an important food, market and game fish since at least the turn of the century, and have played an important role in Hawaiian religious rites (DLNR, 2000). Surgeonfishes are important to nearshore fisheries and are herbivores that help maintain coral ecosystem. Surgeonfishes were heavily depleted in 2018 (NOAA CRCP 2018), indicating this fish group is extremely desirable and faces high pressure from fishing. In Maui, 50% of residents fished for surgeonfishes but rarely did so. In West Maui, surgeonfishes biomass increased by 40% with the help of Kahekili Herbivore Fisheries Management Area which prohibited removing or killing of surgeonfishes and other herbivores to improve coral health (NOAA CRCP 2018).

6.3 Perceived resource conditions

Perceptions of resource conditions and change. In 2020, residents were most likely to perceive the crowding of beaches as bad or very bad. Negative perceptions of beach crowding have important implications because going to the beach was the number one activity residents participated in. When perceived crowding levels become unacceptable, beach goers may seek alternative beach access areas or may discontinue beach activities altogether. High densities of beach visitors can also lead to the potential for increased impacts to environmental conditions if left unmanaged. Monitoring visitor density and perceived crowding levels informs management whether the quality of recreational (and environmental) conditions are at risk.

Residents believed that the *quality of marine resources in general had become worse over the past ten years*, and that *conditions are likely to become worse in the future*. These changing conditions could have a negative impact on the activities residents frequently participate in (such as beach recreation, swimming and snorkeling) and the quality of benefits and experiences that these activities provide. For instance, negative perceptions of ocean water quality and the amount of coral suggests that these are critical issues to manage. These findings indicate residents' perspectives of how resource conditions are changing, but do not necessarily reflect their values or perceived importance of these resources. These perceptions can have important implications for resource managers who wish to identify and respond effectively to locally important issues and problems.

Residents were least certain about how the amount and variety of fish had changed, but their perceptions of the amount of coral seem to be consistent with actual observations showing a decrease in coral cover, such as the sequence of mass bleaching events that occurred between 2014 and 2019 (Jones et al. 2021; NMFS 2019; NOAA 2018). Residents who fished or gathered, on the other hand, were more certain about the conditions of fish numbers and variety and how conditions have changed. This highlights the importance of local knowledge, as individuals who

regularly observe, pursue, and use living marine resources tend to possess a wealth of understanding about the marine environment.

6.4 Awareness of threats to coral reefs

Residents' perceptions of how resource conditions have changed (and will change in the future) can be connected to their awareness of coral reef threats. While the survey did not ask about the impacts of each threat on particular resource conditions, further analysis could examine the links between residents' awareness of threats and their perceptions of resource change. The survey found that residents were familiar with a variety of threats facing coral reefs, including climate change, but were *least familiar with ocean acidification*. National awareness of ocean acidification has been shown to vary (The Ocean Project 2012, Mossler et al. 2017, Cooke and Kim 2019), so more communication and outreach needed to enhance public awareness of climate change impacts, such as ocean acidification, and how these issues threaten not only coral reefs but also daily lives in Hawai‘i.

Residents were *most familiar with threats from pollution, sunscreen, and overfishing*. These are immediate threats that can impact ocean water quality, the amount of coral, and fisheries, all of which were conditions residents believed would become worse in the future. Sustaining marine resources and the important ecosystem services provided by coral reefs requires reducing the number of threats and magnitude of negative impacts. Education and outreach campaigns can help to raise public awareness of coral reef issues and individual actions that residents can take. For example, the survey results showing high awareness of sunscreen as a threat to reefs may have been influenced by the widespread coverage of the sunscreen ban by national and international news outlets. Further focus on informing citizens of coral reef issues and the potential costs to people's livelihoods can promote stronger environmental attitudes, stewardship, and active engagement in conservation activities (Danielson et al. 1995).

Together with findings on perceptions of resource conditions, findings on threats to coral reefs can be useful for a) assessing public perceptions regarding the relative degree of success of current management efforts and as a means for indicating how such efforts might be adjusted to accommodate changing conditions; b) designing new management approaches that are readily understood and therefore more likely to be accepted and followed by resource users; and c) adjusting outreach and educational efforts per changing local observations about threats to the local marine environment.

6.5 Attitudes toward coral reef management strategies

Marine Managed Areas. The majority of residents were familiar with Marine Managed Areas (MMAs) in Hawai‘i. By island and sub-island, awareness of MMAs was higher among residents on West Hawai‘i (island) and Maui compared to on East Hawai‘i (island), Kaua‘i, and O‘ahu. This may be due to the higher prevalence of Marine Life Conservation Districts, Fishery

Management Areas, National Marine Sanctuary and other management areas that are in proximity to West Hawai‘i (island) relative to other Hawaiian areas.

Overall, residents would support initiatives to build and maintain healthy and abundant reefs and fisheries. Residents generally *agreed that MMAs help protect coral reefs and increase the number of fish*. However, there was less agreement on whether there should be more MMAs. This finding may be related to the mixed opinions among residents regarding "who" is negatively impacted from the establishment of MMAs, which in this survey, were fishermen and their livelihoods. The survey found that most people tended to support marine resource protection in general. However, it is important to consider that the degree of their support may vary based on how people are differentially impacted by restrictions imposed by an MMA (Bennett et al. 2019, 2020). Future research could examine how level of support varies by stakeholder group, and could also look at preferences people have for different management strategies and regulations. This informs the tradeoffs between resource protection and use, and has implications for social justice (equity, perceived fairness), effective governance, and the success of marine conservation management actions.

Support for strategies to improve coral reef protection. Information on residents' attitudes can provide managers and decision-makers with a better understanding of which kinds of resource management strategies are most likely to be supported by residents. This survey found *strong support (positive attitudes) for coral restoration efforts and stricter control of pollution sources to preserve water quality*. Residents also *support an effort to manage 30% of Hawai‘i's nearshore waters by 2030* to build and maintain healthy reefs and fisheries. Support for these management strategies can be linked to residents' perceptions of changing resource conditions and threats to reefs. The findings suggest that Hawaiian residents want to see efforts to mitigate threats (i.e., pollution) to coral reefs, and prevent resource conditions (ocean water quality and amount of live coral) from becoming worse. This also suggests that, in general, *current management efforts in the region are responding to residents' needs and desires* for healthy reef resources, but *more efforts are needed to address the perception that resource conditions are becoming worse*.

However, the survey results suggest that some management strategies for fishing activities need careful consideration. While many residents supported catch limits per person for certain fish species and the incorporation of traditional Hawaiian practices into coral reef management, the least amount of support was for the establishment of a non-commercial fishing license. Lack of support may be linked to findings on residents' beliefs about the impacts of MMAs on fishing community livelihoods. Understanding resident support for theoretical management strategies is important for managers and policy makers proposing actual rules and regulations. For example, despite declining support for a non-commercial fishing license, a non-resident recreational fishing license (H.B. 1023) was passed during Hawai‘i's 2021 legislative session.[7] Exclusion of

[7] https://governor.hawaii.gov/main/governor-signs-bills-to-protect-hawaiis-ocean-resources/.

residents from this rule may explain its passing. Similarly, the 2021 legislative session also saw the signature of natural resource cooler inspections (H.B. 1022), and the present study found that the majority of residents were supportive of the inspection of coolers for violation of fishing and poaching regulations.

6.6 Participation in behaviors that may improve coral reef health

Residents varied in their participation in pro-environmental behaviors that may help to improve coral reef health. *More than half of residents donated to environmental causes* at any frequency and *almost 40% used reef-safe sunscreen several times a month or more*. Among the islands, residents on West Hawai‘i (island), Kaua‘i, and Maui were likely to participate in conservation activities. While the survey did not ask respondents for reasons why they participated (or did not), higher reports of reef-safe sunscreen use may reflect residents' high participation rates in beach recreation, swimming, and snorkeling, or values for quality beach and water conditions. This may also indicate successful communication and outreach efforts regarding the sunscreen ban. Future surveys could follow up with questions on motivations or constraints to participation in pro-environmental activities. This would help management target communication and outreach efforts to engage citizen participation in stewardship and conservation activities (Kollmuss and Agyeman 2002).

6.7 Future monitoring cycles

There were a few lessons learned from the second NCRMP socioeconomic data collection in Hawai'i related to the survey instrument and questions used to measure the primary indicators. Minor changes were made to the way questions were asked to improve the 2020 survey from the 2015 survey. Moving forward, the NCRMP team will be making additional adjustments to the survey and data collection effort to further improve the accuracy and validity of the type of information generated, while maintaining comparability between monitoring rounds. Some of the improvements include clarity of wording, refinement and consistency of scales, and additional questions to better capture the "cultural importance" and "pro-environmental behavior" indicators. Making these improvements is necessary to achieve more precise and accurate measurement of indicators, but the NCRMP socio team will continue to assess potential comparability concerns between monitoring cycles for data transparency and trend accuracy.

