

TOURISM CASES

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Sanctuary Count – Toward Building a Visitor Use Monitoring Program in Marine Protected Areas

This case study focuses on developing a visitor use monitoring program for marine protected areas and delves into an application of the work in the Florida Keys National Marine Sanctuary.

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Summary

National marine sanctuaries (NMS) are a network of underwater parks encompassing more than 629,000 square miles of marine and Great Lakes' waters. Estimating the number of users and their activities within NMS poses unique challenges due to their porous borders. This case study will walk through past work, detail more recent work and provide an outline for how to move forward to build a visitor use monitoring program for national marine sanctuaries.

The Value and Interest of the Case Study

This case study adds value by providing a comprehensive approach to understanding visitor use in marine places. There are few studies that provide comprehensive visitor data in marine places, and even fewer that have long-term monitoring programs. This case study provides the framework for national marine sanctuaries that may be applied in other locations.

Background

Marine protected areas (MPAs) are defined as “a region designated and managed for the long-term conservation of marine resources, ecosystem services, or cultural heritage” (NOAA, 2025a). Within the United States, there are nearly 1000 MPAs covering 26% of US waters (NOAA, 2025b). MPAs provide long-term protection to marine and coastal ecosystems and the people that live near and far from them. Types of MPAs include aquatic preserves, National Estuarine Research Reserves, Wildlife Refuges, National Seashores, Wildlife Management Areas, Marine Reserves, Marine Preserves, and National Marine Sanctuaries. MPAs may be managed by state or Federal government. Although some MPAs restrict use, many support multiple uses, including commercial activities.

This Case Study will focus on NMS, which are managed by the Department of Commerce's National Oceanic and Atmospheric Administration's (NOAA) Office of National Marine Sanctuaries (ONMS). The National Marine Sanctuary Act (NMSA) allows sanctuaries to be designated that are "of special national significance due to – (A) its conservation, recreational, ecological, historical, scientific, cultural, archaeological, educational, or esthetic qualities; (B) the communities of living marine resources it harbors; or (C) its resource of human-use values" (NMSA, 2000).

NMS are a network of underwater parks encompassing more than 629,000 square miles of marine and Great Lakes waters. ONMS is currently the trustee for 17 NMS located on the east and west coast of the United States, within the Great Lakes and in the Pacific Islands (Fig. 1).

When determining if an area meets the standards outlined in the NMSA, one consideration is "the feasibility, where appropriate, of employing innovative management approaches to protect sanctuary resources or to manage *compatible uses*". Although, NMS "identify and designate ... areas of the marine environment which are of special and national significance," unless otherwise regulated, do not prohibit use. This means that both commercial and recreational uses are allowable in NMS unless prohibited by law. Some of the many activities that take place in NMS are commercial fishing, recreational fishing, diving, whale watching, research, education. Other activities that may require permits to occur are installing subsurface cables or pipelines for technology, desalination or fiber optics. This chapter will discuss visitation estimation in NMS, including challenges, past work by NOAA's ONMS, work conducted by the larger research community in NMS, and will present a framework to build a visitor use monitoring program for ONMS.

Counting Recreational Users in National Marine Sanctuaries

Counting users in NMS presents many challenges. Three that will be discussed here are porous borders, the location of visitor centers, and scale of measurement. Unlike parks and other land-based protected areas, there are no single-entry points of access in marine areas. Instead, these special places have porous borders – meaning there is an infinite number of entry points. Users may enter from a variety of locations, using various mechanisms for entry (such as a marina, private residence, beach or public boat ramp). Further, a user could enter from a river further inland or an access point on the shore and travel hundreds of miles via boat to a sanctuary, never setting foot on the adjacent shoreline.

The location of services provided to visitors and users is also different from many park and forest sites. Specifically, all NMS visitor centers are located outside of NMS. NMS only protect waters and do not extend inland. Unlike

