https://doi.org/10.7289/V5/TM-NOS-CRCP-30

NOAA Technical Memorandum CRCP 30

National Coral Reef Monitoring Program Socioeconomic Monitoring Component

Summary Findings for Hawai‘i, 2015

NOAA Coral Reef Conservation Program

Silver Spring, MD

February 2018

United States Department of Commerce	National Oceanic and Atmospheric Administration	National Ocean Service
Wilbur R. Ross Secretary	RDML Tim Gallaudet Assistant Secretary of Commerce for Oceans and Atmosphere and Acting Under Secretary of Commerce for Oceans and Atmosphere	Dr. W. Russell Callender Assistant Administrator

https://doi.org/10.7289/V5/TM-NOS-CRCP-30

National Coral Reef Monitoring Program Socioeconomic Monitoring Component

Summary Findings for Hawai‘i, 2015

M. Gorstein, J. Loerzel, A. Levine, P. Edwards, and M. Dillard

National Oceanic and Atmospheric Administration

February 2018

NOAA Technical Memorandum CRCP 30

United States Department of Commerce	National Oceanic and Atmospheric Administration	National Ocean Service
Wilbur R. Ross Secretary	RDML Tim Gallaudet Assistant Secretary of Commerce for Oceans and Atmosphere and Acting Under Secretary of Commerce for Oceans and Atmosphere	Dr. W. Russell Callender Assistant Administrator

About this document

The mission of the National Oceanic and Atmospheric Administration (NOAA) is to understand and predict changes in the Earth's environment and to conserve and manage coastal and oceanic marine resources and habitats to help meet our Nation's economic, social, and environmental needs. As a branch of NOAA, the National Ocean Service (NOS) conducts or sponsors research and monitoring programs to improve the scientific basis for conservation and management decisions. The NOS strives to make information about the purpose, methods, and results of its scientific studies widely available.

Coral Reef Conservation Program (CRCP) along with the National Centers for Coastal Ocean Science (NCCOS) uses the NOAA Technical Memorandum NOS series to achieve timely dissemination of scientific and technical information that is of high quality but inappropriate for publication in the formal peer-reviewed literature. The contents are of broad scope, including technical workshop proceedings, large data compilations, status reports and reviews, lengthy scientific or statistical monographs, and more. NOAA Technical Memoranda published by the CRCP, although informal, are subjected to extensive review and editing, and reflect sound professional work. Accordingly, they may be referenced in the formal scientific and technical literature.

A **NOAA Technical Memorandum NOS** may be cited using the following format: M. Gorstein, J. Loerzel, A. Levine, P. Edwards, and M. Dillard. 2018. National Coral Reef Monitoring Program Socioeconomic Monitoring Component: Summary Findings for Hawai‘i, 2015. US Dep. Commerce, NOAA Tech. Memo., NOAA-TM-NOS-CRCP-30, 69p. + Appendices.

For further information direct inquiries to:

NOAA Coral Reef Conservation Program

Office for Coastal Management, National Ocean Service

National Oceanic and Atmospheric Administration,

1305 East-West Highway, Silver Spring, Maryland 20910

http://coralreef.noaa.gov/

http://www.coris.noaa.gov/monitoring/socioeconomic.html

Acknowledgements

The project investigators would like to extend our appreciation to many individuals and groups that made this work possible. They include: Infosurv Research and its subcontractors for carrying out the telephone survey; Paulo Maurin and Mike Lamier for helping to solicit jurisdictional input on the survey and feedback on survey results; and the many dedicated representatives of federal, state, and county agencies, non-governmental organizations, academic institutions, and user groups who provided input and feedback during the development of the survey. We would also like to thank our reviewers: Paulo Maurin, Anne Chung, and Kirsten Leong for their valuable comments, as well as Chloe Fleming for her editing assistance. Finally, the NCRMP Social Science Team wishes to extend our appreciation to all of the colleagues we have worked with along the way for their support, ideas, and efforts toward the greater goal of long term socioeconomic monitoring of our nation's coral reef states and territories.

Executive Summary

The Socioeconomic Component of the National Coral Reef Monitoring Program (NCRMP) is currently in the process of monitoring socioeconomic indicators across all United States (US) coral reef territories and jurisdictions. These indicators fall under the following broader categories: the demographics of these areas, 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, society's interactions with coral reef resources, and the responses of local communities to coral management. From there, these baseline data are used to develop indicators that describe the state of each jurisdiction and provide researchers with the ability to compare jurisdictions to one another. The National Oceanic and Atmospheric Administration's (NOAA) Coral Reef Conservation Program (CRCP) will use the information for future research, to assess the socioeconomic outcomes of management activities, and to improve the results of programs designed to protect coral reef resources.

This report outlines human dimensions information relevant to coral reef resources in the state of Hawai‘i. For the purposes of this research, investigators focused on the inhabited islands in Hawai‘i: Hawai‘i Island (the Big Island), O‘ahu, Maui, Kaua‘i, Lāna‘i, and Moloka‘i. The findings here are derived from a combination of data gathered through household surveys conducted in November of 2014, and additional secondary sources of socioeconomic information for the region.

With respect to human participation in recreational coral reef-related activities, the surveys demonstrated that Hawai‘i residents participate in swimming and beach recreation most frequently. Additionally, just over 45% of residents indicated that they participate in fishing and/or gathering of marine resources. Though the sample sizes for the islands of Moloka‘i and Lāna‘i were not large enough to be representative of the populations of those islands, some differences in perceptions concerning marine resource condition were identified between respondents based on island of residence. For example, residents on Hawai‘i Island tended to have a more positive perception of current marine resource condition when compared to residents from the islands of O‘ahu, Maui, and Kaua‘i. If perceptions of coral reef health truly vary by location, this may correlate to differing resource quality in different regions, which could, in part, explain the lack of consensus across counties concerning the condition of marine resources. Surveys also revealed that the majority of Hawai‘i residents support a range of potential marine management policies and regulations, and are for the most part familiar with the various threats faced by coral reefs (such as hurricanes, pollution, and coastal development). For a visual snapshot of these survey results, please see the NCRMP socioeconomic component infographic for Hawai‘i.

Unlike several US coral reef jurisdictions, the population of Hawai‘i increased between 2000 and 2010. In addition to a rising population, the jurisdiction faces a number of other social challenges

including an increase in the state's poverty rate and the state's unemployment rate from 2000 to 2010. Coupled with the increasing impact of contaminant runoff, pressures from coastal development, and overfishing in urban areas of Hawai‘i (NOAA CRCP 2010), there is little question that human activities are having an impact on the marine and coastal environment in this region.

There were key lessons learned from this first NCRMP socioeconomic data collection in Hawai‘i. For example, there is a need to fine-tune the survey question pertaining to fish consumption and fishing activity in order to make it more specific to coral reef related fish and invertebrate species, as well as a need to distinguish between locally caught and imported fish. There is also considerable interest at the jurisdictional level to better understand 'commercial' vs. 'non-commercial' fishing, as non-commercial fishing in Hawai‘i is challenging to monitor, and little data is available. Further, local partners have communicated a need to understand key differences across sections of individual islands as they pertain to knowledge, attitudes, and perceptions of coral reefs and coral reef management. As similar surveys are implemented across other US coral reef jurisdictions, the NCRMP team will be making adjustments to the data collection effort to improve upon the type of information being generated. Thus, the findings contained within this report should be considered as a starting point to the development of more detailed research questions for future work. Surveys are planned to be repeated in each US coral reef jurisdiction after the completion of a full monitoring cycle, approximately once every five to seven years.

Table of Contents

List of Tables

List of Figures

List of Acronyms

ABS	Addressed Based Sampling
ACS	American Community Survey
AQI	Air Quality Index
BEA	Bureau of Economic Analysis
BLS	Bureau of Labor Statistics
CATI	Computer Assisted Telephone Interviewing
C-CAP	Coastal Change Analysis Program
CRCP	Coral Reef Conservation Program
ENOW	Economics National Ocean Watch
EPA	Environmental Protection Agency
GDP	Gross Domestic Product
HHS	Department of Health and Human Services
HTA	Hawai‘i Tourism Authority
MPA	Marine Protected Area
MRIP	Marine Recreational Information Program
NCCOS	National Centers for Coastal Ocean Science
NCRMP	National Coral Reef Monitoring Program
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NWS	National Weather Service
OMB	Office of Management and Budget
OR&R	Office of Response and Restoration
PIFSC	Pacific Islands Fisheries Science Center
RDD	Random Digit Dialing
SCUBA	Self Contained Underwater Breathing Apparatus
UNEP	United Nations Environment Programme
US	United States
USGS	United States Geological Survey
WWTF	Wastewater Treatment Facility

Introduction

In 2007, the National Oceanic and Atmospheric Administration's (NOAA) Coral Reef Conservation Program (CRCP) underwent an external review by an expert panel to provide an independent assessment of the CRCP's effectiveness in meeting its mandates and to suggest recommendations for future improvement. Some major recommendations from the external review included increasing the CRCP's social science portfolio, strategically using social science to improve coral reef management by engaging local communities, and better assessing the social and economic consequences of management policies, interventions, and activities on local communities. In response, the *CRCP Social Science Strategy* (Loper *et al*. 2010) recommended three priority activities:

1. Developing of a set of national-level social science indicators related to coral reefs and coral reef management
2. Collecting these indicators via regular and repeated jurisdictional surveys
3. Increasing social science capacity within the coral reef conservation program.

In 2010, the CRCP created the National Coral Reef Monitoring Program (NCRMP), which for the first time included a socioeconomic monitoring component that would improve the Program's ability to track social science information in coral reef jurisdictions. The socioeconomic component of the NCRMP addresses the first two priorities. Because the socioeconomic component of the NCRMP is situated within a larger social science program dedicated to a range of social science activities in United States (US) and international coral reef jurisdictions, the results of this monitoring have a wide range of applications.

The inclusion of socioeconomic indicators in the NCRMP represents a strong step forward for the CRCP, which has recognized the need to integrate socioeconomic information with biophysical indictors relevant to the conservation of coral reef resources. The main purpose of the Socioeconomic Component of the NCRMP is to answer the following questions: What is the status of human knowledge, attitudes, and perceptions regarding coral reefs? And, how are human uses of, interactions with, and dependence on coral reefs changing over time? Integration of socioeconomic information will strengthen national coral reef monitoring and improve the Program's ability to explain how people interact with coral reef resources, as well as how coral reef ecosystems and coral reef management strategies are perceived by the public -- issues of utmost interest to our partners, resource managers, and policy makers.

NOAA's National Marine Fisheries Service (NMFS) has also been involved in the development of national-level social indicators for coastal communities (Jepson and Colburn 2013); however, the NMFS social indicator effort is done at the community level and doesn't include any primary data collected through surveys, whereas the NCRMP does include primary data and is done at the US coral jurisdiction level.

The NCRMP is an integrated long-term program designed to monitor the condition of coral reefs and coral reef ecosystems. The program now conducts sustained observations of biological, climatic, and socioeconomic indicators in US states and territories where coral reefs are present. More information about all components of the monitoring program can be explored in "NOAA Coral Reef Conservation Program: National Coral Reef Monitoring Plan" (NOAA CRCP 2014) available at: ftp://ftp.library.noaa.gov/noaa_documents.lib/CoRIS/CRCP/noaa_crcp_national_coral_reef_monitoring_plan_2014.pdf.

Purpose of this Report

This technical memorandum presents the findings from the initial Hawai'i NCRMP socioeconomic data collection. The report presents preliminary social indicators and provides examples of how composite indicators can be used to analyze changes over time in a long term setting. The main objective is to lay the groundwork for combining and comparing socioeconomic variables with a goal of developing meaningful composite indicators that can be used to examine trends in human dimensions of coral reef resources and better understand human influences on effective coral reef conservation. It should be noted that this report presents information that, in many instances, is being collected for the first time. In all instances, the information represents baseline socioeconomic data for the NCRMP. Some of the variables presented in this report identify gaps in information, and we provide suggestions on how these gaps can be addressed in the future.

Overall Approach of the Socioeconomic Component of NCRMP

The socioeconomic component of the NCRMP gathers and monitors a collection of socioeconomic variables, including demographics in coral reef areas, human use of and their interactions (over time) with coral reef resources, as well as knowledge, attitudes, and perceptions of coral reefs and coral reef management. The overall goal is to track relevant information regarding each jurisdiction's population, socioeconomic characteristics, human interactions with coral reef resources, and the responses of local communities to coral management actions. The CRCP will use the information in future research to assess and monitor socioeconomic status and change over time, to assess the socioeconomic outcomes of management activities, and to improve programs designed to protect coral reefs within each jurisdiction. Ultimately, in consultation with stakeholders, partners, and other scientists, the information collected will inform the development of composite indicators. The development of composite indicators is a method that allows researchers to measure the complex two-way relationship between the environment and humans, in addition to tracking the various facets of this relationship over time by breaking down an intellectually complex and immeasurable concept into its various smaller and more measureable parts to improve communication and policy (Schirnding 2002).

Each composite indicator will be created using primary data from resident surveys in the US coral reef jurisdictions and from existing socioeconomic data collected from secondary sources such as the US Census Bureau and local government agencies. These composite indicators will include information about the population, the social and economic structures, the impacts of society on coral reefs, and the contributions of healthy corals to nearby residents. The composite indicators can also be used to track and assess the status of human knowledge, attitudes, and perceptions regarding coral reefs and management activities related to coral reef resources. The indicators and the rationale for their selection are provided below in Table 1. The process of selecting and prioritizing these indicators can be explored further in the workshop report "Developing Social and Economic Indicators for Monitoring the US Coral Reef Jurisdictions" (Lovelace and Dillard 2012) available at: 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.

Indicator Development

The indicators identified in Table 1 will be developed at the conclusion of the first full monitoring cycle by combining data from primary and secondary sources. The assessment of all US coral reef jurisdictions will draw on indicators that may be composites of multiple distinct measures that address the same higher level concepts such as 'Attitudes towards coral reef management strategies.' For example, Dillard *et al.* (2013) established a methodology for creating composite indicators of well-being in coastal communities, and this work will be used as a guide for developing composite indicators for the well-being of populations living in US coral reef jurisdictions. Box 1 provides a description of the conceptual framework for developing the community well-being composite indicators. This is an example of the way in which multiple measures can be used to assess a single composite indicator, such as Basic Needs or Economic Security, that ultimately captures aspects of a larger concept like well-being. It should be noted that the data presented in this report represent the current status of the collection, ultimately intended to contribute to the development of composite indicators. Once developed, these composite indicators will be used to assess all US coral reef jurisdictions at the conclusion of the first full monitoring cycle. Both the primary and secondary data presented in this report serve as a snapshot of the collection and analysis of the NCRMP socioeconomic monitoring component for Hawai'i in 2015.

Primary Data

Primary data for the socioeconomic component of the NCRMP is collected via surveys administered to individuals reporting on behalf of their households. The survey instrument is composed of one set of questions that remain the same for all US coral reef jurisdictions, as well as a sub-set of jurisdiction-specific questions relevant to local management needs. The NCRMP socioeconomic data are collected using a variety of modes as appropriate to the context in each

jurisdiction. For example, in Hawai‘i, address-based sampling (ABS) as well as a variety of random digit dialing (RDD) methodologies were employed. 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. The survey methodology generally follows Dillman's Tailored Design Method (Dillman 1978; Dillman, Smyth, and Christian 2009). It should be noted that the survey was developed by utilizing questions from a "bank" of over 120 questions. These questions were approved for use by the Office of Management and Budget (OMB), which is responsible for administering the Paper Work Reduction Act (US HHS 1995). This Act ensures that the public is not unduly burdened (in terms of time), and that confidentiality is assured. Surveys are planned to be repeated in each US coral reef jurisdiction after the completion of a full monitoring cycle, approximately once every five to seven years.

Secondary Data

Not only is the use of secondary data ideal for the development of a sustainable, cost effective, and long term socioeconomic monitoring plan, but secondary data is also well suited for the development of composite indicators used to track population and environmental trends over time. Secondary data collection involves compiling data that was gathered by other organizations from multiple sources and across US coral reef jurisdictional geographies into a centralized database. The use of data sources that are collected in a standardized way over time (such as US Census Bureau data) can help facilitate the integration of social, economic, and biophysical data collected under the NCRMP because integration is aided by broad spatial and temporal coverage of social, economic, and biophysical data. Many of the secondary datasets that provide social and economic data have this quality and allow for more robust analyses with biophysical data.

Original sources for much of the secondary data presented in this report can be found in the secondary data sources table (Appendix D). Secondary data items included in this report, but not listed in Appendix D, are not considered part of the formal NCRMP secondary data collection because they are unique to the jurisdiction or are not available in a standardized format over time. These items may be included in the formal NCRMP secondary data collection at a later time if availability across geographies increases.

Box 1: Composite Indicator – Community Well Being

Well-being is a concept used to assess the status of people, either individually or collectively, at different scales (e.g., individual, community and national; Costanza *et al*. 2007). Well-being assessments can be used to determine how people are doing in relation to an optimum standard of life experience (Doyal and Gough 1991) and are generally used by decision-makers to inform policies and programs focused on improving the societal conditions. It provides a means of tracking the relationship between communities and the environment, and a better means of understanding the ecosystem as a whole. When the environment is providing ecosystem services that communities need and desire, well-being has positive gains. Conversely, if there is decline or disruption in ecosystem services, we may expect a decline in well-being, particularly with increased dependence on these services (Butler and Oluoch-Kosura 2006; Costanza *et al*. 1997; MEA 2005). Being able to predict the consequence to humans, both positive and negative, associated with changes in ecosystem states is critical to informed management.

Composite indicators that can ultimately be tracked alongside coral reef ecosystem condition will be employed. The composite indicators are shown in the figure below and each composite indicator is conceptually complex. At the conclusion of the first monitoring cycle, the coral reef jurisdictions like Hawai‘i will be scored on select indicators of well-being. These scores will be compared across US coral reef jurisdictions and will then be used in statistical analyses with indicators of environmental condition to analyze the dynamic relationship between the ecosystem services that people regularly enjoy and community well-being.

Figure 1: Framework of composite indicators for well-being and ecosystem condition, adapted from Dillard *et al.* 2013

Table 1: NCRMP Socioeconomic Indicators

	Indicators	Rationale
1	Participation in coral reef activities (including snorkeling, diving, fishing, harvesting)	Measuring participation in coral reef activities enhances understanding of the economic and recreational importance of 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 linkages 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 management/water supply infrastructure provides general understanding of human impact 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

Geographic Scope

Overall, the NCRMP focuses on the CRCP's geographic priority areas; however, as some of those areas are uninhabited, the socioeconomic variables are being collected from only the inhabited areas. These locations and their sampling units are shown in Table 2. When feasible, indicators formulated at the sub-jurisdictional scale will be reported alongside biological indicators collected at the same scale. Efforts will be made to ensure sufficiently robust sample size to allow for reporting of socioeconomic indicators at appropriate sub-jurisdictional scales.

Table 2: Geographic scope of current NCRMP Socioeconomic Monitoring

Location	Sampling Units
American Samoa	Island of Tutuila (future collections will include the Manua Islands)
Florida	Martin, Palm Beach, Broward, Miami-Dade, and Monroe Counties
Hawai‘i	Islands of Hawai‘i, Maui, O‘ahu, Kaua‘i, Moloka‘i, and 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

Jurisdiction Description

The Hawaiian islands make up the most southern and western state in the United States, with the main Hawaiian islands positioned between the 19th and 22nd parallel north. Seven of these islands (O‘ahu, Maui, Hawai‘i, Kaua‘i, Moloka‘i, Lāna‘i, and Ni‘ihau) are permanently inhabited by people. The island of Hawai‘i within the state of Hawai‘i is also referred to as "the Big Island." Owing to their location in the middle of the Pacific Ocean, Hawai‘i's 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 Hawai‘i 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).

Hawai‘i’s climate is classified as *tropical*; however, Hawai‘i is known to experience other climate types depending on altitude and weather (Kottek *et al.* 2006). The islands receive most rainfall from the trade winds on their north and east flanks (the windward side) as a result of orographic precipitation. Coastal areas, in general, and especially the south and west sides, or leeward sides, tend to be drier. Hawai‘i experiences a small annual variation in temperature range (Giambelluca *et al.* 2014) due to its close proximity to the equator and the nearly constant flow of ocean air across the islands.

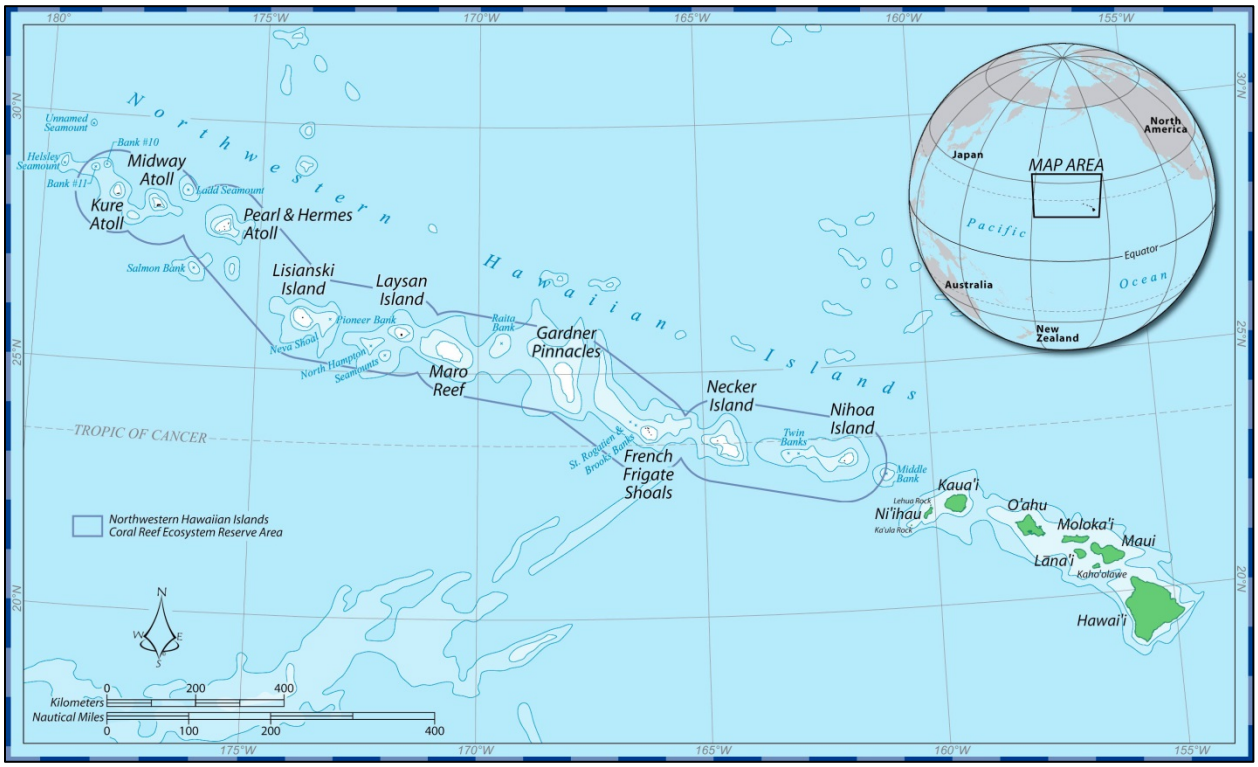


Figure 2: Map of Hawai‘i

Source: NOAA

The Hawaiian Islands were formed millions of years ago by a series of opening fissures along a narrow, northwest trending zone on the ocean floor in the central region of the Pacific Ocean. Molten rock issued at intervals from Earth’s interior formed along these fissures, hardened, and gradually piled up, eventually forming the mountain range that constitutes the Hawaiian Islands. Therefore, the Hawaiian archipelago was built almost entirely by volcanic activity (Macdonald, Abbott, and Peterson 1983). The youngest of the main Hawaiian Islands, Hawai‘i, is still volcanically active and currently growing in size.

The Hawaiian Islands were first settled by Polynesians 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 the Hawaiian Islands. The islands are relatively small and most 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 (Western Pacific Regional Fishery Management Council 2016).

O‘ahu is by far the most populous island in Hawai‘i, containing almost 70% of the state’s population (US Census Bureau 2015), and also hosting the state’s capital of Honolulu. Many of the region’s corals are in close proximity to the state’s shores (Fletcher *et al.* 2008), putting the residents in close proximity to these natural features.

Tourism is an integral part of the Hawaiian economy, producing over $6 billion in gross domestic product (GDP) in 2014. 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.

Methodology

2015 NCRMP Survey

Resident surveys took place in Hawai‘i on the islands of Hawai‘i, O‘ahu, Maui, Kaua‘i, Moloka‘i, and Lāna‘i[1] at the end of 2014, and will be repeated approximately every five to seven years. The survey sampled adults, eighteen years or older, who live on one of the six above islands for at least 3 months out of the year. While the survey is representative of the state of Hawai‘i as a whole, researchers were also able to obtain representative samples at the island level for each of Hawai‘i, O‘ahu, Maui, and Kaua‘i. To align with how most secondary data is collected, this also allows for inferences to be made at the county level for Hawai‘i, Honolulu, Maui, and Kaua‘i counties. [2]

[1] The island of Ni‘ihau is excluded from this data collection given that it is a privately owned island with a resident population of less than 200 people.

[2] The NCRMP socioeconomic survey did not obtain a statistically representative sample of Kalawao County, a very small county on Moloka‘i that is home to Kalaupapa, a former colony for people with Hansen’s disease.

The Hawai‘i survey data collection was focused on the following indicators:

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

More information on the general survey methods applied can be found here: http://www.coris.noaa.gov/monitoring/resources/FAQs_NCRMP_Social_Survey.pdf, while details for the Hawai‘i effort are provided below.

Surveys were conducted via telephone in November of 2014. Phone number lists were purchased for the six islands and included both landline and cell phone numbers. Each number from the list was called up to five times, at which point the number was dropped from the calling process if it had not yet been answered. Contracted surveyors used Computer Assisted Telephone Interviewing (CATI) software and offered the survey in English. A total of 567,152 unique phone numbers were called over the course of the survey, resulting in a total of 2,240 interviews (51.5% cell, 48.5% landline) for a response rate[3] of 1.5% of eligible numbers (not including fax lines, out of service, or non-residents) and a cooperation rate[4] of 28.6%. No names or personally identifiable information were collected during surveying. Figure 3 shows the islands that were sampled as a part of this survey effort. A new open-ended question was introduced into the NCRMP survey instrument for the jurisdiction of Hawai‘i. The question asked respondents to “briefly define ‘your local community’” in reference to a previous question about community involvement in coral reef management. This question was removed after 421 respondents completed the survey due to difficulty amongst the respondents in answering this question, as well as the increased time burden that this question caused.

This report presents a summary of measures collected via the survey instrument and select measures from secondary data sources. A presentation on all survey data results for Hawai‘i is available at: http://data.nodc.noaa.gov/coris/library/NOAA/CRCP/monitoring/SocioEconomic/NCRMPSOCHawaiiReportOut2016_FINAL_061616_update.pdf.

[3] Response rate is defined as the number of complete interviews with reporting units divided by the number of eligible reporting units in the sample.
[4] Cooperation rate is defined as the proportion of all cases interviewed divided by all eligible units ever contacted.

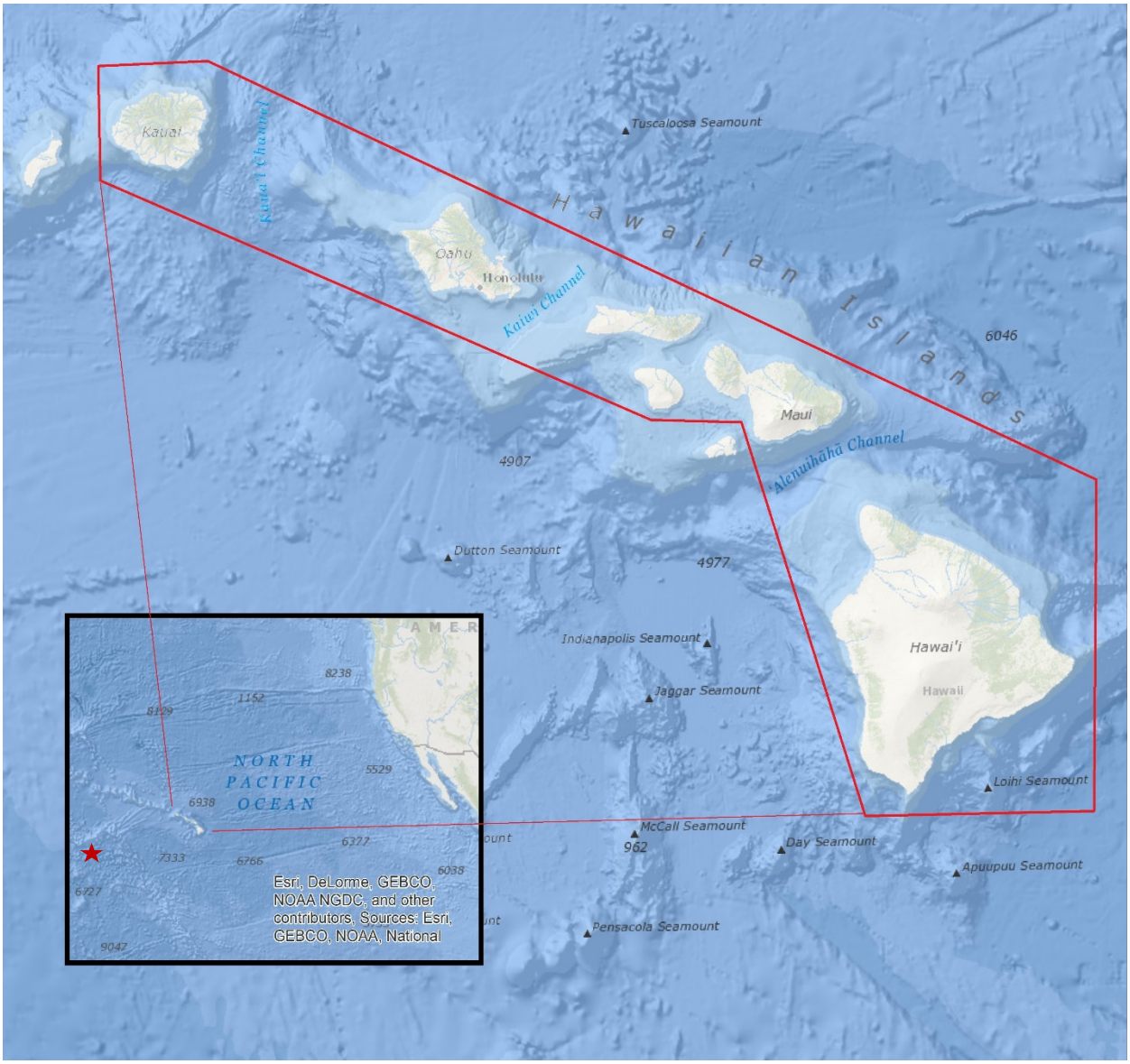


Figure 3: Location of sampled islands in Hawai‘i

Secondary Data Collection

Socioeconomic data were compiled for Hawai‘i from secondary data sources including the US Census Bureau, the US Bureau of Economic Analysis (BEA), the US Bureau of Labor Statistics (BLS), the Environmental Protection Agency (EPA), the US Department of Health and Human Services (HHS), the National Weather Service (NWS), and local government agencies. These data were collected and analyzed at the jurisdiction level (and the county level when data were available at a finer scale). Secondary data collection included cleaning and transforming data prior to analyses, maintaining documentation from original sources, evaluating data for errors, and other data proofing procedures.

