



Marine Recreational Information Program Regional Implementation Plan for the U.S. Caribbean Region



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Overview

Effective management of marine fisheries in the U.S. Caribbean (Puerto Rico and the United States Virgin Islands (USVI)) depends on the acquisition of accurate and timely data regarding the amount of effort expended by fishers, and the type and quantity of catch obtained by those fishers as a result of that effort. A comprehensive fishery management program requires knowledge of all participating fishers, including those fishing for commercial purposes, those fishing for recreation, and those fishing to put food on the table (i.e., subsistence fishers). In the Caribbean region, those fishing ‘sectors’ often blend together, such that on a single fishing trip a fisher may sell some of the resultant catch, give some to boat mates and friends, and take some home to share with their family, creating substantial challenges for those attempting to accurately characterize the catch. In addition, funding constraints preclude collecting a complete census of harvest across that intermingled spectrum of fishers, so data collection needs must be prioritized and available alternatives balanced against each other within the context of cost.

This Regional Implementation Plan (RIP) is designed to identify priority actions that need to be taken to enhance understanding and management of marine recreational fishing activities in state and federal waters surrounding Puerto Rico and the USVI. The RIP was developed by a Regional Implementation Plan Team composed of scientists, citizens, and government representatives knowledgeable of recreational fishing activities, data collection challenges, and analytical needs in the U.S. Caribbean region. Their efforts resulted in the identification of three prioritized program components that must be developed or enhanced, ranked according to greatest need in the region. The first priority is to develop a governance structure that will ensure consistent, accurate, and stable staff administration and data collection/management outcomes. Next, design and implement a marine recreational data collection program for the USVI that is attuned to, and functions within, the unique character of that island group. Finally, refine the existing Puerto Rico Marine Recreational Information Program (MRIP) to ensure that, to the greatest degree practicable, recreational harvest data are being collected from all fishing modes and for all species important to management. Each of these priority needs is more fully discussed in the paragraphs that follow. Appendices are included to provide the background information supporting the choice of each priority and to describe approaches that have been or could be used to address each priority.

Priorities

Develop a Governance Structure

The greatest challenge to a successful recreational data collection program in the U.S. Caribbean region has been and continues to be the lack of a governance structure that effectively supports and manages human resources, that ensures data are collected according to predefined sampling timelines and locations, and that provides quality data management

and delivery. To various degrees, depending on the island and the timeframe, one or more of those components has been lacking in the U.S. Caribbean, resulting in incomplete or inaccurate data that fail to achieve an adequate level of scientific rigor. These data voids constrain the applicability of the information within both a scientific and a management context, and therefore must be minimized to the greatest possible degree. Proper governance is an essential first step to achieving that goal.

Governance Objectives

- 1) Establish a regional Steering Committee to guide all subsequent steps.
- 2) Create a durable, overarching governance structure.
- 3) Develop a centralized personnel management mechanism.
- 4) Establish a regional data management portal.

Implementation of a Marine Recreational Fishery Statistics Survey (MRFSS, the precursor to MRIP) in Puerto Rico occurred in late 1999, funded in part by the U.S. Fish and Wildlife Service's Sportfish Restoration Program. Field work began in 2000, staffed by employees of Puerto Rico's Department of Natural and Environmental Resources (DNER). Shortly thereafter, a consulting company was contracted to increase the number of interviewers. Over the next few years, the turnover rate for both the project lead and interviewers was high, which resulted in issues with on-time reporting, data quality, and communication with the entity supervising data management for Puerto Rico. In 2009, the MRFSS dockside angler interview program was modified to follow the Gulf States Marine Fisheries Commission's GulfFIN (Fisheries Information Network) model, with Puerto Rico providing a program manager and field samplers to cover the assignment schedules for the entire island.

In subsequent years, the program ran into difficulties keeping qualified field samplers in place, and the GulfFIN model was abandoned in 2013. Since then, contractors have been hired by NOAA to conduct recreational data collection, and the MRFSS program evolved into MRIP. The MRIP revised dockside survey approach implemented many changes and improvements to the Puerto Rico recreational data collection program that were designed to remove potential biases from the previous design. At the same time, a contract was established to extend the Atlantic Access Point Angler Intercept Survey (APAIS) to Puerto Rico and to maintain a staff of 15, including one on-island field supervisor who managed the field staff while also ensuring program quality. Under the MRIP arrangement, DNER staff assisted with training new personnel and guiding the contracting company in collecting recreational catch and effort data, but their involvement was otherwise limited due to logistic and communications constraints.

Particularly with respect to DNER participation, recreational data collection has been compromised by frequent and extensive holidays, intercept timing particularly at night, quality of data and quality of interviewers, unpredictable complications with DNER's ability to hire and retain qualified personnel, and the continuing economic crisis on the island. However, an inclusive arrangement, with active involvement of DNER personnel as project leaders for NOAA contracted interviewers, worked relatively well for many years. Although DNER presently does

not participate in the Puerto Rico MRIP, the Department continues to collect data on all fishing modes at tournaments around the island, including Highly Migratory Species, dolphin/wahoo, shoreline, spearfishing, etc. The agency also maintains a small group of interviewers who collect fish morphometric data and perform interviews primarily on the shoreline and private boat fishing modes.

In the USVI, problems with administrative governance were even more substantial and problematic. Initial federal attempts to collect recreational catch and effort data were made from 1979 to 1981, when NOAA conducted data collection in the USVI following the MRFSS protocol. However, that effort was discontinued in 1982 due to a lack of sufficient funds. In 1999, NOAA and the USVI Department of Planning and Natural Resources (DPNR) reinitiated efforts to collect recreational fisheries data. Data collection occurred in 2000, but was again discontinued in 2001 due to difficulties with managing the program, hiring competent staff, and retaining those staff. Staff retention and compensation has been particularly problematic, reflecting the typically low number of recreational fisher intercepts on the islands of the USVI and resultant part-time nature of the job. Employees are simply not able to earn enough money to stick around (B. Kojis, pers. comm.). This lack of intra-island opportunities for collecting effort and catch information will influence the design of an effective U.S. Caribbean governance structure.

Design and Implement USVI MRIP

Establishing an operable governance structure is a necessary precursor to tackling the next priority for U.S. Caribbean recreational data collection, which is to design and implement MRIP in the USVI. Although some recreational tournament data are being collected by the DPNR, a comprehensive recreational data collection program is not in operation on any of the islands that comprise the USVI archipelago. This data deficiency needs to be rectified, regardless of the actual level of recreational fishing that occurs on any of those islands, to ensure federal fishery management obligations are met.

USVI MRIP Objectives

- 1) Develop a Fishing Effort Survey (FES) frame based on verified contact information for each recreational fishing mode (private vessel, for-hire, shoreline, and tournament).
- 2) Develop an Access Point Angler Intercept Survey (APAIS) register of public fishing sites.
- 3) Develop an angler intercept survey design that provides adequate coverage, accuracy, and consistency within the context of sampler security.
- 4) Develop tournament sampling methodology to ensure statistically robust sampling.
- 5) As appropriate, include ecologically and economically important invertebrate species such as queen conch and spiny lobster.

The lack of information on non-commercial (i.e., recreational and subsistence) fishing activities in the USVI creates a challenge for managers charged with maintaining healthy and sustainable fish stocks. That non-commercial sector comprises an essentially unknown (e.g., Goedeke et al., 2016) portion of the USVI fishing community. Obtaining recreational effort and catch data would benefit fisheries management for the individual islands of the USVI, and for the U.S. Caribbean region as a whole, by providing a context for understanding the contribution of USVI recreational fishing activities to the culture and economy of the region (Clements et al., 2016).