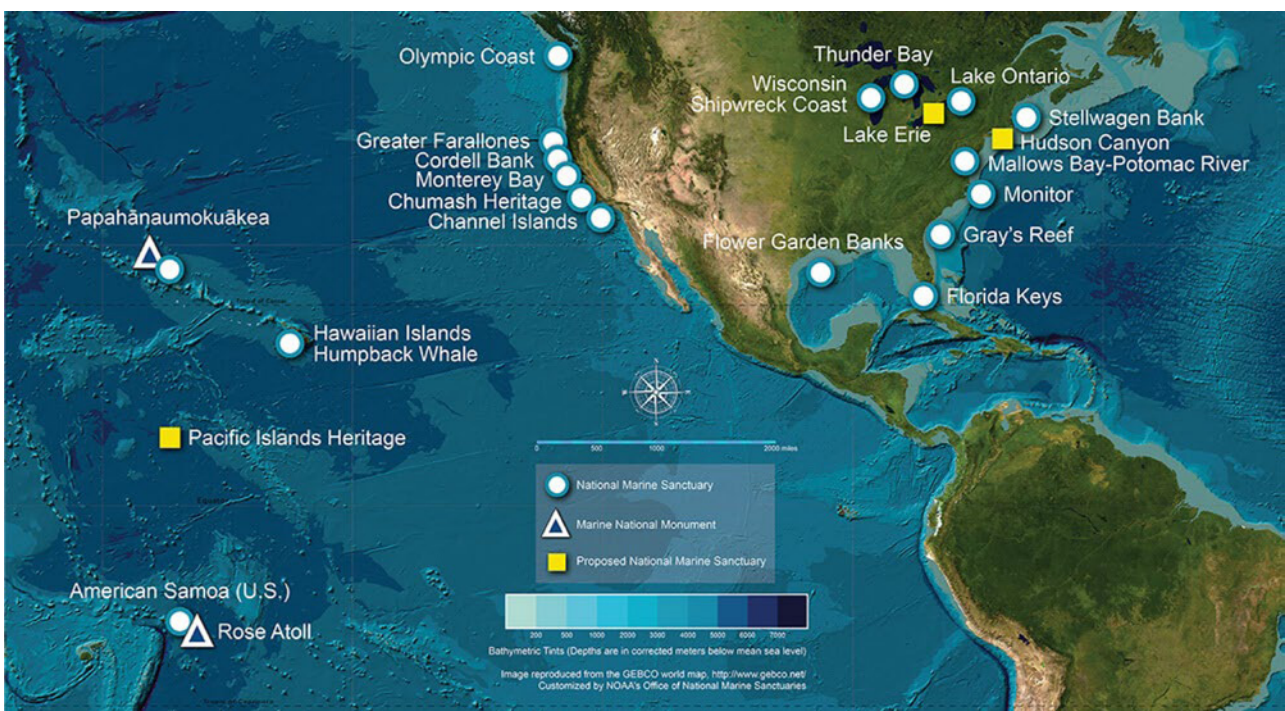


Fig. 1. Map of the national marine sanctuary system. Available at: <https://sanctuaries.noaa.gov/>.

protected areas that have visitor centers located within their boundaries, where anyone who sets foot in the visitor centers by definition has also visited the park, visitors to sanctuary visitor centers do not always visit the associated sanctuary. This poses a unique challenge and question for how to treat visitors to visitor centers versus NMS. Both groups of people still receive direct benefits of sanctuary programming and management, but their experiences, attitudes, perceptions, and expenditures may be different.

Another challenge is the scale of NMS in comparison to sites and distinguished MPAs within them. Counting people to understand use across the whole sanctuary may be sufficient to meet certain management goals, but there may be needs that require understanding use in specific areas, such as coral reefs, seagrass or shipwrecks. These types of sites may provide additional challenges, when they are off-shore, as all users access via boats. The boats may be private/rental boats or chartered boats, entering the water from near or far. To count these users would require people in boats to record their observations – number of boats, people per boat, and who is actually using the below surface resource. However, collecting comprehensive data from these users may be more challenging.

Past Visitation Work

ONMS has estimated recreational use historically using either primary data or secondary data. Three studies will be discussed here, estimating recreational use in Florida Keys National Marine Sanctuaries (FKNMS), estimating whale watching in Stellwagen Bank National Marine Sanctuary (SBNMS) and quantifying recreational fishing in four of the NMS located in California. FKNMS is the only site to have a comprehensive study of recreation and tourism across the sanctuary system (Leeworthy, 2010). This comprehensive study utilized intercept surveys at various entry points and relied on existing data sets to determine the total visitation. Intercept surveys were conducted at the airport, cruise ship terminal, ferry and along US Route 1. Despite the comprehensive nature of this study, it is worth noting that boaters entering from outside of Monroe County may not have been included in the study.