While primary data collection was stratified by island, most secondary data sources delineate sub-jurisdictional geographies by county. Therefore, when sub-jurisdictional secondary data were available, it was collected at the county level. Table 3 below illustrates how the main Hawaiian islands are delineated by county. While the Census collects data separately for Kalawao County (a very small county on the island of Molokaʻi), secondary Census data for Kalawao county will not be reported on in this document given the county's extremely small population (estimated at only 90 persons in 2010), and the fact that access to the county, a former colony for people with Hansen's disease, is highly restricted and the area is largely run as a National Park Service unit.

Table 3: Hawai'i's county delineations by island

Island(s)	County
Hawaiʻi	Hawaiʻi
Oʻahu	Honolulu
Kauaʻi	Kauaʻi
Maui, Lānaʻi, most of Molokaʻi	Maui
Kalaupapa Peninsula, on the north coast of Molokaʻi	Kalawao[5]

The secondary data collection for Hawaiʻi was focused on the following 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

Many of the secondary data presented in this report were taken from the NCRMP socioeconomic project collection as described above. More information about original sources for these data can be found in the data sources table (Appendix D). Secondary data items included in this report, but not in Appendix D, are not considered part of the formal NCRMP secondary data collection because they are unique to the jurisdiction or are not available in a standardized format over time.

[5] Because of its small population, Kalawao County does not have the functions of other Hawaiʻi counties. Instead, it is a judicial district of Maui County, which includes the rest of the island of Molokaʻi. The county has no elected government.

As the secondary data collection and final composite indicator development for Hawai‘i is in progress, there are several indicators that will be more comprehensively addressed by combining the survey (primary) and secondary data. These include indicators which benefit from both existing data from management plans, as well as survey data on the involvement of local residents in resource management decisions (e.g., Governance). At the conclusion of the first full cycle of monitoring, the following indicators will be developed using a combination of primary and secondary data:

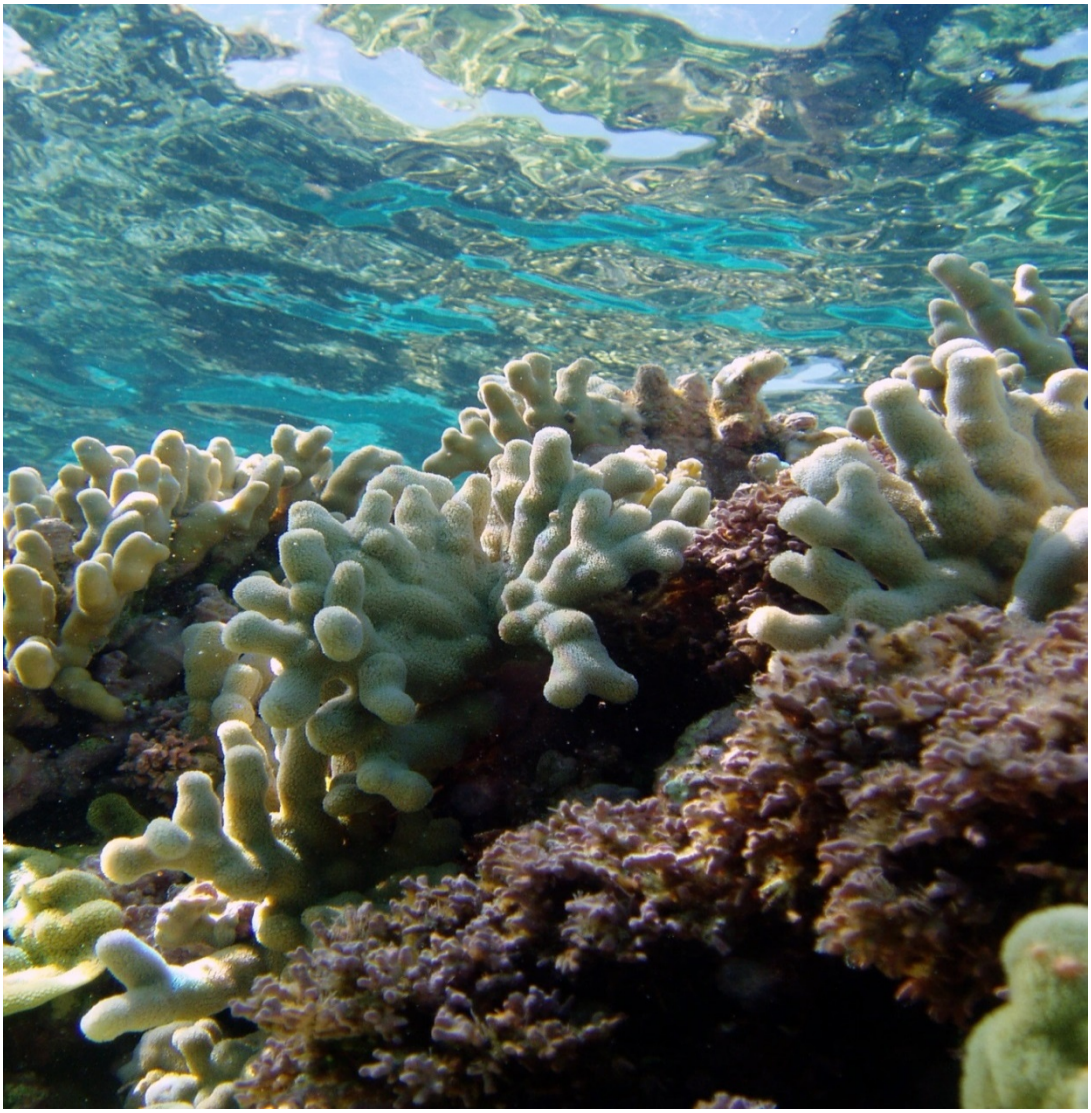
- Governance
- Community well-being
- Cultural importance of coral reefs
- Participation in behaviors that may improve coral health

Data analysis

Data analysis of both survey and secondary data included descriptive analyses (e.g., measures of central tendency, examination of distribution), as well as examinations of statistical relationships between variables (e.g., cross tabulations, correlation, regression analyses). Additionally, geospatial analyses were used to examine the extent of governance and, specifically, the amount of coral reef area under protected status. Some of the key findings will be discussed in the following sections of this report.

In order to obtain a representative survey sample for each island, certain islands were over-sampled in relation to the 2010 US Census population distribution for the state of Hawai‘i. To make statistical inferences concerning Hawai‘i as a whole, post-stratification sampling weights were calculated based on 2010 US Census population numbers to obtain a representative sample of Hawai‘i’s population distribution across the islands. These post-stratification sampling weights were designed to alleviate the under-representation of O‘ahu residents in relation to the total survey sample. Therefore, with the exception of comparisons between islands,[6] any conclusions that are stated concerning relationships between knowledge, attitudes, perceptions, human use, and demographics based on the NCRMP survey data have utilized these weights in their calculations. It also must be noted that the following frequency tables and graphs do not utilize these post-stratification weights, as no statistical conclusions are being drawn from them. Instead, they are merely illustrating the frequency distribution of responses to each survey question. A full breakdown of the representativeness of the Hawai‘i NCRMP sample compared to the 2010 US Census, along with the sampling weights, is available in Appendix C.

[6] Unweighted data are used in island comparisons (Results Section 4) in order to have the necessary sample size for representativeness of each island. Weighted data are used in other statistical analysis to make inferences about Hawai‘i in its entirety, as a stratified random sample.



Coral reefs in Hawai‘i (Photo Credit: Claire Fackler, CINMS, NOAA)

Results

Results Section 1: Primary Data Indicators

Results are reported by indicator in order to demonstrate which individual measures will be used to assess the indicators presented in Table 1. The first section of indicators presented includes those measured through the use of primary survey data; the first of which is the frequency of participation in marine activities related to coral reefs, as displayed in Table 4.

Frequency of participation in recreational and extractive activities

Table 4: Frequency of participation in various extractive and non-extractive reef activities (n=2,240)

	Non-extractive activities								Extractive Activities	
Frequency	**Swimming**	**Snorkeling**	**Diving (SCUBA or free)**	**Waterside/ beach camping**	**Beach recreation**	**Boating**	**Wave riding (surfing, stand up paddle boarding, body boarding)**	**Canoeing /kayaking**	**Fishing (for finfish)**	**Gathering of marine resources (non-finfish)**
Never	18.1%	43.3%	66.9%	47.5%	19.2%	65.5%	57.0%	66.8%	58.5%	72.8%
Once a month or less	27.7%	31.4%	17.2%	37.9%	37.5%	22.8%	18.7%	21.5%	22.7%	17.1%
2-3 times a month	14.3%	8.2%	5.4%	6.8%	18.1%	4.3%	7.0%	4.2%	7.6%	4.5%
4 times a month or more	38.9%	16.2%	10.1%	7.0%	24.6%	6.7%	17.1%	7.2%	10.7%	5.2%
Not sure, Refused, or No response	1.0%	1.0%	0.4%	0.8%	0.6%	0.7%	0.2%	0.3%	0.5%	0.5%

Table 4 outlines respondents' self-reported frequency of participation in coral reef related activities. It must be noted that these results reflect only residents of Hawai‘i, and do not take tourist or visitor activity participation into account. Participation in non-extractive recreational reef activities varies in Hawai‘i, with the two activities that residents participate in most frequently being swimming (81% participate) and beach recreation (80% participate).[7] Participation in fishing and gathering (extractive activities) of marine resources is less common, with 45% of respondents indicating that they fished and/or gathered for marine resources (41% of respondents indicating that they fished, and 27% of respondents indicating that they gathered marine resources).

[7] The most direct linkage between beaches and coral reefs is through the protection afforded to beaches by coral reefs which help protect beaches from erosion due to wave impacts and storm events (Ferrario *et al.* 2013).

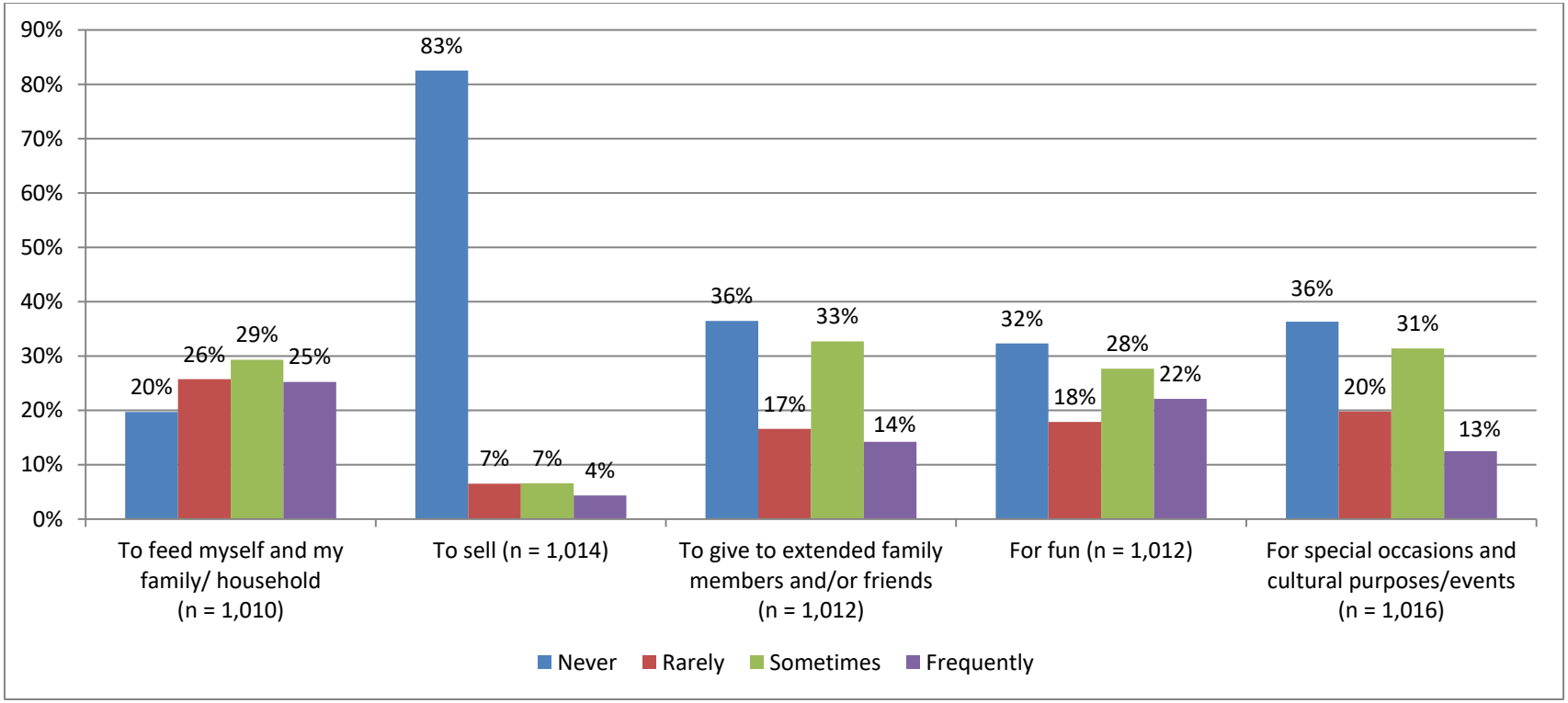


Figure 4: Frequency of fishing for various purposes in Hawai‘i

Figure 4 displays respondents' self-reported reasons for fishing or gathering marine resources. These questions were only answered by respondents who indicated that they participate in fishing and/or gathering in the previous question (Table 4). Therefore, the sample size for this question represents only 45% of total respondents. The most common reason for fishing among Hawai‘i residents who fish is "to feed myself and my family/household," with 80% indicating that they fish to feed themselves, and 25% do so "frequently." Of respondents who fish, fishing "to sell" was the least chosen response, with 83% of respondents indicating that they never sell their catch. This finding suggests that approximately 18% of respondents who fish do so to sell their catch either rarely, sometimes, or frequently.

Frequency of seafood consumption

Of the 2,240 people that responded to the question "How often do you or your family eat fish/seafood?" over 96% indicated that they consume seafood, with almost two thirds indicating that they consume seafood at least once a week. When asked where respondents obtained their seafood from, "purchased by myself or someone in my household at a store or restaurant" was the most frequently encountered response, with 63% of respondents indicating that they use this source as their first or second choice source for seafood. This choice was followed by "purchased by myself or someone in my household at a market or roadside vendor" (46%).

Participation in behaviors that improve coral reef health

Respondents were also asked about their participation in environmental behaviors to improve coral reef health, such as participating in beach clean-ups and volunteering for an environmental group. Of the 2,240 that responded to this question, 81% indicated that they participate in environmental behavior at any frequency, and 27% of respondents indicated that they participate in environmental behavior at least "several times a month or more."

Beach Clean-ups in O'ahu (Photo Credit: Project Aware; MyDive Scuba Network)

Perceived resource condition

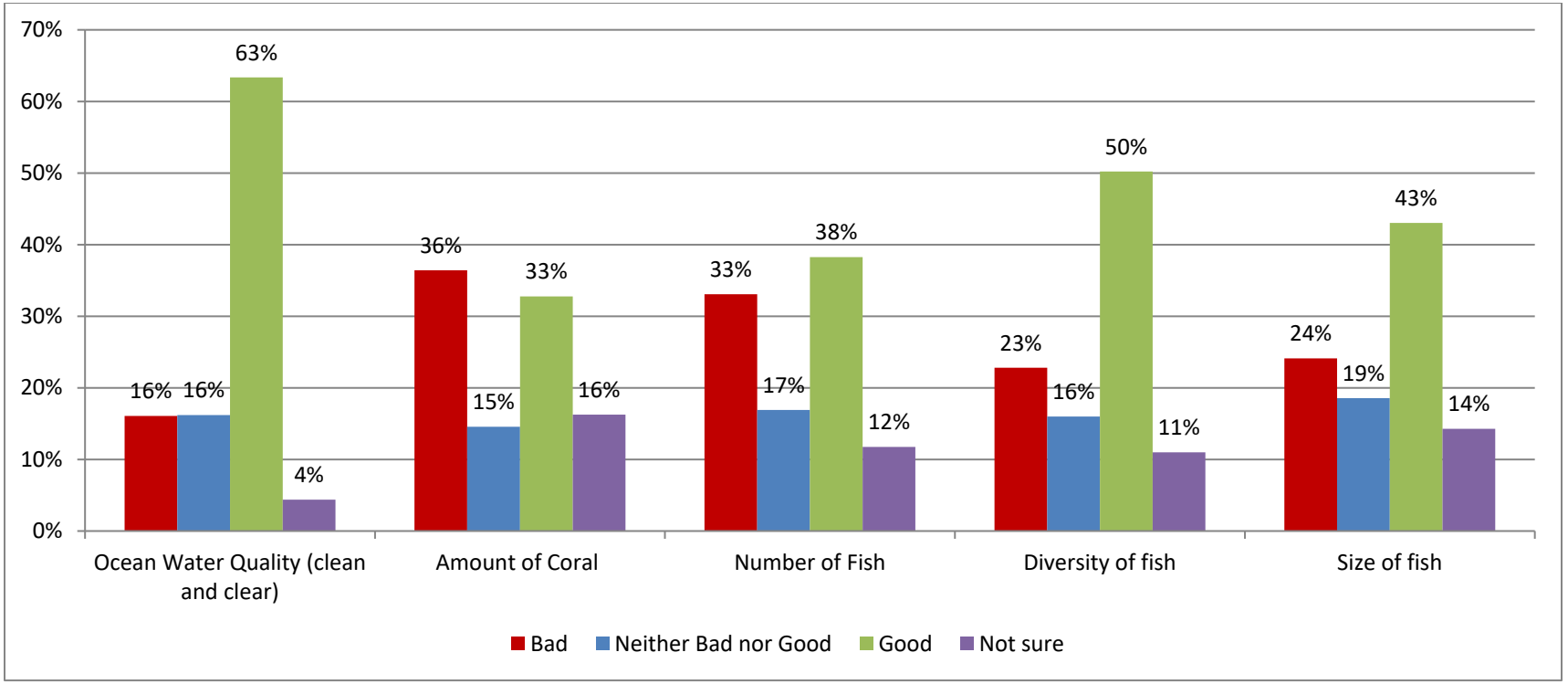


Figure 5: Resident perceptions of current conditions of marine resources (n = 2,240)

Figure 5 illustrates respondents' perceptions of the current condition of marine resources in Hawai'i. Residents perceived ocean water quality to be in the best condition, with 63% of respondents indicating that current ocean water quality was "good." Residents perceived the amount of coral to be in the worst condition, with 36% of respondents indicating that the current condition of the amount of coral was "bad;" however, amount of coral was also the resource that respondents were most unsure about, with an almost equal 33% of residents stating that the amount of coral was good, and 16% of respondents indicating that they were "not sure" of the condition of the amount of coral.

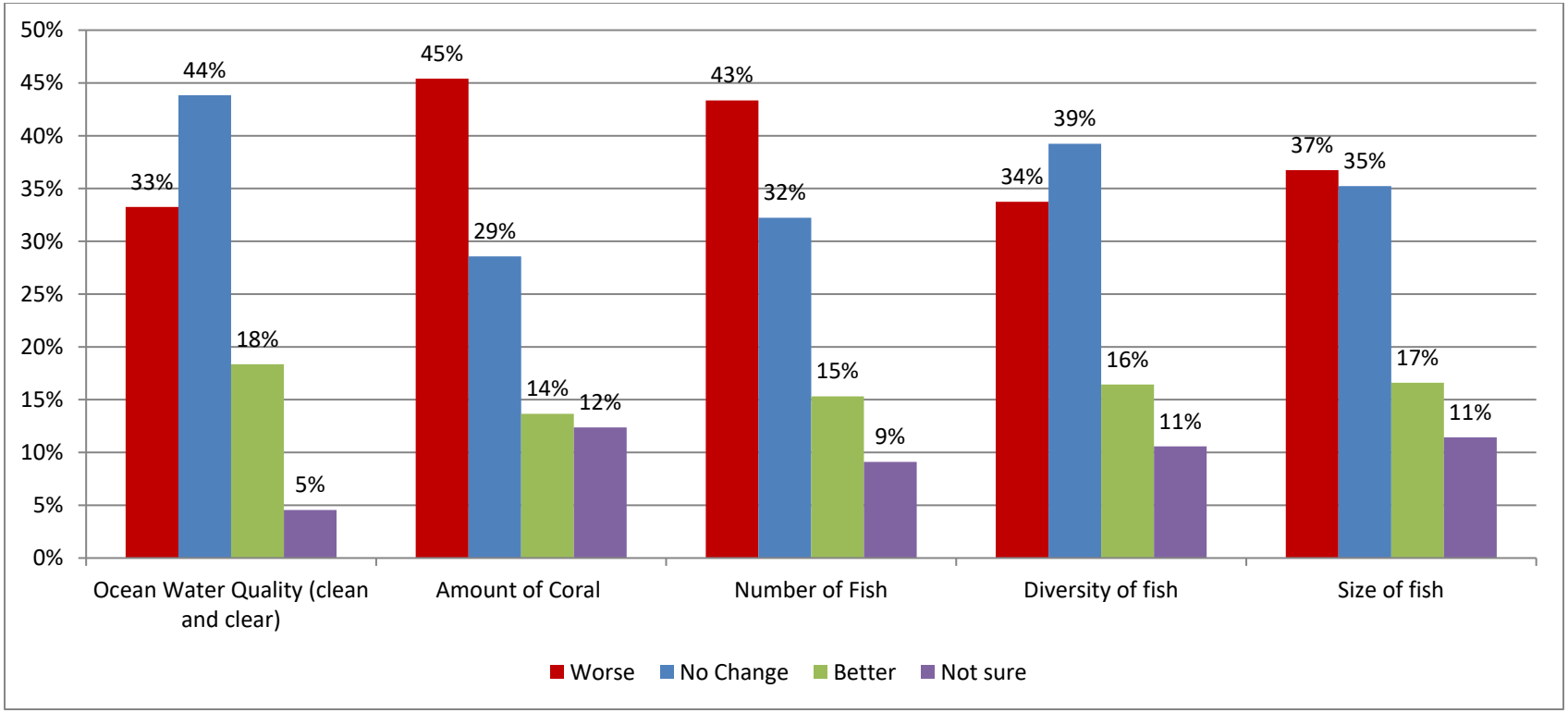


Figure 6: Resident opinions on change in condition of marine resources over past 10 years (n = 2,240)

Figure 6 illustrates respondents' perceptions concerning the change in the condition of marine resource over the last 10 years in Hawai'i. Overall, only a small proportion of respondents believed that the condition of these marine resources has gotten better over the last decade. "Amount of coral" was the marine resource that the highest proportion of respondents felt had gotten worse over the last decade (45%); however, this resource was once again the one that respondents were most unsure about (12%).

Respondents were asked how they felt the condition of marine resources will change over the next 10 years as well. Of the 2,240 that responded, 60% indicated that they thought that the condition of marine resources will "get worse" over the next decade, while 18% felt that the condition would "stay the same," and 18% believed that the condition will "get better."

Attitudes towards coral reef management strategies

Table 5: Resident opinions regarding potential management strategies for Hawai‘i (n = 2,240)

Management Option	Oppose	Neither Support nor Oppose	Support	Not Sure
Better regulation of land use practices to prevent sediment from going to sea	7%	9%	81%	3%
Catch limits per person for certain fish species (size and amount)	8%	5%	84%	3%
Seasonal openings/closures of fisheries	10%	7%	79%	4%
Gear restrictions for fishing	14%	8%	72%	6%
Better treatment of wastewater	5%	3%	90%	2%
Improved law enforcement for existing rules/regulations	9%	6%	83%	3%
Community participation in marine management	4%	4%	89%	2%
Ocean zoning	11%	13%	61%	15%
Designating marine managed areas	9%	6%	80%	5%
Limited use for recreational activities (examples include diving, snorkeling, boating)	25%	10%	61%	4%
No-take zones	13%	9%	66%	12%
Establishment of a non-commercial fishing license	27%	9%	58%	6%

Table 5 depicts respondents' attitudes toward various management options that were presented in the survey as common strategies used in the management of coral reef ecosystems. Overall, respondents were generally very supportive of all potential coral reef management strategies that were presented. The management option with the most support was "better treatment of wastewater," with 90% of respondents supporting this strategy. While the majority of respondents agreed with all of the presented management options, the option with the least support was "establishment of a non-commercial fishing license," with 27% of respondents opposing this strategy. The management options that respondents were the most unsure about were ocean zoning and no-take zones (15% and 12%, respectively).

Knowledge of coral reef rules and regulations

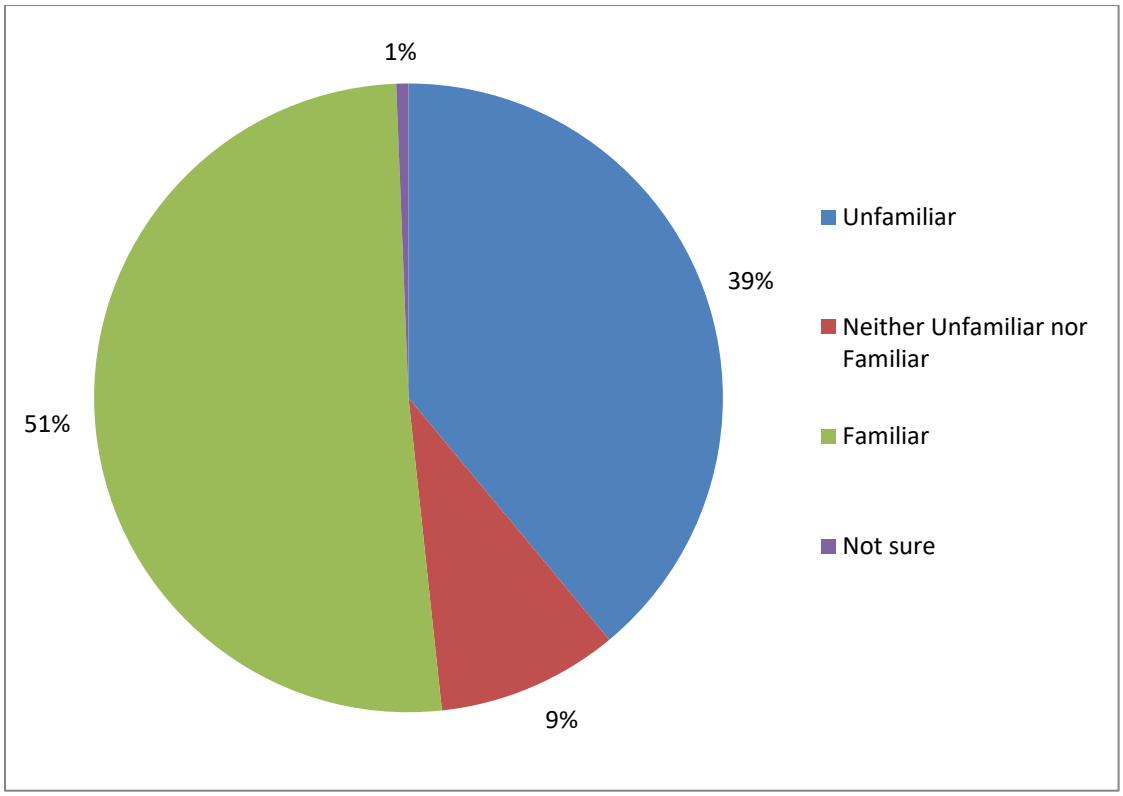


Figure 7: Residents' familiarity with Marine Protected Areas (MPAs) in Hawai'i (n = 2,240)

In order to operationalize the indicator of "knowledge of coral reef rules and regulations," Figure 7 displays respondents' self-reported relative familiarity with MPAs in Hawai'i. It was found that 39% of respondents indicated that they were familiar with MPAs, and 52% were either unfamiliar with MPAs or unsure of their familiarity.