NCRMP continues to collaborate with the biological and climate NCRMP themes and jurisdictional agencies to integrate socioeconomic and biophysical data, and to inform coral reef management and monitoring across all jurisdictions. Comparing perceived coral reef resource conditions to biological data can reveal gaps between residents' perceptions of resources and patterns observed in fisheries, benthic, and climate data. Integration of socioeconomic, biological, and climate NCRMP data provides for a holistic understanding of the socio-ecological connections and implications of the indicators that NCRMP is monitoring. This supports communication of complex data in a way that facilitates resource management decision making.

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Appendix A: 2020 Survey Instrument

OMB SUBMISSION

NOAA Coral Reef Conservation Program
National Coral Reef Monitoring Program (NCRMP)
Resident Coral Reef Survey
OMB Control Number 0648-0646

Survey administered in: English

[ONLINE SCRIPT] Greetings! Welcome to the National Coral Reef Monitoring Program 2020 Hawai´i Survey.

[TELEPHONE SCRIPT] Hello, my name is _____ calling on behalf of the US Department of Commerce and NOAA. We are interested in obtaining your opinions on some important issues related to coral reefs and the environment in Hawai´i. Your household has been selected to participate, and should have received recent mailings from us on how to complete the survey.

[TELEPHONE LANDLINE SCRIPT] – May I please speak to the adult over 18 in your household who had the most recent birthday

a. Selected Person is individual on the phone CONTINUE
b. Selected Person is not available SCHEDULE CALLBACK, WITH _____ THANK CURRENT RESPONDENT, END CALL
c. New individual comes on to the phone – RE-READ INTRODUCTION AND CONTINUE TO S1

S1. [TELEPHONE AND ONLINE SCRIPT] Are you at least 18 years of age?
a. Yes
b. No

IF “NO”, [ONLINE SCRIPT] – Please ask the person over 18 in your household who had the most recent birthday to complete this survey. Thank you.
[TELEPHONE SCRIPT] – Please ask the person over 18 in your household who had the most recent birthday to come to the phone. – RE-READ INTRODUCTION WITH NEW INDIVIDUAL OR SCHEDULE CALLBACK WITH THE SELECTED RESPONDENT
IF NO INDIVIDUAL OVER 18 IN THE HOUSEHOLD EXISTS, TERMINATE THE INTERVIEW

S1A. [TELEPHONE CELLULAR SAMPLE SCRIPT] Are you driving a car or doing anything else that requires your focused attention? (Do not read list) (INTERVIEWER: IF RESPONDENT SAYS YES, READ; Due to safety reasons we will need to call you back at a more convenient time. Thank you.)
1 Yes (SCHEDULE CALL BACK)
2 No

[TELEPHONE AND ONLINE SCRIPT] Your participation is voluntary and will be kept strictly confidential. Notwithstanding any other provisions of the law, no person is required to respond to, nor shall any person

be subjected to a penalty for failure to comply with, a collection of information subject to the requirements of the Paperwork Reduction Act, unless that collection of information displays a currently valid OMB Control Number.

[TELEPHONE AND ONLINE SCRIPT] Public reporting burden for this collection of information is estimated to average 20 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other suggestions for reducing this burden to Erica Towle, National Oceanic and Atmospheric Agency, National Ocean Service, Coral Reef Conservation Program, (1305 East West Highway, Silver Spring, MD, 20910, USA.

S2. [TELEPHONE AND ONLINE SCRIPT] Do you live at least 3 months of the year in Hawai‘i?

a. Yes
b. No

IF “NO”, TERMINATE INTERVIEW

S3. [TELEPHONE AND ONLINE SCRIPT] is your island of residence?

a. Hawai‘i
b. O‘ahu
c. Maui
d. Kauai
e. Other

IF “OTHER”, TERMINATE INTERVIEW

PARTICIPATION IN REEF ACTIVITIES

1. [ONLINE SCRIPT] How often do you participate in each of the following activities in Hawai‘i?

	Never	Once a month or less	2-3 times a month	4 times a month or more
[TELEPHONE SCRIPT] First I’m going to ask you how often you participate in activities relating to fishing and gathering ocean resources – INTERVIEWER – REPEAT SCALE AS NEEDED **[ONLINE VERSION]** ***SUBCATEGORY HEADER OF “Activities related to fishing and gathering ocean resources”***				
Fishing from boat or shore using a pole, line, or net				
Spearfishing (three-prong, spear gun)				
Gathering of marine resources (seaweed, opihi, sea urchins, etc.)				

[TELEPHONE SCRIPT] Now please state how often you participate in the following ocean-activities, not for fishing or gathering resources – INTERVIEWER – REPEAT SCALE AS NEEDED **[ONLINE VERSION]** ***SUBCATEGORY HEADER OF "Ocean activities not related to fishing and gathering ocean resources"***				
Swimming/wading				
Snorkeling				
Diving for recreation (SCUBA, free diving)				
Waterside/ Beach camping				
Beach recreation (beach sports, picnics)				
Boating (sail, motor)				
Canoeing/kayaking				
Wave riding (surfing, kite surfing stand up paddle boarding, body boarding, bodysurfing)				

SKIP PATTERN—IF RESPONDENT ANSWERS 'NEVER' TO ALL ACTIVITIES RELATING TO FISHING AND GATHERING OF OCEAN RESOURCES, THEN SKIP TO #4.

CORAL REEF RELIANCE / CULTURAL IMPORTANCE OF REEFS

2. [TELEPHONE AND ONLINE SCRIPT] How often do you fish for, harvest, or catch marine resources for each of the following reasons in Hawai'i? [TELEPHONE – INTERVIEWER REPEATS SCALE AS NEEDED]

	Never	**Rarely**	**Sometimes**	**Frequently**	**Always**
To feed myself and my family/ household					
To sell					
To give to extended family members and/or friends					
For fun					
For special occasions and cultural events					

3. [TELEPHONE AND ONLINE SCRIPT] How often do you fish for, harvest, or catch the following in Hawai‘i? [TELEPHONE – INTERVIEWER REPEATS SCALE AS NEEDED]

	Never	Rarely	Sometimes	Frequently	Always
Surgeonfish (e.g., manini, palani, kala)					
Parrotfish (e.g., uhu)					
Jacks (e.g., papio, ulua)					
Octopus (tako)					
Limpets (opihi)					

4. [TELEPHONE AND ONLINE SCRIPT] How often do you or your family eat fish/seafood? Family is defined as all persons living under the same roof.
    a. Every day
    b. A few times a week
    c. About once a week
    d. 1-3 times a month
    e. Less than once a month
    f. Never

SKIP PATTERN – IF RESPONDENT ANSWERS ‘NEVER’, THEN SKIP TO #7

5. [TELEPHONE AND ONLINE SCRIPT] How often do you or your family eat **locally-caught** fish/seafood that is harvested **from coral reefs**? (For example, things like parrotfish, goatfish (kumu), surgeonfish, octopus, crab or opihi from nearby coral reefs)?
    a. Every day
    b. A few times a week
    c. About once a week
    d. 1-3 times a month
    e. Less than once a month
    f. Never
    g. Not sure

6. [TELEPHONE AND ONLINE SCRIPT] How often do you get your fish or seafood that your family eats from the following sources? [TELEPHONE – INTERVIEWER REPEATS SCALE AS NEEDED]

	Never	Rarely	Sometimes	Frequently	Always
Purchased by myself or someone in my household at a store or restaurant					
Purchased by myself or someone in my household at a market or roadside vendor					
Caught by myself or someone in my household					
Caught by extended family members					
Caught by friends or neighbors					

7. [TELEPHONE AND ONLINE SCRIPT] To what extent are coral reef environments unimportant or important to you and your family's cultural beliefs and practices?
    a. Very unimportant
    b. Unimportant
    c. Neither unimportant nor important
    d. Important
    e. Very important

AWARENESS AND KNOWLEDGE OF CORAL REEFS – Threats including climate change

8. [TELEPHONE AND ONLINE SCRIPT] Please state the extent to which you disagree or agree with each of the following statements. [TELEPHONE – INTERVIEWER REPEATS SCALE AS NEEDED]

	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree	Not Sure
Coral reefs protect Hawai'i from erosion and natural disasters.						
Coral reefs are only important to fishermen, divers and snorkelers.						
Coral reefs in good condition attract tourists to Hawai'i.						
Coral reefs in good condition provide food for coastal communities to eat						

Coral reefs provide economic opportunities to coastal communities						
Coral reefs are important to Hawai‘i’s culture.						