The FKNMS study collected visitation data, economic and human dimensions data that informs managers. Specifically, trip expenditures and importance satisfaction data were collected. Further, data related to the respondents' activities and whether or not they are a resident of Monroe County was collected. This data collectively, informs managers about who the users are, what they are doing and provides insights into attributes that users believe could be improved to increase user experience and satisfaction. As a result of resource constraints, NOAA had not conducted studies of users in FKNMS since 2008 until two pilot studies were conducted at Gray's Reef NMS and FK NMS, starting in 2019 (Andrew *et al.*, 2021; Burns and Andrew, 2021).

Historically, ONMS has focused on visitation studies to meet specific needs of individual management. An example of this is research that occurred at SBNMS. The sanctuary is located at the mouth of Massachusetts Bay and is one of the top whale watching locations in the world. Previous to this study completed in 2018, only one study had been completed, in 2000, to estimate whale watching and its resulting economic contributions in SBNMS (Hoagland and Meeks, 2000). The last large-scale study to understand whale watching worldwide was completed in 2009 (O'Connor *et al.*, 2009). The lack of data available to understand the use and value of whales, specific to whale watching, is limited.

The SBNMS study collected data from whale watching passengers in 2018 and 2019 (Schwarzmann and Shea, 2020). Surveyors boarded whale watching vessels and collected data from passengers on their return trip to shore (after the whale watching occurred). Surveyors intercepted passengers to complete a short survey and provided information to complete a longer survey about expenditures and attitudes online. Data collected included sociodemographic, importance/satisfaction, expenditures and the primary purpose of their overall trip to the region. The previous two studies utilized primary data collection by NOAA.

However, other research and reports published by NOAA have relied on secondary data. A series of reports published using data from 2010 to 2012 analyzed commercial and recreational fishing activity in the (then) four NMS located in California (Leeworthy *et al.*, 2013; Chen *et al.*, 2015). The data used in this series of reports was provided to ONMS by the California Department of Fish and Wildlife. Using the data provided, ONMS was able to estimate the number of angler-days by mode and sanctuary and the number of boats and average number of persons per boat for private-rental boats. For commercial fishing slightly different metrics to understand use and effort were analyzed; pounds and value of catch and number of vessels.

However, secondary data was and continues to be collected on a geographic scale that does not consistently align with NMS boundaries. Commercial fishing and private/rental boats report their fishing data using fishing blocks. These fishing blocks are 10-min by 10-min blocks overlaid on the ocean. Sanctuary boundaries are

not square, so although some blocks occur exclusively in a sanctuary boundary, many are only partially in the sanctuary. For shoreline fishing, there are six segments along the coastline of California and the endpoints of each segment do not align with the coastal boundaries of sanctuaries. This highlights the challenge of using secondary data to estimate use. Oftentimes, the geographic boundaries of secondary data collection do not align with the boundaries of sanctuaries, so the data is not a one for one match. The data is still useful to inform and estimate the activities and intensity of those activities within and around sanctuaries.

Additional Research to Quantify Use in MPAs

Although NOAA has not conducted many comprehensive visitation studies in NMS, there are several examples of other organizations conducting research to understand use in MPAs. MPA Watch is a community citizen science program that trains volunteers to collect unbiased data observations of what users are doing (MPA Watch, 2025a). The activities they record include both consumptive and non-consumptive recreation such as running, biking, swimming, fishing and kayaking. The volunteer program in California allows for long term monitoring of use within and near MPAs despite state budget constraints. The volunteers are trained to use GPS or compasses to walk a specified route and given specific instructions of when to record people and their activities. Additionally, in the South Coast region and Santa Barbara region, there are boat-based surveys that collect boating activity and shore-based fishing. As an example, the North-central Coast MPA Watch Program, conducted by the Beach Watch project, a joint program of Greater Farallones NMS and Greater Farallones Association, records observations in 10 MPAs across five counties in California (MPA Watch, 2025b). Findings include 95% of all recreational activities shore-based from January to June 2024 across the ten sites and that seven of the ten MPAs monitored observed significant decreases in activities when compared to the same period of time in 2023. These longitudinal data sets are helpful when analyzing trends in use over time. However, they do not provide insights about the users' recreational experience or motivations or data about expenditures and how this use may support local economic activity.