Awareness and knowledge of coral reef functions and threats

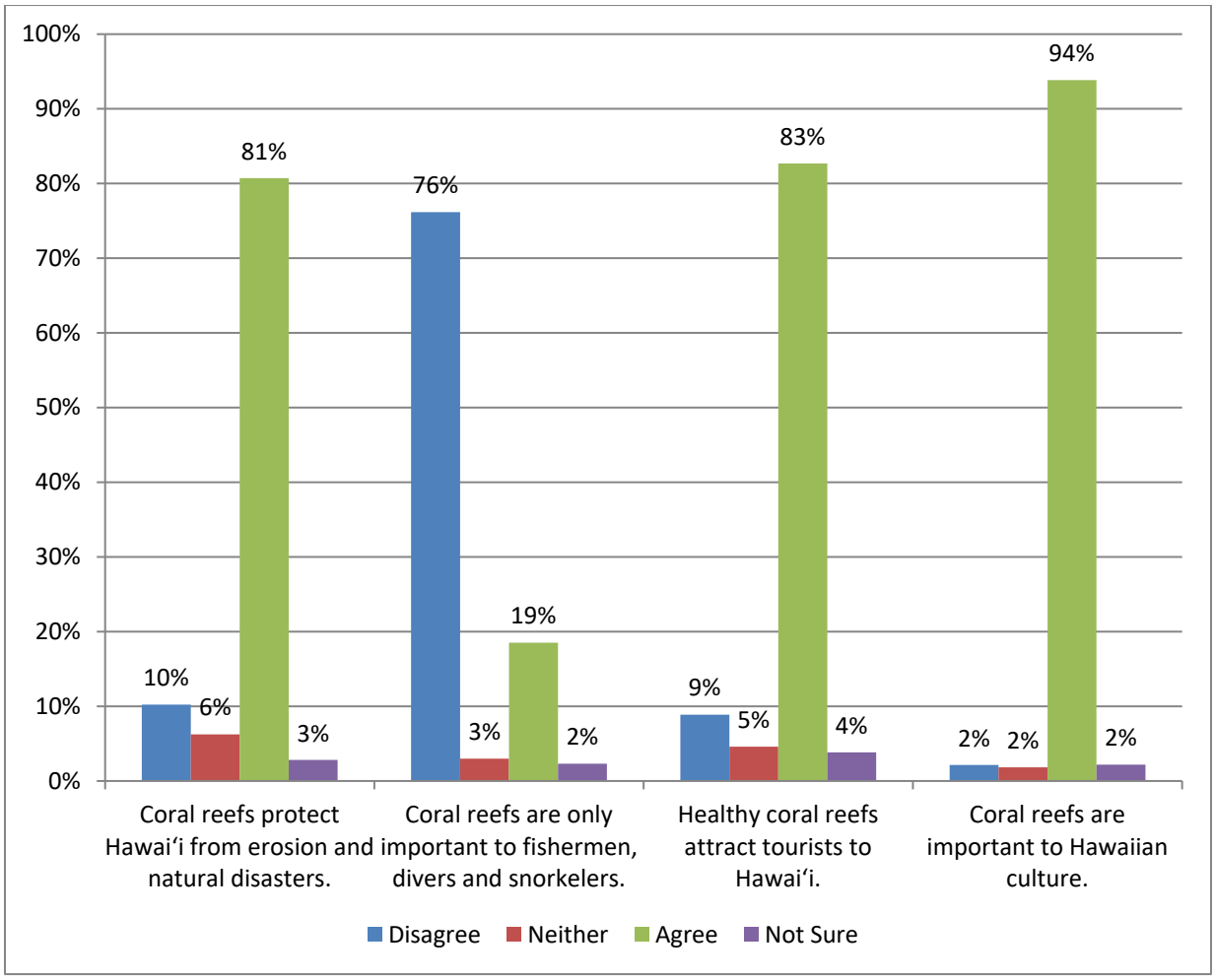


Figure 8: Resident perceptions regarding coral reef services

Figure 8 displays respondent attitudes pertaining to the services and byproducts of healthy coral reef ecosystems. The majority of respondents agreed with the above statements in the graph, except for one item: 76% of respondents disagree with the statement "coral reefs are only important to fishermen, divers and snorkelers." The statement with the highest level of agreement was "coral reefs are important to Hawaiian culture."

Familiarity with threats

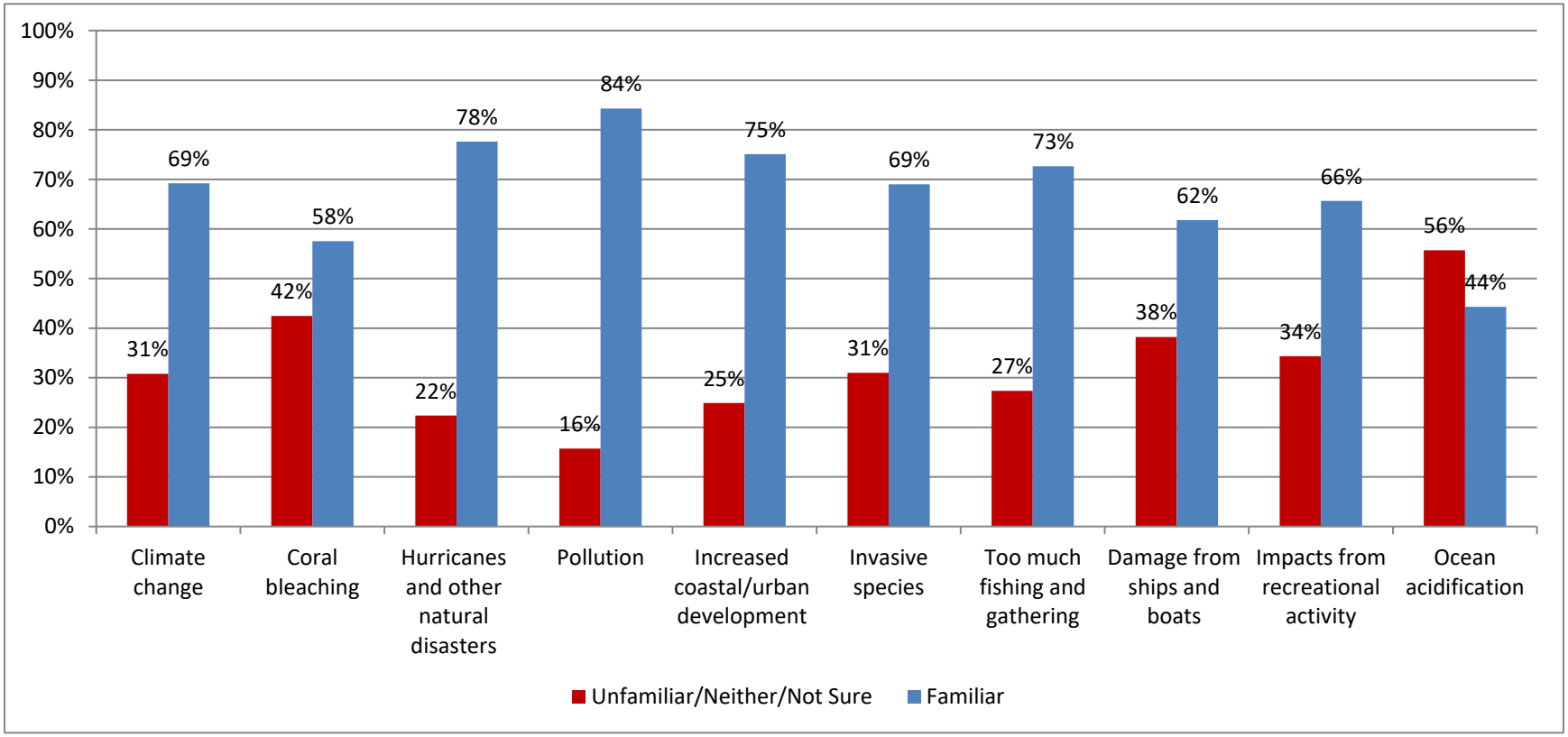


Figure 9: Residents' familiarity with threats to coral reefs (n = 2,240)

Respondents were also asked about their relative familiarity with various items that pose a threat to coral reef ecosystems. Overall, residents were mostly familiar with the various threats faced by coral reefs (Figure 9). The majority of respondents were familiar with all of the threats listed in the survey, with one exception: 56% of respondents were not familiar with ocean acidification. The threat to coral reefs that respondents were most familiar with was pollution (84%), followed by hurricanes and other natural disasters (78%).

Level of threats to coral reefs

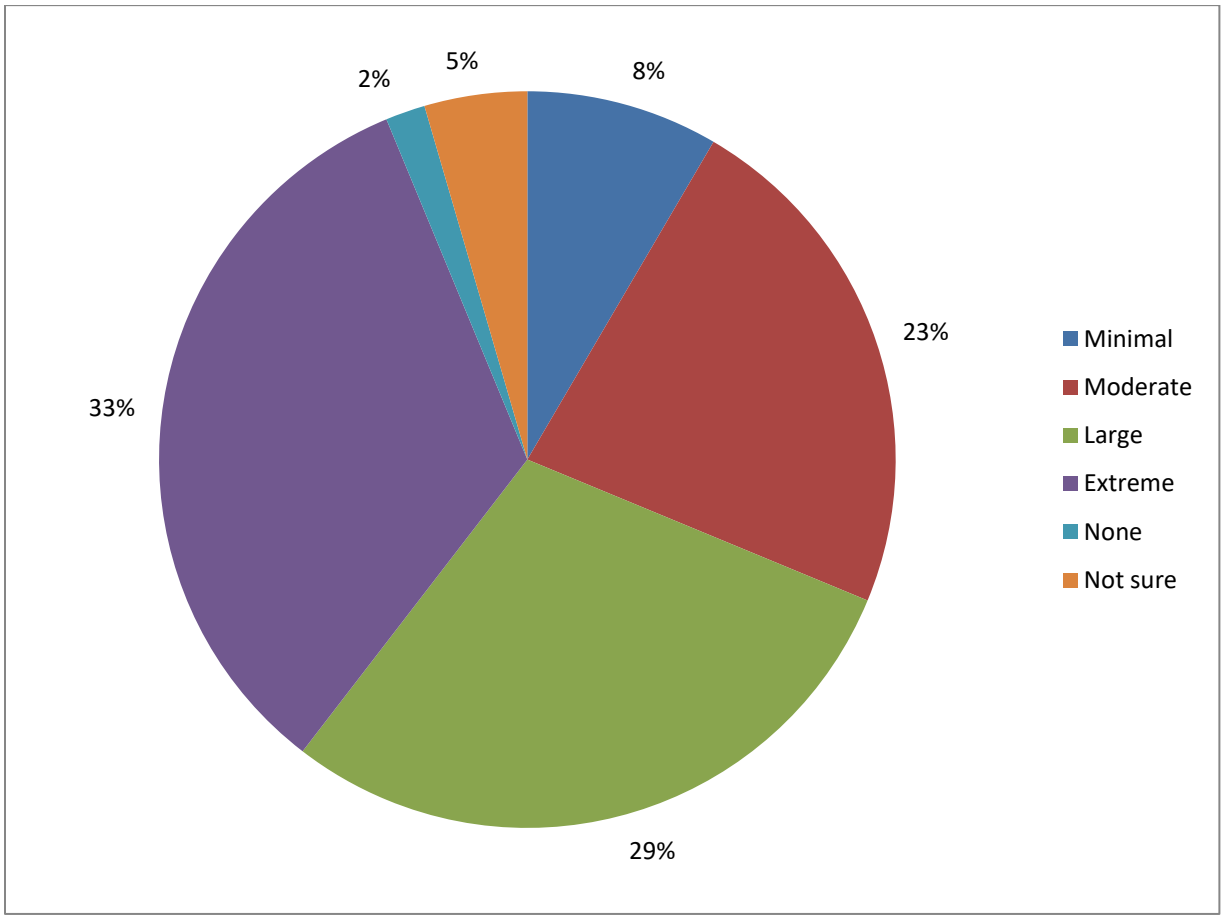


Figure 10: Residents' perceptions of the severity of threats to coral reefs (n = 2,240)

Figure 10 illustrates respondent perceptions concerning the severity of threats facing coral reef ecosystems. Over half of the respondents (62%) believed that the threat severity to coral reefs is at least "large." Only 2% of respondents indicated that they believe coral reefs are facing no threats at all. Additionally, 5% of respondents indicated that they are not sure about the severity of threats to coral reefs.

Results Section 2: Secondary Data Indicators

In the following section, the measures presented for each indicator originate from various secondary data sources. It again must be noted, however, that most secondary data are aggregated at the county level which is at a different spatial scale than how the NCRMP socioeconomic primary data were collected (primary data were collected at the island scale). For a more detailed explanation of how the island and county scales compare and contrast, please see Table 3. The secondary data used in the development of the NCRMP socioeconomic indicators were selected to be specifically relevant for coastal communities adjacent to coral reef ecosystems.

Human population composition and trends near coral reefs

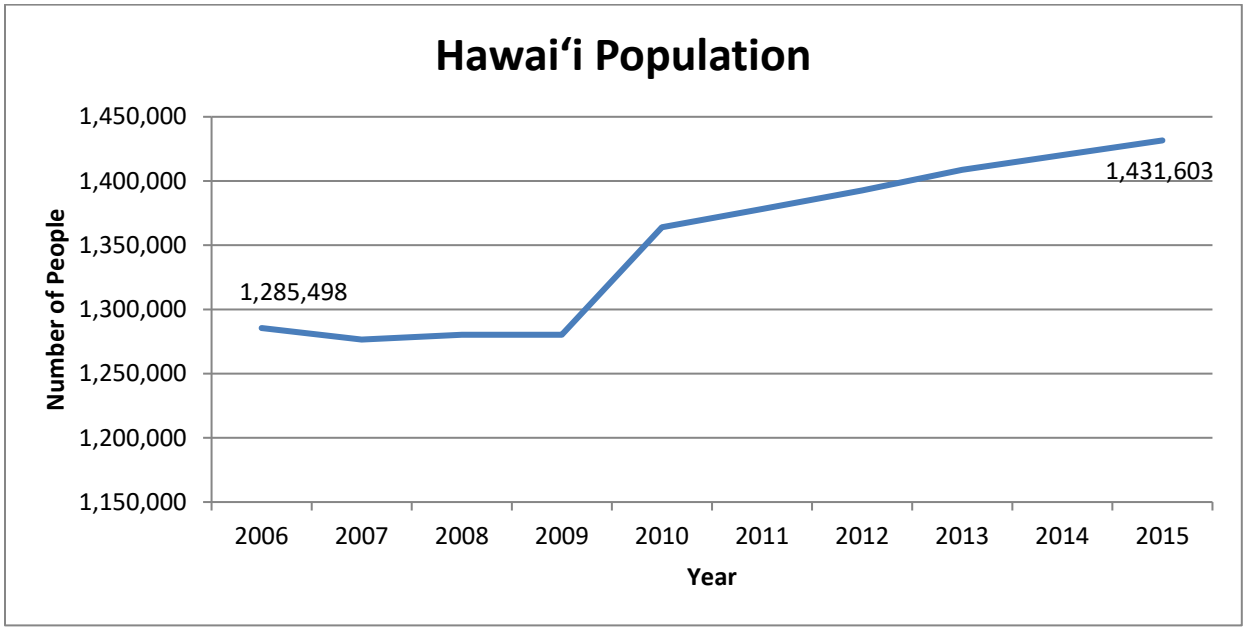


Figure 11: Population Trend in Hawai‘i

Source: US Census Bureau, American Community Survey

Figure 11 illustrates the recent ten year trend in population growth in Hawai‘i (US Census, American Community Survey). The population of Hawai‘i stayed relatively stagnant from 2006-2009, experienced a significant increase from 2009-2010, and then continued slightly upward ever since. The total population in the state increased 11%, from a reported population of 1,285,498 people in 2006 to 1,431,603 people in 2015.

Table 6: Population change for each Hawaiian county, 2000-2010

County	Population Change	Percent Change
Hawai‘i	36,402	24%
Honolulu	77,051	9%
Kaua‘i	8,628	15%
Maui	26,740	21%

Source: US Census Bureau

Table 6 depicts the trend in population growth at the county level in Hawai‘i. Each of the four main counties in Hawai‘i exhibited population increase from 2000-2010. Honolulu County exhibited the most population growth from 2000-2010 in absolute terms when compared to the other Hawaiian counties, while Hawai‘i County exhibited the most growth in percentage terms (US Census).

Table 7: Population density in Hawaiian counties, 2000-2010

County	Population Density, 2000 (persons per square mile of land area)	Population Density, 2010 (persons per square mile of land area)	Percent change in population density, 2000-2010
Hawai‘i	36.9	45.9	24%
Honolulu	1460.8	1,586.7	9%
Kaua‘i	93.9	108.2	15%
Maui	110.5	133.3	21%
Hawai‘i	**188.6**	**211.8**	**12%**

Source: US Census Bureau, Decennial Census of Population and Housing

From 2000 to 2010, population density increased for each of the four main Hawaiian counties (US Census). Hawai‘i County exhibited the largest growth in population density (24%) over the course of the decade, and the overall population density of Hawai‘i increased by 12% from 2000 to 2010.

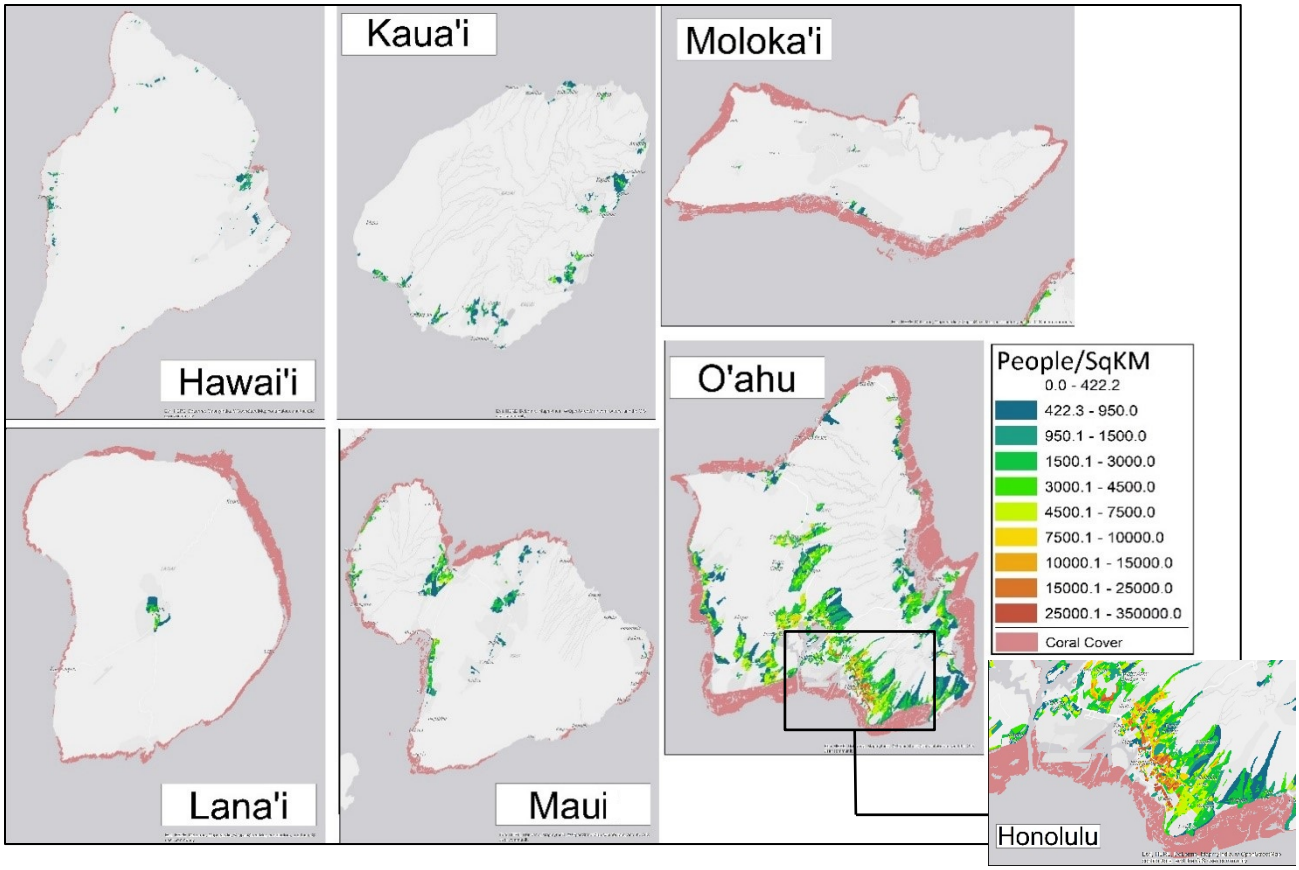


Figure 12: Population density (2010) in Hawai‘i by US Census Block and proximity to coral cover.

Figure 12 above depicts Hawai‘i’s population density at the Census Block level. It is widely understood that increased population density in proximity to coral reefs can lead to stress in the coral reef ecosystem (Brewer *et al.* 2013; Williams *et al.* 2008). The map illustrates an area of high population density (the city of Honolulu on the island of O‘ahu) in relation to coral cover (NOAA 2007),[8] and shows how Hawai‘i contains a few areas of high population density that may impact its coral reef ecosystem through stressors from development, recreation, and other types of anthropogenic effects.

[8] All coral cover data for this report were obtained from The NOAA Coral Reef Information System Hawai‘i Regional Portal: “Shallow-water Benthic Habitats of the Main Hawaiian Islands.”

Racial Composition and Age Structure of Hawai'i

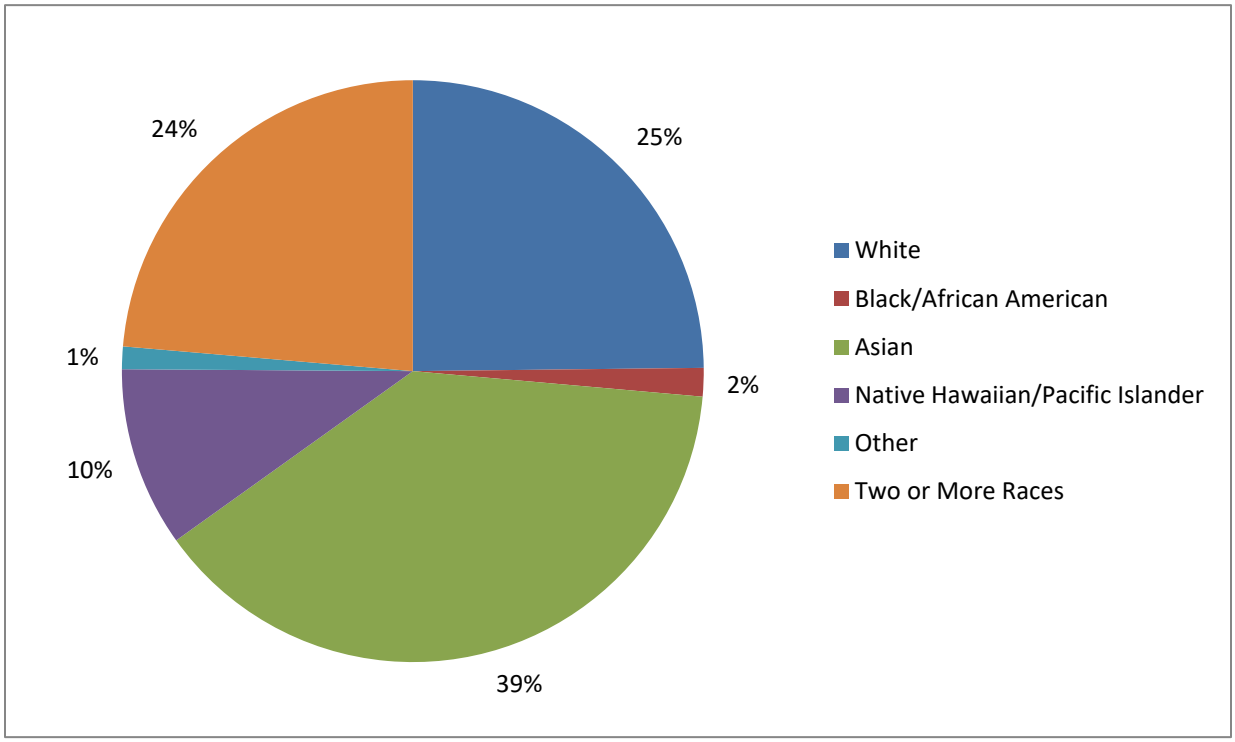


Figure 13: Racial and ethnic composition of Hawai'i

Source: US Census Bureau, Decennial Census of Population and Housing

As evidenced by the above figure, the racial composition of Hawai'i is diverse, with 24% of the population identifying as two or more races, the highest reported level of multi-ethnicity of all US states. Of those identifying with only one race, the most common was Asian (39%), followed by white (25%).

As for the age structure of the population of Hawai'i, the 2010 US Census Bureau reports that 22% of the population was under 18 years old (24% in 2000 Census) and 14% of the population was 65 years or older (13% in 2000 Census). The 2010 US Census Bureau reports an overall median age of 38 years old for the Hawaiian population (36 years old in 2000 Census). The state of Hawai'i has the highest life expectancy of all US states (Lewis and Burd-Sharps 2014).

Community well-being

In addition to the basic demographics described above, composite indicators can be utilized to further explain social variance (see Box 1). Five composite indicators related to human well-being are being tracked as part of the NCRMP socioeconomic component: Economic Security, Health, Basic Needs, Access to Social Services, and Education.

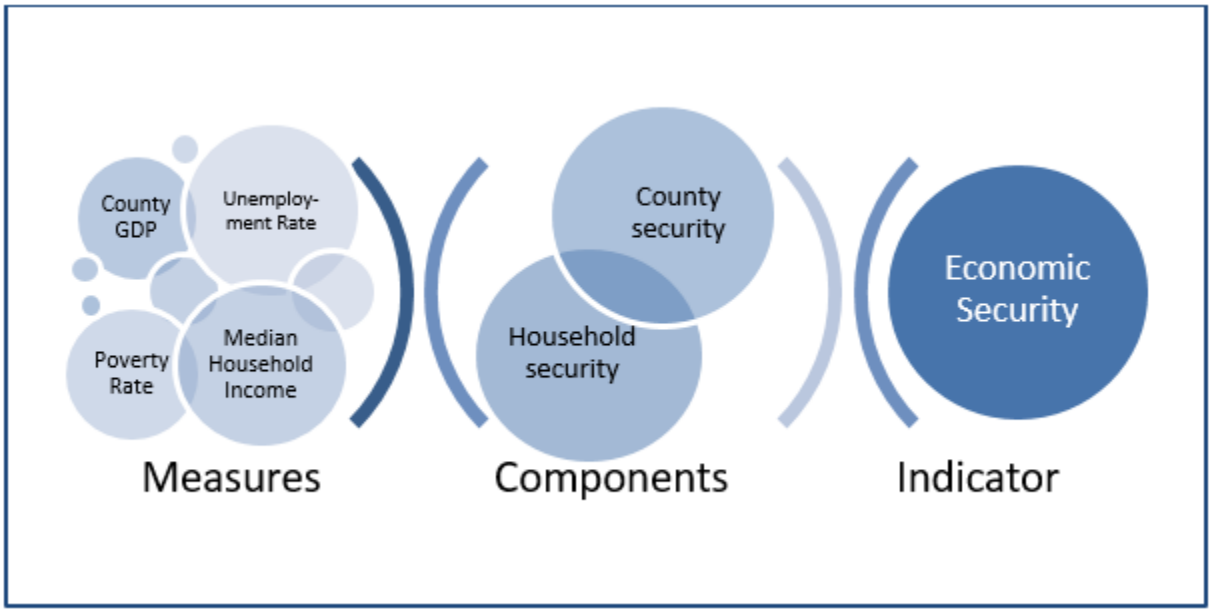


Figure 14: Economic Security presented as an example of operationalizing a composite indicator

Each composite indicator is conceptually complex. The indicators, demonstrated in Figure 14 with *Economic Security*, are made up of multiple of measures that, in turn, operationalize multiple dimensions of the composite indicator.

At the conclusion of the first monitoring cycle, the coral reef jurisdictions will be scored on select indicators of well-being. These scores will allow for comparisons across jurisdictions, and will be used in statistical analyses with indicators of environmental condition to analyze the dynamic relationship between the ecosystem services that people regularly enjoy and community well-being. A selection of measures that will be used to operationalize the well-being composite indicators of Economic Security, Health, Basic Needs, Access to Social Services, and Education are presented and discussed below.

Economic Security

The measures used to operationalize economic security will include gross domestic product, median household income, percent of the population in poverty, unemployment rate, and the amount of households receiving public assistance.