9. [TELEPHONE AND ONLINE SCRIPT] How familiar are you with each of the following potential threats facing the coral reefs in Hawai‘i? [TELEPHONE – INTERVIEWER REPEATS SCALE AS NEEDED]

	Not at All	Slightly	Somewhat	Moderately	Extremely
Climate change					
Coral bleaching					
Hurricanes and other natural disasters					
Pollution (stormwater, wastewater, chemical runoff and trash/littering)					
Coastal/urban development					
Invasive species					
Too much fishing and gathering					
Damage from ships and boats					
Damage to reefs from trampling, standing etc.					
Ocean Acidification					
Sunscreen and lotions with chemicals toxic to coral reefs					

PERCEIVED RESOURCE CONDITION

10. [TELEPHONE AND ONLINE SCRIPT] In your opinion, how would you rate the current condition of each of the following marine resources in Hawai‘i? Please tell me if you would rate each one as very bad, bad, neither bad nor good, good, or very good. [TELEPHONE – INTERVIEWER REPEATS SCALE AS NEEDED]

	Very Bad	Bad	Neither Bad nor	Good	Very Good	Not Sure
Ocean Water Quality (clean and clear)						
Amount of Live Coral						
Number of Fish						

Variety of Fish						
Crowding of Beaches						

11. [TELEPHONE AND ONLINE SCRIPT] How would you say the condition of each of those same marine resources has changed in the past 10 years in Hawai'i? Would you say the resource has gotten a lot worse, gotten somewhat worse, not changed, gotten somewhat better, or gotten a lot better? [TELEPHONE – INTERVIEWER REPEATS SCALE AS NEEDED]

	A lot Worse	**Somewhat Worse**	**No Change**	**Somewhat Better**	**A lot Better**	**Not Sure**
Ocean Water Quality (clean and clear)						
Amount of Live Coral						
Number of Fish						
Variety of Fish						
Crowding of Beaches						

12. [TELEPHONE AND ONLINE SCRIPT] In the next 10 years, do you think the condition of the marine resources overall in Hawai'i will get worse, stay the same or improve?
    a. Get worse
    b. Stay the same
    c. Improve
    d. Not sure

ATTITUDES TOWARDS CORAL REEF MANAGEMENT STRATEGIES AND ENFORCEMENT

13. [TELEPHONE AND ONLINE SCRIPT] Have you heard about the State of Hawaii's effort to improve management of nearshore marine waters by 2030 (the "30 by 30 Initiative")?
    a. Yes, I know about the effort
    b. I have heard about the effort, but I do not know much about it
    c. No, I have not heard about the effort

14. [TELEPHONE AND ONLINE SCRIPT] Would you oppose or support a statewide effort led by the Division of Aquatic Resources in consultation with local communities to effectively manage 30% of Hawai'i's nearshore waters by 2030 to build and maintain healthy and abundant reefs and fisheries for Hawai'i's people?
    a. Strongly oppose
    b. Oppose
    c. Neither support nor oppose

d. Support
e. Strongly support

15. [TELEPHONE AND ONLINE SCRIPT] A Marine managed area is an area of the ocean where human activity is typically restricted to protect living, non-living, cultural, and/or historic resources, such as Marine Life Conservation Districts and community based subsistence fishing areas in Hawai‘i. How familiar are you with Marine managed areas?
    a. Not at All
    b. Slightly
    c. Somewhat
    d. Moderately
    e. Extremely

SKIP PATTERN—IF RESPONDENT ANSWERS ‘NOT AT ALL’, THEN SKIP TO #17.

16. [TELEPHONE AND ONLINE SCRIPT] Please describe the extent to which you disagree or agree with each of the following statements. [TELEPHONE – INTERVIEWER REPEATS SCALE AS NEEDED]

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Not Sure
Marine managed areas protect coral reefs in Hawai‘i						
Marine managed areas increase the number of fish in Hawai‘i						
There should be more marine managed areas in Hawai‘i						
There has been economic benefit to Hawai‘i from the establishment of marine managed areas						
Fishermen’s livelihoods have been negatively impacted from the establishment of marine managed areas in Hawai‘i						
Marine managed areas increase tourism in Hawai‘i						
I generally support the establishment of marine managed areas in Hawai‘i						

17. [TELEPHONE AND ONLINE SCRIPT] Next, please describe the extent to which you oppose or support each of the following strategies to improve the protection of coral reefs in Hawai‘i. [TELEPHONE – INTERVIEWER REPEATS SCALE AS NEEDED]

	Strongly Oppose	Oppose	Neither Support nor Oppose	Support	Strongly Support	Don't Know
Limits per person for certain fish species (size and amount or by season)						
Stricter control of sources of pollution to preserve water quality						
Efforts to restore damaged coral reefs						
Incorporate traditional Hawaiian practices into coral reef management						
Improved law enforcement for existing rules/regulations						
Establishment of a non-commercial fishing license						
Inspection of coolers for violations of fishing or poaching regulations						

PARTICIPATION IN BEHAVIORS THAT MAY IMPROVE CORAL HEALTH

18. [TELEPHONE AND ONLINE SCRIPT] How often do you participate in the following activities to protect the environment in Hawai‘i? [TELEPHONE – INTERVIEWER REPEATS SCALE AS NEEDED]

	Never	Once a year or less	Several times a year	At least once a month	Several times a month or more
Recycling					
Teaching responsible fishing behavior to the next generation					
Volunteering with environmental groups (e.g. beach clean-ups)					
Donating to environmental causes					
Using "reef-safe" forms of sun protection					

19. [TELEPHONE AND ONLINE SCRIPT] Please carefully consider the following HYPOTHETICAL plan to protect coral reefs in Hawai‘i:

    There is a need to raise funds to improve management of coral reefs. IF the state government of Hawai‘i was considering adding a “Reef Conservation Tax” to your income and property taxes to raise these funds, the funds generated from the “Reef Conservation Tax” would go directly to agencies involved in the conservation of coral reefs. The funds would pay for some of the management actions described in previous questions in this survey. These management activities would improve the amount of reef fish, reduce pollution from the land, and restore damaged coral reefs.

    Suppose, in order to implement the new policy, Hawai‘i had to call a statewide referendum where all residents over age 18 were asked to vote on the amount of the tax increase. If the majority of persons vote for the increase, then the tax would be implemented.

    Please note, there is currently NO actual tax under consideration.

    If the proposed hypothetical tax were to cause your household expenses to increase by $XX per year, or in other words, $Y extra per month,[8] how would you vote? Please consider what decision you would make if you really had to spend the extra money, given your current budget.

    (CHECK ONLY ONE ANSWER)
    YES
    NO

SKIP PATTERN-- If respondent answers “yes” to Q19, skip to #21:

20. [TELEPHONE AND ONLINE SCRIPT] What are the main reasons you would vote no on the “Reef Conservation Tax”? (ONLINE- CHECK ALL THAT APPLY) [INTERVIEWER – READ LIST; RECORD ALL THAT APPLY]
    a. This increased tax would be too expensive for me
    b. I don’t trust the government to give the money to the environmental agencies
    c. I don’t think the environmental agencies are effective
    d. I prefer to donate directly to environmental organizations
    e. I don’t believe in raising taxes on principle
    f. I think that current management is effective and doesn’t require more economic resources
    g. Other

[8] Bid range: $10, $25, $50, $100, $250, $500

21. [TELEPHONE AND ONLINE SCRIPT] How often do you use each of the following sources of information to provide you accurate information on coral reefs and coral reef related topics in Hawai‘i?

Sources	Never	Rarely	Sometimes	Frequently	Always
Newspapers, magazines, other print publications					
Radio					
TV					
Online news sources/websites					
Social Media					
Friends and family					
Community leaders					
State Government					
Federal government agencies (NOAA, EPA)					
Non-profit organizations					
Other, please specify					

DEMOGRAPHICS

[TELEPHONE SCRIPT] I just have a few more questions that will help us to interpret our results. As a reminder, the information you provide is completely confidential.
[ONLINE SCRIPT] There are just a few more questions that will help us to interpret our results. As a reminder, the information you provide is completely confidential.

22. [TELEPHONE AND ONLINE SCRIPT] Are you male or female?
    a. Male
    b. Female

23. [TELEPHONE AND ONLINE SCRIPT] What is your year of birth? _____

24. [TELEPHONE AND ONLINE SCRIPT] How long have you lived in Hawai‘i?
    a. 1 year or less
    b. 2-5 years
    c. 6-10 years
    d. more than 10 years
    e. all my life

25. [TELEPHONE AND ONLINE SCRIPT] What is your ZIP code? _____

26. [TELEPHONE AND ONLINE SCRIPT] What race/ethnicity do you consider yourself?
    a. Native Hawaiian
    b. White/Caucasian
    c. Asian
    d. Chinese
    e. Filipino
    f. Japanese
    g. Korean
    h. American Indian or Alaskan Native
    i. Black or African American
    j. Micronesian (e.g., Carolinian, Chamorro, Chuukese, Palauan)
    k. Samoan
    l. Thai
    m. Tongan
    n. Vietnamese
    o. Hispanic or Latino
    p. More than one race/ethnicity
    q. Other
    r. No response

27. [TELEPHONE AND ONLINE SCRIPT] What is the highest level of education you have completed
    a. 8th Grade or Less
    b. Some high school
    c. High School Graduate, GED
    d. Some college, community college or AA
    e. College Graduate
    f. Graduate School, Law School, Medical School
    g. No Response

28. [TELEPHONE AND ONLINE SCRIPT] What is your current employment status?
    a. Unemployed
    b. Student
    c. Employed full time
    d. Homemaker
    e. Employed part time
    f. Retired
    g. No Response

29. [TELEPHONE AND ONLINE SCRIPT] Is your current or most recent occupation related to the marine environment/industry?

a. Yes
b. No

SKIP PATTERN—IF RESPONDENT ANSWERS 'NO', THEN SKIP TO #31.