Visitor Use on Federal Lands

This section will provide a brief overview of the United States Forest Service (USFS) National Visitor Use Monitoring Program (NVUM) and the National Park Services' Visitor Use Statistics and Socioeconomic Monitoring programs (USFS, 2025). The USFS NVUM collects survey data from over 100,000 visitors to National Forest System lands every 5 years (2025). Statistically sound estimates of visitation are provided every year for 20% of national forests annually. In addition to collecting information about activities, demographics, motivations, importance/satisfaction with facilities and services and their expenditures is also collected. The National Park Service's Socioeconomic Monitoring Visitor Surveys collect comprehensive, visitor data to inform park managers. This data equips management about visitors – who they are, what they expect, what they are doing and how much they are spending.

Case Study – NMS Count

In the spirit of other federal agency research efforts, Andrew *et al.* (2021) developed an innovative yet grounded approach to understanding visitor use in NMS. The research team developed the National Marine Sanctuary Counting Framework (NMS-COUNT), building off of 40 years of land and water management and monitoring methods across the federal spectrum of agencies (Burns, 2020).

The NMS-COUNT process offers an iterative framework to address this knowledge gap while involving key stakeholders throughout the process. In this way, communication among site managers, local informants, and researchers is incorporated to help develop and implement the most efficient methodology for a particular sanctuary. Using local input at individual sites provides specific detail and knowledge that can strengthen an overall indexing and/or standardization of best practice methods for obtaining visitor count data.

The NMS-COUNT process engages academics, agency scientists and managers in an iterative process of four phases (Fig. 2). In each phase, methods are analyzed for confidence in producing visitor estimates that are efficient, valid, and reliable; and they are adapted via feedback throughout each successive iteration. Iterations between the three phases ultimately result in a scientific consensus on quantitative goals for measuring visitor use at an agreed upon level of confidence.

NATIONAL MARINE SANCTUARY USE COUNTING PROCESS (NMS-COUNT)

Workflow Diagram Descriptors:

Phase 1 (Discover): Foundational research identifies possible use indicators, methods, and site attributes.

Phase 2 (Develop): A context-specific expert panel provides local insight and feedback to maximize confidence in methodologies.

Phase 3 (Design): Panel data are analyzed to identify information gaps and develop a tailored system of methodologies specific to a park unit.

Phase 4 (Determine): A field study is conducted. Results are evaluated in an objective peer review process to allow feedback and adjustment to validate/standardize methods and indicators most suitable to a unit.