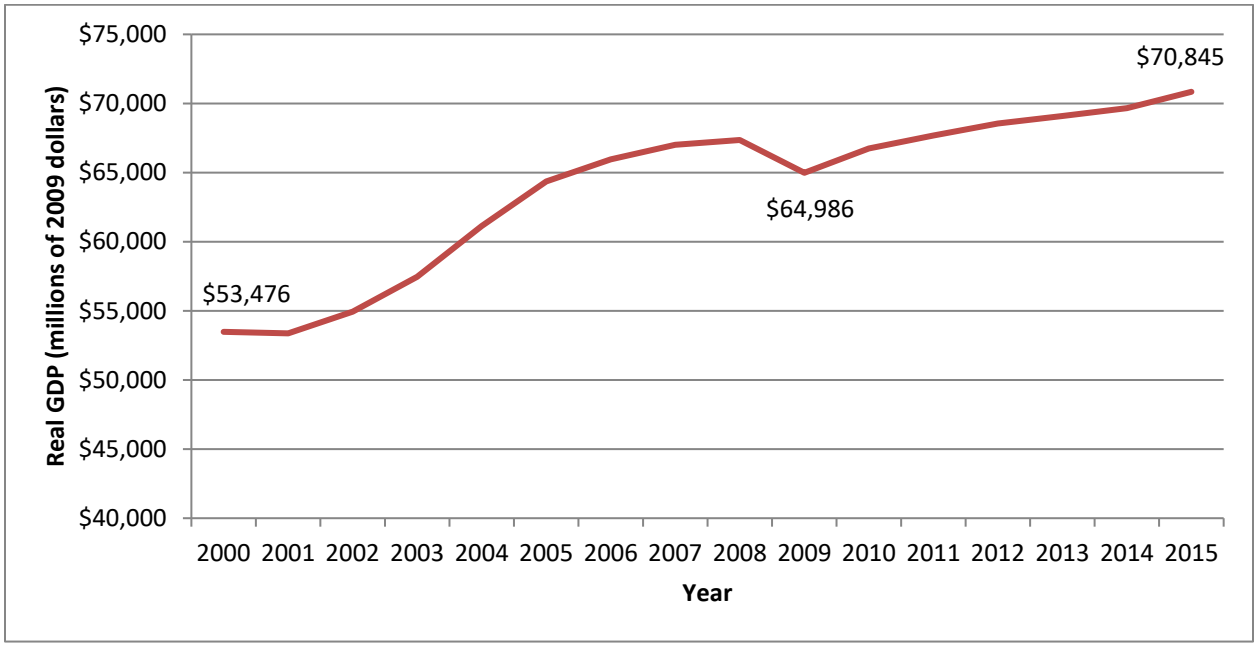


Figure 15: Hawai‘i real GDP

Source: US BEA; Real GDP by State

One of the most telling measures of economic well-being is real gross domestic product (GDP). Since 2000, the overall trend in Hawai‘i’s real GDP (measured in millions of 2009 dollars) was upward (Figure 15). From 2000-2015, real GDP in Hawai‘i has increased by 32%. Real GDP in Hawai‘i rose steadily throughout the 2000s until the Great Recession of 2007-2009, in which real GDP declined by 3% before it started to recover after 2009. Since the recession, Hawai‘i’s real GDP has increased by 9%. The trend in real GDP in Hawai‘i is similar to the US national trend. From 2007 to 2009, the US national real GDP decreased by 3% as well; and overall, US national real GDP increased by 30% from 2000-2015 (increased by 13% since 2009). Additionally, the trend in real GDP growth for each of the individual Hawai‘i counties is similar to the trend for the entire state (with the exception of Hawai‘i County recovering slightly slower after the recession when compared to the other Hawaiian counties). The data show that Hawai‘i seemed to recover from the Great Recession at a similar pace as the nation as a whole.

According to the 2012 ACS five year estimates, 4.2% of the civilian population in Hawai‘i aged 16 years and older were unemployed. This is an increase of 0.4% from the figure of 3.8% reported in the 2000 US Census.

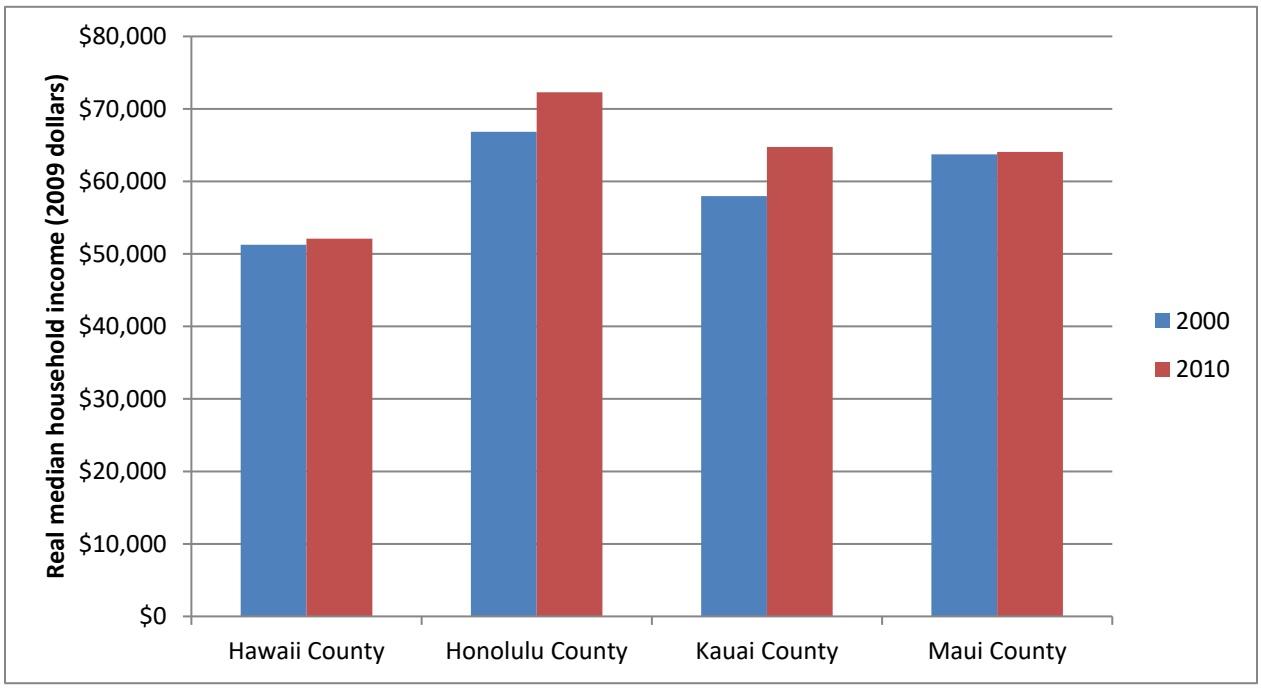


Figure 16: Median household income in Hawai‘i (inflation adjusted to 2009 dollars)

Source: US Census Bureau, Decennial Census of Population and Housing

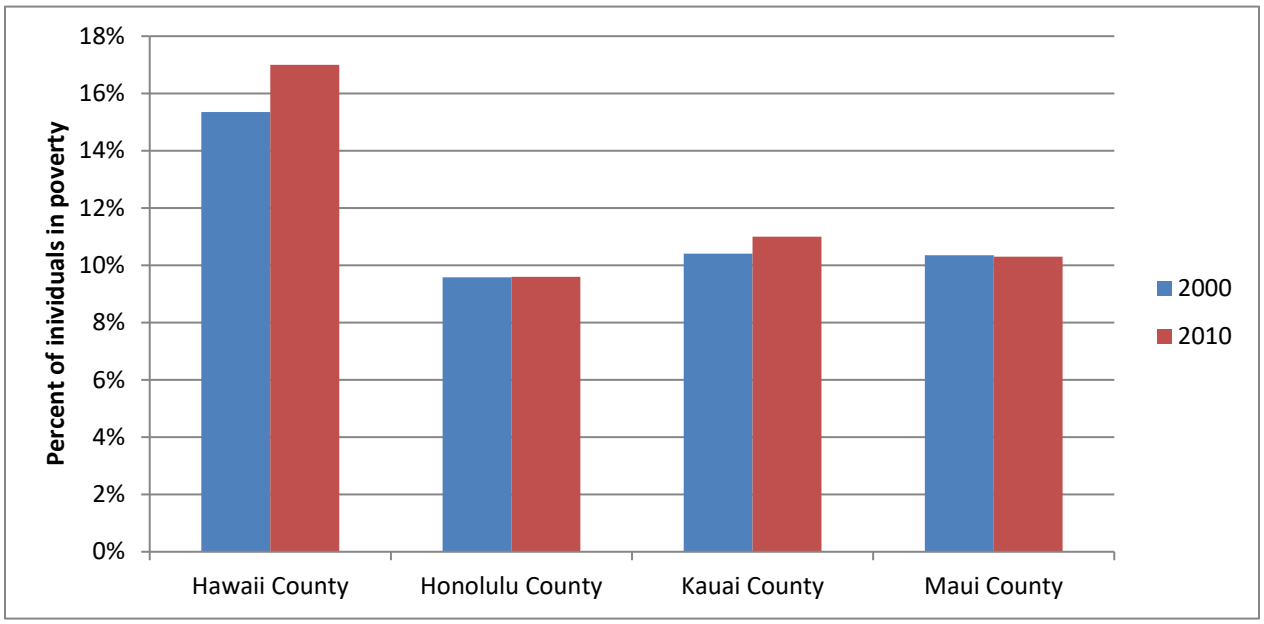


Figure 17: Level of poverty in Hawai‘i

Source: US Census Bureau, Decennial Census of Population and Housing

Real median household income, measured in 2009 dollars using the consumer price index, increased for each of the four main Hawaiian counties from 2000 to 2010 (US Census). The largest increase was observed in Kauaʻi County; and as a whole, real median household income for the state of Hawaiʻi increased by 5.2% from $64,155 in 2000, to $67,492 in 2010. When examining the poverty rate--determined to be $16,760 for a two-person family and $25,360 for a four-person family (US HHS 2010)--Hawaiʻi, Honolulu, and Kauaʻi Counties all exhibited a slight increase in poverty from 2000 to 2010, whereas Maui County exhibited a slight decrease. For the state as a whole, the poverty rate increased by 0.4% from 10.4% in 2000, to 10.8% in 2010.

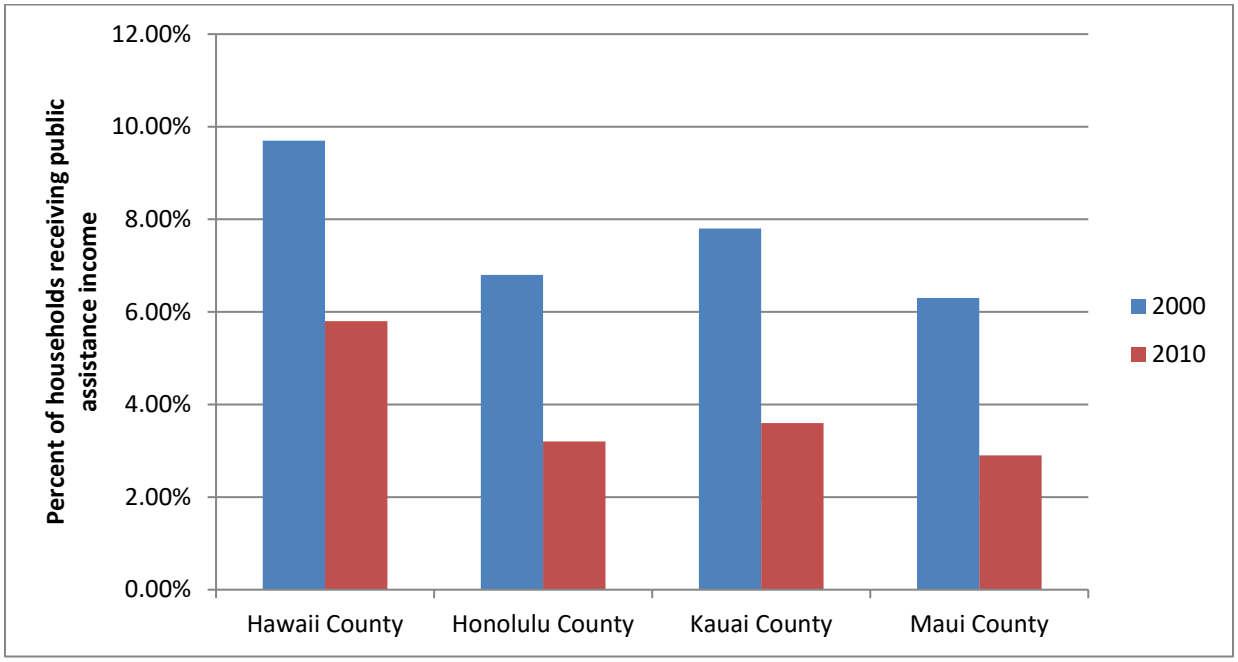


Figure 18: Public assistance in Hawaiʻi

Source: US Census Bureau, Decennial Census of Population and Housing

The percentage of households receiving public assistance income decreased in all of the 4 main Hawaiian counties from 2000 to 2010 (US Census). The largest decrease was observed in Kauaʻi County: 7.8% of households in Kauaʻi County were receiving public assistance income in 2000, compared to just 3.6% of households receiving public assistance income in 2010. For the state of Hawaiʻi as a whole, the percentage of households receiving public assistance income decreased from 7.2% in 2000, to 3.6% in 2010. The complete well-being assessment will examine the percentage of the population in need that is not being served by public assistance in order to measure the efficacy of support services in reaching target populations. Such measures are important to understanding the overall vulnerability of the population, independent of stressors such as resource decline, severe storm events, and climate change.

Health

Health, both physical and mental, contributes tremendously to individual and population well-being. Measures of life expectancy, mortality, and opportunity for a healthful lifestyle can be used to assess a population's health. Some of the measures that will be used as part of the composite indicator for health across all jurisdictions include leading cause of death, life expectancy, and three categories of age-adjusted death rates (from all cancers, from heart disease, and overall). The leading cause of death in Hawai‘i (2010-2012) was heart disease. The average life expectancy (2013-2014) was 81.3 years of age. In 2010, the age-adjusted death rate from all cancers was 140.9 per 100,000 people, the age-adjusted death rate from heart disease was 134.7 per 100,000 people, and the overall age-adjusted death rate was 584.8 per 100,000 people. It is important to track the overall health of the population in relation to the state of the environment, as the impact of environmental stressors on human health has been shown to have severe consequences. For example, a recent report finds that "the air we breathe, the food we eat, the water we drink, and the ecosystems which sustain us are estimated to be responsible for 23% of all deaths worldwide" (UNEP 2016).

Basic Needs, Access to Social Services, and Education

Basic needs, access to social services, and education are important social dimensions of well-being. The measures for basic needs include those related to the adequacy of housing, access to healthy food, and clean water. Basic needs are linked to the environment and its ability to provide the regulating and provisioning services necessary for water, food, and shelter. Of the 2010 US Census Bureau reported figure of 519,508 housing units in Hawai‘i, 455,338 (88%) were occupied. Of the occupied housing units, 262,682 (58%) were owner-occupied and 192,656 (42%) were renter-occupied. In 2010, the median value of owner occupied housing units in Hawai‘i was $508,657 (measured in year 2009 dollars), and the median age of housing units was 33 years old. The average household size in 2010 was 3.09 persons per household. This is an increase of 5.8% from the figure of 2.92 persons per household reported in 2000. Similarly, the average family size in Hawai‘i also increased by 3.2% from 3.42 persons per family in 2000 to 3.53 persons per family in 2010.

In 2010, 93% of the civilian non-institutionalized population in Hawai‘i had health insurance coverage. Also, as of 2010, only 8.7% of occupied households lacked access to a vehicle, and only 2.5% of occupied households lacked access to telephone service. Additionally, fewer than 1% of occupied Hawaiian households lacked access to complete plumbing, and similarly, fewer than 2% of occupied Hawaiian households lacked access to a complete kitchen (US Census). As of 2013, 91.4% of occupied households in Hawai‘i had access to a computer or laptop at home; and of those, 91.8% had access to internet service (US Census, American Community Survey).

One of the key components of community well-being is education. K-12 enrollment, along with high school and college educational attainment will be combined to examine education. In 2010, 90% of Hawai‘i residents aged 25 and older had completed high school or higher (greater than

the national average of 86%), and 30% of Hawai‘i residents aged 25 and older had completed a bachelor’s degree or higher (greater than the national average of 28%). Both of these figures represented an increase in educational attainment since 2000, in which 85% of Hawai‘i residents aged 25 and older had completed high school or higher, and 26% of Hawai‘i residents aged 25 and older had completed a bachelor’s degree or higher (US Census).

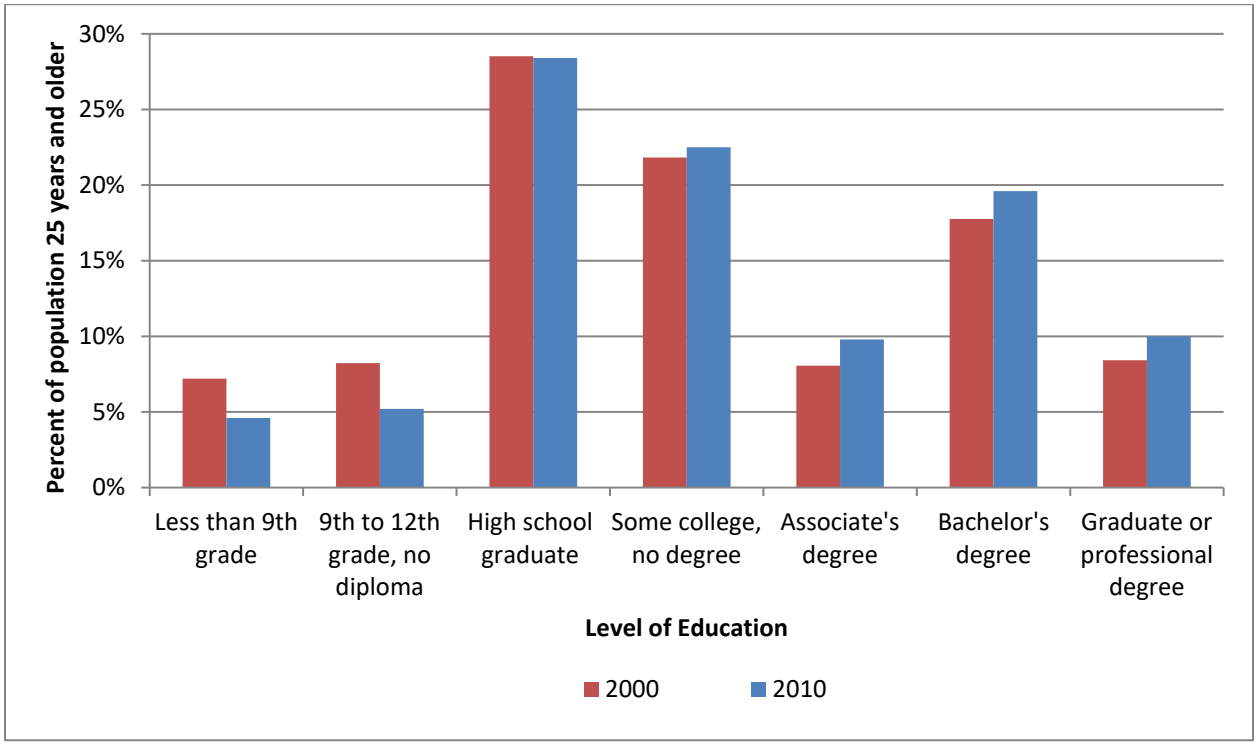


Figure 19: Levels of educational attainment in Hawai‘i

Source: US Census Bureau, Decennial Census of Population and Housing

Physical Infrastructure

In addition to the five community well-being composite indicators, a composite indicator of physical infrastructure will be monitored in order to track coastal development, access to coastal resources, and waste management/water supply infrastructure. Composite indicators for physical infrastructure relate to both the human development footprint, as well as measures in place to mitigate human impacts to the marine environment (e.g., point and non-point sources of land-based pollution, as well as sewage treatment and abatement). Some key aspects of physical infrastructure in Hawai‘i are outlined below.

Pollution

Water

Thirty-six percent of all beaches in Hawai‘i were monitored for water quality in 2012. Of these, 34% were impacted by a beach advisory action; however, only 1.4% of beach days were impacted (EPA). As evidenced by Table 8, of the coastal shoreline water bodies in Hawai‘i that were assessed, 67% were deemed to be “impaired” in 2014 (EPA). A waterbody is considered "impaired" if any one of its uses is not met (“uses” include aquatic life, recreation, fish/wildlife propagation water supply, fish consumption, etc., and “impairments” can be caused by a variety of things including bacteria, dissolved oxygen, sulfate, algal blooms, metal content, mercury, etc.). Along with the prevalence of pollution in Hawai‘i’s non-coastal water bodies, this fact indicates that water pollution in Hawai‘i is fairly widespread.

Table 8: Hawai‘i water quality assessment report; 2014

	Rivers and Streams (miles)	Lakes, Reservoirs, and Ponds (acres)	Bays and Estuaries (sq miles)	Coastal Shoreline (miles)
Good waters	244.4	0.0	2.2	56.2
Previously impaired waters now attaining all uses	0.0	0.0	1.2	11.7
Threatened Waters	0.0	0.0	0.0	0.0
Impaired Waters	2,322.6	4.9	85.8	114.1
Total Assessed Waters	2,567.0	4.9	88.0	170.3
Total Waters	3,905.0	N/A	94.1	1,052.0
Percent of Waters Assessed	65.7%	N/A	93.5%	16.2%
Percent of Assessed Waters that are impaired	90.5%	100%	97.5%	67.0%

Source: US Environmental Protection Agency; Assessment and Total Maximum Daily Load Tracking and Implementation System (ATTAINS)

Air

According to the 2014 EPA National Emissions Inventory, Hawai‘i produced approximately 488,030 short tons of “Tier 1” emissions in the year 2014 (a 29% increase since 2011), 58.2% of which was carbon monoxide, and 13.1% of which was volatile organic compounds. Other emissions included in this figure include nitrogen oxide, particulate matter, sulfur dioxide, and ammonia. The EPA tracks daily air quality through its Air Quality Index (AQI). Table 9 illustrates the number of days under each quality condition for each of the four main counties in Hawai‘i. In 2014 and 2015, Hawai‘i County experienced “unhealthy days” much more frequently than did the other counties in Hawai‘i due to volcanic activity. It also should be noted that air quality in Hawai‘i is affected by volcanic activity along with strength/direction of wind, and this could lead to differing air quality on windward and leeward sides of individual counties.

Table 9: Hawai‘i air quality days by county

	2015					2014				
County	Good days	Moderate days	Unhealthy for Sensitive Groups days	Unhealthy days	Very Unhealthy days	Good days	Moderate days	Unhealthy for Sensitive Groups days	Unhealthy days	Very Unhealthy days
Hawai‘i	2	58	154	148	3	15	77	142	130	1
Honolulu	328	37	0	0	0	349	10	0	1	0
Kaua‘i	363	2	0	0	0	338	6	0	0	0
Maui	344	21	0	0	0	332	8	1	0	0

Source: US Environmental Protection Agency, Air Quality Index

Land cover

Impervious land cover is a good indicator of development and is also associated with land-based pollution that can damage coral reefs. Hawai‘i had a total of 690.4 square kilometers of impervious cover out of a total of 16,663.8 square kilometers of land area in 2010 (approximately 4.1% of Hawai‘i is impervious cover) (NOAA Digital Coast, C-CAP). Honolulu County has the most impervious land cover out of the four main Hawaiian counties (Table 10).

Table 8: Impervious surfaces by county, 2010

County	Total Land Area (Sq. km)	Impervious Cover (Sq. km)	Percent of Impervious Cover
Hawai‘i	10,457.7	224.8	2.1%
Honolulu	1,545.0	316.2	20.5%
Kaua‘i	1,623.7	14.0	0.8%
Maui	3,006.3	134.3	4.5%
Hawai‘i Total	**16,632.7**	**689.3**	**4.1%**

Source: 2010 US Census Bureau, Decennial Census of Population and Housing and NOAA C-CAP

As of 2013, the development of man-made shorelines in Hawai‘i reached a total of 315.19 km (195.85 miles), or about 13% of the recorded total shoreline area (NOAA/OR&R 2013). For the purposes of this report, man-made shorelines include:

> “sheltered solid man-made structures (wooden or concrete seawalls, boat docks, and the like that are not directly exposed to the ocean); riprap (large stones or other large rough cut solid materials placed on the shore to prevent or reduce erosion due to wave action); exposed, solid man-made structures (wooden or concrete seawalls, boat docks, and the like that are directly exposed to the ocean); and, sheltered riprap (large stones or other large rough cut solid materials placed on shore in an area not exposed to the ocean in order to prevent or reduce erosion due to wave action)” (NOAA/OR&R 2013).

The large stretch of northwestern Hawaiian Islands that lie northwest of Kaua‘i and extend to Kure Atoll remain largely undeveloped. As one ventures inland on any of the six inhabited Hawaiian Islands, development becomes progressively less dense as the land transitions from a low-lying coastal landscape to a higher elevation volcanic landscape.

Building Permits

Building permits are indicative of economic and development trends, and data concerning these permits are utilized here to further operationalize the composite indicator of physical infrastructure. As of 2016, the number of building permits granted has decreased by 52%, and the value of building permits (in inflation adjusted dollars) have decreased by 37% since 2007

(Table 11). The number and value of building permits granted in Hawai‘i has varied year to year since 2006, although the total value of building permits decreased between 2007 and 2011, and increased since then with a slight dip in 2016 (US Census Bureau 2016). These figures indicate that although there was a declining emphasis on built development in Hawai‘i during the recession years and immediate years after the recession, the investment in new structures has been on the rise in recent years.

Table 91: Building Permits in Hawai‘i; 2007-2016

Year	Number of building permits	Value of building permits (nominal dollars)	Value of building permits (constant 2015 dollars)
2007	6,972	$1,724,319,000	$1,971,504,662
2008	4,115	$1,170,964,000	$1,289,059,485
2009	2,617	$779,010,000	$860,637,620
2010	3,442	$773,013,000	$840,230,135
2011	2,743	$653,884,000	$688,994,012
2012	2,993	$756,981,000	$781,454,941
2013	3,882	$1,019,271,000	$1,037,034,966
2014	3,066	$1,011,786,000	$1,012,986,966
2015	5,422	$1,582,395,000	$1,582,395,000
2016	3,375	$1,261,126,000	$1,245,414,930

Source: US Census Bureau; Building Permits Survey: New Privately Owned Housing Units Authorized

Waste Management and Water Supply

The State of Hawai‘i Department of Health reports that approximately 38.1% of Hawai‘i’s residents used septic tanks, cesspools or some other means of sewage treatment (State of Hawai‘i Department of Health 2017). Of occupied households, 3,278[9] (<1%) had incomplete plumbing facilities (US Census, American Community Survey). As of 2016, there were 14 landfill facilities in Hawai‘i (EPA 2016).

As of 2010, 1,304,617 people (96%) in Hawai‘i were served by the public water supply (ground water and surface water), and 55,684 people (4%) were reported to be self-serviced (US Geological Survey 2010). As of 2012, there were 22 publically owned wastewater treatment facilities (WWTF) in Hawai‘i, 18 of which are in the study area (see Figure 20). These facilities serve approximately 800,000 people (EPA 2012). Figure 20 illustrates WWTFs in proximity to coral cover (NOAA 2007) throughout the main Hawaiian Islands.

[9] +/-432; 2011-2015 American Community Survey estimates

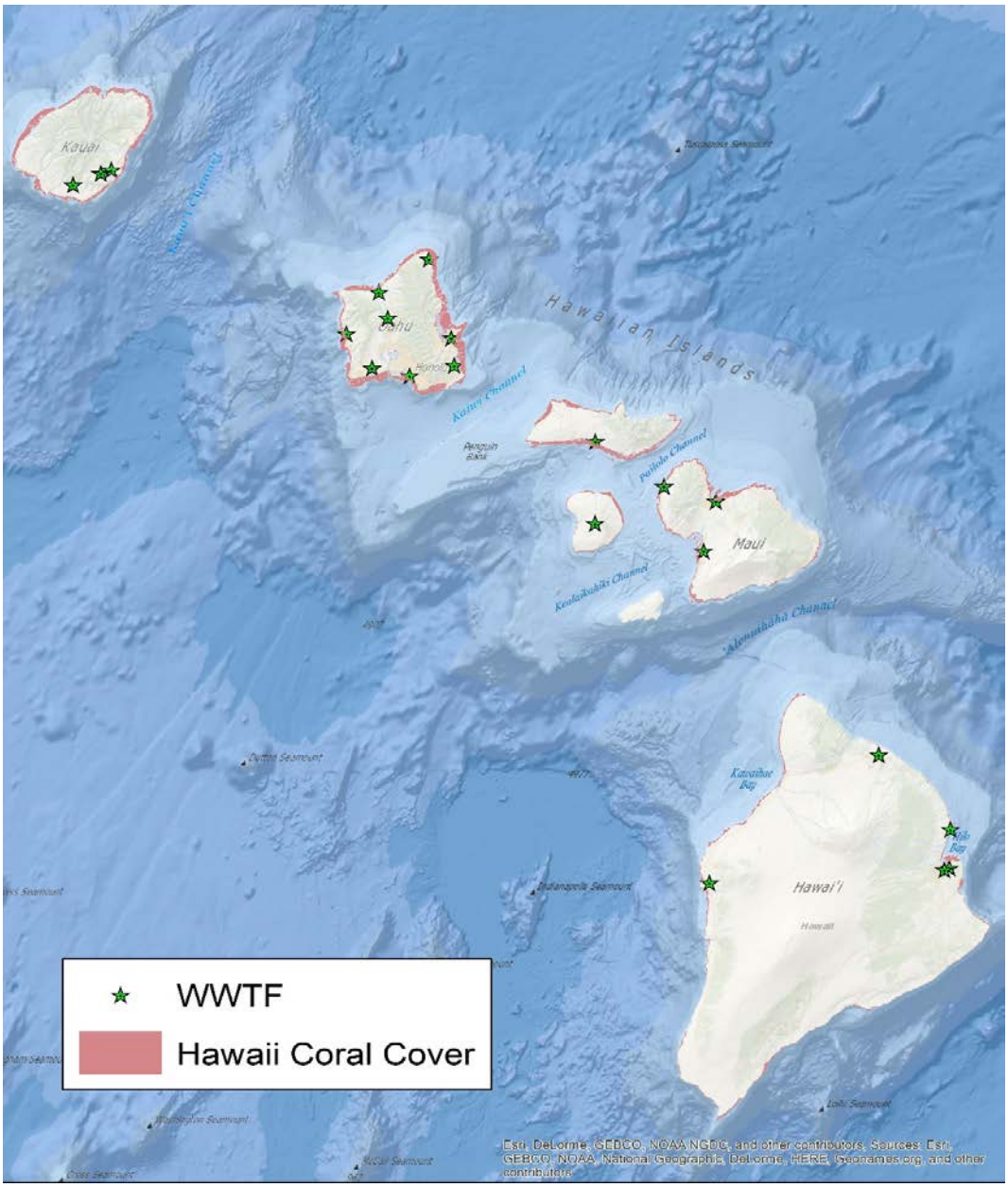


Figure 20: The proximity of wastewater treatment facilities to coral reef cover in Hawai‘i

Physical Access to Coastal Resources

The state of Hawai‘i has 24.4 miles of accessible, swimmable sandy beach coastline and 184.9 miles of sandy shoreline overall. Additionally, Hawai‘i has 250 public beach parks, an estimated 1,600 surfing sites, and 67 boating facilities (State of Hawai‘i Office of Planning 2006; Hawai‘i Department of Land and Natural Resources 2017). Beach, boating, and recreation activities are accessible to Hawai‘i residents across all of the islands (see Figures 21 and 22), although many coastal areas are difficult to access via land due to lack of paved roads and private property owners restricting access.