30. [TELEPHONE AND ONLINE SCRIPT] Please indicate the industry that best fits your current or most recent occupation.
    a. Commercial fishing
    b. Charter fishing
    c. Dive/snorkel operation
    d. Marina/boat operation
    e. Other watersports
    f. Eco-tour operation
    g. Ecological research
    h. Ocean/coastal management
    i. Artisan
    j. Education
    k. Other, please specify _____

31. [TELEPHONE AND ONLINE SCRIPT] How many adults aged 18 years or older live in your household, including yourself? _____

32. [TELEPHONE AND ONLINE SCRIPT] Do you own a working cellphone, landline, or both?
    a. Cellphone
    b. Landline
    c. Both

33. [TELEPHONE AND ONLINE SCRIPT] What is your annual household income?
    a. Under $10,000
    b. $10,000-19,999
    c. $20,000-29,999
    d. $30,000-39,999
    e. $40,000-49,999
    f. $50,000-59,999
    g. $60,000-74,999
    h. $75,000-99,999
    i. $100,000-149,999
    j. $150,000 or More
    k. No Response

[TELEPHONE AND ONLINE SCRIPT] Thank you for taking the time to provide your responses for the NOAA National Coral Reef Monitoring Program 2020 Hawaii survey.

Appendix B: Data Collection Protocols and Weighting Efforts

B.1 Data Collection

A random sample of households proportional to stratum size was selected using stratified systematic sampling. The survey was then administered using a two-phase approach.

In phase one, 17,501 home addresses were sent letters inviting respondents to complete the survey either online (survey link) or by phone (toll-free number), and each letter contained a unique respondent passcode. Invitations were printed on NOAA letterhead and stated the purpose of the survey and the importance of their voluntary and confidential participation. Contact information and the survey's Office of Management and Budget (OMB) control number were also provided. If there was no response to the initial letter, a reminder post card was sent. If there was no response to the reminder post card, a follow-up phone call was made by trained phone surveyors to the cell phone or landline number associated with the address, if available.

In phase two, 6,000 additional home addresses were sent the same letters used in phase one, with the same post card and telephone follow-up protocols in place. Further, in an effort to boost response rates of the existing sample, select addresses from phase one (8,656 out of the original 17,501)[9] were sent a second reminder letter and postcard, but did not receive telephone follow-up calls. In total, 23,501 home addresses were contacted and 2,700 respondents completed the survey (2,407 respondents completed the survey by web and 293 completed the survey by phone). All results were self-reported by survey respondents.

B.2 Weighting

Data were weighted to account for sample design and non-response, and then calibrated based on key variables (age category, gender, education, race, and household income) within each stratum to ensure data were representative of the adult population of Hawai‘i. This was accomplished through iterative proportional fitting, a method commonly referred to as "raking." Iterative proportional fitting creates a weight for each survey respondent to help the sample become more representative of true population characteristics. In this analysis, weights were created to match five of the survey sample's demographic data to the true demographic characteristics of the Hawai‘i population: sex (male, female), age group (18-34, 35-44, 45-54, 55-64, and 65 or older), education level (some college or less, college degree or higher), race (White, Asian, Native Hawaiian/Pacific Islander, Other Races), and median household income (less than $50,000, $50,000-99,999, $100,000-149,000, $150,000 or higher). These population controls were from the U.S. Census Bureau 2018 ACS 5-Year estimates.[10] Finally, weights were trimmed to ensure

[9] These records were based on the original mailing of 17,501 records, but excluded undeliverables, nonrespondents from the telephone follow-up, and those who had at least partially completed the online survey instrument.

[10] U.S. Census Bureau. 2018. 2014-2018 American Community Survey 5-Year Estimates. Electronic dataset. Accessed 8 August 2021 <https://data.census.gov/cedsci/>.

no single final weight dominated the distribution. A comparison between the demographics in the weighted sample is presented in Table B1.

Table B1: Demographics of true population and weighted respondents.

Demographic Variables		Population	Weighted Respondents
Location of Residence	East Hawai‘i Island	8.2	9.5
	West Hawai‘i Island	5.8	6.6
	Kaua‘i	5.0	6.0
	Mau‘i	11.0	13.0
	O‘ahu	70.1	65.1
Gender	Female	50.1	50.1
Race	White	25.0	27.7
	Asian	37.8	35.4
	Native Hawaiian / Pacific Islander	10.1	8.9
	Other	27.2	28.0
Age	18-34	29.8	20.9
	35-44	16.0	15.3
	45-54	15.8	15.7
	55-64	16.4	17.7
	65+	22.0	30.4
Education	Some college or less	70.2	65.3
	College degree or higher		34.7
Household Income	Under $50,000	31.3	30.3
	$50,000-$99,999	30.7	29.6
	$100,000-$149,999	19.3	20.5
	$150,000 or higher	18.5	19.6

Appendix C: Hawai‘i Island and Sub-Island Results for 2020

Table C1: Proportion of participation in activities by stratum.

Activity	East Hawaiʻi	West Hawaiʻi	Kauaʻi	Maui	Oʻahu	Total
Extractive						
Fishing from boat or shore using a pole, line, or net	45.7%	40.4%	49.3%	41.5%	27.7%	33.3%
Gathering of marine resources (seaweed, opihi, sea urchins, etc.)	20.3%	25.1%	30.5%	27.2%	10.7%	15.9%
Spearfishing (three-prong, spear gun)	15.2%	20.1%	21.8%	23.2%	12.8%	15.4%
Non-extractive						
Beach recreation (beach sports, picnics)	83.9%	81.8%	85.5%	83.9%	75.4%	78.3%
Boating (sail, motor)	17.7%	30.1%	31.9%	37.3%	18.3%	22.3%
Canoeing/kayaking	26.1%	36.8%	40.1%	40.2%	27.4%	30.3%
Diving for recreation (SCUBA, free diving)	23.3%	32.3%	22.8%	34.8%	19.0%	22.5%
Snorkeling	57.4%	77.9%	59.1%	63.7%	45.6%	52.0%
Swimming/wading	78.6%	89.1%	82.1%	85.9%	74.5%	77.8%
Waterside/beach camping	48.1%	50.2%	52.3%	52.7%	36.1%	41.3%
Wave riding (surfing, kite surfing, stand up paddle boarding, body boarding, bodysurfing)	33.2%	49.2%	44.0%	51.9%	42.4%	43.3%

Table C2: Frequency percent of reasons for fishing and gathering reasons by stratum.

Reason	Frequency	East Hawaiʻi	West Hawaiʻi	Kauaʻi	Maui	Oʻahu	Total
To feed myself and my family/household	Never	24.4%	12.2%	8.8%	10.4%	25.3%	20.3%
	Rarely	20.3%	22.1%	15.7%	26.5%	27.2%	24.8%
	Sometimes	24.9%	37.4%	39.5%	35.8%	23.6%	28.3%
	Frequently	6.9%	14.1%	13.7%	7.9%	10.2%	10.0%
	Always	23.5%	14.2%	22.4%	19.4%	13.7%	16.6%
For fun	Never	32.3%	31.7%	26.3%	26.7%	19.4%	23.9%
	Rarely	16.6%	39.0%	20.4%	28.9%	31.8%	29.1%
	Sometimes	27.2%	13.2%	26.4%	24.2%	23.6%	23.5%
	Frequently	11.8%	5.4%	13.0%	14.2%	8.4%	9.9%
	Always	12.1%	10.6%	13.9%	6.0%	16.8%	13.7%
To give to extended family members and/or friends	Never	36.5%	32.6%	22.2%	25.8%	43.6%	37.1%
	Rarely	15.9%	20.7%	16.0%	34.1%	19.8%	21.4%
	Sometimes	35.1%	31.1%	37.2%	24.1%	21.8%	25.9%
	Frequently	3.5%	7.2%	15.3%	5.8%	9.0%	8.2%
	Always	9.0%	8.5%	9.4%	10.2%	5.7%	7.4%
To sell	Never	89.7%	84.4%	83.0%	89.9%	94.1%	91.1%
	Rarely	7.5%	11.9%	6.9%	4.7%	4.4%	5.7%
	Sometimes	0.9%	2.9%	3.7%	4.4%	1.1%	2.0%
	Frequently	1.9%	0.1%	0.1%	0.2%	0.4%	0.5%
	Always	0.0%	0.7%	6.3%	0.7%	0.0%	0.7%
For special occasions and cultural events	Never	51.1%	51.8%	28.8%	32.3%	61.6%	51.9%
	Rarely	20.5%	15.6%	16.2%	34.5%	21.2%	22.4%
	Sometimes	12.7%	15.3%	41.9%	22.0%	10.1%	15.5%
	Frequently	7.6%	5.3%	4.3%	3.4%	5.4%	5.3%
	Always	8.1%	12.0%	8.8%	7.9%	1.7%	5.0%

Table C3: Proportion of frequency of fishing for certain species by stratum.