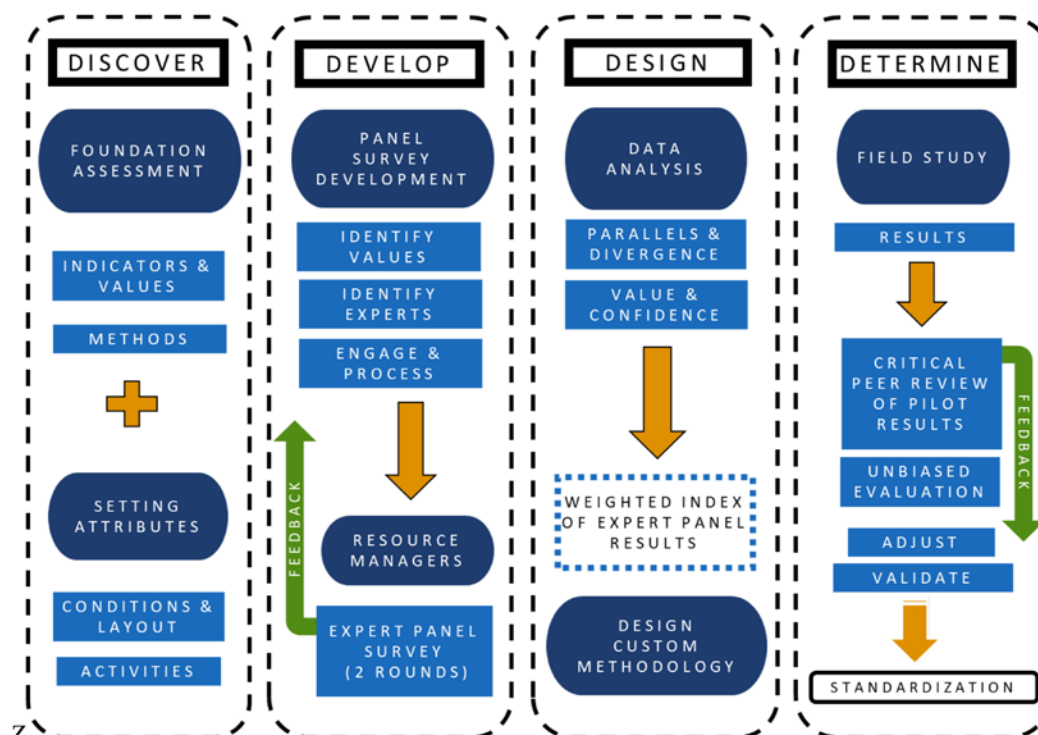


Fig. 2. Workflow diagram of the National Marine Sanctuaries Visitor Counting (NMS-COUNT) development process.

In Phase 1, researchers review the literature for a comprehensive understanding of methods in visitor sampling, estimation, and monitoring in a range of settings. From this research, potential methods and the types of data they produce are identified, as well as the advantages and disadvantages of using each method at different scales. To examine which methods and indicators of visitation are most effective in a chosen NMS, all site attributes, visitor activities, and conditions (social, biophysical, regulatory, spatial, and temporal, etc.) of the sanctuary are inventoried. Researchers then determine which methods are potentially appropriate for that particular sanctuary, at a range of confidence levels (low to high).

Phase 2 brings together various agency managers, local stakeholders, and researchers to address a set of management objectives and associated monitoring needs. In this collaborative process, all stakeholders contribute their knowledge and perspectives on legal mandates, policies and factors that influence visitation and use within a specific sanctuary. Managers and local informants participate in a series of surveys/workshops that progress from a more broadly-based questionnaire to one with more specific questions based upon prior feedback. The expert panel discusses visitor trends and challenges specific to monitoring visitation at their site. The results of each iterative survey and workshop provide detailed insight into the current state of knowledge on visitation and level of confidence in the ways this information has been obtained.

In Phase 3, data from expert panel input are analyzed and gaps are identified. A methodology is designed specific to the Sanctuary based on this analysis. In Phase 4, a field study tests the methodology and performance of measures. The results of the study and all phases are then used to validate and standardize methods, and to advance the development of visitation indicators and models.

The first two phases of the NMS-COUNT process were necessary in order to develop the survey instruments. Phase 1 consisted of a foundation assessment and the creation of a literature review (Andrew *et al.*, 2021), which helped guide the development within Phase 2. This second phase consisted of a panel survey development that engaged local resource managers and had two rounds of an expert panel survey. Expert panels are often used when specialized input and opinion is required. In Phase 3, a custom methodology was designed, which also included the design and development of the survey instruments.

Visitation estimation

In a typical year, the survey respondents reported spending an average of 31 days engaged in ocean recreation activities in FKNMS and an average of 19 days traveling offshore for any activity more than 3 miles. Overall, summertime is when visitors spent more time doing recreation activities. Visitors reported that in a typical year they visit the FKNMS 21 days on average. Visitors were asked how many years they have been participating in ocean activities. Respondents stated that they have been fishing for 28 years, diving for 14 years, snorkeling for 23 years and doing general boating for 27 years on average. When visitors were asked about the activities they do during their ocean recreation trips in the Florida Keys, visitors were more likely to spend their days doing private fishing (mean = 22 days) and general boating (mean = 24 days), while only 6 of those days were spent doing charter fishing. Boaters commonly use larger personal boats that are 21 feet and hire/charter boats that are 23 feet, and have approximately four people on average in their groups when fishing, four people when general boating, four when snorkeling and three when diving in FKNMS. There were 24.5% of the visitors that go fishing in inshore open water (0–3 miles from shore), while only 1.6% go diving and 4.5% snorkeling in this type of site. Less than one-quarter (20.6%) of the visitors go fishing in offshore (3–200 miles) open water (Andrew *et al.*, 2021).

Expenditures

Respondents were asked to select the amount of money they spent in each activity for a *single trip* in Upper Florida Keys (Table 1). The results showed that visitors spent on average US\$260 (United States Dollars) on fishing and \$167 on general boating, approximately \$107 diving and \$66 on snorkeling. The respondents reported the estimated total individual spending of their group on a typical visit/trip to the Florida Keys in different locations. The highest average amount of expenditures was in the Islamorada/Upper Matecumbe Key area with \$690. Key Largo had an average expenditure of \$297 and visitors also reported they spent on average \$375 in other locations within the Upper Keys. Survey respondents were asked how much money in total they would *individually* spend on a typical trip to the Florida Keys.