As discussed in the Appendix, the overriding priority for the USVI is to establish a program management structure that provides the framework within which consistent, quality data can be obtained. The first requirement of this management structure is that it solve problems emanating from the diffuse, multi-island nature of the USVI, the lack of need for full-time sampling teams on each island, and the difficulty associated with retaining quality personnel while offering them only part-time employment. Experience obtained from the 1999-2000 USVI MRFSS sampling effort clearly revealed that the tenure of part-time employees is unacceptably short, and that filling vacancies can be a time-consuming process. Vacant sampling positions invariably result in missed sampling opportunities, greatly reducing the statistical applicability of the data that are obtained.

Then, a sampling frame must be established that accurately and efficiently identifies who is fishing and the level of effort invested in recreational fishing activities. While other regions can rely on databases generated from saltwater recreational fishing licenses and successful return rates from mail or telephone surveys, those methods are of limited applicability in the USVI. A recreational fishing license does not exist in the USVI, and enrollment in the National Saltwater Angler Registry (NSAR) has been minimal. Further complicating the establishment of a statistically valid sampling frame, many residents do not have individual mailboxes, limiting the effectiveness of a mail survey approach, and a telephone survey approach is equally inadequate due to a lack of landlines and associated directory listings. There is also a strong contingent of non-resident fishers, including tourists and seasonal residents, for whom even boater registration data are not available.

In conjunction with the effort sampling frame, an efficient angler intercepts scheme must be devised. A recent study by Goedeke et al. (2016) discovered that shoreline fishers are only infrequently encountered during creel surveys, resulting in a very poor accounting of the type and amount of catch realized by this fishing mode. Apparently, there are few primary fishing access points and many shoreline areas in the USVI are private or present security risks for the samplers. Conducting intercept surveys for other fishing modes in the USVI also can be challenging due to the diffuse nature of fishing and vessel launching activities. Thus, a register of recreational fishing access points must be developed, and from that an intercept survey sample design developed that will achieve MRIP statistical requirements of a percent standard error ≤ 20 percent. This intercept survey design must adequately account for activity in all fishing modes, including private vessel, shoreline, tournament, and for-hire.

The importance of collecting data on recreational harvest of various invertebrate species, including but not limited to spiny lobster and queen conch, needs to be assessed. Invertebrates historically have not been included in the MRFSS/MRIP sampling program, but many of these species are of major importance to the U.S. Caribbean fishing economy. Their place in USVI recreational fishing activities is poorly known. Initially, a pilot study assessing their role in the USVI recreational fishery should be conducted.

Refine Puerto Rico MRIP

Once a U.S. Caribbean MRIP governance structure is established, and following implementation of MRIP in the USVI, the existing Puerto Rico MRIP should be revised as appropriate to resolve issues with the type, quality, and consistency of data being collected. A recreational fishing data collection program has been ongoing in Puerto Rico since 1999, and the resultant data are being applied to fisheries management in federal waters surrounding Puerto Rico, but as discussed in the Appendix, there is a need to strengthen oversight and administration of this program. Additionally, administration of the Puerto Rico program must be conducted in concert with administration of a USVI program in order to maximize cost efficiency program stability.

Puerto Rico MRIP Objectives

- 1) Replace the current Coastal Household Telephone Survey (CHTS) methodology with a Fishing Effort Survey (FES) methodology for obtaining effort information.
- 2) Ascertain the importance of alternative shoreline fishing methods, particularly kayak, jet ski, snorkel, and SCUBA, to the island's recreational harvest.
- 3) Modify tournament sampling methodology to ensure statistically robust sampling.
- 4) As appropriate, include ecologically and economically important invertebrate species such as queen conch and spiny lobster.

The Puerto Rico MRIP has maintained continuous data collection since 1999, but some modifications to the program are needed to ensure comprehensive and accurate data collection continues into the future. Evolving technologies and changing approaches to recreational fishing require a responsive and adaptive sampling strategy. In particular, as users move away from landline telephones, the CHTS approach becomes less effective (Brick et al., 2012). Thus, the greatest need in the Puerto Rico MRIP program is a revision of the effort sampling survey to better estimate fishing pressure within this changing technological and social environment. Although a recreational fishing license program has been designed and is ready for implementation (Lilyestrom, pers. comm.), actual implementation continues to be delayed. In the meantime, a concerted education and outreach effort should be made to convince recreational fishers of the need and value of signing on to the NSAR. Information obtained from the NSAR, and even moreso from a recreational fishing license, would substantially inform effort survey design.

Next, it may be necessary to sample new fishing modes, including for example kayak, jet ski, and snorkel/SCUBA fishers who depart from and return to the shore. For example, kayak fishers are listed in the private vessel mode, but they often operate in the same manner as shoreline fishers. Tournament fishing is a major component of Puerto Rico's recreational sector, but sampling such events is complicated by the spatially and temporally unpredictable nature of some of these events. In the case of both new and tournament fishing mode data collection, recent insights into the current Puerto Rico MRIP have highlighted the need to better define fishing modes to avoid duplicating or omitting valuable information. Potential modification may be as simple as a sampling location adjustment or, depending on context, may require a more substantive reconsideration of the composition of each fishing mode.

As in the USVI, there is a need to obtain data on recreational harvest of various invertebrate species such as spiny lobster and queen conch that historically have not been included in the MRFSS/MRIP sampling program but that are of major importance in the U.S. Caribbean. As noted for the USVI, current MRIP data collection does not include invertebrate species, although spiny lobster and queen conch support important commercial fisheries in Puerto Rico and both species are recreationally harvested (Valle-Esquivel and Trumble, 2016). Those authors investigated recreational harvest of queen conch and spiny lobster in Puerto Rico, but were unable to draw strong conclusions regarding effort or harvest due to a low number of successful fisher intercepts. Thus, developing an appropriate sample design for effort and creel surveys will be a necessary precursor to obtaining a better understanding of the importance and need for including invertebrates in Puerto Rico's recreational harvest sampling program. Following achievement of that survey design goal, a pilot study to understand the role of invertebrates to recreational fishers can be conducted in accord with that survey design.

Appendix: Background Information

Team Composition

Developing a Regional Implementation Plan for the U.S. Caribbean was a team effort, requiring input from federal, local, and private subject matter experts to obtain the information necessary to design a comprehensive and effective implementation plan. The MRIP RIP for the U.S. Caribbean included the following participants:

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Priorities Development

Components that comprise a successful Regional Implementation Plan (RIP) were reviewed and assessed for the Caribbean region and three priorities were identified and ranked according to greatest need: 1) establish a regional governance structure; 2) establish a marine recreational information program in the USVI; and 3) refine the existing Puerto Rico marine recreational information program. As this RIP is developed and improved additional data needs may arise

that take precedence and the plan priorities will shift, but at this time the three listed actions are of utmost importance and are further developed below.

Establish a Regional Governance Structure

The largest hurdle to data collection in the U.S. Caribbean is lack of effective regional governance, without which marine recreational information programs (MRIP) either breakdown or suffer continuous setbacks.

It is recommended to appoint a Steering Committee and design a working administrative structure. The Steering Committee would be tasked with overseeing the program and would include representatives from NOAA's Office of Science and Technology, Southeast Regional Office, Southeast Fisheries Science Center, and Highly Migratory Species office, along with representatives from the governments of Puerto Rico and the USVI, and the Caribbean Fisheries Management Council. In addition to program administration, members of the Steering Committee would research previous data collection projects, identify preferred methodologies, define data and research needs, and recommend the most efficient and effective data collection strategies for Puerto Rico and the USVI.