Species	Frequency	East Hawaiʻi	West Hawaiʻi	Kauaʻi	Maui	Oʻahu	Total
Jacks (e.g., papio, ulua)	Never	37.0%	49.2%	24.0%	37.0%	34.5%	35.6%
	Rarely	39.7%	27.2%	29.1%	23.2%	24.8%	27.0%
	Sometimes	10.0%	21.9%	32.4%	27.0%	26.9%	24.8%
	Frequently	10.7%	1.6%	13.0%	7.4%	7.6%	7.9%
	Always	2.6%	0.2%	1.5%	5.4%	6.2%	4.7%
Limpets (opihi)	Never	56.1%	56.2%	45.0%	43.3%	66.0%	58.4%
	Rarely	24.8%	17.5%	25.3%	32.5%	29.5%	28.0%
	Sometimes	11.6%	17.2%	23.4%	18.6%	3.8%	10.0%
	Frequently	7.5%	9.1%	5.9%	2.7%	0.0%	2.7%
	Always	0.0%	0.0%	0.5%	2.8%	0.7%	0.8%
Octopus (tako)	Never	58.1%	65.2%	55.5%	42.8%	54.7%	54.2%
	Rarely	24.3%	16.4%	20.7%	23.1%	17.3%	19.4%
	Sometimes	10.6%	13.6%	19.8%	25.2%	21.3%	19.8%
	Frequently	7.0%	4.1%	3.1%	4.7%	5.0%	5.0%
	Always	0.0%	0.7%	0.9%	4.2%	1.6%	1.7%
Parrotfish (e.g., uhu)	Never	62.8%	56.8%	55.0%	57.6%	51.6%	54.8%
	Rarely	25.1%	6.2%	22.8%	29.7%	29.2%	26.2%
	Sometimes	5.8%	33.4%	19.8%	11.1%	16.3%	15.9%
	Frequently	6.4%	3.6%	1.9%	0.9%	1.8%	2.4%
	Always	0.0%	0.0%	0.5%	0.7%	1.0%	0.7%
Surgeonfish (e.g., Manini, palani, kala)	Never	43.3%	48.4%	41.2%	50.3%	48.1%	47.3%
	Rarely	29.4%	29.5%	27.1%	29.6%	29.9%	29.5%
	Sometimes	18.1%	20.4%	23.0%	14.1%	16.6%	17.3%
	Frequently	9.3%	1.5%	8.2%	3.9%	3.0%	4.3%
	Always	0.0%	0.2%	0.5%	2.1%	2.3%	1.6%

Table C4: Cultural importance of coral reef environments by stratum.

Importance	East Hawaiʻi	West Hawaiʻi	Kauaʻi	Maui	Oʻahu	Total
Very unimportant/unimportant	17.8%	19.4%	14.2%	11.8%	12.5%	13.5%
Neither unimportant nor important	8.3%	14.3%	9.3%	11.2%	18.4%	15.7%
Important/very important	73.8%	66.3%	76.5%	77.0%	69.1%	70.8%

Table C5: Frequency of seafood consumption by stratum.

Frequency	East Hawaiʻi	West Hawaiʻi	Kauaʻi	Maui	Oʻahu	Total
Never	4.3%	1.3%	3.2%	2.1%	2.8%	2.8%
Less than once a month	16.0%	8.8%	11.5%	9.5%	9.0%	9.9%
1-3 times a month	27.9%	33.2%	29.7%	30.4%	29.2%	29.5%
About once a week	26.4%	31.2%	20.0%	28.5%	29.8%	28.8%
A few times a week	24.6%	23.9%	34.2%	28.1%	27.6%	27.5%
Every day	0.9%	1.7%	1.4%	1.5%	1.5%	1.5%

Table C6: Frequency of seafood consumption from local coral reefs by stratum.

Frequency	East Hawaiʻi	West Hawaiʻi	Kauaʻi	Maui	Oʻahu	Total
Never	25.5%	34.0%	25.4%	27.6%	29.0%	28.6%
Less than once a month	44.5%	36.8%	39.2%	37.0%	37.1%	37.9%
1-3 times a month	13.1%	17.7%	18.5%	24.2%	15.5%	16.7%
About once a week	4.5%	7.2%	5.8%	5.7%	5.6%	5.6%
A few times a week	4.3%	3.2%	6.1%	2.7%	1.7%	2.4%
Every day	0.0%	0.3%	0.0%	0.0%	0.1%	0.1%
Not sure	8.0%	0.8%	4.9%	2.8%	11.1%	8.7%

Table C7: Top two sources of seafood by stratum.

Source	Frequency	East Hawaiʻi	West Hawaiʻi	Kauaʻi	Maui	Oʻahu	Total
Purchased by myself or someone in my household at a store or restaurant	Never	7.3%	4.7%	7.8%	5.3%	6.1%	6.1%
	Rarely	15.5%	17.4%	15.5%	15.7%	11.9%	13.3%
	Sometimes	37.5%	41.6%	44.4%	28.9%	31.4%	33.1%
	Frequently	26.1%	24.5%	22.1%	34.4%	29.2%	28.8%
	Always	13.6%	11.7%	10.2%	15.7%	21.5%	18.7%
Purchased by myself or someone in my household at a market or roadside vendor	Never	33.1%	34.1%	26.9%	27.3%	37.9%	35.1%
	Rarely	18.9%	27.2%	23.2%	22.3%	16.9%	18.9%
	Sometimes	31.4%	24.1%	34.4%	29.1%	22.7%	25.1%
	Frequently	12.5%	10.7%	11.8%	17.9%	14.9%	14.6%
	Always	4.1%	3.9%	3.7%	3.4%	7.6%	6.2%
Caught by myself or someone in my household	Never	46.7%	52.4%	37.8%	49.3%	66.1%	59.5%
	Rarely	25.7%	21.3%	17.8%	25.9%	18.4%	20.2%
	Sometimes	14.6%	18.1%	23.7%	14.8%	10.5%	12.7%
	Frequently	5.3%	6.3%	13.5%	6.2%	2.7%	4.3%
	Always	7.7%	1.9%	7.3%	3.8%	2.3%	3.2%
Caught by extended family members	Never	52.0%	54.2%	38.8%	50.2%	66.1%	60.3%
	Rarely	32.3%	19.1%	22.6%	26.6%	23.0%	24.1%
	Sometimes	8.8%	22.3%	28.7%	18.5%	8.2%	11.8%
	Frequently	1.6%	3.4%	8.3%	2.9%	2.3%	2.8%
	Always	5.2%	0.9%	1.5%	1.7%	0.4%	1.1%
Caught by friends or neighbors	Never	25.3%	23.6%	16.3%	33.5%	49.4%	41.4%
	Rarely	36.8%	41.0%	33.4%	32.4%	29.4%	31.5%
	Sometimes	34.9%	31.6%	37.0%	29.7%	18.0%	23.1%
	Frequently	0.7%	3.6%	10.8%	2.6%	2.8%	3.1%
	Always	2.3%	0.2%	2.5%	1.8%	0.4%	0.9%

Table C8: Perceptions of marine resource current condition by stratum.

Resource	Current condition	East Hawaiʻi	West Hawaiʻi	Kauaʻi	Maui	Oʻahu	Total
Amount of live coral	Very bad/bad	46.5%	45.8%	47.4%	51.7%	51.6%	50.5%
	Neither bad nor good	15.3%	22.6%	18.8%	16.9%	18.5%	18.2%
	Good/very good	17.9%	23.9%	18.8%	15.6%	16.3%	17.0%
	Not sure	20.4%	7.7%	15.0%	15.8%	13.6%	14.2%
Crowding of beaches	Very bad/bad	57.4%	50.6%	61.0%	66.9%	69.5%	66.3%
	Neither bad nor good	26.3%	30.5%	23.7%	17.0%	20.7%	21.6%
	Good/very good	7.4%	14.5%	11.2%	11.4%	6.0%	7.7%
	Not sure	9.0%	4.3%	4.1%	4.7%	3.7%	4.4%
Number of fish	Very bad/bad	40.2%	37.8%	30.4%	38.8%	40.6%	39.5%
	Neither bad nor good	15.6%	20.0%	28.7%	28.0%	22.2%	22.6%
	Good/very good	23.5%	33.0%	25.6%	20.5%	20.8%	22.1%
	Not sure	20.7%	9.2%	15.3%	12.8%	16.4%	15.8%
Ocean water quality (clean and clear)	Very bad/bad	26.5%	19.2%	26.2%	25.8%	28.2%	27.0%
	Neither bad nor good	20.8%	22.7%	25.6%	24.4%	27.8%	26.2%
	Good/very good	43.3%	55.5%	42.3%	44.4%	39.9%	42.0%
	Not sure	9.4%	2.6%	5.9%	5.4%	4.1%	4.8%
Variety of fish	Very bad/bad	30.5%	26.7%	19.7%	30.8%	30.5%	29.6%
	Neither bad nor good	18.5%	21.2%	30.8%	26.5%	23.8%	23.9%
	Good/very good	31.2%	43.8%	34.1%	28.9%	32.1%	32.5%
	Not sure	19.8%	8.2%	15.4%	13.8%	13.6%	13.9%

Table C9: Perceived change in resource conditions over the past ten years by stratum.