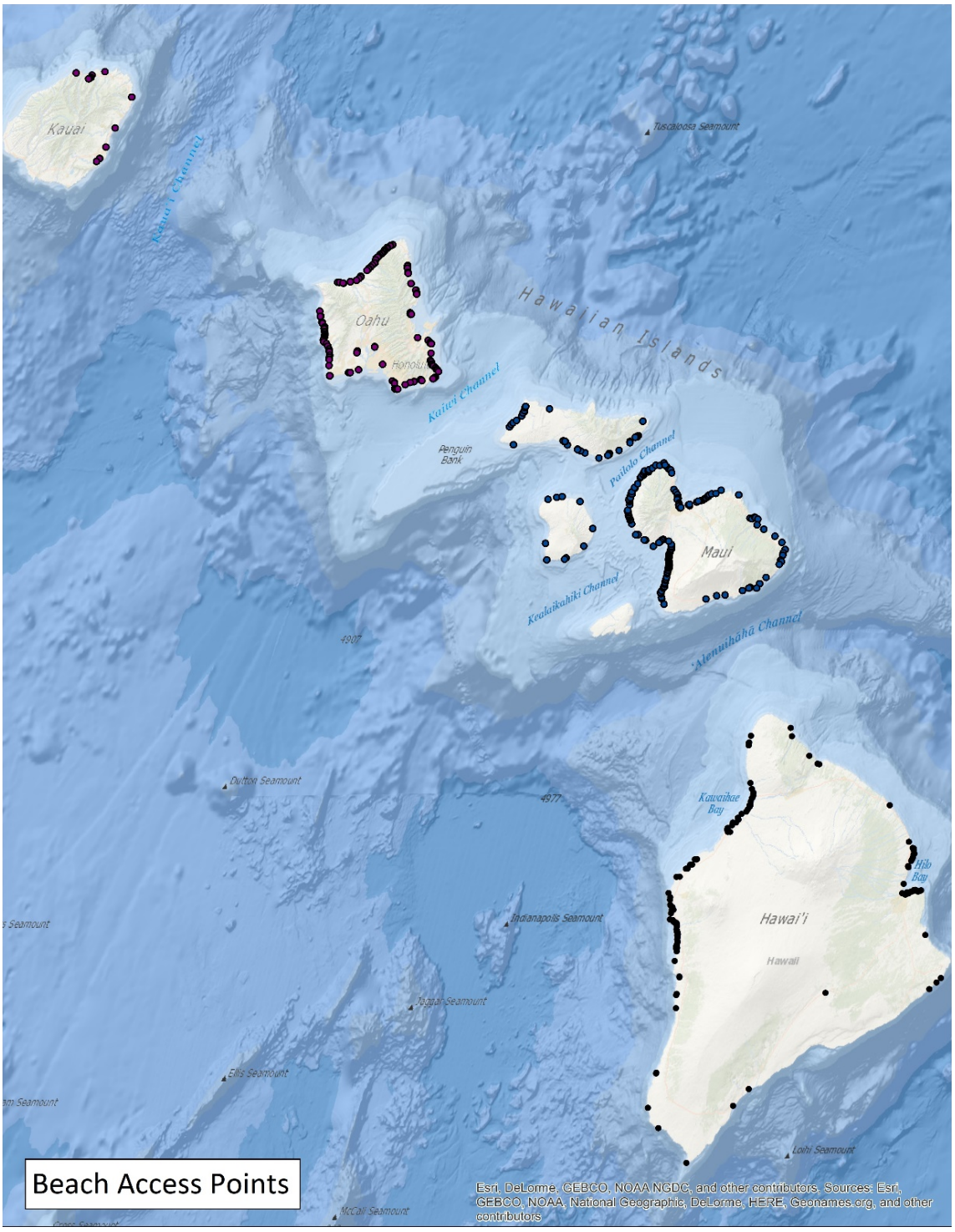


Figure 21: Beach Access via designated parks in Hawai‘i

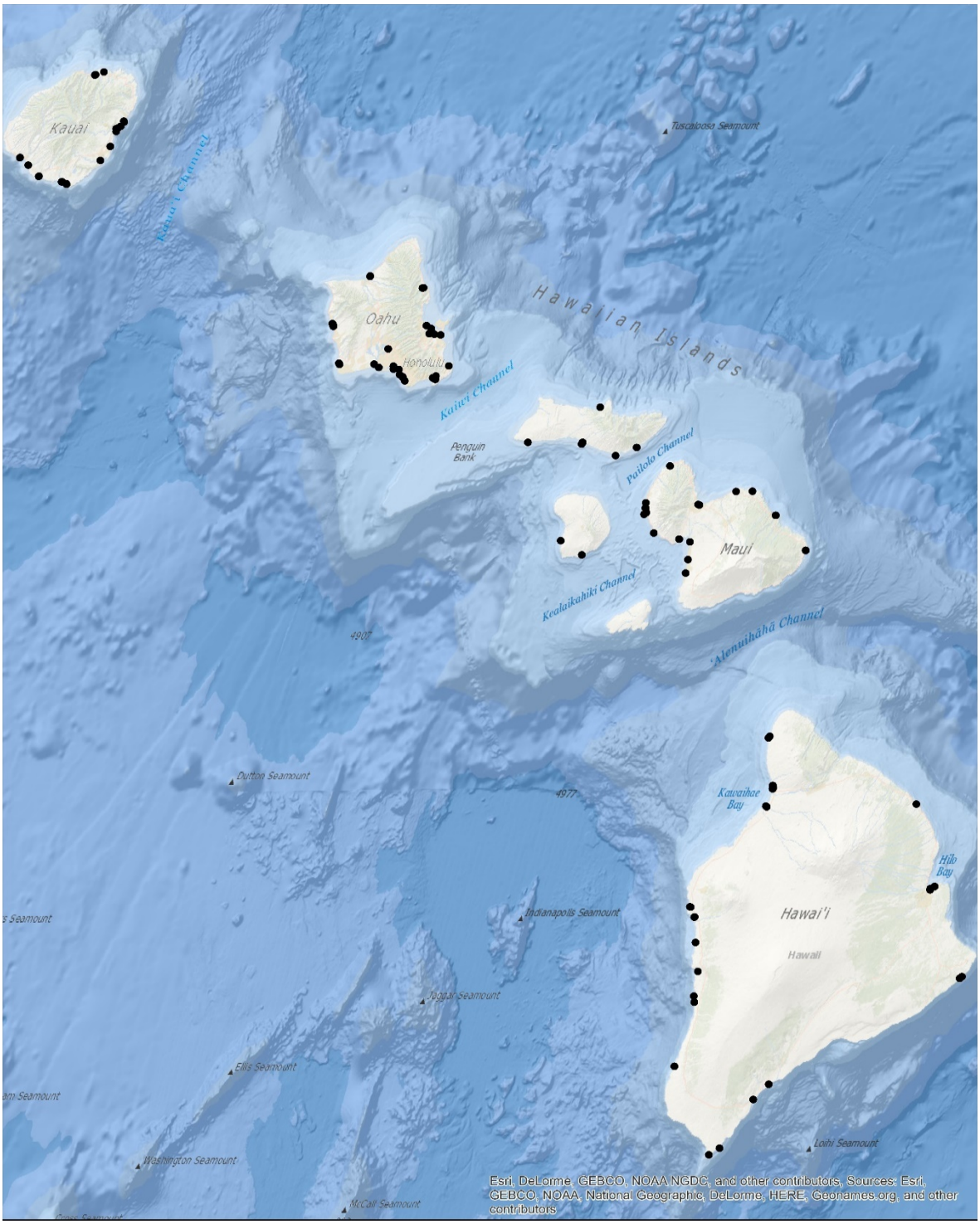


Figure 22: Recreational boating facilities[10] in Hawai‘i

[10] Includes small boat harbors, launch ramps, piers, anchorages, and deep draft harbors.

Economic activities related to reefs

Also relevant to the NCRMP socioeconomic monitoring component are a wide range of economic activities that make use of the coastal and marine environments in Hawai‘i. These activities, many of which are outlined below, can have direct and indirect impacts on coral reefs.

Ocean-Related Industry

Table 102: Hawai‘i Ocean Sector Economy, 2014[11]

County	Number of establishments	Number of employees	Wages (millions of dollars)	GDP (millions of dollars)	Percent of Total GDP
Hawai‘i	565	11,489	$350.35	$776.68	11.11%
Honolulu	2,500	51,351	$1,553.53	$2,232.42	3.84%
Kaua‘i	322	4,487	$92.62	$169.94	5.17%
Maui	669	21,581	$795.07	$1,758.92	22.16%
Hawai‘i Total	4,063	111,672	$3,883.95	$7,416.88	9.70%

Source: NOAA Digital Coast, ENOW

Table 12 shows a snapshot of the ocean sector economy in Hawai‘i for the year 2014. These numbers reflect the sum of all economic activities related to the following industries: marine construction, living resources, offshore mineral extraction, ship/boat building, tourism/recreation[12], and marine transportation. These aforementioned industries contributed roughly $7.42 billion to the economy of Hawai‘i in 2014 (a 3.8% inflation-adjusted increase from the previous year), and supported 111,672 employees at 4,063 establishments in the region. The ocean sector in Honolulu County alone produced over $2.2 billion in GDP in 2014, and supported 51,351 employees at 2,500 establishments. Overall, ocean-related industry represented just under 10% of Hawai‘i’s total GDP in 2014, and Maui County was especially dependent on ocean-related industry, as these industries comprised 22% of Maui’s total county GDP in 2014 (NOAA Digital Coast, ENOW 2014).

Fishing

Much of fishing in Hawai‘i, both commercial and non-commercial, is coral reef dependent. Coral reefs provide the habitat that is necessary for several commercially important fish species such as

[11] Please note that due to absent information at the county level, not all columns in the table will add up to the exact figure for the statewide total.

[12] The tourism/recreation sector for the ocean economy takes into account boat dealers, full service restaurants, limited service eating places, cafeterias, snack and nonalcoholic beverage bars, hotels (non-casino) and motels, bed and breakfast inns, marinas, RV parks and recreational camps, scenic and sightseeing transportation (water), sporting and athletic good manufacturing, scenic and sightseeing transportation (other), sport and recreation institutions, recreation goods rentals, amusement and recreation services not elsewhere classified, zoo/botanical gardens, and nature parks/other similar institutions (NOAA Digital Coast 2015).

snapper, grouper, spiny lobster, and parrotfish. Studies have shown that when coral reefs are healthier and more widespread, fish biomass and abundance increases as well (Vincent *et al.* 2011; Friedlander and DeMartini 2002); therefore, the health of coral reefs is an important driver of commercial and non-commercial fishing harvest and value. While healthy coral reef ecosystems directly impact coral reef fish species, it is also important to note that coral reef ecosystems still support pelagic fish population and health as they provide critical nursery habitat for juveniles (Thorrold and Williams 1996; Doherty and Carleton 1997) and act as a food source for pelagic species that venture near the coast, such as sharks (Roff *et al.* 2016).

Table 113: Commercial fishing harvest for coral reef fish species in Hawai‘i, 2004-2014[13]

Year	Harvest caught (in lbs)	Harvest sold (in lbs)	Value of Harvest (nominal dollars)	Value of Harvest (Constant 2015 dollars)
2004	923,687	785,753	$2,894,582	$3,631,896
2005	784,633	692,991	$2,686,057	$3,259,811
2006	704,686	595,053	$2,341,665	$2,753,048
2007	731,311	621,268	$2,364,538	$2,703,501
2008	781,614	649,818	$2,574,717	$2,834,385
2009	782,821	655,353	$2,722,616	$3,007,902
2010	840,672	695,403	$2,792,273	$3,035,074
2011	710,632	586,167	$2,421,408	$2,551,424
2012	766,053	657,550	$2,813,491	$2,904,454
2013	798,241	714,175	$3,116,292	$3,170,603
2014	764,951	666,972	$3,238,727	$3,242,571

Source: Pacific Islands Fisheries Science Center; Western Pacific Fisheries Information Network

Table 13 displays time-series data concerning commercial fish harvest of coral reef species in Hawai‘i for the years 2004-2014. Both the amount of harvest and the value of the harvest have fluctuated over time, but the overall trend in pounds harvested and inflation adjusted harvest value since 2004 is slightly downward. Since 2004, the Hawai‘i coral reef fishery harvest in pounds has decreased by 17%, and the Hawai‘i coral reef fishery harvest value in inflation-adjusted 2015 dollars has decreased by 11%, indicating that the coral reef ecosystem has lost some commercial fishing value over this time.

[13] Species included in these figures include: bigeyes, groupers, damselfishes, snappers, filefishes, flounders, goatfishes, groupers, hawkfish, parrotfishes, pufferfishes, reef jacks, rudderfish, scorpionfishes, squirrelfishes, surgeonfishes/tangs, tilapia, trumpetfish, wrasses, and other unknown reef fish.

Table 124: Non-commercial fishing harvest (in lbs) by mode of fishing for coral reef fish species in Hawai‘i, 2004-2014[14]

Year	Shore	Charter boat	Private/Rental boat	Total
2004	1,263,889	N/A	1,359,186	2,623,075
2005	1,070,499	N/A	938,182	2,008,681
2006	1,572,835	N/A	973,239	2,546,074
2007	395,862	N/A	478,145	874,007
2008	839,792	N/A	282,287	1,122,079
2009	402,089	N/A	282,974	685,063
2010	552,242	N/A	747,301	1,299,543
2011	557,358	N/A	364,508	921,866
2012	994,190	N/A	758,813	1,753,003
2013	1,066,438	N/A	499,475	1,565,913
2014	1,109,405	N/A	751,491	1,860,896

Source: NOAA NMFS Marine Recreational Information Program (MRIP)

Table 135: Number of non-commercial fishing angler trips by mode of fishing in Hawai‘i, 2004-2014[15]

Year	Shore	Charter boat	Private/Rental boat	Total
2004	2,162,066	N/A	708,725	2,870,791
2005	1,892,365	N/A	578,038	2,470,403
2006	2,074,280	N/A	569,812	2,644,092
2007	2,101,730	N/A	474,941	2,576,671
2008	1,966,120	N/A	564,478	2,530,598
2009	1,721,919	N/A	441,107	2,163,026
2010	1,906,698	N/A	483,532	2,390,230
2011	1,157,684	N/A	224,029	1,381,713
2012	1,194,534	N/A	324,954	1,519,488
2013	1,215,738	N/A	297,138	1,512,876
2014	1,050,598	N/A	323,807	1,374,405

Source: NOAA NMFS Marine Recreational Information Program (MRIP)

[14] Species included in these figures include: bandtail goatfish, bigeye trevally, bigscale soldierfish, blackspot sergeant, blacktail snapper, Bluefin trevally, bluestripe snaper, conger eels, convict tang, dragon wrasse, giant trevally, goldring surgeonfish, green jobfish, groupers, Hawaiian hogfish, highfin rudderfish, island jack, manybar goatfish, moray eels, pink snapper, razrofishes, smallmouth bonefish, squirrel fishes, stingrays, striped mullet, unicornfishes, von siebolds snapper, whitemouth trevally, whitesaddle goatfish, whitetip soldierfish, yellowstripe goatfish, other barracudas, other butterflyfishes, other damselfishes, other goatfishes, other hawkfishes, other scorpionfishes, other sea chubs, other skate/rays, other snappers, other soldierfishes, other surgeonfishes, and other wrasses.

[15] Includes angler trips targeting all fish species (i.e. not limited to coral reef angler trips).

Table 14 displays non-commercial fishing harvest of coral reef fish species by mode of fishing in Hawai‘i for the years 2004-2014, and Table 15 displays the number of angler trips taken in Hawai‘i for the years 2004-2014. It must be noted that no license is required to participate in non-commercial fishing in Hawai‘i. Non-commercial fishing effort in pounds harvested and in number of angler trips taken have both fluctuated over time as well, similar to commercial fishing effort. However, the overall trend for non-commercial fishing effort in Hawai‘i since 2004 has been downward. Since 2004, the amount of weight estimated to be harvested by non-commercial fishers targeting coral reef species has decreased by 29%, and the number of non-commercial angler trips taken regardless of target species has decreased by 52%. The most common mode of fishing utilized is from shore (76% of all angler trips in 2014), and in most years, fishing from shore also yields the most coral reef fish harvest in terms of weight (60% of all coral reef fish weight harvested in 2014). McCoy (2015) found that non-commercial catch for nearshore coral reef species is at least 9 times the reported commercial nearshore coral reef fish catch.

A study commissioned by NOAA’s NMFS found that an estimated 87,000 non-commercial anglers generated $285 million in direct expenditures[16] for the state of Hawai‘i (Lovell, Steinbeck, and Hilger 2013) in 2011 (approximately $300.3 million in 2015 dollars). This analysis included residents of and visitors to Hawai‘i. Residents spent $69 million on trip expenses: $3 million on for-hire trips, $21 million on private boat trips, and $45 million on shore trips. Non-residents spent $37 million on trip expenses: $37 million on for-hire trips, $102,000 on private boat trips, and $69,000 on shore trips. It was also found that marine non-commercial fishing in Hawai‘i contributed 2,900 jobs to the state’s economy, generated $311 million in output (sales) (approximately $327.7 million in 2015 dollars), contributed $186 million to the state’s gross domestic product (approximately $196 million in 2015 dollars), and contributed $119 million in income (approximately $125.4 million in 2015 dollars) in 2011.

Spearfishing, while not nearly as widespread as regular fishing, is also a popular extractive activity in the Hawaiian Islands, and in many cases, brings people into direct contact with coral reefs. A survey of spearfishermen conducted in Hawai‘i in 2007 (Stoffle and Allen 2012) found that they fished an average of 45 days in the past year (median of 36), and that the majority of spearfishing trips were conducted from shore (55%) and from private boats (45%). This same survey also found that the most common reef species/fish targeted by spearfishermen are parrotfish, squirrelfish, tangs, snappers, jacks, flagtails, surgeonfish, chubs, filefish, goatfish, peacock grouper, eel, octopus, and lobster. Additionally, kayaking has become increasingly popular among spearfishermen because it is relatively inexpensive compared to owning a private fishing vessel, and it provides fishermen access to certain areas that were once difficult or impossible to get to by swimming. As is the case with other types of fishing in Hawai‘i,

[16] Includes fishing for all fish species.

spearfishing both establishes and maintains relationships among people, both formally (through clubs/organizations/competitions) and informally through general comradery and practicing traditional cultural methods of resource extraction. Further, Walsh (2013) found that the average annual commercial spear fishery value in West Hawai‘i was $25,647 from 2007-2011, and an annual average of 16 commercial spear fishermen were active during these years.

Fishing also provides an important source of food for Hawai‘i residents. In a recent survey of over 1,180 non-commercial fishermen across the state (Madge, Hospital, and Williams 2016), fishing for food was considered a primary or secondary motivation for fishing by 50% of respondents,[17] and the majority of fishermen shared their catch with family and/or friends. However, the same survey found that almost half (48%) of fishermen stated that they were fishing less now than in the past (only 16% stated that they fished more), primarily due to lack of free time and financial constraints. Sixty-five percent of these fishermen stated that nearshore coral reef fisheries were declining.

Allen and Bartlett (2008) found that 11% of households in Hawai‘i fish, and this figure contrasts with what the NCRMP survey found.[18] There are, however, some key methodological differences between the NCRMP survey and Allen and Bartlett (2008). The survey conducted by Allen and Bartlett only asked households about their participation in fishing over the last 2 months, while the NCRMP survey offers a choice “once a month or less” (which was selected by about 23% of households). Additionally, the NCRMP sampling frame includes cell and landline users, while Allen and Bartlett only included landline users. Additional analysis of the NCMRP sample found that cell phone users were statistically significantly more likely to participate in fishing when compared to landline users.

Snorkeling/Diving

Cesar and van Beukering (2004) found that the recreational divers in Hawai‘i generated $14.3 million in direct expenditures (approximately $19 million in 2015 dollars), and that recreational snorkelers generated $52.6 million in direct expenditures (approximately $70 million in 2015 dollars) in 2001. The total economic value added (direct and indirect) of recreational diving and snorkeling in Hawai‘i was calculated to be $304.2 million in 2001 (approximately $407 million in 2015 dollars). This analysis included residents of and visitors to Hawai‘i.

Tourism

Tourism is a very important and integral aspect of the Hawaiian economy. According to the Hawai‘i Tourism Authority (HTA), there were 8,308,114 tourist arrivals in Hawai‘i in 2014 that spent $14,821 million dollars (HTA 2015). Sixty-seven percent of these arrivals were from the

[17] This survey specifically targeted non-commercial fishermen in the state of Hawaii, as opposed to the NCRMP data collection process which targeted members of the general population, some of whom engage in fishing.
[18] The NCRMP survey found that 41% of households fished.

US and Canada, with the second-largest source of visitors being Japan (18% of arrivals). Tourist visitation also provides a significant source of revenue to the state, with $420.9 million collected in Transient Accommodation Taxes, $3.5 million of which went to the State Department of Land and Natural Resources, which is responsible for marine resource management in the state (HTA 2015). The tourism and recreation industry in Hawai‘i produced a GDP of over $6.4 billion in 2014 (a 2.4% inflation-adjusted increase from the previous year), while supporting 101,061 employees at 3,773 establishments (NOAA Digital Coast, ENOW).

Tourists enjoying marine wildlife viewing in Hawai‘i (Photo Credit: Jarrod Loerzel)

Beach goers recreating at Three Tables Beach in O‘ahu (Photo Credit: Peter Edwards)

Results Section 3: Combination Primary and Secondary Data Indicators

The final section of results presents Governance as an example of a composite indicator that will be measured through a combination of primary NCRMP survey data as well as secondary data. Below, examples of both types of measures are featured. The measurements concerning the sources of coral reef-related information, the level of trust for each information source, and involvement in coral reef decision making come from NCRMP survey data, while all other facets of the governance composite indicator were derived from secondary data sources.

Governance

Governance measures such as public trust, percent area of coral reefs under management or protection, level of community involvement in decision making/local reef governance, and the presence, longevity, and focus of MPAs and other marine managed areas were used to assess governance related to coral reefs and the marine environment for Hawai‘i.

Sources of coral reef-related information and level of trust

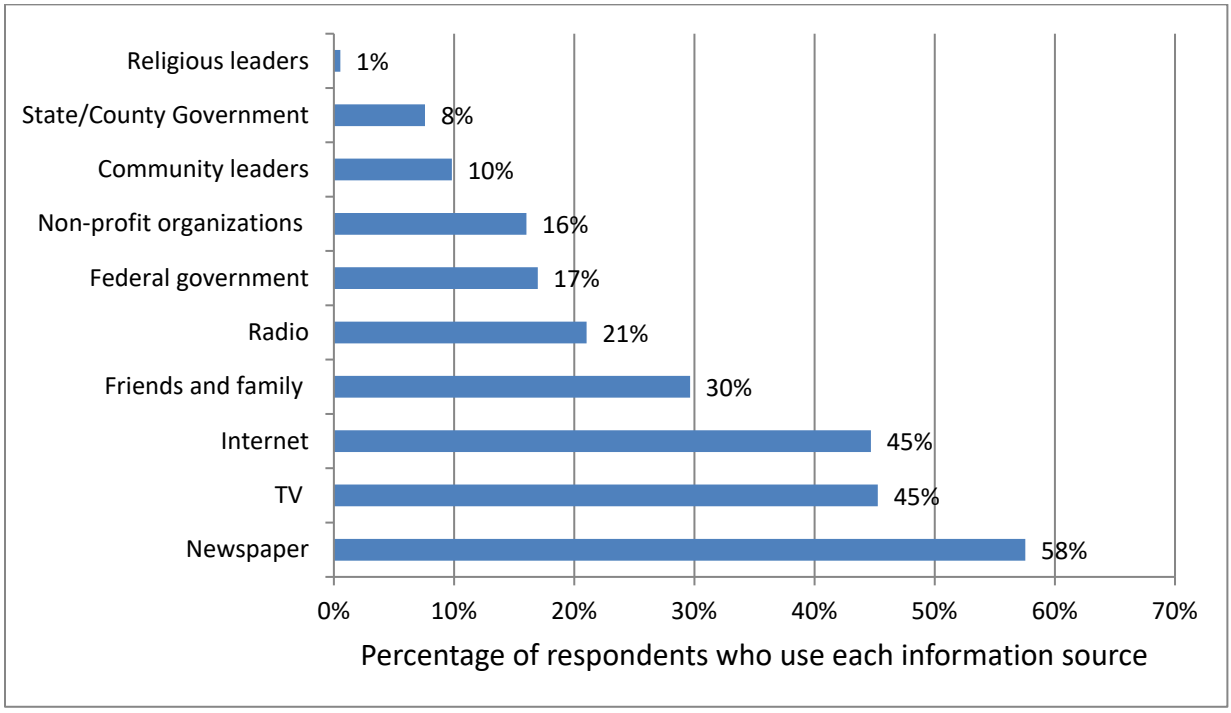


Figure 23: Top sources of information on coral reefs (n = 2,240)

Fifty-eight percent of respondents indicated that the newspaper is their source for information pertaining to coral reefs (first, second, or third choice). Respondents' top 3 sources for information about coral reefs and the environment were newspaper, television, and the internet (Figure 23). The least used information sources were religious leaders and the state/county government. Respondents were then asked to rate their trustworthiness of each of the information sources that they indicated they used (Figure 24).

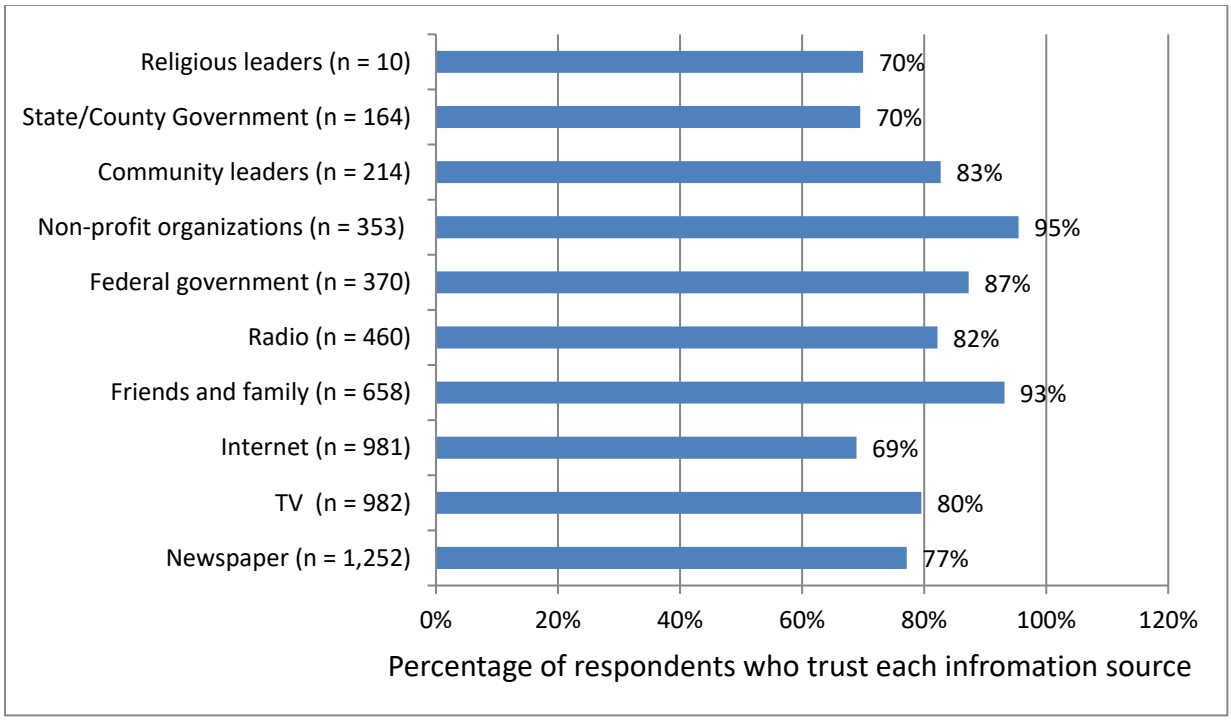
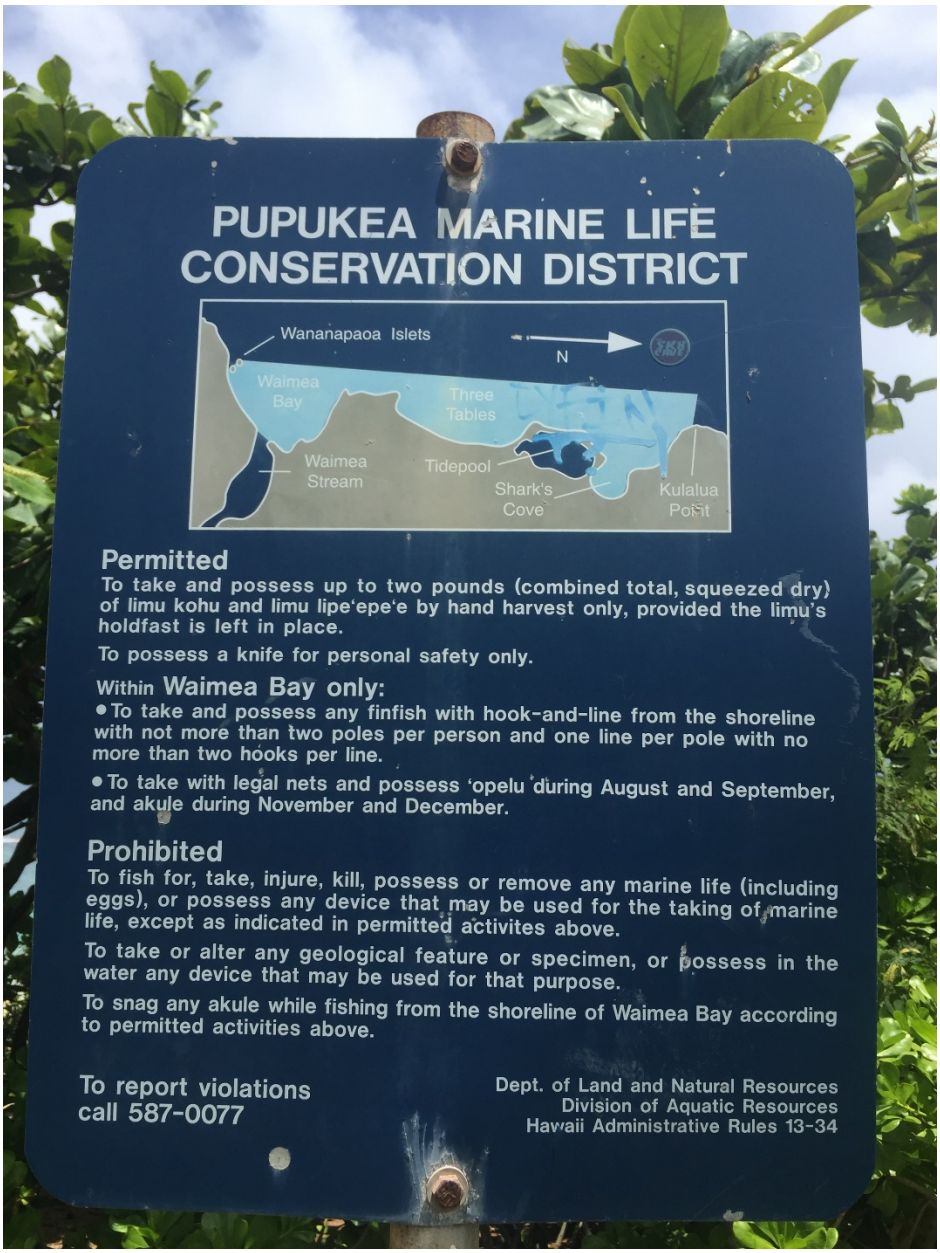


Figure 24: Respondent level of trust in each coral reef information source

In terms of trust, 77% (newspaper), 80% (television), and 69% (internet) of respondents indicated that these sources are "very trustworthy" or "trustworthy" (Figure 24). According to respondents, the information sources that people trusted most (when they used them) were non-profits (95%) and friends/family (93%), whereas the information sources found to be least trustworthy ("very untrustworthy" or "untrustworthy") by people who use them were the state/county government (18%) and religious leaders (10%).