Previous challenges to establish a Marine Recreational Information Program (MRIP) in the USVI stemmed from a flawed administrative construct. As a result, previous effort never persisted for more than a few years. Similarly, recent and ongoing challenges to the Puerto Rico MRIP result from administrative challenges, including difficulty finding, training, retaining and effectively supervising quality personnel. Until a functional regional governance structure is in place, one that encompasses all islands in the U.S. Caribbean, any other needs are of lesser importance.

Implementation of MRFSS in Puerto Rico was initiated in late 1999, funded in part by the U.S. Fish and Wildlife Service's Sportfish Restoration (SFR) program. Field work began in 2000, staffed by Puerto Rico DNER. Shortly thereafter, Macro International Inc. was contracted to increase the number of interviewers. Over the next few years, turnover rates for both the project lead and interviewers were high, which resulted in issues with on-time reporting, data quality, and communication with the entity supervising data management for Puerto Rico.

In 2009, the MRFSS dockside angler interview program was modified to follow the Gulf of Mexico GulfFIN model, with Puerto Rico providing a program manager and field samplers to cover the assignment schedules for the entire island. That structure encountered difficulties as well, particularly keeping qualified field samplers in place. As a result, the GulfFIN model was abandoned in 2013.

Since 2013, contractors have been hired by NOAA and the MRFSS program evolved into MRIP. The MRIP revised dockside survey approach implemented many changes and improvements to the Puerto Rico recreational data collection program that were designed to remove potential

biases from the previous design. At the same time, a contract was established to extend the Atlantic APAIS to Puerto Rico. This approach involved a staff of 15 including one on-island supervisor to manage the field staff. The supervisor also was responsible for conducting quality control on all field operations, including data review and unannounced field visits to assignment sites, and to report to senior project staff on the mainland United States. Under this new MRIP arrangement in Puerto Rico, DNER continued to assist with training new personnel, sharing experience, and guiding the new contracting company in collecting recreational catch and effort data. Otherwise, DNER involvement is limited due to issues of logistics and communications.

Historically, recreational data collection, particularly with respect to DNER participation, has been complicated by frequent and extensive holidays, intercept timing particularly at night, quality of data and quality of interviewers, unpredictable complications with DNER's ability to hire and retain qualified personnel, and the continuing economic crisis on the island. An inclusive arrangement, with active DNER involvement as project leaders for NOAA contracted interviewers, worked relatively well in the past and should serve as a model going forward.

Although DNER presently does not participate in the Puerto Rico MRIP, the Department continues to collect data on all modes at tournaments around the island, including HMS, dolphin/wahoo, shoreline, spearfishing, etc. They also maintain a small group of interviewers who collect fish morphometric data and interview shoreline, private vessel, and tournament participants with an emphasis on shoreline and private vessel modes.

Establish USVI Marine Recreational Information Program

The second priority recommended in this RIP is to establish a comprehensive recreational data collection program in the USVI. At present, an MRIP recreational data collection program is not operational in the USVI. Initial federal attempts to collect recreational catch and effort data were made from 1979 to 1981, when NOAA conducted data collection in the USVI as part of the Marine Recreational Fisheries Statistics Survey (MRFSS). However, this effort was discontinued in 1982 due to a lack of sufficient funds. In 1999, NOAA and the USVI Department of Planning and Natural Resources reinitiated efforts to collect recreational fisheries data. Data collection occurred in 2000, but was discontinued in 2001 due to logistical problems.

To accomplish this goal, the first step will entail designing a sampling frame that accurately accounts for non-commercial fishing participants around the islands (including full-time resident recreational and artisanal fishers along with seasonal visitors and tourists), that can distinguish between the many fishing sectors (commercial, recreational, private vessel, for-hire, charter, shoreline, etc.) and that will determine the best methods for contacting those fishers (mail, telephone, email, etc.). Once the frame is established, then targeted fishing and landing locations for each island need to be identified and a sampling schedule and frequency generated. Next, the desired catch parameters (count, weight, size, etc.) should be established and selected based on a weighted design that ensures the most useful information is collected. Finally, since local participation and ownership is paramount to program success, effective

reporting and outreach methods should be tested and refined. Ideally those methods would align with the methods used in the Puerto Rico MRIP and translatable to the entire Caribbean region.

Historical Review of Sampling Efforts (Munoz et al., 2013a)

Recreational fishing is important for USVI locals, and is a popular tourist activity primarily for the charter and private vessel modes. While some of the non-game species (e.g., queen conch and spiny lobster) are targeted, most species of fish in the estuarine, inshore, and open water areas are harvested by recreational fishers. There are no state or federal recreational fishing licenses requirements, except for shrimp on St. Croix and bait and line fishing in the Great St. James Marine Reserve, St. Thomas.

Three fishing subsectors are well defined in the USVI, including offshore pelagic and deepwater snapper, inshore pelagic, and reef fish, and each targets a different suite of species. Deep water (≥ 2000 meters) is accessible within 400 meters of the coast in St. Croix and constitutes a good location for fishing large pelagic gamefish such as blue marlin, white marlin, tuna, dolphin and wahoo. Dolphin and wahoo are two of the most sought-after species for USVI recreational anglers. The inshore pelagic species include great barracuda, cero mackerel, little tunny and numerous jack species. Reef fish species include snappers, groupers, grunt, triggerfish, and squirrelfish.

An HMS angling permit or HMS Charter/Headboat permit is required for highly migratory species (HMS – billfishes, tunas, swordfish, and sharks) in federal waters and all vessels located in USVI territorial waters for more than 60 days are required to be registered in the USVI. These vessels use their documentation number as their territorial registration number and must display the USVI registration sticker on the port side of the vessel. Historically, over 60% of the recreational boats fishing in the USVI during marlin season originate from the U.S. mainland, Puerto Rico, the Dominican Republic, the Bahamas, or the British Virgin Islands with the remainder owned by local residents. There is a mandatory internet/telephone reporting system in the USVI for all billfishes, swordfish, and bluefin tuna. Although bluefin tuna are generally not found in territorial or federal waters around the USVI, this system provides information on any landing of bluefin tuna, non-tournament billfish, and swordfish within 24 hours of landing. However, information regarding discards (live and dead) and bycatch is not currently collected in the HMS reports.

Fishing activity in the USVI has evolved through time and newly targeted species and types of gears (e.g., SCUBA) have emerged. Some fishers use several types of gears during the same trip, making it difficult to separate the effort corresponding to each gear type. Also, the coastal geography of the islands makes it challenging to implement standard MRIP data collection procedures. For example, in St. Croix there are many open spaces that provide easy access to the water for fishing purposes, which creates a challenge for field interviewers and survey planning. Similar sampling challenges occur for marinas and private sites due to access issues

and for night fishing due to safety issues, which results in under-coverage of certain angler populations.

The lack of information for non-commercial fishing, which includes recreational and subsistence fishing activities, from the USVI creates a challenge for managers charged with maintaining healthy and robust fish stocks in the Caribbean region. That non-commercial sector comprises a large portion of the fishing in the USVI, and obtaining effort and catch would benefit fisheries management for the individual islands as well as the U.S. Caribbean region.