Resource	Change in condition	East Hawai'i	West Hawai'i	Kaua'i	Maui	O'ahu	Total
Amount of live coral	A lot worse/somewhat worse	60.4%	73.6%	67.3%	76.6%	73.1%	72.1%
	No change	8.5%	7.8%	5.5%	5.5%	5.7%	6.0%
	Somewhat better/a lot better	4.7%	1.1%	6.7%	3.9%	2.1%	2.8%
	Not sure	26.4%	17.5%	20.5%	14.0%	19.1%	19.1%
Crowding of beaches	A lot worse/somewhat worse	69.0%	80.3%	74.8%	83.1%	79.4%	78.7%
	No change	12.7%	7.0%	8.7%	8.0%	9.9%	9.6%
	Somewhat better/a lot better	1.2%	1.6%	4.8%	3.1%	1.2%	1.7%
	Not sure	17.1%	11.1%	11.7%	5.9%	9.5%	10.0%
Number of fish	A lot worse/somewhat worse	61.3%	62.8%	57.4%	70.2%	67.3%	66.2%
	No change	10.6%	15.7%	9.9%	8.7%	6.2%	7.8%
	Somewhat better/a lot better	3.8%	1.7%	9.2%	3.5%	3.2%	3.6%
	Not sure	24.2%	19.8%	23.5%	17.7%	23.2%	22.4%
Ocean water quality (clean and clear)	A lot worse/somewhat worse	55.8%	58.9%	60.3%	64.4%	69.4%	66.3%
	No change	19.4%	25.1%	17.7%	17.4%	14.3%	16.1%
	Somewhat better/a lot better	5.7%	0.6%	8.6%	5.4%	3.9%	4.3%
	Not sure	19.1%	15.3%	13.4%	12.7%	12.3%	13.3%
Variety of fish	A lot worse/somewhat worse	55.5%	59.5%	52.1%	61.1%	60.1%	59.3%
	No change	14.9%	21.0%	18.4%	15.1%	11.7%	13.5%
	Somewhat better/a lot better	3.8%	1.5%	4.9%	3.5%	4.1%	3.9%
	Not sure	25.8%	17.9%	24.6%	20.4%	24.1%	23.4%

Table C10: Perceived overall marine resource change over the next 10 years by stratum.

Predicted change	East Hawaiʻi	West Hawaiʻi	Kauaʻi	Maui	Oʻahu	Total
Get worse	64.0%	69.4%	57.9%	59.3%	71.1%	68.0%
Stay the same	8.8%	10.8%	13.0%	9.6%	9.6%	9.8%
Improve	8.8%	9.3%	15.3%	13.0%	6.7%	8.4%
Not sure	18.4%	10.5%	13.8%	18.0%	12.6%	13.8%

Table C11: Perceptions of coral reef services by stratum.

Value	Agreement	East Hawaiʻi	West Hawaiʻi	Kauaʻi	Maui	Oʻahu	Total
Coral reefs are important to Hawaii's culture	Strongly disagree/disagree	1.9%	2.4%	2.9%	0.7%	1.7%	1.7%
	Neither disagree nor agree	4.9%	2.8%	3.2%	3.1%	3.6%	3.6%
	Agree/strongly agree	91.3%	93.7%	93.2%	94.8 %	92.8%	93.0 %
	Not sure	1.9%	1.1%	0.7%	1.4%	1.9%	1.7%
Coral reefs in good condition provide food for coastal communities to eat	Strongly disagree/disagree	4.6%	3.4%	2.6%	2.7%	3.3%	3.3%
	Neither disagree nor agree	3.1%	12.7%	4.7%	8.1%	7.7%	7.5%
	Agree/strongly agree	88.8%	79.5%	90.1%	86.3 %	85.8%	86.0 %
	Not sure	3.5%	4.4%	2.6%	2.9%	3.2%	3.3%
Coral reefs are only important to fishermen, snorkelers, and divers	Strongly disagree/disagree	80.5%	85.8%	82.1%	79.1 %	78.1%	79.2 %
	Neither disagree nor agree	3.8%	4.1%	8.3%	5.7%	6.5%	6.1%
	Agree/strongly agree	13.9%	9.9%	9.4%	15.0 %	13.3%	13.1 %
	Not sure	1.7%	0.1%	0.2%	0.2%	2.1%	1.6%
Coral reefs provide economic opportunities to coastal communities	Strongly disagree/disagree	7.3%	4.7%	5.5%	5.1%	3.3%	4.1%
	Neither disagree nor agree	7.8%	18.2%	13.6%	9.6%	13.2%	12.5 %
	Agree/strongly agree	81.0%	70.0%	77.3%	81.1 %	76.5%	77.1 %
	Not sure	4.0%	7.1%	3.6%	4.2%	7.1%	6.2%
Coral reefs protect Hawaii from erosion and	Strongly disagree/disagree	5.5%	2.8%	4.3%	1.2%	2.4%	2.7%
	Neither disagree nor agree	6.4%	6.4%	7.1%	4.5%	6.4%	6.2%

natural disasters	Agree/strongly agree	82.2%	86.5%	82.9%	88.7 %	85.1%	85.2 %
	Not sure	5.9%	4.3%	5.6%	5.7%	6.1%	5.9%
Coral reefs in good condition attract tourists to Hawaii	Strongly disagree/disagree	6.6%	4.4%	4.5%	8.0%	6.5%	6.5%
	Neither disagree nor agree	11.8%	8.6%	16.7%	8.5%	10.9%	10.9 %
	Agree/strongly agree	75.9%	80.3%	75.3%	81.2 %	78.8%	78.7 %
	Not sure	5.7%	6.7%	3.5%	2.3%	3.8%	4.0%

Table C12: Threat familiarity by stratum.

Threat	Familiarity	East Hawaiʻi	West Hawaiʻi	Kauaʻi	Maui	Oʻahu	Total
Climate change	Not at all	8.1%	4.7%	4.3%	8.8%	7.8%	7.6%
	Slightly	13.4%	5.9%	15.3%	7.5%	10.8%	10.6%
	Somewhat	17.3%	18.8%	21.9%	16.2%	17.7%	17.8%
	Moderately	31.4%	32.6%	23.4%	31.3%	29.3%	29.6%
	Extremely	29.8%	38.0%	35.0%	36.2%	34.3%	34.4%
Coastal/urban development	Not at all	9.8%	5.4%	5.7%	9.7%	13.6%	11.7%
	Slightly	11.0%	3.9%	12.7%	5.0%	12.3%	10.7%
	Somewhat	23.1%	24.0%	23.5%	15.0%	19.6%	19.8%
	Moderately	26.9%	37.3%	28.1%	33.1%	26.9%	28.5%
	Extremely	29.2%	29.5%	30.0%	37.3%	27.6%	29.2%
Coral bleaching	Not at all	13.4%	10.2%	12.4%	8.0%	12.7%	12.0%
	Slightly	14.9%	6.8%	12.7%	7.2%	11.2%	10.8%
	Somewhat	9.1%	13.1%	17.6%	17.6%	19.2%	17.5%
	Moderately	29.7%	30.6%	27.7%	29.2%	26.1%	27.2%
	Extremely	32.9%	39.3%	29.6%	38.0%	30.7%	32.4%
Damage from ships and boats	Not at all	12.7%	4.9%	7.9%	8.7%	11.8%	10.8%
	Slightly	9.0%	9.1%	15.9%	9.5%	14.9%	13.4%
	Somewhat	22.0%	19.3%	21.7%	25.4%	20.8%	21.5%
	Moderately	32.8%	43.2%	25.3%	31.0%	28.3%	29.9%
	Extremely	23.5%	23.5%	29.2%	25.4%	24.1%	24.5%
Damage to reefs from trampling, standing, etc.	Not at all	8.2%	1.7%	5.7%	7.5%	9.3%	8.3%
	Slightly	10.1%	2.3%	13.1%	4.0%	9.9%	8.8%
	Somewhat	16.0%	14.6%	18.1%	13.7%	17.0%	16.4%
	Moderately	27.7%	35.0%	25.7%	28.4%	28.7%	28.8%
	Extremely	38.1%	46.5%	37.5%	46.4%	35.1%	37.7%
Hurricanes and other natural disasters	Not at all	10.9%	6.6%	5.6%	8.9%	11.7%	10.5%
	Slightly	12.8%	8.9%	17.7%	7.9%	14.0%	13.0%
	Somewhat	23.2%	31.6%	22.8%	29.5%	23.9%	25.0%
	Moderately	30.1%	35.1%	24.3%	25.4%	26.4%	27.0%