Involvement in coral reef management decision making

Survey respondents in Hawai‘i were asked how much they felt their communities were involved in protecting and managing coral reefs, with 51% stating that communities were at least "moderately involved," and 17% stating that communities were "not involved at all." Respondents were also asked this question at the individual level, with 26% indicating that they themselves were at least "moderately involved" in decisions related to protecting and managing coral reefs, and 53% indicating that they were "not at all involved."



An Example of Conservation Governance in Hawai'i (Photo Credit: Peter Edwards)

Defining "Community"

After respondents were asked about how much they felt their communities were involved in protecting and managing coral reefs, an additional open-ended follow up question asked respondents to "briefly define" their local community.[19] Since the response to this question was open-ended, responses were post-coded to determine general categories of responses. Definitions of community varied widely, but fell into three broad categories, with some overlap:

1. Responses that defined their "local community" geographically, socially, or through engagement in activities/livelihoods (38%)
2. Responses that described community involvement through community interests, characteristics, or involvement in activities to manage marine resources (76%)
3. Those that did not know/were unsure how to define their local community (12%)

It should be noted that 28% of respondents provided answers that were coded as both category 1 and category 2. The diversity of definitions indicates that residents identify with a variety of types of communities, providing both opportunities and challenges for community engagement in coral reef management.

Other governance indicators

Based on the NOAA MPA Inventory, 87.9% of all marine managed areas in Hawai‘i had management plans in place (2014) (Table 16). The oldest inventoried marine managed area was established in 1949, while others were established as recently as 2009. Of the inventoried marine managed areas, cultural heritage was a primary conservation focus of 4 MPAs, sustainable production was the primary focus of 39, and natural heritage was the primary focus of 15 MPAs. Additionally, commercial and recreational fishing were prohibited at 9 of the marine managed areas. The largest of these marine managed areas is the Papahānaumokuākea Marine National Monument in the Northwestern Hawaiian Islands. Although this is outside of the NCRMP socioeconomic region, it is managed jointly by the state of Hawai‘i, NOAA, and the US Fish and Wildlife Service. Based on the NOAA MPA Inventory and NOAA (2007), investigation shows that 17% of the mapped coral reef ecosystems in and around the main Hawaiian Islands were under some form of management regime. It should be noted, however, that this analysis of known coral reef habitat falling within management boundaries is not intended to equate to an assessment of management adequacy or efficacy. Additional metrics would be required for this type of evaluation.

[19] This question was removed after 421 respondents completed the survey due to difficulty amongst the respondents in answering this question, as well as the increased time burden that this question caused.

Table 146: Details of the Marine Managed Areas of Hawai‘i[20]

Site Name	Government Level	Management Plan	Coral Area (sq.km)	Area (sq.km)
Waikiki-Diamond Head Fishery Management Area	State	MPA Programmatic Management Plan	0.84	0.97
Paiko Lagoon Wildlife Sanctuary	State	Site-Specific Management Plan	0.00*	0.12
Ahihi-Kinau Natural Area Reserve	State	Site-Specific Management Plan	2.70	8.40
Pupukea Marine Life Conservation District	State	Community Agreement	0.73	1.03
Waikiki Marine Life Conservation District	State	MPA Programmatic Management Plan	0.28	0.32
Old Kona Airport Marine Life Conservation District	State	MPA Programmatic Management Plan	0.40	1.06
Molokini Shoal Marine Life Conservation District	State	MPA Programmatic Management Plan	0.17	0.36
Manele-Hulopoe Marine Life Conservation District	State	MPA Programmatic Management Plan	0.63	1.12
Lapakahi Marine Life Conservation District	State	MPA Programmatic Management Plan	0.50	0.54
Kealakekua Bay Marine Life Conservation District	State	MPA Programmatic Management Plan	0.46	1.24
Honolua-Mokuleia Bay Marine Life Conservation District	State	MPA Programmatic Management Plan	0.11	0.18
Puako Bay, Puako Reef Fishery Management Area	State	MPA Programmatic Management Plan	1.02	1.37
Hanauma Bay Marine Life Conservation District	Partnership	Site-Specific Management Plan	0.28	0.41
Waialea Bay Marine Life Conservation District	State	MPA Programmatic Management Plan	0.08	0.14
Moku-o-loe Island (Coconut Island) Marine Laboratory Refuge	State	MPA Programmatic Management Plan	0.24	0.30
Hilo Bay, Wailoa River, Wailuku River Fishery Management Area	State	MPA Programmatic Management Plan	1.62	6.19

[20] This table reflects the most recent iteration of the NOAA MPA Inventory; however, it should be noted that the He‘eia National Estuarine Research Reserve was established in 2017 on the island of O‘ahu as NOAA’s 29th National Estuarine Research Reserve. This designation encompasses 5.60 square kilometers of upland, estuarine, and marine habitats within the He‘eia estuary and Kāne‘ohe Bay.

Site Name	Government Level	Management Plan	Coral Area (sq.km)	Area (sq.km)
Kona Coast Fishery Management Area	State	MPA Programmatic Management Plan	1.54	7.06
Waimea Bay, Waimea Recreational Pier Fishery Management Area	State	No Management Plan		0.01
Kahului Harbor Fishery Management Area	State	No Management Plan	0.01	0.04
West Hawai‘i Regional Fishery Management Area	State	MPA Programmatic Management Plan	24.91	227.52
Hanamaulu Bay, Ahukini Recreational Pier Fisherey Management Area	State	No Management Plan		0.37
Kailua Bay Fishery Management Area	State	No Management Plan	0.03	0.04
Port Allen Fisherey Management Area	State	No Management Plan		0.10
Kaho'olawe Island Reserve	Partnership	Site-Specific Management Plan	14.55	202.94
Nawiliwili Harbor Fishery Management Area	State	MPA Programmatic Management Plan		0.14
Ka Lae (South Point) Bottomfish Restricted Fishing Area	State	Non-MPA Programmatic Fisheries Management Plan	0.01	53.73
Lele‘iwi Point Bottomfish Restricted Fishing Area	State	Non-MPA Programmatic Fisheries Management Plan	2.95	118.35
Upolu Bottomfish Restricted Fishing Area	State	Non-MPA Programmatic Fisheries Management Plan	0.12	909.56
Mokumana - Umalei Point Bottomfish Restricted Fishing Area	State	Non-MPA Programmatic Fisheries Management Plan		161.58
Moku Ho'oniki, Moloka‘i - Lipoa Point., Maui Bottomfish Restricted Fishing Area	State	Non-MPA Programmatic Fisheries Management Plan		51.44
Kaluapapa Bottomfish Restricted Fishing Area	State	Non-MPA Programmatic Fisheries Management Plan	0.00*	60.77
Penguin Bank Bottomfish Restricted Fishing Area	State	Non-MPA Programmatic Fisheries Management Plan		270.00
Makapu'u Point Bottomfish Restricted Fishing Area	State	Non-MPA Programmatic Fisheries Management Plan	2.58	190.25
Manele Harbor Fishery Management Area	State	MPA Programmatic Management Plan		0.02
Ka'ena Bottomfish Restricted Fishing Area	State	Non-MPA Programmatic Fisheries Management Plan		85.36
Makahu'ena Bottomfish Restricted Fishing Area	State	Non-MPA Programmatic Fisheries Management Plan		51.08

Site Name	Government Level	Management Plan	Coral Area (sq.km)	Area (sq.km)
Niʻihau Bottomfish Restricted Fishing Area	State	Non-MPA Programmatic Fisheries Management Plan		40.97
Ka'ula Rock Bottomfish Restricted Fishing Area	State	Non-MPA Programmatic Fisheries Management Plan		86.34
Kiholo Bay Fishery Management Area	State	MPA Programmatic Management Plan	1.74	2.66
Wai'opae Tidepools Marine Life Conservation District	State	MPA Programmatic Management Plan	0.14	0.20
Honolulu Harbor Fishery Management Area	State	No Management Plan	0.01	1.56
Ala Wai Canal Fishery Management Area	State	MPA Programmatic Management Plan		0.22
Waialua Bay (Haleiwa Harbor) Fishery Management Area	State	MPA Programmatic Management Plan	0.02	0.16
Pokai Bay Fishery Management Area	State	MPA Programmatic Management Plan	0.64	0.88
He'eia Kea Wharf Fishery Management Area	State	No Management Plan		0.01
Kapalama Canal Fishery Management Area	State	MPA Programmatic Management Plan		0.05
Kahekili Herbivore Fisheries Management Area	State	MPA Programmatic Management Plan	0.44	1.84
Keauhou Bay Fishery Management Area	State	MPA Programmatic Management Plan	0.08	0.08
Kawaihae Harbor Fishery Management Area	State	MPA Programmatic Management Plan		0.01
Kaunakakai Harbor Fishery Management Area	State	MPA Programmatic Management Plan	0.02	0.15
Papahānaumokuākea Marine National Monument	Partnership	Site-Specific Management Plan		363,686.94
Hawaiian Islands Humpback Whale National Marine Sanctuary	Federal	Site-Specific Management Plan	293.74	3,554.97
Kalaupapa National Historical Park	Partnership	Site-Specific Management Plan	3.17	43.29
Kaloko-Honokohau National Historical Park	Federal	Site-Specific Management Plan	1.64	5.20
Puukohola Heiau National Historic Site	Federal	Site-Specific Management Plan	0.02	0.35
Pearl Harbor National Wildlife Refuge	Federal	Site-Specific Management Plan	0.00*	0.42
WestPac Bed	Federal	Non-MPA Programmatic Fisheries Management Plan		39.47

Site Name	Government Level	Management Plan	Coral Area (sq.km)	Area (sq.km)
Lobster Closed Areas	Federal	Non-MPA Programmatic Species Management Plan		N/A
			358.41	**369,879.87**

Source: 2014 NOAA Marine Protected Areas Inventory

Results Section 4: Island Comparisons

This results section focuses on statistical comparisons across the Hawaiian Islands for which the NCRMP socioeconomic component team obtained representative samples: Hawai‘i Island, O‘ahu, Maui, and Kaua‘i. A one-way ANOVA analysis was administered to compare the knowledge, attitudes, and perceptions of residents across the four aforementioned islands. Post-stratification sampling weights are not utilized in this analysis as it was necessary to obtain a statistically representative sample for each island individually. Each island is examined individually without weights, and is compared to each of the other individual islands. Table 18 below illustrates these findings. For example, the cell “Hawai‘i>O‘ahu***” pertaining to the activity index indicates that we are 99% confident that residents on Hawai‘i Island, on average, participate in coral reef-related activates more frequently when compared to residents of O‘ahu. On average, residents of O‘ahu are less reliant upon coral reefs when compared to residents of Hawai‘i, Maui, and Kauai‘i. On average, fewer O‘ahu residents fish/gather marine resources when compared to residents of Hawai‘i, Maui, and Kaua‘i. Residents of Hawai‘i Island, on average, have a more positive perception of current marine resource condition when compared to residents of O‘ahu, Kaua‘i, and Maui. O‘ahu residents, on average, are less familiar with coral reef threats when compared to residents of Hawai‘i Island, Maui, and Kaua‘i. O‘ahu residents, on average, are less likely to participate in pro-environmental behavior when compared to residents of Hawai‘i Island, Maui, and Kaua‘i.

Table 15: One-way ANOVA analysis across islands[21]

Variable	Conclusion
Activity index[22]	Hawai‘i>O‘ahu***
	Maui>O‘ahu***
	Kaua‘i>O‘ahu***
	Maui>Hawai‘i*
	Kaua‘i>Hawai‘i**
Fishing/Gathering marine resources	Hawai‘i>O‘ahu***
	Maui>O‘ahu***
	Kaua‘i>O‘ahu***
Present condition index[23]	Hawai‘i>O‘ahu**
	Hawai‘i>Maui***
	Hawai‘i>Kaua‘i**
Last 10 years condition index[24]	O‘ahu>Kaua‘i**
	Hawai‘i>Kaua‘i*
Believes the condition of marine resources will get worse over the next decade	Kaua‘i>O‘ahu***
Agree that healthy coral reefs attract tourists to Hawai‘i	Hawai‘i>O‘ahu***
	Maui>O‘ahu***
	Kaua‘i>O‘ahu**
Threat Familiarity index[25]	Hawai‘i>O‘ahu**
	Maui>O‘ahu***
	Kaua‘i>O‘ahu***
Believes the threat level to coral reefs is “large” or “extreme”	Maui>O‘ahu**
	Kaua‘i>O‘ahu*
Is familiar with MPAs	Hawai‘i>O‘ahu**
	Maui>O‘ahu***
	Maui>Kaua‘i***

[21] * = statistically significantly different with 90% confidence; ** = statistically significantly different with 95% confidence; *** = statistically significantly different with 99% confidence

[22] An additive index variable created by adding up the responses to all of the activity questions, and then scaling 0-100. The index increases as activity participation frequency increases. Respondent had to answer all questions in the index to receive an index value. Answers of “not sure” are considered missing.

[23] An additive index variable was created by adding up the responses to all of the current marine resource condition questions, and then scaling 0-100. The index increases as positive perception increases. Respondent had to answer all questions in the index to receive an index value. Answers of “not sure” are considered missing.

[24] An additive index variable was created by adding up the responses to all of the change in marine resource condition questions, and then scaling 0-100. The index increases as positive perception increases. Respondent had to answer all questions in the index to receive an index value. Answers of “not sure” are considered missing.

[25] An additive index variable was created by adding up the responses to all of the threat familiarity questions, and then scaling 0-100. The index increases as familiarity increases. Respondent had to answer all questions in the index to receive an index value. Answers of “not sure” are considered missing.

Variable	Conclusion
Management Support Index[26]	O‘ahu>Kaua‘i**
	Maui>Kaua‘i***
	Hawai‘i>Kaua‘i*
Participates in pro-environmental behavior	Hawai‘i>O‘ahu*
	Maui>O‘ahu***
	Kaua‘i>O‘ahu***
Believes community is at least moderately involved in protecting and managing coral reefs	Maui>O‘ahu**
Indicates that they themselves are at least moderately involved in protecting and managing coral reefs	Maui>O‘ahu***
	Kaua‘i>O‘ahu**
Reef Reliance Index[27]	Hawai‘i>O‘ahu***
	Maui>O‘ahu***
	Kaua‘i>O‘ahu***

[26] An additive index variable was created by adding up the responses to all of the management support questions, and then scaling 0-100. The index increases as management support increases. Respondent had to answer all questions in the index to receive an index value. Answers of “not sure” are considered missing.

[27] This index includes the coral reef activity questions of “fishing” and “gathering marine resources;” the fishing reason questions of “to feed myself/my family,” “to sell,” and “for special occasions/cultural events;” and the seafood source question. Those who "never" fish or gather are assigned 1s ("never") for the fishing reason questions. For seafood source, the choice of interest was “caught myself.” In order to scale the “caught myself” seafood source response in the same way as the other questions in the index (a 1-4 scale), a 1 was assigned to those who do not catch seafood themselves, a 2 was assigned to those who indicated catching seafood themselves was their second choice source, a 3 was assigned to those who indicated catching seafood themselves was their first choice source, and a 4 was assigned to those who indicated that catching seafood themselves was their only source. An additive index was then created and scaled 0-100; increasing as reliance upon coral reefs increases. Respondent had to answer all questions in the index to get an index value. Answers of “not sure” are considered missing.

Discussion

While the NCRMP data collection effort collects data from a range of sources, our discussion will focus primarily on the new data collected via the Hawai‘i resident survey. Based on the survey findings, a few general conclusions about the population of Hawai‘i and their interactions with coral reefs can be made. These can be considered preliminary findings, and more detailed analyses of these data are planned for the future. We conclude this section by proposing directions for future research.

With respect to **participation in reef activities**, Hawai‘i residents participate in a variety of purely recreational coral reef related activities, with swimming and beach recreation being the most frequent. Residents on Maui and Kaua‘i participated more frequently in coral reef related recreational activities when compared to residents of the other Hawaiian Islands (Table 18). These activity participation rates do not take the participation rates of tourists into account.

Our survey found that over 45% of households stated that they engaged in fishing and/or gathering (41% participate in fishing, 27% participate in gathering, 45% participate in one of either fishing or gathering). The survey found that 66% of households consumed fish/seafood once a week or more, and that most fishers (82%) did not sell the fish they catch; however, it is uncertain what proportion of fishing targeted coral reef species, and what proportion of fish protein consumed comes from coral reef versus non-coral reef fish species, as these distinctions were not specified in the survey. The need for this clarification has been noted, and as a result, the survey question will be adjusted in future iterations of the NCRMP survey. Additionally, seafood consumed by Hawai‘i residents is predominantly purchased in supermarkets, grocery stores, and restaurants.

Survey respondents were asked about their perceptions of the health of Hawai‘i’s coral reef resources. The findings showed that residents had varying perceptions of **marine resource conditions**. The majority found ocean water quality and the diversity of fish to be in good condition, while perceptions are less consistent regarding the amount of coral and fish size/diversity. Residents had mixed perceptions regarding the change in marine resources over time, with most residents perceiving resource conditions to be either the same or worse than 10 years ago, and 18% or less perceiving resource conditions to be improving over time. When examining the effect of tenure (i.e. how long a resident has lived in the jurisdiction), additional analysis found that residents who have lived in Hawai‘i for their entire lives had a more negative perception concerning the current condition of marine resources, and were also more likely to perceive that the change in the condition of marine resources had worsened over the last decade (Table E1). Some differences in perceptions concerning marine resource condition were identified between respondents based on island of residence as well. For instance, residents on Hawai‘i Island tended to have a more positive perception of current marine resource conditions when compared to residents of O‘ahu, Maui, and Kaua‘i (Table 18). Perceptions of coral reef health may correlate to differing resource quality within and across different islands, which

could, in part, explain the lack of consensus concerning the condition of marine resources. It also should be noted that perceptions of marine resource condition may vary within different parts of each of these islands (rural, urban, user non-user etc.).

Regarding the public's **awareness and knowledge of coral reef functions and threats**, this study found that the majority of the population are familiar with the threats facing coral reefs asked about in the survey (with the exception of ocean acidification). Over 60% of the respondents also believed that the condition of coral reef resources would get worse in the next 10 years, and over 60% believed that the threats to coral reefs are at least "large" or "extreme." This suggests a lack of confidence amongst Hawai‘i residents that current threats to coral reefs are being (or can be) effectively addressed by current management or mitigation efforts.

The study found that the public's **attitudes towards coral reef management strategies and enforcement** were largely positive. Residents expressed support for most of the potential marine management measures asked about in the survey, some of which are in use or proposed in various parts of Hawai‘i. These results concerning support for coral reef resource management are one of the main highlights of this survey. The data indicate that a wide majority of residents support coral reef management in a general sense. In particular, 90% of the respondents supported better treatment of wastewater, and 80% supported designating marine managed areas. The least supported management option was "establishment of a non-commercial fishing license" (58% support). Additional analysis found that respondents who were more reliant on marine resources (for food, sustenance, economics, etc.) were generally less supportive of marine management policies and regulations (Table E2); although, for the most part these users were still supportive of the management options presented in the survey. Given the substantial range of management options presented in the survey and the potential for these options to be applied in various combinations, this question was developed to provide a range of important feedback for resource managers. The responses allowed for evaluation of both support for each option, as well as the reaction to the particular words used to describe the management strategy. For example, although some marine protected areas may limit recreational use, respondents were extremely favorable when considering the designation of marine managed areas. However, when asked about limited recreational use alone, respondents' support for such regulations decreased.

With respect to **knowledge of coral reef rules and regulations** in Hawai‘i, 51% of respondents indicated that they were familiar with MPAs. It also should be noted that not all regulations concerning coral reefs are related to MPAs. We also attempted to track public participation and attitudes with respect to some measures of the **governance** of coral reefs and associated resources. It was found that 87.9% of all marine managed areas in Hawai‘i had management plans in place, and 17% of all coral reef habitat was under some form of management. Respondents indicated a moderate level of community involvement in coral reef decision making, and a high level of involvement in pro-environmental behavior aimed at improving the health of the marine environment and coral reefs (81% of survey respondents indicated that they participate in pro-environmental behavior). The survey also found that Hawai‘i residents

infrequently relied on the federal and local government as top information sources regarding coral reef topics; however, those who did rely on the federal and local government for information considered them to be trustworthy sources. The internet, while more widely used, and considered a top information source by 45% of the population, wasn't considered as trustworthy as other coral reef information sources.

In terms of **human population composition and trends near coral reefs**, the population of Hawai‘i has increased by 11% from 2006-2015, and each Hawaiian county has experienced population growth and increased population density during this period. The largest population center in Hawai‘i, the city of Honolulu, is in close proximity to coral reefs, which brings even more humans into contact with the coral reef ecosystem. This increases the risk for anthropogenic stressors, but also provides ample ecosystem services to Hawai‘i residents. As for **community well-being**, real GDP in Hawai‘i increased by 13% from 2000-2015, and real median household income increased for each Hawaiian county from 2000-2010. However, Hawai‘i, Honolulu, and Kaua‘i Counties all experienced slight increases in poverty rate from 2000-2010. Household reliance on public assistance decreased in all Hawaiian counties from 2000-2010, and 93% of the civilian non-institutionalized population in Hawai‘i had health insurance coverage in the year 2010. Educational attainment has been on the rise from 2000-2010, both in terms of high school and college completion. When tracking **physical infrastructure**, it was found that 4.1% of the area in the main Hawaiian Islands is covered in impervious surfaces. With regards to pollution, the 2014 EPA Hawai‘i water quality assessment report found that 67% of coastal shoreline waters are impaired, and the EPA national emissions inventory found that air emissions increased by 29% from 2011 to 2014. Most Hawai‘i residents (96%) are served by the public water supply, less than 1% of households lacked access to complete plumbing facilities, and there were 14 landfills in Hawai‘i as of 2016. When examining public access to coastal resources, it was found that Hawai‘i has 250 public beach parks, an estimated 1,600 surfing sites, and 67 boating facilities.

Hawai‘i residents participate in several **economic activities related to reefs**, including fishing, diving, snorkeling, and marine construction. NOAA OCM found that 9.7% of Hawaiian GDP ($7.4 billion) is related to the ocean economy. Maui County is especially dependent upon the ocean economy, with 22% of their county GDP being derived from ocean economy sectors. The weight and value of coral reef fish species commercially harvested in Hawai‘i decreased from 2004-2014, and the weight of coral reef fish species harvested through non-commercial means has also decreased over this time period as well. The tourism and recreation industry in Hawai‘i is highly reliant upon coral reefs and produced a GDP of over $6.4 billion in 2014.

Future approaches and research ideas

There were a few lessons learned from this first NCRMP socioeconomic data collection in Hawai‘i. As similar surveys are implemented across other US coral reef jurisdictions, the NCRMP team will be making adjustments to the data collection effort to improve upon the type

of information generated. These findings can be considered as a starting point to develop more detailed research questions for future work. For example, there is a need to fine-tune the survey question on fish consumption and fishing activity to make it more specific to coral reef related fish and invertebrate species, as well as a need to distinguish between locally caught and imported fish. There is also a need to understand key differences across sections of individual islands as they pertain to knowledge, attitudes, and perceptions of coral reefs and coral reef management. Other questions may be modified once all US coral reef jurisdictions have been surveyed, with the aim of maintaining comparability of questions across the different jurisdictions, and ensuring that included questions can provide information relevant to the local context and management needs in Hawai‘i. Additionally, when collecting secondary data regarding fisheries landings and participation in fishing, the team plans to further disaggregate coral reef fish species from the total figures that include wider pelagic and longline species.

Another future research direction is to conduct analyses that explore relationships between different socioeconomic indicators, as well as comparisons between sub-populations as defined by the sampled respondents. These may include demographic categories such as age, gender, or familiarity with coral reefs, among others. For example, our results showed that there was a difference in the perceptions of those who fish/gather versus those who do not in relation to their attitudes towards most coral reef management measures (fishermen/gatherers tended to have lesser levels of agreement with the coral reef management strategies presented in the survey; Table E3). The study also found that all things held equal, fishing and gathering were less common on O‘ahu (in terms of the proportion of the island population that participates) when compared to the other islands (Table E4), however if proportions are extrapolated to each island’s population, O‘ahu is home to more fisher/gatherers than any other Hawaiian island. Additional improvements to the survey instrument might also include better distinguishing the sources of information on coral reefs and level of trustworthiness. This would provide information that could be incorporated into specific public outreach and education programs for current and future management measures.

The collection of **secondary data,** including economic impacts of tourism and fishing, as well as data contributing to the development of some of the community well-being composite indicators, will continue over time. As updated data sets are produced by relevant agencies, these will be collected, synthesized, and housed within a centralized database, and will then be used to track changes over time. These data may be incorporated into composite indicators that combine or compare biophysical parameters (e.g., fish biomass) with commercial landings data and public perceptions of general reef health. It is notable that population growth and net increases in population density in Hawai‘i may have a potential impact on coral reef resources. Net growth could result in increased demand for coral reef ecosystem services including recreation and provisioning (food, products). Growth could also result in increases in impervious surfaces due to general urbanization as well as higher volumes of solid and sewage waste production. This, in turn, can add more stress to coral reef ecosystems in Hawai‘i.

The NCRMP socioeconomic data collection builds upon and supplements the considerable social science research that has been conducted in Hawai‘i to date. Integrating NCRMP data with these studies, or comparing and contrasting findings, has the potential to provide a more complete understanding of human interactions with coral reef resources in the territory. For example, Brander and van Beukering (2013) found that Hawai‘i’s coral reefs provide an estimated $1.747 billion per year in ecosystem service benefits to humans in year 2007 dollars (includes recreation/tourism, amenity, research, fishery, and non-use value). The socioeconomic monitoring data collected through NCRMP provides further evidence of the contribution of Hawai‘i’s coral reefs to the economic stability of the communities within the state.

In the near future, NCRMP research efforts plan to integrate social and biophysical data streams to obtain a more in-depth understanding of social-ecological relationships. For instance, we plan to compare resident perceptions of coral reef resource condition to biological indicators at the island level, and within and across jurisdictions. Finally, ongoing analyses of the individual metrics presented here will move us toward reporting the survey and secondary data collection results for a variety of composite indicators such as governance and perceived resource condition. These composite indicators will aid in comparisons across jurisdictions, where individual metrics may not be the same. Further, the use of composite indicators will support communication of complex data in a way that facilitates resource management decision making.

Coral Reefs in Hawai‘i (Photo credit: NOAA, Kevin Lino)

References

Allen, S. and Bartlett, N. 2008. “Hawaii Marine Recreational Fisheries Survey: How Analysis of Raw Data Can Benefit Regional Fisheries Management and How Catch Estimates are Developed; An Example Using 2003 Data.” NOAA NMFS Pacific Islands Fisheries Science Center. Honolulu, HI. Administrative Report H-08-04. Pp. 33 + Appendices.

Brander, L., and P. van Beukering. 2013. “The Total Economic Value of U.S. Coral Reefs: A Review of the Literature.” NOAA Coral Reef Conservation Program. Silver Spring, MD. Pp. 28.

Brewer, T.D., J.E. Cinner, A. Green, and R.L. Pressey. 2013. “Effects of human population density and proximity to markets on coral reef fishes vulnerable to extinction by fishing.” Conservation Biology 27(3): 443-452.

Butler, C., and W. Oluoch-Kosura. 2006. "Linking Future Ecosystem Services and Future Human Well-Being." Ecology & Society 11(1): 1-16.