As illustrated from previous attempts to implement and maintain an MRIP in the USVI, several challenges are associated with collecting data among the three islands. Hardest to overcome is the difficulty in designing a sampling frame, i.e. who is fishing and the best way to contact (survey) them? While other regions can rely on databases generated from saltwater or recreational fishing licenses and successful return rates from mail or telephone surveys, those methods aren't as easily adaptable to the Caribbean region. Additionally, the coastal geography of the islands makes it challenging to implement standard data collections techniques. What's more, engaging fisher participation in a culture that craves independence can be difficult.

Several issues were identified in previous recreational data collection efforts as possible factors that might influence the success of future recreational fishery data collection efforts in the USVI. Primary among these issues was the difficulty of recruiting, hiring and retaining field interviewers. There is a strong need for better selection, training and compensation of field interviewers. Also, a number of problems were discovered in the frames used to collect effort and catch data. For example, previous intercept sampling designs failed to account for subsistence fishing. Additionally, an update of the USVI site registry is needed, including more comprehensive and accurate pressure estimates for each wave to increase sampling efficiency and productivity. In the past, the MRFSS program selected many access sites with very low pressure resulting in few intercepts. To obtain better estimates of effort (fisher-days), improved frames (e.g., better data on telephone ownership, household distribution and composition) are needed for the telephone portion of the MRFSS.

For the USVI, the high volume of fishing by visitors (nonresidents) makes it necessary to separate effort and catch by resident status. For visitors, intercept surveys may be the only viable approach for obtaining information. Resident surveys could use a dual-frame approach (phone and mail surveys) to improve coverage of data collection. For on-site sampling it will be necessary to include marinas and ports. For shoreline fishing, the different islands can be divided into segments of reasonable size or expected effort; marinas, boat ramps or piers can be clustered by proximity to facilitate survey coverage, while marinas or sites with high pressures can be split into sections of manageable size to ensure coverage. As with the current MRIP design used on the mainland, the intercepts can be performed during different time intervals to estimate effort at different time points. Similarly, rental and dive boats should be identified and a modified questionnaire designed for these groups. Although there are few charter boats in the USVI, it is important to include this group to assure full coverage of

recreational fishing. Data collection options for the charter boat mode include mandatory logbook submission or a sampling design that selects a random sample of weeks or trips as opposed to per trip reporting. As a quality check, charter boat site visits should be incorporated into the study design. Other options to collect mode-specific effort and catch estimates include: aerial counts of shoreline anglers and fishing vessels; using a monitoring vessel to count shoreline anglers and fishing vessels; and a combination of creel and mail surveys.

It is also critical to invest resources to improve survey participation. For example, public meetings should be scheduled, newspaper articles published explaining the need to conduct the survey, fliers posted in fishing clubs, and stakeholders and universities engaged to bring the message to different groups. To further encourage participation, incentives such as caps, T-shirts, or recreational fishing gear could be offered as a reward for participation. Focus groups should be convened to help assess the effectiveness of a mail or telephone survey.

Data collection efforts within the region should be conducted at the species level, and multi-agency efforts should be monitored to avoid double counting. Table 1 lists the many sources of catch and effort information. Methods to produce estimators using different types of data (e.g., survey data, report card data, etc.) should also be explored.

Table 1. Recreational catch and effort data collection methods that are currently used on mainland, or are new, that could be used in USVI. Bold text denotes ongoing data collection methods and plain text denotes new methods or methods that are currently used on the mainland and that could be used in the USVI.

Data Source	Data Collected	Collection Method
Fisher household address	Effort for shoreline sites, HMS Landings (?)	Mail
Fisher phone number	Effort for shoreline sites, HMS Landings (?)	Random Digit Dial (RDD)
Private vessel frame	Effort for marinas, HMS landings, visiting anglers (?)	Mail, RDD, Web survey
Coastal household phone list	Effort shoreline and private vessel	Random Digit Dial (RDD)
HMS License list	Non-tournament landings, catch, size, weight	Mail, RDD, Web survey
Tournaments	Catch, size, weight	On-site data collection
Intercept (MFRSS)	Catch, effort, biological data all modes residents and visitors	On-site data collection
Charter Logbooks	Catch, effort charter mode	On-site data collection

In contrast to the situation in Puerto Rico, in the USVI there is no immediate effort to implement a mandatory recreational fishing license system. Thus, this source of information for developing an effort sampling frame and estimating location-specific fishing pressure will not soon be available. An initiative to develop a recreational licensing program in the USVI, and a complimentary enforcement strategy, is highly recommended. As with Puerto Rico, an appropriate outreach program must be developed to maximize compliance with the license

requirement. In the meantime, the requirement to participate in the National Saltwater Angler Registry needs to be advertised and enforced.

Shoreline Angler Survey (Goedeke et al., 2016)

A roving study was conducted to collect information on non-commercial shoreline fishing on the island of St. Croix via site counts and interviews. Surveys were generally conducted by one surveyor. All non-commercial fishers were interviewed and/or counted unless they were in groups >17 in which case a subsample was obtained. The fishing activity (fishing, diving, camping, etc.) was recorded and the data analyzed to answer two specific questions: do certain shoreline activities co-occur; and is there significant spatial and temporal variation?

The roving survey was well-suited to St. Croix's open coastline and fishing was concentrated around Christiansted and on the Fredericksted fishing pier. The shoreline survey encounter rates were extremely low suggesting that shoreline fishing effort may have been overestimated in the past. The shoreline survey ended early due to the low sample sizes obtained. Both physical and legal challenges were encountered. However, the roving survey approach was considered by surveyors to be the best approach to obtain catch data for the shoreline recreational fishing mode although an effective program will require additional sampling capacity. Remote sensing or access technology (aerial surveys, satellite imagery, beachcams or drones), in addition to or in place of roving surveyors, would enhance shoreline survey results as would surveys conducted from the water via a "bus-route" approach. Those modifications would require a larger data collection team and a full-time field staff. In light of low encounter rates, a statistically valid household survey should be considered to increase investment value.

Refine Puerto Rico Marine Recreational Information Program

Since Puerto Rico does not currently require that fishers obtain a recreational fishing license, the Steering Committee team should persuade local fishers to register with the National Saltwater Angler Registry (<https://www.countmyfish.noaa.gov/register/>) to help enhance the current sampling frame and update contact methods for those fishers. Current MRIP data collection does not include invertebrate species, although spiny lobster and queen conch comprise two major fisheries in the region, which creates a major data gap. Caribbean MRIPs should be tailored to include at minimum these two invertebrate species, and the committee should determine the best way to incorporate invertebrate data into existing surveys. Recent insights into the current Puerto Rico MRIP also highlighted the need for defining fishing sectors to avoid duplicating or omitting valuable information. For example, kayak fishers are listed in the private vessel mode, but they oftentimes operate in the same manner as shoreline fishers, so sampling methods need to be modified to increase survey success. That modification may be a simple sampling location adjustment, or depending on the number of fishers, may require a more lengthy reorganization of fishing sectors.

The Puerto Rico MRIP was established in 1999 and has been maintained through the years, albeit with a few challenges. Top program needs include: 1) an updated sampling frame to estimate fishing pressure; 2) catch and effort data for specific invertebrate species; and 3) fully defined sectors that include alternative fishing modes (i.e., kayak and jet ski). Additional priorities within those program needs were ranked (see Data Collection Prioritization section). A regional Steering Committee should be established and would be responsible for reviewing additional priorities and incorporating them into the program as necessary and appropriate.

Fishing Effort Survey (Anonymous, 2014)

The Coastal Home Telephone Survey (CHTS) is a random digit telephone survey designed to identify and interview households and household members within the designated survey area to determine if they participated in recreational saltwater fishing during the designated period. Surveys are limited to full-time occupied housing units and exclude institutional housing, seasonal residences, businesses, mobile phones, and pay phones. Sampling is maintained on a continual basis through the use of current telephone directories, reverse directories, and information from telephone companies.