	Extremely	23.1%	17.9%	29.5%	28.3%	24.2%	24.5%
Invasive species	Not at all	9.0%	7.6%	13.0%	11.7%	11.3%	11.0%
	Slightly	11.3%	15.3%	15.7%	8.8%	13.5%	12.9%
	Somewhat	18.4%	14.1%	17.9%	17.4%	20.6%	19.4%
	Moderately	32.6%	37.8%	28.0%	31.9%	29.4%	30.5%
	Extremely	28.7%	25.3%	25.4%	30.2%	25.3%	26.2%
Ocean acidification	Not at all	30.5%	20.6%	26.1%	23.7%	28.6%	27.4%
	Slightly	15.0%	15.0%	15.7%	11.7%	14.6%	14.4%
	Somewhat	17.4%	19.0%	23.2%	19.9%	18.0%	18.6%
	Moderately	18.5%	30.5%	17.2%	26.0%	19.1%	20.6%
	Extremely	18.6%	14.9%	17.9%	18.7%	19.7%	19.1%
Pollution (stormwater, wastewater, chemical runoff, and/or trash/littering)	Not at all	4.8%	1.3%	2.7%	4.7%	4.1%	3.9%
	Slightly	6.9%	5.8%	10.5%	3.7%	6.9%	6.6%
	Somewhat	10.0%	13.9%	15.7%	12.0%	16.9%	15.3%
	Moderately	37.0%	41.3%	25.7%	35.4%	28.5%	30.9%
	Extremely	41.3%	37.7%	45.5%	44.2%	43.7%	43.3%
Sunscreen and lotions with chemicals toxic to coral reefs	Not at all	5.8%	2.0%	3.1%	5.5%	4.8%	4.7%
	Slightly	6.5%	4.1%	13.7%	3.4%	9.3%	8.2%
	Somewhat	14.2%	8.9%	16.9%	12.5%	19.2%	17.0%
	Moderately	31.9%	35.1%	23.9%	32.6%	30.3%	30.7%
	Extremely	41.7%	49.9%	42.4%	46.1%	36.4%	39.4%
Too much fishing and gathering	Not at all	6.7%	3.9%	6.5%	8.2%	7.0%	6.9%
	Slightly	6.8%	7.3%	13.6%	7.4%	14.9%	12.6%
	Somewhat	30.2%	19.0%	26.4%	19.0%	18.6%	20.3%
	Moderately	26.7%	39.6%	20.8%	29.0%	28.1%	28.4%
	Extremely	29.5%	30.2%	32.6%	36.5%	31.4%	31.9%

Table C13: Familiarity with marine managed areas by stratum.

Familiarity	East Hawaiʻi	West Hawaiʻi	Kauaʻi	Maui	Oʻahu	Total
Not at all familiar	31.3%	16.7%	29.7%	17.6%	27.1%	25.7%
Slightly familiar	19.7%	28.3%	24.3%	21.8%	23.5%	23.3%
Somewhat familiar	28.2%	30.1%	28.9%	28.7%	26.7%	27.5%
Moderately familiar	17.2%	17.2%	11.6%	23.7%	14.7%	16.1%
Extremely familiar	3.7%	7.6%	5.5%	8.3%	8.0%	7.4%

Table C14: Agreement with marine managed area functions by stratum.

Statement	Agreement	East Hawaiʻi	West Hawaiʻi	Kauaʻi	Maui	Oʻahu	Total
Marine managed areas protect coral reefs in Hawaii	Strongly disagree/disagree	1.5%	3.4%	2.1%	0.9%	4.4%	3.4%
	Neither disagree nor agree	2.9%	9.4%	9.7%	7.9%	10.3%	9.2%
	Agree/strongly agree	90.4%	83.5%	83.0%	90.3%	81.1%	83.5%
	Not sure	5.3%	3.7%	5.2%	0.9%	4.2%	3.9%
Marine managed areas increase the number of fish in Hawaii	Strongly disagree/disagree	6.7%	2.2%	1.0%	2.7%	4.7%	4.2%
	Neither disagree nor agree	5.7%	12.5%	13.9%	7.2%	9.1%	9.1%
	Agree/strongly agree	78.4%	83.3%	74.9%	77.2%	78.9%	78.7%
	Not sure	9.1%	2.0%	10.2%	12.9%	7.3%	8.0%
There should be more marine managed areas in Hawaii	Strongly disagree/disagree	9.3%	5.9%	13.2%	4.7%	7.7%	7.6%
	Neither disagree nor agree	12.7%	21.2%	22.4%	13.8%	17.3%	17.0%
	Agree/strongly agree	73.5%	65.4%	56.5%	75.1%	67.1%	68.1%
	Not sure	4.6%	7.5%	7.9%	6.3%	7.8%	7.3%
There has been an economic benefit to Hawaii from the establishment of marine managed areas	Strongly disagree/disagree	6.8%	4.3%	6.0%	4.1%	5.8%	5.5%
	Neither disagree nor agree	23.3%	37.1%	30.0%	22.4%	28.1%	27.7%
	Agree/strongly agree	48.2%	41.0%	43.3%	51.7%	48.2%	47.9%
	Not sure	21.8%	17.7%	20.7%	21.8%	17.9%	18.9%
Fishermen's livelihoods have been negatively impacted from the establishment of MMAs in Hawaii	Strongly disagree/disagree	22.2%	25.3%	18.2%	24.0%	22.2%	22.5%
	Neither disagree nor agree	27.7%	37.9%	31.1%	30.9%	34.1%	33.2%
	Agree/strongly agree	29.1%	19.0%	31.7%	19.1%	19.8%	21.1%
	Not sure	21.0%	17.8%	19.0%	26.0%	23.8%	23.2%
Marine managed areas increase tourism in Hawaii	Strongly disagree/disagree	12.8%	14.1%	11.1%	13.2%	12.4%	12.6%
	Neither disagree nor agree	26.6%	27.5%	34.4%	26.8%	29.6%	29.1%
	Agree/strongly agree	37.2%	40.5%	32.8%	41.2%	43.3%	41.6%
	Not sure	23.5%	17.9%	21.8%	18.9%	14.8%	16.7%

I generally support the establishment of marine managed areas in Hawaii	Strongly disagree/disagree	9.3%	3.7%	6.1%	2.5%	5.0%	5.0%
	Neither disagree nor agree	8.9%	15.0%	19.3%	12.1%	12.9%	13.0%
	Agree/strongly agree	78.8%	76.6%	71.8%	81.6%	78.4%	78.4%
	Not sure	3.1%	4.7%	2.9%	3.9%	3.7%	3.7%

Table C15: Familiarity with Hawaii 30 x 30 initiative by stratum.

	East Hawaiʻi	West Hawaiʻi	Kauaʻi	Maui	Oʻahu	Total
No, I have not heard about the effort	63.7%	65.8%	62.4%	68.5%	68.5%	67.5%
I have heard about the effort, but I do not know much about it	30.9%	24.0%	33.5%	27.0%	27.6%	28.0%
Yes, I know about the effort	5.4%	10.2%	4.1%	4.5%	3.9%	4.6%

Table C16: Support for an initiative similar to Hawaii 30 x 30 initiative by stratum.

Support	East Hawaiʻi	West Hawaiʻi	Kauaʻi	Maui	Oʻahu	Total
Strongly oppose/oppose	5.7%	3.2%	10.2%	3.5%	3.7%	4.3%
Neither oppose nor support	18.1%	22.3%	15.2%	9.9%	16.4%	16.1%
Support/strongly support	76.2%	74.5%	74.6%	86.5%	79.8%	79.7%

Table C17: Support for coral reef management strategies by stratum.

Strategy	Support	East Hawaiʻi	West Hawaiʻi	Kauaʻi	Maui	Oʻahu	Total
Limits per person for certain fish species (size and amount or by season)	Strongly oppose/oppose	1.6%	1.3%	7.7%	2.7%	3.9%	3.5%
	Neither oppose nor support	13.7%	11.7%	10.4%	6.1%	10.5%	10.3%
	Support/strongly support	83.3%	84.5%	78.5%	89.1%	83.2%	83.7%
	Don't know	1.3%	2.5%	3.4%	2.2%	2.5%	2.4%
Stricter control of sources of pollution to preserve water quality	Strongly oppose/oppose	3.0%	1.8%	0.7%	1.9%	0.9%	1.3%
	Neither oppose nor support	2.7%	7.1%	5.0%	5.6%	5.2%	5.1%
	Support/strongly support	93.4%	89.1%	93.9%	91.9%	92.4%	92.3%
	Don't know	0.9%	1.9%	0.4%	0.7%	1.5%	1.3%
Efforts to restore damaged coral reefs	Strongly oppose/oppose	0.0%	0.4%	0.2%	3.0%	0.4%	0.7%
	Neither oppose nor support	4.4%	5.8%	4.0%	2.2%	5.3%	4.7%