Cesar, H. and P. van Beukering. 2004. “Economic Valuation of the Coral Reefs of Hawai‘i.” Pacific Science. 58(2): 231-242.

Costanza, R., B. Fisher, S. Ali, C. Beer, L. Bond, R. Boumans, N.L. Danigelis, J. Dickinson, C. Elliot, J. Farley, D.E. Gayer, L.M. Glenn, T. Hudspeth, D. Mahoney, L. McCahil, B. McIntosh, B. Reed, S. A T. Rizui, D.M. Rizzo, T. Simpatico and R. Snapp. 2007. “Quality of Life: An Approach Integrating Opportunities, Human Needs, and Subjective Well-Being.” Ecological Economics 61: 267-76.

Costanza, R. R. D’Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R.V. O’Neill, J. Paruelo, R.G. Raskin, P. Sutton, and M. van den Belt. 1997. “The Value of the World’s Ecosystem Services and Natural Capital." Nature 387: 253-260.

DeMartini, E.E. and A.M. Friedlander. 2004. “Spatial patterns of endemism in shallow water reef fish populations of the Northwestern Hawaiian Island.” Mar. Ecol. Prog. Ser. 271: 281-296.

Hawai‘i Department of Land and Natural Resources. 2017. “DOBOR Recreational Boating Facilities.” Division of Boating and Ocean Recreation. URL: http://dlnr.Hawai‘i.gov/dobor/dobor-facilities/. Accessed 5-20-2017.

Dillard, M. K., T. L. Goedeke, S. Lovelace, and A. Orthmeyer. 2013. "Monitoring Well-being and Changing Environmental Conditions in Coastal Communities: Development of an Assessment Method." NOAA Technical Memorandum NOS NCCOS 174. Silver Spring, MD. Pp. 176.

Dillman, Don A. 1978. “Mail and Telephone Surveys: The Total Design Method.” New York: Wiley-Interscience.

Dillman, Don A, J.D. Smyth, and L.M. Christian. 2009. “Internet, mail and mixed-mode surveys: The Tailored Design Method,” (3rd ed.). Hoboken, NJ: John Wiley.

Doherty, P.J. and J.H. Carleton. 1997. “The Distribution and Abundance of Pelagic Juvenile Fish Near Grub Reef, Central Great Barrier Reef. In: H.A. Lessios and I.G. Macintyre (eds.). Proceedings of the 8th International Coral Reef Symposium Vol. 2. Smithsonian Tropical Research Institute, Panama. 1155-1160.

Doyal, L. and I. Gough. 1991. “A Theory of Human Need.” London, England: Palgrave Macmillan.

Environmental Protection Agency. 2012. “Clean Watersheds Needs Survey (CWNS) – 2012 Report and Data.” Hawai‘i State Fact Sheet. URL: https://www.epa.gov/sites/production/files/2015-10/documents/cwns_fs-hi.pdf. Accessed 6-24-16.

Environmental Protection Agency. 2016. “National and State Lists of Landfills and Energy Projects.” Landfill Methane Outreach Program; Landfill-level data only (all landfills) – updated March 2016. URL: https://www3.epa.gov/lmop/projects-candidates/. Accessed 6-27-17.

Ferrario, F., M. Beck, C. Storlazzi, F. Micheli, C. Shepard, and L. Airoldi. 2013. “The Effectiveness of Coral Reefs for Coastal Hazard Risk Reduction and Adaptation.” Nature Communications 5:3784. Pp. 9. doi: 10.1038/ncomms4794.

Fletcher, C., C. Robinson, C. Conger, M. Engels, E. Feirstein, N. Frazer, C. Glenn, R. Grigg, E. Grossman, J. Harney, E. Isoun, C. Murray-Wallace, J. Rooney, K. Rubin, C. Sherman, and S. Vitousek. 2008. “Geology of Hawai‘i Reefs.” In: B.M. Riegl and R.E. Dodge (eds.) “Coral Reefs of the USA.” Springer Science and Business Media B.V. Pp. 435-87.

Friedlander, A., and E. DeMartini. 2002. “Contrasts in Density, Size, and Biomass of Reef Fishes Between the Northwestern and the Main Hawaiian Islands: The Effects of Fishing Down Apex Predators.” Marine Ecology Progress Series. 230: 253-264.

Friedlander, A., G. Aeby, R. Brainard, E. Brown, K. Chaston, A. Clark, P. McGowan, T. Montgomery, W. Walsh, I. Williams, and W. Wiltse. 2008. “The State of Coral Reef Ecosystems of the Main Hawaiian Islands". Pp. 219-61, edited by Department of Commerce: NOAA NOS NCCOS. Silver Spring, MD: NOAA/NCCOS Center for Coastal Monitoring and Assessment’s Biogeography Team.

Giambelluca, T.W., X. Shuai, M.L. Barnes, R.J. Alliss, R.J. Longman, T. Miura, Q. Chen, A.G. Frazier, R.G. Mudd, L. Cuo, and A.D. Businger. 2014. “Evapotranspiration of Hawai‘i: Final report submitted to the U.S. Army Corps of Engineers”—Honolulu District, and the Commission on Water Resource Management, State of Hawai‘i. URL: http://climate.geography.Hawai‘i.edu/. Accessed 6-20-16.

Hawai‘i Tourism Authority. 2015. “2015 Annual Report to the Hawai‘i State Legislature.” Honolulu, HI. Pp. 56.

Jepson, M., and L. Colburn. 2013. “Development of Social Indicators of Fishing Community Vulnerability and Resilience in the U.S. Southeast and Northeast Regions.” U.S. Dept. of Commerce. NOAA Technical Memorandum NMFS-F/SPO-129. Pp. 64.

Jokiel, P.T. 1987. “Ecology, biogeography and evolution of corals in Hawai‘i.” Trends in Ecology and Evolution. 2(7): 179-182.

Kay, E.A. and S.R. Palumbi. 1987. “Endemism and evolution in Hawaiian marine invertebrates.” Trends in Ecology and Evolution. 2(7): 183-186.

Kottek, M., J. Grieser, C. Beck, B. Rudolf, and F. Rubel, 2006: “World Map of Köppen-Geiger Climate Classification updated.” Meteorologische Zeitschrift. 15(3): 259-263.

Lewis, K. and S. Burd-Sharps. 2014. “American Human Development Report: The Measure of America 2013–2014.” Measure of American of the Social Science Research Council. Pp. 59.

Loper, C., A. Levine, J. Agar, M. Hamnett, V. R. Leeworthy, M. Valdez-Pizzini, and K. Wallmo. 2010. "NOAA Coral Reef Conservation Program Social Science Strategy: 2010-2015."

Lovelace, S., and M. Dillard. 2012. "Developing Social and Economic Indicators for Monitoring the US Coral Reef Jurisdictions: report from a scientific workshop to support the National Coral Reef Monitoring Program." Charleston, SC: National Oceanic and Atmospheric Administration, National Ocean Service, National Centers for Coastal Ocean Science, Hollings Marine Laboratory.

Lovell, S., S. Steinbeck, and J. Hilger. 2013. “The Economic Contribution of Marine Angler Expenditures in the United States, 2011.” U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-F/SPO-134. Pp. 188.

Macdonald, G., A. Abbott, and F. Peterson. 1983. “Volcanoes in the Sea: The Geology of Hawai‘i.” 2nd Edition. University of Hawai‘i Press; Honolulu, HI. Pp. 523.

Madge, L., J. Hospital, and E.T. Williams. 2016. “Attitudes and Preferences of Hawaii Non-commercial Fishermen: Report from the 2015 Hawaii Saltwater Recreational Fishing

Survey." U.S. Dep. Commerce, NOAA Tech. Memo., NOAA-TM-NMFS-PIFSC-58. Pp. 36 + Appendices. doi:10.7289/V5/TMPIFSC-58.

Maragos, J.E., D.C. Potts, G.S. Aeby, D. Gulko, J.C. Kenyon, D. Siciliano, and D. VanRavenswaay. 2004. "2000-2002 Rapid Ecological Assessments of corals (Anthozoa) on shallow reefs of the Northwestern Hawaiian Islands." Part 1: Species and Distribution. Pacific Science Journal. 58(2): 211-230.

McCoy, K. 2015. "Estimating Nearshore Fisheries Catch for the Main Hawaiian Islands." University of Hawaii at Manoa, Department of Biology.

National Oceanic and Atmospheric Administration (NOAA) Coral Reef Conservation Program (CRCP). 2010. "Priorities for Coral Reef Management in the Hawaiian Archipelago: 2010-2020." Silver Spring, MD: NOAA.

National Oceanic and Atmospheric Administration (NOAA) Coral Reef Conservation Program (CRCP). 2014. "National Coral Reef Monitoring Plan." Silver Spring, MD: NOAA Coral Reef Conservation Program.

National Oceanic and Atmospheric Administration (NOAA) Coral Reef Information System (CoRIS). 2007. "Shallow-water Benthic Habitats of the Main Hawaiian Islands." URL: https://products.coastalscience.noaa.gov/collections/benthic/e97hawaii/data2007.aspx. Accessed: 12-21-17.

National Oceanic and Atmospheric Administration (NOAA), Office for Coastal Management (OCM). 2013. "Economics: National Ocean Watch (ENOW) Sectors and Industries and the North American Industry Classification System (NAICS)." Available at: https://coast.noaa.gov/ digitalcoast/sites/default/files/uploaded/files/NAICS-Table_1.pdf. Accessed 5-18-2016.

National Oceanic and Atmospheric Administration (NOAA), Office of Response and Restoration (OR&R). 2001. "Sensitivity of Coastal Environments and Wildlife to Spilled Oil: Hawai'i: ESIP". Available at: http://response.restoration.noaa.gov/maps-and-spatial-data/download-esi-maps-and-gis-data.html.

Randall, J.E. 1998. "Zoogeography of shore fishes of the Indo-Pacific region." Zoological Studies. 37: 227–268.

Roff, G., C. Doropoulos, A. Rogers, Y. Bozec, N.C. Krueck, E. Aurellado, M. Priest, C. Birrell, and P. Mumby. 2016. "The Ecological Role of Sharks on Coral Reefs." Trends in Ecology & Evolution. 31(5): 395-407.

Schirnding, Y. 2002. "Health in Sustainable Development Planning: The Role of Indicators." World Health Organization; Geneva. WHO/HDE/HID/02.11.

State of Hawai‘i Office of Planning. 2006. “Section 309 Enhancement Area Grant Program FY 2006-2010: Assessment and Strategy.” Coastal Zone Management Program Publication Pursuant to NOAA Award No. NA05NOS4191060.

State of Hawai‘i Department of Health. 2017. “Wastewater.” Available at: http://health.hawaii.gov/cwb/clean-water-branch-home-page/polluted-runoff-control-program/prc-hawaiis-implementation-plan/wastewater/.

Stoffle, B. W., and S. D. Allen. 2012. “The sociocultural importance of spearfishing in Hawai`i.” U.S. Department of Commerce, NOAA Tech. Memo., NOAA-TM-NMFS-PIFSC-31. Pp. 38.

Thorrold, S. and D. Williams. 1996. “Meso-Scale Distribution Patterns of Larval and Pelagic Juvenile Fishes in the Central Great Barrier Reef Lagoon.” Marine Ecology Press Series. 145: 17-31.

United Nations Environment Programme (UNEP). 2016. "Healthy Environment, Healthy People." in Thematic Report of the Second session of the United Nations Environment Assembly of the United Nations Environment Programme. Nairobi, Kenya.

United States Census Bureau. 2010. "Decennial Census of Population and Housing." in Summary File 2. Washington, DC.

United States Census Bureau. 2015. "County Total Population Estimates and Components of Population Change." In Population and Housing Unit Estimates. Washington, DC.

United States Department of Health and Human Services. 1995. "Paper Work Reduction Act (PRA) of 1995."

United States Department of Health and Human Services. 2010. “The 2010 Poverty Guidelines for Hawai‘i.” Office of the Assistant Secretary for Planning and Evaluation. URL: https://aspe.hhs.gov/2010-hhs-poverty-guidelines. Accessed 6-17-16.

Vincent, I.V., C.M. Hincksman, I.R. Tibbetts, and A. Harris. 2011. “Biomass and Abundance of Herbivorous Fishes on Coral Reefs off Andavadoaka, Western Madagascar.” Western Indian Ocean Journal of Marine Science. 10(1): 83-99.

Walsh, W. 2013. “Background Paper on SCUBA Spearfishing.” Hawai‘i Division of Aquatic Resources. Honolulu, HI. Pp. 43.

Western Pacific Regional Fishery Management Council. 2016. “Fishery Ecosystem Plan for the Hawaii Archipelago.” Honolulu, HI. Pp. 105 + Appendices.

Williams, I.D., W.J. Walsh, R.E. Schroeder, A.M. Friedlander, B.L. Richards, and K.A. Stamoulis. 2008. “Assessing the Importance of Fishing Impacts on Hawaiian Coral Reef

Fish Assemblages Along Regional-Scale Human Population Gradients.” Environmental Conversation. 35(3): 261-272.

Appendix A: National Coral Reef Monitoring Program

Understanding Socioeconomic Connections

The Socioeconomic Component of the National Coral Reef Monitoring Plan (NCRMP) gathers and monitors a collection of socioeconomic variables, including demographics in coral reef areas, human use of coral reef resources, as well as knowledge, attitudes, and perceptions of coral reefs and coral reef management. The overall goal of the socioeconomic monitoring component is to track relevant information regarding each jurisdiction's population, social and economic structure, the impacts of society on coral reefs, and the impacts of coral management on communities. NOAA's Coral Reef Conservation Program (CRCP) will use the information for research and to improve the results of programs designed to protect coral reefs.

The main purpose of the Socioeconomic Component of NCRMP is to answer the following questions: What is the status of human knowledge, attitudes, and perceptions regarding coral reefs? And, how are human uses of, interactions with, and coral dependence on coral reefs changing over time?

More details can be found here: http://www.coris.noaa.gov/monitoring/socioeconomic.html

Appendix B: The NCRMP Survey Instrument

OMB SUBMISSION

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

Hawai‘i Survey

Survey conducted in (circle one): *English*

Introduction: *[greeting specific to jurisdiction]*

Hello, my name is [interviewer name]. I'm calling from [CONTRACT COMPANY] on behalf of the National Oceanic and Atmospheric Administration (NOAA) and the National Coral Reef Monitoring Program. We are interested in obtaining your opinions on important issues related to coral reefs in Hawai‘i. You were selected because you live in a coastal area near coral reefs.

This survey is being conducted in accordance with the Privacy Act of 1974 and the Paperwork Reduction Act. Your participation is voluntary, your answers are confidential and you can stop the interview at any time. The interview is expected to take less than 20 minutes. If you have questions or would like to know more about the survey I will provide you with contact information.

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. The OMB Control number for this survey is 0648-0646

The 20 minute estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

Please send comments regarding this burden estimate or any other suggestions for reducing this burden to Peter Edwards, National Oceanic and Atmospheric Agency, National Ocean Service, Coral Reef Conservation Program, (1305 East West Highway, Silver Spring, MD, 20910, USA).

1. Are you at least 18 years of age?

   IF "YES" CONTINUE TO SCREENING QUESTION 2. IF "NO", END SURVEY.

2. Do you live in Hawai‘i at least 3 months of the year?

   IF "YES" CONTINUE WITH QUESTION #1 OF THE SURVEY.

Now that we have established that you are qualified, we will continue with the survey. Remember that you can stop at any time.

PARTICIPATION IN REEF ACTIVITIES

1. How often do you usually participate in each of the following activities?

	Never	Once a month or less	2-3 times a month	4 times a month or more	No Response
Swimming/wading					
Snorkeling					
Diving (SCUBA or free diving)					
Waterside/ beach camping					
Beach recreation (land based beach sports, picnics)					
Boating					
Wave riding (surfing, stand up paddle boarding, body boarding)					
Canoeing/kayaking					
Fishing (for finfish)					
Gathering of marine resources (non-finfish such as lobsters, octopus, opihi, seaweed)					

SKIP PATTERN-- If respondent answers 'never' to BOTH fishing AND gathering of marine resources, then skip to #3:

CORAL REEF RELIANCE / CULTURAL IMPORTANCE OF REEFS

2. How often do you fish or harvest marine resources for each of the following reasons?

	Frequently	Sometimes	Rarely	Never	No Response
To feed myself and my family/ household					
To sell [INTERVIEWER CAN PROMPT: "or for work" to include fishing/harvesting as part of employment]					

	Frequently	Sometimes	Rarely	Never	No Response
To give to extended family members and/or friends					
For fun					
For special occasions and cultural purposes/events					

3. How often does your family eat fish/seafood?

    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

4. What are the two main sources of the fish and seafood that you and your family eats?
    a. Purchased by myself or someone in my household at a store or restaurant
    b. Purchased by myself or someone in my household at a market or roadside vendor
    c. Caught by myself or someone in my household
    d. Caught by extended family members
    e. Caught by friends or neighbors
    f. Other, please specify _____
    g. Not Sure
    h. Refused

PERCEIVED RESOURCE CONDITION

5. In your opinion, how are Hawai‘i’s marine resources currently doing? Please rank from very bad to very good.

	Very Bad	Bad	Neither Bad nor	Good	Very Good	Not sure
Ocean Water Quality (clean and clear)						
Amount of Coral						
Number of Fish						
Diversity of fish						

	Very Bad	Bad	Neither Bad nor	Good	Very Good	Not sure
Size of fish						

6. How would you say the condition of each of the following has changed over the last 10 years: from 1=it has gotten a lot worse to 5=it has gotten a lot better.

	A lot Worse	Somewhat Worse	No Change	Somewhat Better	A lot Better	Not Sure
Ocean Water Quality (clean and clear)						
Amount of Coral						
Number of Fish						
Diversity of fish						
Size of fish						

7. In the next 10 years, do you think the condition of the marine resources in Hawai‘i will get worse, stay the same or improve?
    a. Get worse
    b. Stay the same
    c. Improve
    d. Not sure

AWARENESS AND KNOWLEDGE OF CORAL REEFS

8. Please say whether you disagree or agree with each of the following statements.

	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree	Not Sure
Coral reefs protect the Hawai‘i from erosion and natural disasters.						
Coral reefs are only important to fishermen, divers and snorkelers.						
Healthy coral reefs attract tourists to Hawai‘i.						

	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree	Not Sure
Coral reefs are important to Hawaiian culture.						

9. How familiar are you with each of the following potential threats facing the coral reefs in Hawai‘i?

	Very Unfamiliar	Unfamiliar	Neither Familiar nor Unfamiliar	Familiar	Very Familiar	Not sure
Climate change						
Coral bleaching						
Hurricanes and other natural disasters						
Pollution (stormwater, wastewater, chemical runoff and trash/littering)						
Increased coastal/urban development						
Invasive species						
Too much fishing and gathering						
Damage from ships and boats						
Impacts from recreational activity (examples include trampling of reefs, anchor damage)						
Ocean acidification						

10. Do you believe that the threats to coral reefs in Hawai‘i are:

    a. Extreme
    b. Large
    c. Moderate
    d. Minimal
    e. None
    f. Not sure

AWARENESS OF CORAL RULES AND REGULATIONS

11. 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. Examples in

Hawai‘i include marine life conservation districts, fisheries management areas, and community based subsistence fishing areas. How familiar are you with Marine Managed Areas?

a. Very Unfamiliar
b. Unfamiliar
c. Neither Unfamiliar nor Familiar
d. Familiar
e. Very Familiar
f. Not sure

ATTITUDES TOWARDS CORAL REEF MANAGEMENT STRATEGIES AND ENFORCEMENT

12. The following are common strategies used to manage the marine environment. We are interested in your opinion about the use of these strategies for the protection of coral reefs in Hawai‘i. Please indicate how much you disagree or agree with each of the following:

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Not Sure
Better regulation of land use practices to prevent sediment from going to sea						
Catch limits per person for certain fish species (size and amount)						
Seasonal openings/closures of fisheries						
Gear restrictions for fishing						
Better treatment of wastewater						
Improved law enforcement for existing rules/regulations						
Community participation in marine management						
Ocean zoning						
Designating marine managed areas						
Limited use for recreational activities (examples include diving, snorkeling, boating)						
No-take zones						
Establishment of a non-commercial fishing license						

PARTICIPATION IN BEHAVIORS THAT MAY IMPROVE CORAL CONDITION

13. How often do you participate in any activity to protect the environment (for example, beach clean ups, volunteering with an environmental group, recycling)?

    a. Not At All
    b. Once a year or Less
    c. Several times a year
    d. At least once a month
    e. Several Times a Month or more
    f. Not Sure

14. Which of the following would you consider to be your top 3 sources of information about coral reefs and the environment in Hawai‘i?
    Interviewer checks the top 3 sources of information in box below.

15. To what degree do you trust each of your top rated sources of information to provide you the most accurate information on coral reefs and coral reef related topics in Hawai‘i?
    Respondent rates only the top 3 sources of information in box below.

Top 3	Sources	Very untrustworthy	Untrustworthy	Neither Trustworthy nor Untrustworthy	Trustworthy	Very Trustworthy	Not sure
	Newspapers, other print publications						
	Radio						
	TV						
	Internet						
	Friends and family						
	Community leaders						
	Religious leaders						
	Government (jurisdictional)						
	Federal government agencies (NOAA, EPA)						
	Non-profit organizations						
	Other						

16. How involved is your local community in protecting and managing coral reefs?

    a. Not at all involved
    b. Somewhat involved
    c. Moderately involved
    d. Involved
    e. Very involved
    f. Not sure

17. In thinking about the previous question, how would you briefly define “your local community”? [***open ended***] _____

18. How involved are you in making decisions related to the management of coral reefs in Hawai‘i?

    a. Not at all involved
    b. Slightly involved
    c. Moderately involved
    d. Involved
    e. Very involved
    f. Not sure

DEMOGRAPHICS

19. Are you male or female?
    a. Male
    b. Female

20. What is your year of birth? _____

21. 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 [but less than all my life]
    e. all my life

22. Including your primary language, please name each language you speak.

a. English
b. Spanish
c. French
d. Illocano
e. Vietnamese
f. Chinese
g. Japanese
h. Korean
i. Tagolog
j. Hawaiian
k. Hawaii Pidgin English
l. Sāmoan
m. Chamorro
n. Carolinian
o. Tongan
p. Other: Please list _____
q. No Response

23. What race/ethnicity do you consider yourself?

a. White
b. Native Hawaiian
c. Chinese
d. Japanese
e. Filipino
f. Korean
g. Vietnamese
h. Other Asian _____
i. Micronesian (includes Chuukese, Kasraean, Marshallese, Palauan, Pohnpeian, Yapese, Carolinian, Chamorro, and others)
j. Samoan
k. Tongan
l. Other Pacific Islander _____
m. Black or African American
n. American Indian or Alaskan Native
o. Hispanic or Latino
p. Other
q. No response

24. 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

25. What is your current employment status?
    a. Unemployed
    b. Student
    c. Employed full-time
    d. Homemaker
    e. Employed part-time
    f. Retired
    g. None of the above: Please specify _____
    h. No Response

26. What is your occupation? [***open ended***] _____

27. May I ask, 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

THANK YOU FOR YOUR TIME

If you would like a copy of the results, please provide us with your mailing address or email address (write on separate contact sheet that is not linked to survey answers).
Do you have questions or comments for which you would like me to provide our contact information?

Appendix C: Hawai‘i NCRMP Survey Demographic Results[28,29]

Island	Percent of sample	Percent of sample (weighted)	Percent of population (2010 US Census)
O‘ahu	29%	70%	70%
Hawai‘i	28%	14%	14%
Maui	21%	11%	11%
Kaua‘i	19%	5%	5%
Moloka‘i	2%	1%	1%
Lāna‘i	<1%	<1%	<1%

Gender	Sample	2010 US Census
Male	54%	50%
Female	45%	50%
No Response	<1%	N/A

Race/Ethnicity	Sample	2010 US Census
White	38%	27%
Asian	25%	42%
Native Hawaiian/Pacific Islander	13%	9%
Hispanic	3%	7%
Black/African American	1%	2%
American Indian/Alaskan Native	<1%	<1%
Other	2%	1%
2 or more races	12%	18%
No Response	6%	N/A

[28] The Hawai‘i NCRMP survey results are presented using post stratification sampling weights (weighted by island population). The weights are as follows: O‘ahu = 2.40, Hawai‘i = 0.49, Maui = 0.50, Kaua‘i = 0.26, Moloka‘i = 0.22, Lāna‘i = 0.29.

[29] 2010 US Census results in this section refer to the adult population of Hawai‘i.

Age	Sample	2010 US Census
18-24 year olds	9%	12%
25-44 year olds	24%	34%
45-64 year olds	37%	35%
65-84 year olds	20%	16%
85+ years old	2%	3%
No Response	9%	N/A

Education Level	Sample	2010 US Census[30]
Less than high school	3%	10%
High School Graduate, GED	20%	30%
Some college, community college or AA	28%	34%
College Graduate	31%	18%
Graduate School, Law School, Medical School	15%	9%
No Response	3%	N/A

Annual Household Income	Sample[31]	2010 US Census[32]
Under $10,000	10%	6%
$10,000 to $19,999	6%	7%
$20,000 to $29,999	11%	8%
$30,000 to $39,999	9%	8%
$40,000 to $49,999	9%	8%
$50,000 to $59,999	11%	8%
$60,000 to $74,999	10%	10%
$75,000 to $99,999	13%	15%
$100,000 to $149,999	12%	18%
$150,000 or More	9%	13%

[30] 2012 ACS 5-yr estimates used as a proxy. The 2010 US Census did not collect this information.
[31] Answers of "no response" are left absent from the analysis of household income due to high rate of occurrence (approximately 26%).
[32] 2012 ACS 5-yr estimates used as a proxy. The 2010 US Census did not collect this information.

Year(s) of Residence[33]	Sample
1 year or less	4%
2-5 years	10%
6-10 years	8%
More than 10 years (less than all my life)	40%
All my life	39%

Languages Spoken[34]	Sample
English	94%
Spanish	9%
Hawaiian	7%
Japanese	7%
Tagolog	6%
French	4%
Ilocano	3%
Chinese	2%
Hawaiian Pidgin English	2%
Samoan	1%
Other	8%

Employment Status[35]	Sample
Unemployed	6%
Student	4%
Employed full-time	47%
Homemaker	4%
Employed part-time	7%
Retired	25%
No Response	7%

[33] The 2010 US Census did not collect this type of information.

[34] The 2010 US Census did not collect this type of information, and the 2012 ACS 5-yr estimates collected this data in a different fashion than that of the Hawai‘i NCRMP survey.

[35] The 2010 US Census did not collect this information across the categories of the Hawai‘i NCRMP survey.