The CHTS questionnaire includes a household screening to identify eligible fishing households and an angler questionnaire to collect detailed information about recent saltwater fishing trips. An interview consists of a successful contact with a household resident and enumeration of the number of household members (including zero) that participated in recreational saltwater fishing during the designated period. Currently designated reference periods are in 2-month waves, and data collection is conducted during a two-week period at the end of each wave (i.e., the last week of the wave being surveyed and the first week of the next wave). Anglers are asked to recall all recreational, saltwater fishing trips taken in the last two months (from date of interview). Respondents are asked for details on each trip, including trip dates, fishing modes, location of the fishing access site, and general area of fishing including river and estuarine saltwater cutoff points.

Other pilot studies have compared the use of a mail, rather than telephone, approach to obtain effort data. The coverage of both the mailing addresses and telephones in Puerto Rico should be examined to assess the level of coverage of all residents on the island and the cost efficiencies between mail and telephone approaches.

Representatives from Puerto Rico indicate it is likely that a mandatory recreational fishing license system will be implemented in Puerto Rico, in compliance with existing enabling legislation. This will provide an ideal frame to obtain effort estimates as well as estimates of fishing pressure (defined as the average number of fishers at the site) for different locations. MRIP pilot studies on the mainland have identified a considerable amount of fishing activity (as much as 50% of total effort) by non-licensed anglers. Enforcing the license program therefore must be a priority, and appropriate outreach programs must be developed to reduce the number of non-licensed anglers. Until that license program is fully functional, recreational

anglers need to sign on to the National Saltwater Angler Registry, and the requirement to participate in this registry needs to be enforced.

A dual frame approach (using a license frame and a randomized list of residents) has been pilot tested on the mainland and this approach may be considered if initial data indicate a group of potential anglers is missing in the license program. One list of angler information that is available to Puerto Rico DNER is the High Migratory Species (HMS) permit list. Puerto Rico could develop a dual frame approach consisting of either the license frame or the HMS permit list and a random sample of residents (phone numbers or mailing addresses). It is critical to evaluate all frames and frame combinations and remove duplicates prior to sampling.

Data from the CHTS (or its replacement) will be helpful to improve the site selection for interviewer visits. Procedures need to be established and followed to ensure that collection of basic information from the license applicant frame is as accurate as possible (e.g., checking IDs for name when the license is purchased and obtaining an accurate address with telephone number). However, anglers that do not purchase a license will not be on the list. For example, there are exemptions for some demographic groups that eliminate their obligation to possess a fishing license. Of course, anglers who refuse to purchase a license also will not be on the list.

APAIS Access Point Angler Intercept Survey

Present Status (Passerotti, pers. comm.)

The Puerto Rico angler intercept survey follows the design and management of the U.S. coastal state MRIP APAIS, with the exceptions of no registry of for-hire vessels and that no head boats presently operate in Puerto Rico. The site registry works best when reviewed and updated frequently. This is currently done by the contractor conducting the interviews, and changes are based on monthly reporting of site conditions by interviewers.

Interviews are conducted year-round at various sites across the main island of Puerto Rico. Survey site and time intervals are pre-determined based on a NOAA draw with sites chosen from a fishing location register. Angler interviews are the primary goal but are not always possible, in which case confirmed trip counts suffice. As of 2016, all anglers are intercepted at each site, regardless of fishing mode, and are pre-screened for eligibility prior to initiating the interview.

The sample draw incorporates time of day as well as site location so the selected sampling units cover the temporal and spatial extent of the population. The revised MRIP design includes sampling throughout the 24 hour period, and the contractor administering the survey since 2014 is addressing the data gaps resulting from nighttime fishing. Table 2 provides a summary of data collected from each intercept.

Table 2. Access Point Angler Intercept Survey data collected from private vessel, for-hire, and shoreline modes in the ongoing Puerto Rico MRIP data collection program. Data are collected in 2-month waves every 12-months. Reports are due 21 days after each wave.

Survey Component	Variables Collected	Other Resolution	Fate
Effort	(by angler): Boat hours (boat modes only), Fishing days in past 2 months/12 months, Gear soak hours, Home city/state/zip	Area fished, Gear type, Target	Effort, CPUE for landings
Unavailable Catch	(to lowest taxonomy): Number, Disposition	Area fished, Gear type, Target	Landings (number), Discards
Sampled Catch	(by species): Length, Individual weight, Number, Disposition	Area fished, Gear type, Target	Landings (number and weight), Discards

Suggested Enhancements (Munoz et al. 2013a; Lilyestrom, pers. comm.; Passerotti, pers. comm.)

Coverage of remote island areas (particularly Culebra and Vieques) with limited access will require construction of special primary sampling units that can be sampled during an accessible period of time. There is no evidence of unique fisheries operating in these areas, so sample allocation should be proportional to fishing pressures (anglers or catch). Following data review, modification of the sample design may be possible, with remote areas sampled less frequently.

It would be helpful to conduct angler focus group meetings to investigate how to best obtain fishing access site information. Similarly, it would be useful to compare whether the use of maps or just a description of the location is more suitable. Closed sites and very low pressure sites result in low data collection productivity in the current MRIP survey. There is a need to obtain accurate fishing pressure information based on catch rather than effort to identify low, medium and high pressure sites by month, type of day, and time of day combinations.

In Puerto Rico, shoreline fishing includes fishing at beach segments and at piers, and also includes flats waders, spear fishers, conch/lobster divers, and those fishing from kayaks, jet skis and small boats that return to the shoreline. The questionnaire used for the intercept survey could include a box to denote kayak, jet ski, and small boat fishing activity. These vessels are classified as ‘private vessel’ and are intercepted in the Puerto Rico APAIS. The same or a different box could be used to denote other forms of shoreline associated ‘non-vessel’ fishing.

Appropriate testing of modifications to existing collection forms is encouraged. There are sites with high fishing activity where it is difficult to complete all surveying within the allotted time frame. To address this problem, Puerto Rico needs to adjust the sampling frame (e.g., splitting the shoreline into more manageable segments), though this has largely been addressed by better management of the site register.

It is necessary to review the estimation process used to produce total catch estimates. For example, catch for vessels is based on data collected from vessels returning to a boat ramp. However, private vessels such as head boats and dive boats do not operate from boat ramps. Although no head boats operate in Puerto Rico, dive boats do and they may host 6 or more recreational harvesters on a single trip.

NOAA Fisheries is working on a registry of for-hire vessels that would be available for verification by APAIS interviewers. This registry needs to be completed, validated, and applied.

Considerations for U.S. Caribbean Region

Queen Conch and Spiny Lobster Pilot Study (Valle-Esquivel and Trumble, 2016)

MRAG Americas conducted a study from March 2014-June 2016 to obtain information on recreational harvest of spiny lobster and queen conch. The study consisted of formal and informal interviews and field observations with fishermen, dive operators and locals. Interviews collected information on conch and lobster harvest, fishing sites, species composition and size, and other activities. Sampling was conducted by four staff during daytime hours over 12 months and included 118 sites on the main island, 29 on Vieques, and 13 on Culebra.

Interviewers sampled beaches, ramps, docks, piers, villages, marinas, and nautical clubs. Sites were stratified to account for presence/absence and intensity. Only 47 intercepts were obtained, which prevented identification of spatial patterns, but it was determined that new sites were not needed to capture conch and lobster harvest information. For example, despite the low sample size, large numbers of harvested juvenile conch were observed, particularly on Vieques and Culebra.