Visitors were also asked to enter the estimated individual expenditures in different types of services. Lodging (\$869.21), food at restaurants (\$405.71), and fees for charter fishing (\$398.01) are the categories with the highest averages of expenditure for a typical visit to the Florida Keys. Regarding expenditures segmented by seasons, the results showed that the average amount of expenditures that visitors spent during the summer was \$1,124.39, while fall (\$670.01) was considered the season when visitors spent less money during their trip in the Florida Keys.

The findings of this specific case study show the importance of understanding not only visitor perceptions of their experience and the recreation setting but also their economic expenditures. This allows us to understand where people spend various amounts of both money and time, and helps to build a typology of use in a given setting. Several papers have been produced using the data collected from this effort, with several more in review (Gazal *et al.*, 2022; Burns *et al.*, 2024).

Providing Value to the American Public

The NMSA authorizes NOAA to designate as NMS areas of the marine environment that are of special national (and, in some cases, international) significance due to the area's "conservation, recreational, ecological, historical, scientific, cultural, archaeological, educational, or esthetic qualities," "communities of living marine resources," or "resource or human-use values." 16 U.S.C. 1433(a). Importantly, the NMSA mandates that NOAA "conduct, support, or coordinate research, monitoring, evaluation, and education programs" and specifically authorizes NOAA to conduct "environmental and socioeconomic assessment[s]" to fulfill that mandate. 16 U.S.C. 1440(b)(1).

The Expanding Public Lands Outdoor Recreation Experiences (EXPLORE) Act, 2025, recognizes the importance of this data. In this Act, "Congress declares that it is the policy of the Federal Government to foster and encourage recreation on Federal recreational lands and waters, to the extent consistent with the laws applicable to specific

Table 1. Expenditures in Florida Keys from survey responses across activities, expenditure types, locations, and seasons.

On a typical trip for the following activities, please indicate the total amount of expenditures you make on average for a single trip to Florida Keys National Marine Sanctuary		
	Mean (\$)	Frequency
\$ Fishing	260.11	348
\$ General Boating	166.74	280
\$ SCUBA Diving	106.71	213
\$ Other Activities	74.98	142
\$ Snorkeling	65.64	256
Please enter the estimated individual expenditures you make in Florida Keys National Marine Sanctuary over the entirety of a typical visit or trip		
\$ Lodging (hotel, condo rental, camping, etc.)	869.21	253
\$ Food at restaurants	405.71	262
\$ Fees for charter fishing	398.01	178
\$ Local fuel expenses (gas/diesel)	305.30	265
\$ Food at grocery stores	287.65	258
\$ Equipment for personal/private recreation (e.g. fishing/diving gear, etc.)	225.04	228
\$ Sightseeing and entertainment (recreation activities, tours, excursions)	183.54	192
\$ Gift shop items/souvenirs	162.45	202
\$ Fees for charter diving/snorkeling	131.43	150
\$ Local automobile transportation (Uber, taxi, rental car, etc.)	107.06	172
\$ Other expenses	101.30	126
Enter the estimated total individual spending of your group on a typical visit/trip to the upper Florida Keys National Marine Sanctuary in the following areas		
\$ Islamorada/Upper Matecumbe Key	690.12	159
\$ Other Location	374.67	108
\$ Key Largo	296.68	146
\$ Tavernier/Plantation Key	212.36	125
\$ North Key Largo/Old Rhodes Key	190.40	128
In a typical year, estimate your total spending on Florida Keys National Marine Sanctuary ocean recreation for each season		
\$ Winter (Dec–Feb)	1909.37	173
\$ Summer (Jun–Aug)	1124.39	165
\$ Spring (Mar–May)	790.85	156
\$ Fall (Sep–Nov)	670.01	136
Approximately how much would you individually spend (\$ in total) on a typical trip to Florida Keys National Marine Sanctuary?		
1 Typical trip to Florida Keys total cost	1744.54	201
2 If no trip, estimate of what a typical trip to Florida Keys would cost	1083.04	107

areas of Federal recreational lands and waters, including multiple-use mandates and land management planning requirements” (EXPLORE Act, 2025). Section 133 explicitly states the “Secretaries shall seek to capture comprehensive recreation use data to better understand and inform decision making by the Secretaries.” This data may be used to support small businesses applying for loans to expand, damage assessment of disasters that disrupt human use and recreation, congressional planning and inform infrastructure needs in and around these special places. The applications of this data create value to the American people. This list below is not exclusive, but does provide examples of the ways visitor use data provides benefits to the American public.