Appendix D: NCRMP Secondary Data Sources for Hawai‘i

Source (originator)	*Data Set Title*	*Publication Date*	*Abstract*	*Data Year(s)*	*URL*
Centers for Disease Control and Prevention	Stats of the State of Hawai‘i	2012	These data are on birth and death records in the state of Hawai‘i. They are compiled from birth and death certificates as well as patient medical records.	2009	http://www.cdc.gov/nchs/pressroom/stats_states.htm
Central Intelligence Agency	The World Factbook Life Expectancy at Birth	2013	These data represent the average number of years to be lived by a group of people born in the same year, if mortality at each age remains constant in the future.	2014	https://www.cia.gov/library/publications/the-world-factbook/rankorder/2102rank.html
Central Intelligence Agency	The World Factbook Inflation Rate (Consumer Prices)	2014	Inflation rate (consumer prices) compares the annual percent change in consumer prices with the previous year's consumer prices.	2003-2014	https://www.cia.gov/library/publications/the-world-factbook/rankorder/2092rank.html
Department of Commerce (DOC), National Oceanic and Atmospheric Administration (NOAA), Ocean and Coastal Resource Management (OCRM), National Marine Protected Areas Center (MPAC)	MPA Inventory Database (10/2014)	2014	The MPA Inventory is a comprehensive catalog that provides detailed information for existing marine protected areas in the United States. The inventory provides geospatial boundary information (in polygon format) and classification attributes that seek to define the conservation objectives, protection level, governance and related management criteria for all sites in the database. The comprehensive inventory of federal, state and territorial MPA sites provides governments and stakeholders with	2014	http://marineprotectedareas.noaa.gov/dataanalysis/mpainventory/

Source (originator)	*Data Set Title*	*Publication Date*	*Abstract*	*Data Year(s)*	*URL*
			access to information to make better decisions about the current and future use of place-based conservation. The information also will be used to inform the development of the national system of marine protected areas as required by Executive Order 13158.		
Department of Commerce (DOC), National Oceanic and Atmospheric Administration (NOAA), National Ocean Service (NOS), Office for Coastal Management (OCM)	Time-Series Data on the Ocean and Great Lakes Economy for Counties, States, and the Nation between 2005 and 2012 (Sector Level) (ENOW)	2015	Economics: National Ocean Watch (ENOW) contains annual time-series data for over 400 coastal counties, 30 coastal states, 8 regions, and the nation, derived from the Bureau of Labor Statistics and the Bureau of Economic Analysis. It describes six economic sectors that depend on the oceans and Great Lakes and measures four economic indicators: Establishments, Employment, Wages, and Gross Domestic Product (GDP).	2005-2014	http://coast.noaa.gov/dataregistry/search/dataset/C3722030-943C-4BEE-B063-06715F815891
Department of Commerce (DOC), National Oceanic and Atmospheric Administration (NOAA), National Ocean Service (NOS), Coastal Services Center (CSC)	Spatial Trends in Coastal Socioeconomics (STICS): Total Economy of Coastal Areas	2013	These market data provide a comprehensive set of measures of changes in economic activity throughout the coastal regions of the United States. In regard to the sources of data, establishments, employment, and wages are taken from the Quarterly Census of Employment and Wages (QCEW). These data series also is known as the ES-202 data. These data are based on the quarterly reports of nearly all employers in the United States. These reports are filed with each state's employment or labor	1990-2014	http://coast.noaa.gov/dataregistry/search/dataset/info/coastaleconomy

Source (originator)	*Data Set Title*	*Publication Date*	*Abstract*	*Data Year(s)*	*URL*
			department, and each state then transmits the data to the Bureau of Labor Statistics (BLS), where the national databases are maintained. The data for the Coastal Economies have been taken from the national databases at BLS (except in the case of Massachusetts). Gross State Product (GSP) data are taken from the Bureau of Economic Analysis (BEA), which develops the estimates of GSP from a number of sources. In regard to "employment," data are reported by employers, not employees, and does not contain any information about age. There is no difference between "employed" and "employment". The source is known as the payroll survey, a survey filed by employers every 3 months showing the number of people employed at each establishment in each of the preceding 3 months.		
Environmental Protection Agency	EPA Assessment and Total Maximum Daily Load Tracking and Implementation System (ATTAINS)	2014	The Assessment and Total Maximum Daily Load (TMDL) Tracking and Implementation System (ATTAINS) is an online system for accessing information about the conditions in the Nation's surface waters. The Clean Water Act requires states, territories and authorized tribes (states for brevity) to monitor water pollution and report to EPA every two years on the waters they have evaluated. This	2002, 2004, 2006, 2008, 2010, 2012, 2014	https://www.epa.gov/waterdata/assessment-and-total-maximum-daily-load-tracking-and-implementation-system-attains

Source (originator)	*Data Set Title*	*Publication Date*	*Abstract*	*Data Year(s)*	*URL*
			process is called assessment. Part of this process is deciding which waters do not meet water quality standards because they are too polluted. These degraded waters are called impaired (polluted enough to require action) and are placed on a State list for future actions to reduce pollution. This information reported to EPA by states is available in ATTAINS. The information is made available via the ATTAINS web reports, as well as through other EPA tools. The ATTAINS web reports provide users with easy access to view the information on the status of waters at the national, state and site-specific waterbody levels. To access this information, click the Get Data/Tool tab above.		
Environmental Protection Agency	EPA Annual Beach Notification Summary Reports -- Closures and Advisories	2012	These fact sheets summarize beach monitoring and notification data submitted to EPAfor each swimming season. Beach water monitoring is conducted primarily to detect bacteria that indicate the possible presence of disease-causing microbes (pathogens) from sewage or fecal pollution. People swimming in water contaminated with these types of pathogens can contract diseases of the gastrointestinal tract,	2006, 2010, 2011, 2012	http://water.epa.gov/type/oceb/beaches/2011_season.cfm

Source (originator)	*Data Set Title*	*Publication Date*	*Abstract*	*Data Year(s)*	*URL*
			eyes, ears, skin, and upper respiratory tract. When monitoring results show levels of concern, the state or local government issues a beach advisory or closure notice until further sampling shows that the water quality is meeting the applicable standards. Beach water pollution can occur for a number of reasons including stormwater runoff after heavy rainfall, treatment plant malfunctions,sewer system overflows, and pet and wildlife waste on or near the beach. To help minimize beachgoers' risk of exposure to pathogens in beachwaters, EPA is helping communities build and properly operate sewage treatment plants, working to reduce overflows as much as possible, and working with the U.S. Coast Guard to reduce discharges from boats and larger ships. Under the Beaches Environmental Assessment and Coastal Health (BEACH) Act of 2000, EPA provides annual grants to coastal and Great Lakes states, territories, and eligible tribes to help local authorities monitor their coastal and Great Lakes beaches and notify the public of water quality conditions that may be unsafe for swimming.		
Environmental Protection Agency	Environmental Protection Agency; Air	2016	This data set provides the number of days per year that air advisories were in effect (i.e. the number of “good” days,	1980-2016	https://www.epa.gov/outdoor-air-quality-data/air-

Source (originator)	*Data Set Title*	*Publication Date*	*Abstract*	*Data Year(s)*	*URL*
	Quality Index Report		the number of “moderate” days, the number “unhealthy for sensitive groups” days, “unhealthy” days, and “very unhealthy” days). The data can be delineated by county or by city. The pollutants examined are CO, PM2.5, PM10, NO2, O3, and SO2.		quality-index-report
Environmental Protection Agency; Technology Transfer Network Clearinghouse for Inventories & Emissions Factors.	The National Emissions Inventory	2016	This data set summarizes ammonia, carbon monoxide, nitrogen oxide, particulate matter, sulfur dioxide, volatile organic compounds, mercury, acid gas, greenhouse gases, glycol ether, metals, VOC, PCBs, POM, and PAH emissions at the national, state, and county level for 2011 and 2014. Data is measured in tons.	2011, 2014	https://www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei
Environmental Protection Agency; Landfill Methane Outreach Program (LMOP)	Landfill-level data only	2016	LMOP tracks key data for landfill gas (LFG) energy projects and municipal solid waste (MSW) landfills in the United States. LMOP’s Landfill and Landfill Gas Energy Database contains information about projects in various stages such as planning, under construction, operational, and shutdown, and is also a data repository for more than 2,400 MSW landfills that are either accepting waste or closed in the past few decades. The LMOP Database contains landfill information such as such as physical address, latitude and longitude, owner/operator organization, operational status, year opened, actual or expected closure	2016	https://www.epa.gov/lmop/landfill-gas-energy-project-data-and-landfill-technical-data#landfills

Source (originator)	*Data Set Title*	*Publication Date*	*Abstract*	*Data Year(s)*	*URL*
			year, design capacity, amount of waste in place, gas collection system status, and LFG collected amount. For landfills that report under EPA's Greenhouse Gas Reporting Program (GHGRP), LMOP cross-references that dataset by including GHGRP's 7-digit Facility Identifier.		
Gallup	Gallup Economic Confidence Index	2015	Gallup's Economic Confidence Index is based on the combined responses to two questions asking Americans, first, to rate economic conditions in the country today, and second, whether they think economic conditions in the country as a whole are getting better or getting worse. The Index is computed by adding the percentage of Americans rating current economic conditions (("excellent" + "good") minus "poor") to the percentage saying the economy is ("getting better" minus "getting worse"), and then dividing that sum by 2. The Index has a theoretical maximum value of +100 and a theoretical minimum value of -100. Values above zero indicate that more Americans have a positive than a negative view of the economy; values below zero indicate net-negative views, and zero indicates that positive and negative views are equal.	2013-2014	http://www.gallup.com/poll/125735/economic-confidence-index.aspx

Source (originator)	*Data Set Title*	*Publication Date*	*Abstract*	*Data Year(s)*	*URL*
Hawai‘i Tourism Authority	Hawaii Historical Visitor Statistics	2008-2013	This data set contains information on the arrivals to the Hawai‘i Islands, the purpose of visits, tourist expenditures, and tourist activities.	2007-2012	http://www.hawaiitourismauthority.org/research/reports/historical-visitor-statistics/
HML Project Team	Environmental Use and Dependence - HML Project Team Collection	2014	This data set is comprised of uses occurring in study areas as well as attendance figures for parks located in the study areas. Park visitation to national, state, and county parks as well as National Wildlife Refuge areas are included in this data set. Use data includes fishing, diving, and boating in the study area. Sources: -AS Sources: U.S. Fish and Wildlife Service, National Park Service, U.S. Department of Homeland Security/U.S. Coast Guard Office of Auxiliary and Boating Safety, Professional Association of Diving Instructors, National Oceanic and Atmospheric Administration. -CNMI Sources: U.S. Fish and Wildlife Service, National Park Service, U.S. Department of Homeland Security/U.S. Coast Guard Office of Auxiliary and Boating Safety, Professional Association of Diving Instructors, Diveadvisor.com, National Oceanic and Atmospheric Administration.	2013	

Source (originator)	*Data Set Title*	*Publication Date*	*Abstract*	*Data Year(s)*	*URL*
			-FL Sources: U.S. Fish and Wildlife Service, National Park Service, U.S. Department of Homeland Security/U.S. Coast Guard Office of Auxiliary and Boating Safety, Professional Association of Diving Instructors, Diveadvisor.com, Worldwidefishing.com, Florida Fish and Wildlife Conservation Commission, Florida Department of Highway Safety and Motor Vehicles, Florida Park Service. -Guam Sources: U.S. Fish and Wildlife Service, National Park Service, U.S. Department of Homeland Security/U.S. Coast Guard Office of Auxiliary and Boating Safety, Professional Association of Diving Instructors, Diveadvisor.com, National Oceanic and Atmospheric Administration. -HI Sources: U.S. Fish and Wildlife Service, National Park Service, U.S. Department of Homeland Security/U.S. Coast Guard Office of Auxiliary and Boating Safety, Professional Association of Diving Instructors, Diveadvisor.com, Worldwidefishing.com, Department of Land and Natural Resources, National Oceanic and Atmospheric Administration, Hawai‘i Tourism		

Source (originator)	*Data Set Title*	*Publication Date*	*Abstract*	*Data Year(s)*	*URL*
			Authority, National Association of State Park Directors, County of Hawai‘i Fire Department: Ocean Safety Division. -PR Sources: U.S. Fish and Wildlife Service, National Park Service, U.S. Department of Homeland Security/U.S. Coast Guard Office of Auxiliary and Boating Safety, Professional Association of Diving Instructors, Diveadvisor.com, Worldwidefishing.com, Puerto Rico Department of Natural and Environmental Resources, U.S. Department of Agriculture. -USVI Sources: U.S. Fish and Wildlife Service, National Park Service, U.S. Department of Homeland Security/U.S. Coast Guard Office of Auxiliary and Boating Safety, Professional Association of Diving Instructors, Diveadvisor.com, Worldwidefishing.com, National Archives and Records Administration Office of the Federal Register, Department of Planning and Natural Resources Division of Fish & Wildlife.		
Institute for Health Metrics and Evaluation (IHME)	United States Adult Life Expectancy by	2011	This is a complete time series for life expectancy from 1987 to 2007 for all US counties, and released as part of	2007	http://ghdx.healthdata.org/record/united-states-adult-life-

Source (originator)	*Data Set Title*	*Publication Date*	*Abstract*	*Data Year(s)*	*URL*
	County 1987-2007		IHME research published in *Population Health Metrics.*		expectancy-county-1987-2007
National Oceanic and Atmospheric Administration (NOAA), Coastal Change Analysis Program (CCAP)	National Oceanic and Atmospheric Administration, Coastal Change Analysis Program (CCAP) Regional Land Cover Data	2012	The Coastal Change Analysis Program (C-CAP) produces a nationally standardized database of land cover and land change information for the coastal regions of the U.S. C-CAP products are developed using multiple dates of remotely sensed imagery and consist of raster-based land cover maps for each date of analysis, as well as a file that highlights what changes have occurred between these dates and where the changes were located. These data highlight the relative effects of different landscape features on water quality, such as increased polluted runoff from impervious surfaces and the mitigating impacts of forests. NOAA produces high resolution C-CAP land cover products, for select geographies. GIS and tabular data was accessed June 2012 and prepared for the project by NOAA Coastal Services Center, Charleston SC.	2001-2007 (various)	http://www.csc.noaa.gov/digitalcoast/data/ccapregional
National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS)	Marine Recreational Information Program (MRIP)	2015	The Marine Recreational Information Program, or MRIP, is the way NOAA Fisheries counts and reports marine recreational catch and effort. Driven by data provided by anglers and captains, MRIP produces better information through better science and, equally	1981-2015	http://www.st.nmfs.noaa.gov/recreational-fisheries/index

Source (originator)	*Data Set Title*	*Publication Date*	*Abstract*	*Data Year(s)*	*URL*
			important, increased transparency, accountability, and engagement. NOAA Fisheries is entrusted with ensuring the long-term health of ocean fisheries and other marine life in federal waters. One of our most important jobs is working with both commercial and recreational fishermen to count what species are being caught, when, where, and how. This information is used to decide how many fish can be taken recreationally and commercially without negatively affecting the sustainability of individual fisheries. It also ensures appropriate measures are taken to recover fisheries in trouble.		
National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), Fisheries Statistics Division	Annual Commercial Landing Statistics	2015	The NOAA Fisheries, Fisheries Statistics Division has automated data summary programs that anyone can use to rapidly and easily summarize U.S. commercial fisheries landings. These programs allow you to query our commercial fishery data bases and summarize United States domestic commercial landings in several formats. Domestic fishery landings are those fish and shellfish that are landed and sold in the 50 states by U.S. fishermen and do not include landings made in U.S. territories or by foreign fishermen. You can summarize the	1950-2015	http://www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/annual-landings/index

Source (originator)	*Data Set Title*	*Publication Date*	*Abstract*	*Data Year(s)*	*URL*
			pounds and dollar value of commercial landings by your choice of years, months, states and species for the years 1990 onwards. The volume and value of 1950 onwards landings can be summarized by: years, states and species; by years, states, species and fishing gears; or years, states, species, finfish or shellfish groups, and price per pound.		
National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), Marine Recreational Information Program (MRIP)	Marine Recreational Fisheries Statistics Survey (MRFSS)	2015	The Marine Recreational Fisheries Statistics Program team provides essential marine recreational fisheries information to government, scientists, and the public. Since 1979, we have conducted the annual Marine Recreational Fisheries Statistics Survey (MRFSS). The purpose of this national survey is to provide a reliable database for estimating the impact of recreational fishing on marine resources. The MRFSS now encompasses nearly 30 years of continuous and standardized data, and represents the most scientifically credible and consistent picture of marine recreational catch, effort, and participation in the world.	1981-2015	http://www.st.nmfs.noaa.gov/st1/recreational/queries/
National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries	Western Pacific Fisheries Information Network	2016	Established in 1981, the Western Pacific Fisheries Information Network (WPacFIN) is a cooperative program involving the WPacFIN central office at the Pacific Islands Fisheries Science	1980-2015	https://www.pifsc.noaa.gov/wpacfin/

Service (NMFS), Pacific Islands Fisheries Science Center (PIFSC),			Center (PIFSC) and fisheries agencies of American Samoa, the Commonwealth of the Northern Mariana Islands (CNMI), Guam, and Hawaii. WPacFIN compiles fisheries information collected by these agencies and provides them technical expertise and tools to help them collect, manage, summarize, and quality control fishery-dependent data needed for local, federal, and international assessment and management decisions. WPacFIN also works closely with the Western Pacific Regional Fishery Management Council and NOAA's Pacific Islands Regional Office (PIRO).		
National Oceanic and Atmospheric Administration (NOAA), National Ocean Service, Office of Response and Restoration, Hazardous Materials Response Division, Seattle, Washington	Hawaii ESI: HYDRO (Hydrology Polygons and Lines)	2001	This data set contains vector arcs and polygons representing coastal hydrography used in the creation of the Environmental Sensitivity Index (ESI) for Hawai'i. The HYDRO data layer contains all annotation used in producing the atlas. The annotation features are categorized into three subclasses in order to simplify the mapping and quality control procedures: GEOG or geographic features, SOC or socioeconomic features, and HYDRO or water features. This data set comprises a portion of the ESI for Hawai'i. ESI data characterize the marine and coastal environments and wildlife by their sensitivity to spilled oil. The ESI data include information for three main components: shoreline	1978-2001	http://archive.orr.noaa.gov/topic_subtopic_entry.php?RECORD_KEY%28entry_subtopic_topic%29=entry_id,subtopic_id,topic_id&entry_id%28entry_subtopic_topic%29=849&subtopic_id%28entry_subtopic_topic%29=8&topic_id%28entry_subtopic_topic%29=1

			habitats, sensitive biological resources, and human-use resources.		
The Henry J. Kaiser Family Foundation	State Health Facts: Infant Mortality Rate (Deaths per 1,000 Live Births)	2013	These data represent the number of infant deaths per 1,000 live births based on linked birth and death records from the period from 2007-2009.	2007-2009	http://kff.org/other/state-indicator/infant-death-rate/
The Henry J. Kaiser Family Foundation	State Health Facts: Number of Cancer Deaths per 100,000 Population	2013	These data represent age-adjusted rates per 100,000 U.S. standard population. Rates for the United States and each state are based on populations enumerated in the 2010 census as of April 1. Rates for Puerto Rico, Virgin Islands, Guam, American Samoa, and Northern Marianas are based on the 2010 census, estimated as of July 1, 2010. Since death rates are affected by the population composition of a given area, age-adjusted death rates should be used for comparisons between areas because they control for differences in population composition.	2010	http://kff.org/other/state-indicator/cancer-death-rate-per-100000/
The World Bank	World Bank – Annual Visitor Arrivals	2014	The World Bank is a vital source of financial and technical assistance to developing countries around the world. We are not a bank in the ordinary sense but a unique partnership to reduce poverty and support development. The World Bank Group comprises five institutions managed by their member countries. Annual visitor arrivals is an international tourism indicator based on the number of tourists who travel to a country other than that in which they usually reside, and outside their usual	1995-2014	http://data.worldbank.org/indicator/ST.INT.ARVL

			environment, for a period not exceeding 12 months and whose main purpose in visiting is other than an activity remunerated from within the country visited. When data on number of tourists are not available, the number of visitors, which include tourists, same-day visitors, cruise passengers, and crew members, is shown instead.		
The World Bank	World Bank – Fish/Mammal species threatened	2010, 2011	The World Bank is a vital source of financial and technical assistance to developing countries around the world. We are not a bank in the ordinary sense but a unique partnership to reduce poverty and support development. The World Bank Group comprises five institutions managed by their member countries. Fish species are based on Froese, R. and Pauly, D. (eds). 2008. Threatened species are the number of species classified by the IUCN as endangered, vulnerable, rare, indeterminate, out of danger, or insufficiently known. Mammal species are mammals excluding whales and porpoises. Threatened species are the number of species classified by the IUCN as endangered, vulnerable, rare, indeterminate, out of danger, or insufficiently known.	2010, 2011	http://data.worldbank.org/indicator/EN.FSH.THRD.NO http://data.worldbank.org/indicator/EN.MAM.THRD.NO
The World Bank	World Bank – Climate Change	2012	The World Bank is a vital source of financial and technical assistance to developing countries around the world. We are not a bank in the ordinary sense	1900-2012	http://sdwebx.worldbank.org/climateportal/index.cfm?page=downsca

	Knowledge Portal		but a unique partnership to reduce poverty and support development. The World Bank Group comprises five institutions managed by their member countries. The World Bank Climate Change Knowledge Portal reports monthly data since 1900 on temperature and precipitation for each world nation		led_data_download&menu=historical
The World Bank	World Bank - Population, Total	2014	The World Bank is a vital source of financial and technical assistance to developing countries around the world. We are not a bank in the ordinary sense but a unique partnership to reduce poverty and support development. The World Bank Group comprises five institutions managed by their member countries. Total population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship--except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of their country of origin. The values shown are midyear estimates.	2012-2013	http://data.worldbank.org/indicator/SP.POP.TOTL
The World Bank	World Bank - GDP (current US$)	2014	The World Bank is a vital source of financial and technical assistance to developing countries around the world. We are not a bank in the ordinary sense but a unique partnership to reduce poverty and support development. The World Bank Group comprises five institutions managed by their member countries. GDP at purchaser's prices is	2005-2013	http://data.worldbank.org/indicator/NY.GDP.MKTP.CD/countries/PR?display=graph

			the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in current U.S. dollars. Dollar figures for GDP are converted from domestic currencies using single year official exchange rates.		
The World Bank	World Bank - Improved water source (% of population with access)	2015	Access to an improved water source refers to the percentage of the population using an improved drinking water source. The improved drinking water source includes piped water on premises (piped household water connection located inside the user's dwelling, plot or yard), and other improved drinking water sources (public taps or standpipes, tube wells or boreholes, protected dug wells, protected springs, and rainwater collection).	1990-2015	http://data.worldbank.org/indicator/SH.H2O.SAFE.ZS
U.S. Department of Commerce Bureau of Economic Analysis	Advance 2013 and Revised 1997-2012 Statistics of GDP by State	2014	These statistics reflect the results of the comprehensive revision of gross domestic product (GDP) by state for 1997–2012. This revision not only incorporates new and revised source data, but it also includes significant improvements in classification and statistical methods to more accurately portray the state economies. Significant changes introduced with this revision include: updated industry definitions consistent with the 2007 North American	1997-2013	https://www.bea.gov/newsreleases/regional/gdp_state/gsp_newsrelease.htm

			Industry Classification System (NAICS), results of the 2013 comprehensive revision of state personal income, results of the 2013 comprehensive revision of the national income and product accounts and the 2014 comprehensive revision of the annual industry accounts, which included the recognition of research and development (R&D) expenditures as capital, the capitalization of entertainment, literary, and other artistic originals, the expansion of the capitalization of the ownership transfer costs of residential fixed assets, the use of an improved accrual accounting treatment of transactions for defined benefit pension plans, and improved methods for computing financial services provided by commercial banks		
U.S. Department of Health and Human Services	National Vital Statistics Reports: Deaths: Preliminary Data for 2011	2012	These are preliminary U.S. data on deaths, death rates, life expectancy, leading causes of death, and infant mortality for 2011 by selected characteristics such as age, sex, race, and Hispanic origin. Preliminary data in this report are based on records of deaths that occurred in calendar year 2011, which were received from state vital statistics offices and processed by the Centers for Disease Control and Prevention's National Center for Health Statistics (NCHS) as of June 12, 2012.	2011	http://www.cdc.gov/nchs/data/nvsr/nvsr61/nvsr61_06.pdf
U.S. Department of Health and Human Services	National Vital Statistics Reports:	2013	These data represent final 2010 data on U.S. deaths, death rates, life expectancy, infant mortality, and trends by selected	2010	http://www.cdc.gov/nchs/data/nvsr

	Deaths: Final Data for 2010		characteristics such as age, sex, Hispanic origin, race, state of residence, and cause of death.		/nvsr61/nvsr61_04.pdf
U.S. Energy Information Administration	EIA State Electricity Profiles	1991-2014	The State Electricity Profiles presents a summary of key State statistics for 2000, and 2004 through 2010. The tables present summary statistics; ten largest plants by generating capacity; top five entities ranked by retail sales; electric power industry generating capacity by primary energy source; electric power industry generation of electricity by primary energy source; utility delivered fuel prices for coal, petroleum, and natural gas; electric power emissions estimates; retail sales, revenue, and average revenue per kilowatthour by sector; and utility retail sales statistics. Data published in the State Electricity Profiles are compiled from five forms filed annually by electric utilities and other electric power producers.	1990-2014	http://www.eia.gov/electricity/state/
United States Census Bureau	Census 2000	2002	Summary File 3 contains population and housing data based on Census 2000 questions asked on the long form of a one-in-six sample of the population. Population items include marital status, disability, educational attainment, occupation, income, ancestry, veteran status, and many other characteristics. Housing items include tenure (whether the unit is owner- or renter-occupied), occupancy status, housing value, mortgage status, price	2000	http://www.census.gov/main/www/cen2000.html

			asked, and more. In addition to the 50 states and District of Columbia, the U.S. Census Bureau also conducts censuses and surveys in the the United States' Island Areas. Census and survey operations are conducted in cooperation with the governments of the the Island Areas and frequently include modifications to the questionnaires to help the local and federal governments better understand the populations being counted.		
United States Census Bureau	2010 Census	2011	Summary File 1 shows detailed tables on age, sex, households, families, relationship to householder, housing units, detailed race and Hispanic or Latino origin groups, and group quarters.	2010	http://www.census.gov/2010census/data/
United States Census Bureau	2008-2012 ACS 5-Year Estimates	2013	The ACS provides information on more than 40 topics, including education, language ability, the foreign-born, marital status, migration and many more. Each year the survey randomly samples around 3.5 million addresses and produces statistics that cover 1-year, 3-year, and 5-year periods for geographic areas in the United States and Puerto Rico.	2012	http://www2.census.gov/acs2012_5yr/summaryfile/
United States Census Bureau	2013 Population Estimates: Annual Estimates of the Resident Population:	2014	The estimates are based on the 2010 Census and reflect changes to the April 1, 2010 population due to the Count Question Resolution program and geographic program revisions. The resident population for each year is estimated since the most recent decennial census by using measures of population	2010-2013	http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=PEP_2013_PEPANNRES&prodType=table

	April 1, 2010 to July 1, 2013		change. The resident population includes all people currently residing in the United States.		
United States Census Bureau	2009-2013 ACS 5-Year Estimates	2014	The ACS provides information on more than 40 topics, including education, language ability, the foreign-born, marital status, migration and many more. Each year the survey randomly samples around 3.5 million addresses and produces statistics that cover 1-year, 3-year, and 5-year periods for geographic areas in the United States and Puerto Rico.	2013	http://www2.census.gov/acs2013_5yr/summaryfile/
United States Census Bureau	Building Permits Survey	2015	Data collected include number of buildings, number of housing units, and permit valuation by size of structure. This survey covers all places issuing building permits for privately-owned residential structures. Over 98 percent of all privately-owned residential buildings constructed are in permit-issuing places.	2004-2014	http://www.census.gov/construction/bps/stateannual.html
United States Census Bureau	Quarterly Workforce Indicators	2015	The Quarterly Workforce Indicators (QWI) are a set of economic indicators including employment, job creation, earnings, and other measures of employment flows. The QWI are reported using detailed firm characteristics (geography, industry, age, size) and worker demographics information (sex, age, education, race, ethnicity). QWI data are available through the following access tools:	2013-2015	http://lehd.ces.census.gov/data/
United States Census Bureau	County Business Patterns	2014	County Business Patterns (CBP) is an annual series that provides subnational economic data by industry. This series	1998-2012	http://www.census.gov/econ/cbp/

			includes the number of establishments, employment during the week of March 12, first quarter payroll, and annual payroll.		
United States Department of Agriculture Food and Nutrition Service	Supplemental Nutrition Assistance Program: Average Monthly Participation (Persons)	2015	SNAP offers nutrition assistance to millions of eligible, low-income individuals and families and provides economic benefits to communities. The number of persons participating is reported monthly. Annual averages are the sums divided by twelve.	2010-2014	http://www.fns.usda.gov/pd/supplemental-nutrition-assistance-program-snap
US Geological Survey; Water Use in the United States	Estimated Use of Water in the United States: County-Level Data	2010	These data files present water-use estimates by county for the United States, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands which support the State-level water-use estimates published in USGS Circular 1405, Estimated Use of Water in the United States in 2010. All States provided estimates for public supply, domestic, irrigation, livestock, aquaculture, industrial, mining, and thermoelectric power water use. All States also provided estimates of public supply deliveries for domestic use. All States have estimates of the total population served by public supply and how many people consume each type of water (groundwater, surface water, self-serviced). States optionally may have estimated public supply population served by groundwater and surface water. All States will have estimates of total irrigation. States optionally may	2010	http://water.usgs.gov/watuse/data/2010/index.html

			have estimated subtotals for crop irrigation and golf-course irrigation. No consumptive-use data were collected nationally for any of the categories for 2010. No commercial water-use data were collected nationally for 2010. No wastewater release data were collected nationally for 2010. No hydroelectric power instream use data were collected nationally for 2010. Public-supply deliveries for commercial, industrial, and thermoelectric power were not collected nationally for 2010.		

Appendix E: Statistical Analyses Referenced in the Report[36]

Table 16: T-test; Tenure and Marine Resource Condition Perception

Marine Resource	Has not lived in Hawai'i their whole life		Has lived in Hawai'i their whole life		Statistical test for difference	
	Weighted n	Mean	Weighted n	Mean	t	P value
Current Conditions						
Ocean water quality	1317	3.79	829	3.53	5.59***	<0.01
Amount of coral	1139	3.02	729	2.81	3.78***	<0.01
Number of fish	1182	3.15	770	2.84	5.81***	<0.01
Diversity of Fish	1200	3.51	766	3.20	6.20***	<0.01
Size of Fish	1139	3.34	763	3.06	5.67***	<0.01
Change in conditions over last 10 years						
Ocean water quality	1284	2.89	841	2.77	2.58***	<0.01
Amount of coral	1182	2.58	782	2.48	1.96**	0.05
Number of fish	1217	2.69	808	2.53	3.19***	<0.01
Diversity of Fish	1205	2.87	787	2.67	3.95***	<0.01
Size of Fish	1183	2.77	777	2.63	2.71***	<0.01

Note: Answers of "not sure" left absent from this analysis
Higher mean values indicate a more positive perception

Table 17: Pearson correlation analysis; Reef Reliance and Management Support

Variable	Management Support Index
Reef Reliance Index	-0.092***

[36] * statistically significant with 90% confidence; ** = statistically significant with 95% confidence; *** = statistically significant with 99% confidence

Table 18: T-test; Fishing/Gathering and Management Support

Management Approach	Respondent DOES NOT fish/gather		Respondent DOES fish/gather		Statistical test for difference	
	weighted n	Mean	weighted n	Mean	t	p value
Better regulation of land use practices to prevent sediment from going to sea	1308	4.11	874	4.11	-0.08	0.94
Limits per person for certain fish species (size and amount)	1308	4.24	877	4.14	2.73***	<0.01
Seasonal openings/closures of fisheries	1263	4.06	870	4.00	1.44	0.15
Gear restrictions for fishing	1246	3.98	868	3.82	3.67***	<0.01
Better treatment of wastewater	1304	4.38	878	4.34	1.30	0.20
Law enforcement of existing rules/regulations	1297	4.17	879	4.11	1.57	0.12
Community participation in management	1304	4.21	875	4.26	-1.70*	0.09
Marine zoning	1125	3.91	793	3.80	2.60***	<0.01
Designated marine protected area	1263	4.11	870	3.99	3.21***	<0.01
Limited use for recreational activities (fishing, diving, snorkeling, boating)	1296	3.67	872	3.41	5.35***	<0.01
No Take Zones	1132	3.95	821	3.71	5.59***	<0.01
Establishment of a non-commercial fishing license	1222	3.62	855	3.27	6.67***	<0.01

Note: Answers of "not sure" left absent from this analysis
Higher mean values indicate more support

Table 19: Pearson correlation analysis; O'ahu Residence and Fishing/Gathering

Variable	Fishes and/or Gathers for marine resources
Resident of O'ahu	-0.117***