Regarding queen conch and spiny lobster recreational harvest, a more intensive and adaptive sampling strategy is needed. Alternative methods, such as social media surveys and community based studies, should be developed to better understand how and where harvest occurs and if harvest patterns can be discerned. If the current recreational monitoring program in Puerto Rico is to be restructured, it should account for the mixed nature of the fishery, the prevalence of opportunistic fishing, the distinction between recreational and subsistence fishing, and the large incidence of unlicensed commercial fishing activity. In general, the program should characterize recreational fishing for these species in terms of the spatial and temporal distribution of the activity, the preferred modes of fishing, the methods and gears used, the target species, and the association with other recreational activities. These data could then be used to determine if and how to include queen conch and spiny lobster (and possibly other invertebrates) in the MRIP survey.

It would also be beneficial to develop and implement a pilot roving-survey study to evaluate the effectiveness of different approaches for collecting information on recreational fishing for

queen conch and spiny lobster in Puerto Rico. That study could assess whether a roving survey could adequately estimate the amount of recreational catch and effort for these species, identify spatial and temporal patterns, determine differences in catch composition and effort among different modes (shoreline and boats) and site types, determine if there is a clear distinction between the recreational and commercial sectors that harvest these species, and determine if queen conch harvest regulations are observed, specifically the size-limit and the closed season.

Highly Migratory Species (Randy Blankinship, pers. comm.)

A number of recent studies investigated dockside intercept surveys, the HMS automatic reporting system, a catch card option, and a telephone study using the vessel registry to estimate HMS data. These studies revealed issues (e.g., underreporting) in existing data collection systems (e.g., HMS mandatory reporting) and provided recommendations to improve existing data collection efforts.

Currently, the number of marinas or access sites that harbor HMS vessels is relatively small. Reporting stations need to be established at all marinas with HMS vessels, or reporting needs to be otherwise facilitated using phone or internet methods. The catch/card program needs to be enforced at the dock to increase compliance and improve success, for example by giving the permit holders (e.g., vessel captains or vessel owners) access to kits containing the same forms used in the internet or phone system. It would be beneficial to provide outreach emphasizing the importance of the information for the sustainability of the resource. There is also a need to conduct separate surveys (phone or mail) of a sample of listed members to assess the under-reporting suspected in the current system.

Tournaments (Munoz et al., 2013a; b)

Currently, Puerto Rico's DNER collects tournament data and has HMS and non-HMS tournament data for many past years. This coverage is not currently considered part of MRIP, but has been included as part of a new MRIP sampling design that was pilot tested on the mainland. Current tournament coverage occurs during non-holidays and collected data includes species, weight, length, bycatch and catch-and-release. Some vessel-specific data are collected, including name of vessel, name of captain, vessel length and weight, number of anglers, number of hours fished, hours of trip, number of lines and area fished.

USVI DPNR monitors tournaments and collects landing by species, number of vessels, and weight and size data. All boats registered in the tournament and returning to the marina are intercepted to obtain information on catch.

Staff should be available to sample on holidays and other days not presently covered and to provide additional training to tournament observers. Data should be recorded for all tournaments to obtain effort as well as catch-and-release data for both the targeted species

and the bycatch. Additional questions should be added to the survey forms to obtain other important data, including for example to identify commercial vessels with landings during the tournament. Collected contact information (e.g., mailing address, email and phone number) could be used later to obtain effort data.

Port Sampling Pilot Project (Gedamke et al., 2016)

A two-phase dockside intercept project, involving first the USVI then Puerto Rico, stratified surveys into high-use and low-use sites within each of six districts: St. Thomas and St. Croix districts (fall 2015 = off season) and Puerto Rico north, east, south, west coast districts (spring 2016 = high season). A 30-day sampling effort was conducted within each phase. Two sites were randomly chosen each day and sampled between 9am – 5 pm by two person teams, though nights and Sundays were not sampled. The objective of the dockside intercepts was to count and identify catch with the main variable of interest being the number (pounds) of fish. Estimates of among-day and among-site variability were derived and generally there was a wide variety of species reported.

Future efforts must align state and federal sampling and integrate all sampling efforts (commercial, recreational, HMS, etc.) with an established level of participation. St. Croix fishers were more resistant to sampling based on their need to move product to market. An individual-based sampling scheme should be explored and full-time employees are recommended. A minimum of two, and ideally four, samplers per district is needed, with some level of night sampling, e.g., for yellowtail snapper.

Because the observed sampling error was related to sampling days and number of samplers during the 30-day project, a year of sampling is needed to fully elucidate variance and logistics. Sampling one site per day was sufficient in most cases, which would reduce costs, and the effort allocation should be adjusted to increase sampling at St. Thomas high effort sites and at the east and west sites in Puerto Rico.

Additional suggested survey revisions include post-stratification by gear, identification and stratification by top performing fishers vs. other fishers, consideration of individual-based approaches for top performers, provision of ice or development of a more rapid sampling routine (< 10 minutes), and development of a mobile sorting and photography station.

Developing Future Sampling Priorities

In order to estimate recreational harvest in any region, information is required regarding the amount of effort expended on recreational fishing and the amount and type of catch resulting from that effort (Table 3).

Effort refers to the estimated amount of time spent fishing by an individual angler, using a particular gear in a particular area (state or federal waters). From this information, estimates of the following can be made:

- How many people are fishing;
- Where people are fishing;
- How many hours are spent fishing, by gear type.

Table 3. Data needs for recreational effort and catch estimation.

Data Needs	Options
Fishing Mode	Private vessel, for-hire, shoreline (including kayak), tournament
Catch	Species, bycatch, discards, catch by number or weight, size, catch per unit effort
Effort	Number fishing, per hour, per trip, location, GPS coordinates, gear type
Report Period	Annual
Report Frequency	per trip, monthly, bi-monthly, semi-monthly, semi-annual
Recreational Fishing License Holder	Boat registration, Charter Captain, Individual, Vessel Captain
Other	Gear, fishing grid, fishing site cluster, harvest zone (state versus federal waters)

Regarding effort data, an MRIP evaluation of alternative approaches to collecting fishing effort data in the U.S. Caribbean region indicates that mail surveys generally yield a better response rate than telephone surveys and the resultant information is more complete and accurate (Anonymous, undated). However, surface mail delivery is not as common in the U.S. Caribbean as it is on the mainland. Mail is not delivered to homes in the USVI for the most part. Instead, most people have public or private post office boxes and those boxes may be shared. For example, the MRIP evaluation revealed that quite a few people (>10) had the same mail address at a Red Hook, St. Thomas private site, perhaps reflecting seasonal residence.

The mode of fishing will also influence the approach to data acquisition. In the case of private vessels, a telephone survey is likely to provide a higher contact rate if those phone numbers are faithfully updated (Kojis, pers. comm.). Access to this private vessel fisher information can be obtained from their boater registration application, which includes the vessel owners contact telephone number and mailing address. However, while new registrants are generally added to the registration database in a timely manner, retired registrations may not be removed in a similarly timely manner (Lilyestrom, pers. comm.). This may inflate the true population and likely increase variance. For-hire fishers must be licensed. Licensing information therefore defines that population. The shoreline mode, including kayak anglers, flats waders, and free-diving spear fishers, is much more diffuse and diverse, with no obligation to register or be licensed, and will be the most difficult group to communicate with. For tournament fishers, participating vessels are required to have a designated captain who can serve as the contact point. Instituting a recreational fishing license would facilitate data collection and considerably enhance coverage, accuracy, and data applicability for all four modes.