	Support/strongly support	92.7%	91.7%	94.9%	93.8%	92.7%	92.9%
	Don't know	2.9%	2.0%	0.8%	1.0%	1.7%	1.7%
Incorporate traditional Hawaiian practices into coral reef management	Strongly oppose/oppose	4.7%	3.4%	3.3%	2.0%	3.1%	3.2%
	Neither oppose nor support	13.2%	14.4%	11.5%	14.3%	17.5%	16.1%
	Support/strongly support	76.7%	75.1%	80.2%	73.4%	72.3%	73.5%
	Don't know	5.4%	7.2%	4.9%	10.3%	7.0%	7.2%
Improved law enforcement for existing rules/regulations	Strongly oppose/oppose	4.6%	3.5%	5.1%	4.2%	2.3%	3.0%
	Neither oppose nor support	14.0%	14.7%	16.7%	13.3%	13.1%	13.6%
	Support/strongly support	77.4%	79.7%	72.5%	78.0%	81.2%	79.8%
	Don't know	4.0%	2.1%	5.8%	4.5%	3.4%	3.7%
Establishment of a non-commercial fishing license	Strongly oppose/oppose	33.2%	21.2%	29.3%	25.5%	22.2%	24.1%
	Neither oppose nor support	15.4%	23.9%	23.3%	25.0%	23.4%	22.8%
	Support/strongly support	41.4%	47.7%	37.2%	37.8%	45.2%	43.6%
	Don't know	10.0%	7.2%	10.1%	11.6%	9.2%	9.5%
Inspection of coolers for violations of fishing or poaching regulations	Strongly oppose/oppose	6.4%	8.3%	6.5%	7.0%	5.8%	6.2%
	Neither oppose nor support	15.4%	13.8%	16.6%	14.0%	12.2%	13.1%
	Support/strongly support	71.5%	75.3%	69.7%	75.5%	76.3%	75.3%
	Don't know	6.7%	2.6%	7.2%	3.5%	5.7%	5.4%

Table C18: Participation in pro-environmental behaviors by stratum.

Behavior	Frequency	East Hawai'i	West Hawai'i	Kaua'i	Maui	O'ahu	Total
Recycling	Never	9.8%	2.8%	3.3%	3.6%	2.5%	3.4%
	Once a year or less	0.7%	9.5%	2.5%	2.4%	3.0%	3.1%
	Several times a year	14.1%	4.9%	12.5%	11.1%	10.5%	10.7%
	At least once a month	9.5%	15.2%	22.4%	15.1%	19.4%	17.8%
	Several times a month or more	66.0%	67.7%	59.4%	67.8%	64.7%	65.1%
Teaching responsible fishing behavior to the next generation	Never	53.0%	45.4%	44.6%	52.4%	61.4%	57.4%
	Once a year or less	24.6%	23.5%	16.9%	13.8%	16.4%	17.3%
	Several times a year	13.5%	11.0%	12.6%	11.8%	8.0%	9.5%
	At least once a month	3.5%	2.3%	6.5%	3.6%	3.7%	3.8%
	Several times a month or more	5.3%	17.8%	19.4%	18.4%	10.4%	12.0%
Volunteering with environmental groups (e.g. beach clean-ups)	Never	60.6%	37.5%	43.8%	40.8%	54.1%	51.3%
	Once a year or less	26.3%	41.5%	34.2%	31.0%	27.7%	29.3%
	Several times a year	9.7%	12.6%	12.6%	16.6%	12.6%	12.9%
	At least once a month	0.7%	5.8%	3.7%	4.3%	3.4%	3.4%
	Several times a month or more	2.8%	2.7%	5.8%	7.3%	2.2%	3.2%
Donating to environmental causes	Never	51.2%	28.0%	39.1%	36.0%	49.1%	45.6%
	Once a year or less	31.7%	46.4%	40.3%	39.1%	33.0%	35.0%
	Several times a year	14.9%	18.0%	11.6%	14.6%	10.7%	12.1%
	At least once a month	0.8%	5.4%	3.3%	5.2%	3.2%	3.4%
	Several times a month or more	1.3%	2.3%	5.7%	5.2%	4.0%	3.9%
Using "reef-safe" forms of sun protection	Never	34.0%	16.6%	28.1%	18.1%	28.3%	26.8%
	Once a year or less	6.3%	9.1%	4.6%	8.0%	10.8%	9.5%
	Several times a year	16.9%	8.5%	15.7%	11.0%	13.3%	13.1%
	At least once a month	10.7%	10.9%	7.8%	8.9%	11.2%	10.7%
	Several times a month or more	32.1%	54.8%	43.8%	53.9%	36.4%	39.9%

Table C19: Usage of sources for coral reef related information by stratum

Source	Frequency	East Hawaiʻi	West Hawaiʻi	Kauaʻi	Maui	Oʻahu	Total
Newspapers, magazines, or other print publications	Never	12.7%	13.1%	15.8%	13.9%	21.2%	18.6%
	Rarely	19.1%	23.3%	20.1%	16.2%	18.2%	18.5%
	Sometimes	38.1%	37.5%	39.1%	40.8%	36.4%	37.4%
	Frequently	21.9%	24.2%	19.7%	21.6%	18.4%	19.6%
	Always	8.2%	1.9%	5.4%	7.5%	5.8%	5.9%
Radio	Never	29.2%	39.0%	23.3%	25.1%	33.1%	31.5%
	Rarely	27.7%	21.1%	21.3%	24.4%	22.1%	22.8%
	Sometimes	32.6%	28.4%	36.5%	37.5%	33.4%	33.7%
	Frequently	5.6%	10.6%	14.6%	9.6%	7.9%	8.4%
	Always	4.9%	0.9%	4.3%	3.4%	3.5%	3.5%
TV	Never	21.2%	28.0%	23.7%	19.1%	23.5%	23.0%
	Rarely	16.6%	15.1%	16.4%	21.9%	19.1%	18.8%
	Sometimes	41.8%	40.1%	31.7%	35.3%	33.5%	34.8%
	Frequently	15.2%	13.5%	20.2%	13.6%	15.9%	15.6%
	Always	5.2%	3.3%	8.0%	10.1%	8.1%	7.7%
Online news sources/websites	Never	16.5%	13.3%	14.5%	11.7%	16.5%	15.6%
	Rarely	10.9%	17.2%	10.1%	16.0%	15.7%	15.0%
	Sometimes	48.2%	34.9%	35.4%	43.8%	37.7%	39.2%
	Frequently	15.9%	32.1%	31.7%	21.1%	21.1%	21.9%
	Always	8.5%	2.4%	8.3%	7.4%	9.0%	8.2%
Social media	Never	29.5%	25.3%	30.7%	19.9%	28.7%	27.6%
	Rarely	23.7%	18.6%	17.9%	14.2%	16.4%	17.1%
	Sometimes	34.0%	33.2%	27.0%	40.8%	33.4%	34.0%
	Frequently	9.9%	21.3%	15.2%	19.7%	15.1%	15.6%
	Always	2.9%	1.6%	9.2%	5.4%	6.4%	5.8%
Friends and family	Never	9.5%	7.7%	9.3%	14.3%	21.1%	17.6%
	Rarely	19.8%	11.9%	11.8%	15.0%	17.0%	16.4%
	Sometimes	52.2%	45.8%	40.4%	42.4%	37.2%	40.0%
	Frequently	14.8%	31.3%	27.1%	20.8%	18.7%	19.9%
	Always	3.8%	3.4%	11.4%	7.5%	5.9%	6.1%
Community leaders	Never	25.0%	28.9%	22.7%	21.8%	33.5%	30.2%
	Rarely	29.5%	27.9%	20.4%	31.3%	26.4%	27.1%
	Sometimes	37.0%	33.7%	44.2%	34.2%	30.2%	32.4%
	Frequently	8.4%	9.3%	9.9%	9.1%	9.2%	9.2%
	Always	0.2%	0.2%	2.8%	3.6%	0.7%	1.1%
State government	Never	22.0%	20.6%	22.2%	17.1%	28.0%	25.2%
	Rarely	24.2%	26.7%	20.4%	27.8%	24.6%	24.9%
	Sometimes	42.8%	44.3%	43.3%	41.8%	37.4%	39.3%

	Frequently	10.3%	6.9%	11.6%	10.0%	8.2%	8.7%
	Always	0.7%	1.4%	2.5%	3.3%	1.8%	1.9%
Federal government agencies (NOAA, EPA)	Never	19.1%	21.3%	18.0%	18.1%	21.1%	20.3%
	Rarely	20.9%	23.6%	15.1%	26.1%	21.4%	21.7%
	Sometimes	42.0%	39.6%	38.5%	32.8%	33.6%	35.0%
	Frequently	16.7%	13.1%	22.6%	17.3%	19.3%	18.6%
	Always	1.3%	2.4%	5.7%	5.7%	4.6%	4.4%
Non-profit organizations	Never	22.6%	18.8%	19.9%	18.5%	29.6%	26.2%
	Rarely	29.8%	21.9%	19.2%	19.7%	22.1%	22.4%
	Sometimes	35.3%	38.9%	43.9%	43.2%	32.1%	35.0%
	Frequently	10.1%	19.7%	13.0%	15.0%	12.7%	13.2%
	Always	2.2%	0.7%	3.9%	3.6%	3.4%	3.2%
Other, please specify	No	86.8%	84.2%	86.6%	85.6%	90.1%	88.6%
	Yes	13.2%	15.8%	13.4%	14.4%	9.9%	11.4%

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