1. Understanding both importance and satisfaction of users, managers may implement programs to improve the user experience, enhancing the utility these unique settings provide to people (Leeworthy *et al.*, 2015b; Schwarzmenn and Shea, 2020).
2. Second, many federal lands and waters have visitor centers that provide educational experiences to the American people. Given people have limited resources, and time is one of those, the fact that tens of thousands of people chose to visit the Eco-Discovery Center of Florida Keys National Marine Sanctuary or the Great Lakes Maritime Heritage Center of Thunder Bay National Marine Sanctuary every year, reveals that people derive value from experiencing hands-on exhibits and learning about these places (Schwarzmenn *et al.*, 2020a, b).
3. Information asymmetry is a market failure, resulting in one party having more information than the other, and may result in an inefficient allocation of resources. When complete and accurate information is not

used to allocate funds, the social efficient level of protection to ensure an optimal supply of recreational opportunities may not be reached. (Inefficient allocations may result in too little or too much space being reserved for outdoor recreation).

4. Federal lands and waters are public goods (and may be open-access resources). Public goods are often undersupplied by private markets. Due to the challenge of excluding users, it is not profitable to provide these goods and services. Free-riders can simply enter the area and benefit from the resources without paying for the services being provided. However, for the government to provide the quantity and quality of federal lands and waters understanding uses and intensities is imperative.
5. Monitoring of public lands and waters also provides management with the information necessary to ensure users are safe by providing law enforcement and public safety services. For example, the National Park Service has Search and Rescue Teams to help distressed users. In January 2025, Park Rangers rescued a stranded hiker by scaling a steep, loose slope in California's Death Valley (NPS, 2025). Knowing peak times and seasons for visitation helps to staff accordingly.
6. Occasionally, human use harms public resources. The Deepwater Horizon Oil Spill of 2010 resulted in a settlement of BP paying up to \$8.8 billion for restoration (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016). The damage assessment and settlement amount took into account lost recreational uses, including 16,857,116 user days of boating, fishing and beach going within and along the Gulf of America.
7. Visitor use also supports management in meeting the goals of ocean conservation and stewardship. Understanding recreational demand for specific spatial locations in the water, allows managers to install buoys and monitor changing conditions of resources. These buoys help to keep users safe, protect resources from anchor damage and concentrate recreational use away from commercial uses, such as commercial fishing, shipping and ocean exploration.

The data ONMS would collect from the socio-economic research and monitoring would provide NOAA and ONMS leadership, local and state governments, and small businesses with visitor use information in order to make informed decisions regarding budgets, policy, infrastructure, education, research, safety of users and enforcement. The data would be used to continue to support local communities and successfully manage national marine sanctuaries, marine monuments and marine resources. Additionally, the data would be provided to the public, including sanctuary communities, small businesses and industry.

Sanctuary Visitation Program

The Visitation Program would be based on primary and secondary data, and address many of the limitations of past efforts that only use one source of data. Although the primary tool of a national marine sanctuary visitor use monitoring program would be collecting data directly from users via surveys, alternative data sources and collection techniques are needed to elevate the platform and resulting estimates. The following data would be used:

1. Visitor surveys – primary data collection from users
2. Service operators – data about the location and number of passengers on for-hire trips
3. Direct observations through on-site observers and remote observations.
4. Collaborator counts – data from other entities.
5. Volunteered geographic information (VGI) – created by internet users such as Twitter, iBird, etc.
6. Acoustic monitoring – underwater hydrophones
7. Mobile device locations – geospatial data

NOAA's ONMS plans to develop three related surveys to collect relevant data from users of national marine sanctuaries. Two surveys would be developed for data collection from individual recreationalists. One survey would focus on their importance/satisfaction, motivations and attitudes toward management, the second would focus on expenditures. Both surveys would collect data about the activities respondents engaged in, the length of their stay, where they stayed and characteristics of their travel group. The third component would be similar to work done in SBNMS that collected data from operators about the number of trips, number of passengers and percentage of trips in the sanctuary and general attitude and perception questions towards the sanctuary and sanctuary management.