Catch is the estimated catch, by species, per angler per unit time. Catch rate can be estimated using intercept interviews, but also can be estimated using other approaches such as mail/telephone surveys, angler diary surveys (i.e., logbooks), etc. Those alternative approaches are of particular value when dockside surveys are not practical or feasible. In any case, a distinction is made between fish caught, landed and available for inspection (Type A), fish caught and killed but not available for inspection (Type B1), and fish caught but released alive (Type B2). This information allows determination of:

- What species are being caught;
- How many of each species are being caught;
- How many of each species are kept for food or bait;
- How many of each species are discarded, and the condition of the discarded fish;
- Size and weight of a sample of each species caught;
- Catch per unit effort (CPUE) for each species.

Determining CPUE requires knowledge of the number of fishers aboard the vessel, the gear used and time spent fishing (by gear) for each of those fishers, and the species-specific catch of each fisher including specimens that were caught but not returned to shore. For stock assessment, resource monitoring, and management purposes, it is necessary to convert total recreational landings to an equivalent weight of fish. To accomplish this, length and weight data must be obtained.

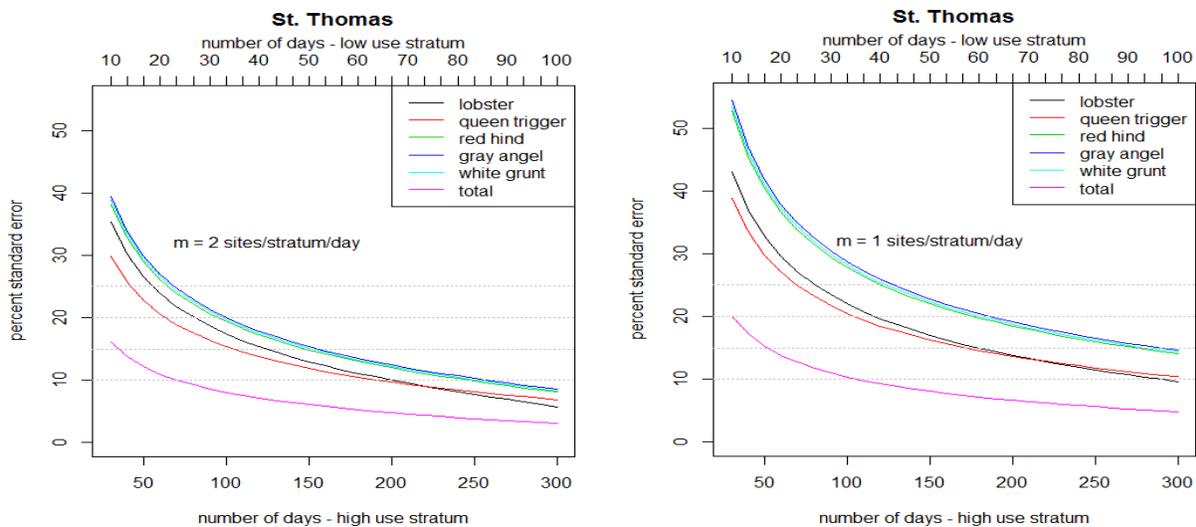


Figure 1. Standard error of estimated St. Thomas *commercial* landings expressed as a percentage of the landings for a fixed ratio (3:1) of sampling effort in the high use and low use strata for 2 (left) or 1 (right) port sampling agents per stratum per day (from Gedamke et al. 2016).

The precision of the acquired data also must be optimized (Figure 1). A pilot study of commercial and recreational landings data acquisition methods throughout the U.S. Caribbean

(Gedamke et al., 2016) included an evaluation of the precision of the resultant data. That study determined that for each of the island groups, and for the north, south, east, and west coasts of Puerto Rico, an overall precision (Percent Standard Error) less than 25, and in most cases equal to or less than 20, was achievable although higher variances were recorded for some species within some areas. But that information was derived from vessel based sampling methods. Shoreline fishers are a more diverse group (Valle-Esquivel and Trumble, 2016; Goedeke et al., 2016), with effort levels that are not well-known but which may be much lower than previously thought. A complex trade-off between need and availability is expected for this mode. Tournaments are typically (but not always) discrete, spatially and temporally predictable, events characterized by fishing activity in a relatively small area and targeting a common group of species. Variance among vessels is therefore expected to be low. An exemplary exception is the international, year-long Kayak Wars tournament, which has at least twice included the entire island of Puerto Rico as a fishing area.

The methods used to collect effort and catch data will be influenced by the frequency with which those data are intended to be reported and used. Historically, MRIP data are calculated and reported for two month periods (i.e., waves), but this reporting timeline does not always align well with data needs. For example, managing to annual catch limits (ACLs) would require more frequent reporting. When the ACL for a particular species or species group is exceeded, accountability measures (AMs) are applied as a means of restricting future harvest to a level below that ACL. Applying an AM results in a reduction in the length of the fishing year for the pertinent species or species group. The length of that closure is determined based on monthly harvest rates, so there is management value to calculating and reporting recreational data on a monthly rather than bi-monthly basis.

Estimating recreational harvest in the U.S. Caribbean will require accurate and timely data on the amounts of effort expended and type of catch realized and will require a recreational sampling program that can adapt to the unique attributes and challenges of the region. Exactly what data are collected, and the manner in which those data are collected, will be guided by constituent needs as constrained by logistics and budget.

Data Collection Prioritization

When establishing or refining a marine recreational fishing data collection program, a multitude of data needs can be identified. Ideally, a program that captures data to address all of those needs would be implemented. However, funding and logistic constraints may preclude acquisition of all desired data, in which case choices must be made. In anticipation that funding saturation will not occur, either for the life of the project or for intermittent periods during that lifetime, the team responsible for developing this RIP was tasked with prioritizing data needs.

Within each of Puerto Rico and the USVI, each participant was asked to rank the data need (recreational fishing variable) from 1-5, with 1 being the lowest priority and 5 being the highest priority. The individual rankings within each data need were used to calculate a mean ranking

and the standard deviation around each mean. These values were generally derived from nine individual rankings for Puerto Rico data needs and ten individual rankings for USVI data needs. However, in a few cases the respondent did not rank a category, resulting in a few cases where only eight rankings were available for Puerto Rico (seven in one case) and only nine rankings were available for the USVI.

Priority rankings were similar between Puerto Rico (Table 4) and the USVI (Table 5). Generally, data needs ranked highest in the Private Vessel and For-Hire modes and were ranked least essential for the Kayak mode. Data on effort, the number of fish caught by the group, the length (and to a lesser degree, weight) of those fish, and the number of fish discarded was considered to be the most essential information to be collected from each fishing mode.

Table 4. Priority ranking of recreational fishing data collection needs in *Puerto Rico*. Each respondent was asked to rank each category separately from 1-5, with 5 indicating the highest priority data. Highest rank within each mode is italicized. For each mode, the majority level for each (Group or Fisher) is listed in parentheses. For modes with Group as the majority level, priority ranks at the Fisher level are noted by a †. The Island Municipality data need focuses on the islands of Vieques and Culebra, but would similarly apply to other small islands in the region such as Mona.

Recreational Fishing Variable	Private Vessel (Group)		For-hire (Group)		Tournament (Group)		Shoreline (Fisher)		Kayak (Fisher)	
	AVE	SD	AVE	SD	AVE	SD	AVE	SD	AVE	SD
Effort (hours per trip)	<i>5.0</i>	0.0	<i>4.7</i>	0.7	<i>4.0</i>	0.9	<i>5.0</i>	0.0	<i>3.6</i>	1.4
Trip length	4.1	0.9	4.2	1.0	3.8	1.1	-	-	3.2	1.2
Time fishing	4.4	1.0	4.6	1.0	4.3	1.1	4.4	1.0	3.7	1.2
Discards	4.8	0.4	4.9	0.3	4.7	0.5	4.8	0.4	4.0	1.0
Number caught	4.9	0.3	<i>5.0</i>	0.0	4.6	0.5	4.9	0.3	3.9	1.2
	4.8†	0.4	4.8†	0.4	4.4†	0.5				
Landings (lbs)	4.4	0.7	4.7	0.7	4.3	1.0	4.7	0.7	3.7	1.3
	4.6†	0.7	4.3†	0.7	4.4†	1.0				
Fish weight	4.8	0.4	4.8	0.4	4.7	0.5	4.8	0.4	4.2	1.3
Fish length	4.8	0.4	4.8	0.4	4.7	0.5	4.8	0.4	4.2	1.3
Island Municipality	4.2	1.0	3.6	0.7	3.2	1.6	4.2	1.0	-	-
Five-year Socioeconomics	4.3	0.7	4.3	0.7	3.6	1.4	4.1	0.9	2.8	1.6

Collection of effort and catch data for a variety of invertebrate species also was prioritized. As a matter of policy, MRIP is a finfish sampling program and generally does not include invertebrate harvest as a component of the MRIP survey. But species such as spiny lobster and queen conch contribute substantially to both commercial and recreational harvest activities in the U.S. Caribbean, and are therefore included in federal fisheries management in the region. Reflecting this importance, the need to collect effort and catch data for spiny lobster and queen conch ranked very high in both Puerto Rico and the USVI (Table 6).

Table 5. Priority ranking of recreational fishing data collection needs in the *USVI*. Each respondent was asked to rank each category separately from 1-5, with 5 indicating the highest priority data. Highest rank within each mode is italicized. For each mode, the majority level for each (Group or Fisher) is listed in parentheses. For modes with Group as the majority level, priority ranks at the Fisher level are noted by a †. The Island Municipality data need was derived based on the islands of Vieques and Culebra in Puerto Rico, but would similarly apply to small islands of the USVI such as Water Island.

Recreational Fishing Variable	Private Vessel (Group)		For-hire (Group)		Tournament (Group)		Shoreline (Fisher)		Kayak (Fisher)	
	AVE	SD	AVE	SD	AVE	SD	AVE	SD	AVE	SD
Effort (hours per trip)	4.8	0.6	4.7	0.7	3.8	1.1	3.7	1.4	2.2	1.3
Trip length	3.2	1.1	3.0	1.2	2.9	1.1	-	-	2.6	1.1
Time fishing	3.8	1.1	3.6	1.3	3.4	1.4	3.5	1.4	2.8	1.2
Discards	4.7	0.5	4.6	0.7	4.6	0.5	4.1	1.1	3.6	1.1
Number caught	<i>5.0</i>	0.0	<i>5.0</i>	0.0	<i>4.9</i>	0.3	4.6	0.7	4.0	1.2
	4†	1.4	3.8†	1.4	3.8†	1.5				
Landings (lbs)	4.9	0.3	4.9	0.3	4.8	0.7	4.5	0.7	3.9	1.2
	3.9†	1.4	4.3†	0.9	3.6†	1.5				
Fish weight	4.1	1.3	4.1	1.3	4.5	0.7	4.6	0.7	3.7	1.3
Fish length	4.8	0.4	4.9	0.3	4.8	0.4	4.6	0.7	3.9	1.3
Island Municipality	4.8	0.4	4.6	0.5	3.1	1.1	3.8	1.5	-	-
Five-year Socioeconomics	4.4	0.5	4.4	0.5	3.3	1.1	3.5	1.4	2.2	1.0

Table 6. Priority ranking of recreational fishing data collection needs for invertebrates in Puerto Rico and the USVI. Each respondent was asked to rank each category separately from 1-5, with 5 indicating the highest priority data. Highest rank within each mode is italicized.

Invertebrate	Puerto Rico		U.S. Virgin Islands	
	AVE	STD	AVE	STD
Spiny lobster	4.9	0.3	4.9	0.3
Queen conch	4.9	0.4	4.9	0.3
Whelk	2.9	1.7	2.3	1.1
Octopus	3.2	1.0	2.0	1.1
Land crab	2.4	1.7	1.9	1.1
Blue crab	2.4	1.6	1.7	1.1
Other	2.6	1.1	1.7	1.2

Research/Information Needs Summary

Additional USVI Research/Information Needs

- Evaluate the efficiency/feasibility of a USVI-wide vs. island-based sampling approach.
- Evaluate the need and applicability of obtaining catch and effort data for specific invertebrate species, for example queen conch, spiny lobster, whelk, and octopus.
- Develop an outreach program to explain to constituents the need and value of being a licensed recreational fisher and participating in recreational reporting activities.
- Develop a methodology to obtain catch and effort data from the smaller islands, including but not limited to Water Island.
- Obtain catch and effort data from alternative or newly developing fishing modes, for example kayak and jet ski fishing.
- Develop a plan for instituting a recreational fishing license.

Additional Puerto Rico Research/Information Needs

- Develop a methodology to obtain catch and effort data from the smaller islands, including but not limited to Culebra and Vieques.
- Evaluate the need and applicability of obtaining catch and effort data for specific invertebrate species, for example queen conch, spiny lobster, whelk, and octopus.
- Obtain catch and effort data from alternative or newly developing fishing modes, for example kayak and jet ski fishing.
- Develop an outreach program to explain to constituents the need and value of being a licensed recreational fisher and participating in recreational reporting activities.

Additional Caribbean Region Research/Information Needs

- Develop a framework for national level of coordination of data collection/sampling activities in the region.
- Develop an effective methodology for estimating effort and determining catch of shoreline fishers, including for example drones, beach cams, and roving survey designs.
- Develop/refine a method for regional coordination of U.S. Caribbean data collection/sampling activities.
- Estimate inter-island landings transfers, including for example landing of fish caught in the USVI but landed in Puerto Rico or landing of fish caught in the USVI but landed in the British Virgin Islands.
- Estimate species- and mode-specific magnitude of illegal/unreported harvest.
- Investigate the opportunity and value of developing an integrated program for collecting effort and catch data for both the commercial and recreational sectors.

- Develop a dockside catch card program for the HMS mode, including kits containing the needed forms.
- Evaluate the need to expand catch sampling efforts to include nights, weekends, and holidays.
- Investigate social media-based data acquisition strategies.

Additional General Research/Information Needs

- Evaluate alternative approaches to develop a statistically valid effort sampling frame for each fishing mode within each island.
- Develop method to ensure boater registration databases are complete, comprehensive, and annually updated.
- Develop a method for identifying the recreational effort and catch of licensed commercial fishers.
- Identify and map access sites used by recreational fishers.
- Properly define and describe fishing gears used in the recreational fishery.
- Develop statistically valid intercept designs for the shoreline mode that respond to temporally and spatially dynamic patterns of effort.
- Evaluate alternative outreach methodologies and their relative merits.
- Identify the appropriate spatial allocation of resources for data collection and program administration.
- Establish a regional administration plan that ensures data continuity and adaptive allocation of resources.
- Assess the need to obtain information on the individual's motivation to fish, whether it be for competition, excitement, ancillary food, or basic sustenance.

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