Additionally, observational data will be used. Through citizen science and leveraging Americans who volunteer to support the sanctuary mission, observational data of recreationalists may be recorded. This approach requires citizen scientists to be trained to identify transects and then the volunteers walk the transects and record the recreational activities they observe users doing.

Secondary data may also be used to inform visitor counts, and possibly provide more comprehensive visitor use data. Secondary data may be divided into two categories. The first, is survey data collected by those outside

of the agency that may include more robust data such as activities completed, geospatial location, importance/satisfaction and/or expenditure data. The second is providing data sets that provide counts of use by location. An example of secondary data collected by partners is survey efforts conducted by Ecotrust and the National Marine Sanctuary Foundation. In 2013, Ecotrust collected data about non-consumptive recreation to provide socio-economic monitoring of MPAs in the North Central California Region (Chen *et al.*, 2013). ONMS was able to obtain the data and documentation from Ecotrust and produce sanctuary specific reports (Leeworthy *et al.*, 2015a).

Other secondary data may also provide information on the locations where people access NMS and the locations that experience heavier use. Collecting use data from existing access points (like state parks, marinas, overlooks) along coastlines may help to inform sampling design for surveys, and provide information to managers about where concentrations of people exist.

As discussed in Andrew *et al.* (2021), there are other technologies that may be used to provide estimates of visitors or detect presence of vessels. Technologies used in this report include volunteered geographic location data, automated information systems (AIS) (required on all domestic vessels of more than 65 feet engaged in commercial use such as fishing or charter operations) and hydrophone acoustic data. Each has strengths and weaknesses. For example, social media posts may provide information on what people are doing and their satisfaction, but it is not a random sample and social media is not used by all users. AIS is only required for larger vessels, although some smaller recreational vessels use the technology for safety reasons. The data set is able to provide counts of vessels by size class, but does not provide information on the number of passengers. Despite this, the data set largely misses small recreational vessels. Hydrophone data is only able to record vessel noises, so although the type of engine may be identified, data about what the vessel is doing (transiting through the sanctuary, fishing, non-consumptive recreation) or the number of passengers is absent (McKenna *et al.*, 2024).

Other datasets under consideration by ONMS include mobile device location, and buoy data. Mobile device data allows researchers to monitor the number of people (so long as they have a cell phone) present at a location, but does not reveal what they are doing, expenditures or their satisfaction (Woodward and Ahmadiani, 2025). Buoy data may provide images of users, but the count data is restricted to the visibility and site line of the buoy.

The previous data sets, despite their limitations, provide valuable information to researchers. Information provided includes counts of users and presence of vessels. Presence of vessels when combined with a multiplier or estimate of the number of people per vessel may inform researchers about the total number of users. Also, most of the secondary datasets provide specific geospatial location data of use, allowing researchers to understand presence and intensity of use around specific geographic locations or features.

Conclusions

Comprehensive visitor use data is imperative to managing healthy, multi-use natural places. In addition to meeting Congressional mandates of the EXPLORE Act and the NMSA, comprehensive data may be used to inform the value of these special places provided by recreation and tourism use. Further, by understanding where users congregate, resources such as buoys and signage may be provided to provide safe access that minimizes impacts to resources while supporting alternative uses in locations away from recreationalists. The plans laid out in this case study present a proposed path forward to develop a comprehensive visitor use management program for NOAA's Office of National Marine Sanctuaries.

Developing a visitor monitoring program for an agency is a complex process that can be accomplished by understanding previous research and replicating and extending previous research methods. With chronic underfunding of socio-economic efforts an agency cannot afford to "reinvent the wheel," and must hold true to established methods of designing and implementing socio-economic research studies. The NOAA ONMS visitor monitoring effort also places a great emphasis on reporting research findings to field-based resource leaders and staff. Data are typically presented using technology, such as ARC-GIS, where management recommendations are laid out temporally and spatially, based on previous research, specific study findings, and the realities of any given sanctuary. Another overarching foundation of the NOAA ONMS visitor monitoring effort has been to ensure that the research methods used can be replicable across as many sanctuary settings as possible, with the goal of developing a system-wide visitor monitoring program.

Conflict of interest

The authors have no conflicts of interest to declare.

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