

Evaluation and Improvement of the Current Sampling and Estimation Methods for the Puerto Rico Recreational Fishing Survey and Development of a Survey Design(s) for Collecting Recreational Fishing Data in the US Virgin Islands

FY 2012 Proposal

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1. Overview

1.1. Sponsor

MRIP

1.2. Focus Group

Survey Design and Evaluation

1.3. Background

Puerto Rico - The Puerto Rico Marine Recreational Fisheries Statistics Program (PR-MRFSS) was instituted in 1999 as an effort to monitor recreational fishing in Puerto Rico (Dr. Craig Lileystrom, personal communication). Prior to this project, there was no continuous information regarding marine recreational fishing activities in the island. The program has provided much information on the recreational fishery, affording the quantification of the marine recreational catch and effort by various user groups. Data from this project was used in the formulation of the first modern Fisheries Regulation for Puerto Rico in 2004, in subsequent amendments to this, and in the most recent Fisheries Regulation 7949 (2010). It is also used by the CFMC for Fisheries Management Plans and amendments, by numerous other groups and individual researchers. The PR-MRFSS program (now termed the Marine Recreational Information Program (MRIP)) is divided in three components: data collection on marine fishing tournaments and assessment of recreational fisheries through intercept surveys and household telephone surveys. Project staff attend marine fishing tournaments and collects biometrical and catch and release data as well as total participation and effort information from records (logbooks). The three main recreational fishing modalities, shoreline, charter boat and private/rental, are assessed using an intercept interview form adapted for Puerto Rico from the Marine Recreational Fisheries Statistics Survey. Data collected includes catch, species identification, fish weight and length, effort, location, bait, fishing gear and basic socioeconomic data (party size, place of residence, species targeted etc.). This information enables estimates of total recreational fishing catch and effort by mode, by wave and by year. An economic add-on was performed in 2011 to give the first estimate of the economic value of marine recreational fishing in Puerto Rico. Strengths of the Puerto Rico program include the monitoring of nearly all Puerto Rico tournaments (which standard MRFSS does not do) and quality assurance and control validations on all interviews (whereas standard MRFSS only does 10%). Although great progress had been made in development of the PR-MRFSS, a programmatic review is essential to identify areas of the recreational sector that have not been sampled adequately or, in some cases, missed entirely and to improve the overall quality of the program. Some shortfalls in the program have been already identified. The primary focus of MRFSS is finfish. However, other recreational fisheries resources are intensively harvested, but are not currently sampled, particularly lobster and conch. Additionally, night fishing is not sampled and point intercept shoreline surveys at private docks are not conducted. It is also believed that the spearfishing sector may not be adequately sampled. Puerto Rico lacks a recreational fishing license program, which would prove valuable as a sampling frame. Puerto Rico's 78 municipalities are equated with "counties" in the states, which may be inappropriate since municipalities are so small. US Virgin Islands - Saltwater recreational fishing is one of the most important outdoor activities in the U.S. Virgin Islands (CFMC 1985; Griffith et al. 1988; Hinkey et al. 1994; Friedlander and Contillo 1994; Adams 1996; Friedlander 1995). Telephone surveys conducted by Jennings (1992), Eastern Caribbean Center (2002) and Mateo (1999) indicate that as much as 10% of the population participates in recreational fishing. Mateo (2004) estimated that recreational anglers on St. Croix and St. Thomas annually caught 35,225 pounds and 137,412 pounds of fish, respectively, fishing from boat, shoreline or boat and shoreline. Besides personal enjoyment and providing an important source of household dietary protein, recreational fishing activities also contribute significantly to the Virgin Islands economy. Hinkey et al. (1994) estimated that more than \$25 million dollars were spent on activities associated with recreational fishing. Several categories of recreational fishing have been identified, including charter boat, private boat (both inshore and offshore), shore and pier (Jennings 1992; Mateo 2004). The recreational line fishery may be divided into three sectors, offshore, inshore and reef fish fisheries (Adams 1996 and Mateo et. al. 2000). These three fishery sectors target pelagic, coastal and demersal fish species/groups, respectively (Toller et. al. 2005). Tobias and Dupigny (2009) reported that 38% of the U.S. Virgin Islands recreational powerboat owners with vessels greater than 16 feet fish recreationally for marlin and pelagic fish species. Significant differences exist in the offshore recreational fisheries for pelagic species between St. Thomas and St. Croix. The St. Thomas offshore fleet consists primarily of large charter boats and a small fleet of vessels that are present only during the summer when blue marlin fishing peaks (Griffith et al. 1988; Hinkey et al. 1994; Adams 1995; Mateo et al. 2000). The St. Croix offshore fleet is composed of smaller, privately owned vessels and a few charter boats (Griffith et al. 1988; Hinkey et al. 1994, Garcia-Moliner et al. 2002). Unique to St. Croix, deep water in excess of 1000 m is located on the north and west coast less than one-half kilometer, but in most areas one to two kilometers, from shore, which enables smaller vessels to easily access the pelagic fishery. The fleet typically numbers less than 30 boats. Effort on St. Croix is concentrated on pelagic species other than marlin (dolphin, wahoo, king mackerel and tunas) (Tobias 1994; Adams 1995). The U.S. Virgin Islands developed a recreational fisheries port sampling program in 1981 and has used various methods, including telephone surveys, socio-economic surveys, logbooks, shoreline roving creel surveys, dockside interviews and fishing tournaments, to collect data on recreational fishing activities (Tobias 1985 and 1991; Brandon 1989; Jennings 1992; Adams 1995; Adams et al. 1996; Mateo 2004; Toller et al. 2005). However, a continuous, statistically valid survey methodology and resulting long-term recreational dataset is lacking. The redirection of program funding and reduction of staff have limited recreational fisheries data collection to recreational fishing tournaments only (Toller et al. 2005), the majority of which are for coastal pelagic or pelagic fish species. Data on recreational landings of federally-managed resources, such as shallow water reef fish, is sparse and non-existent for lobster, conch, deep water snappers and other resources. Federal mandates, as a result of the Magnuson-Stevens Fisheries Conservation and Management Reauthorization Act of 2007, require management plans for

resources in federal waters of the Exclusive Economic Zone to eliminate overfishing of overfished stocks by 2010 and all other managed stocks by 2011. Annual catch limits (ACLs) and accountability measures (AMs) are required for all managed species that comprise the commercial and recreational fishery. In order to establish viable ACLs that are equitable and fair to all U.S Caribbean user groups, it is essential to know the amount of harvest of the managed resources by recreational fishers. Although a draft Virgin Islands recreational fisher license program and recreational fishing regulations was developed by the St. Croix and St. Thomas/St. John Fisheries Advisory Committees to initiate the collection of this essential information (Tobias 2010), the program has not received government sanction. At the present time, U.S. Virgin Islands ACLs have been established for federally-managed species based on average catch rates of the commercial fishery only. There is a need to establish a baseline survey of the recreational fishers in the Virgin Islands to establish the universe of fishers and effort and catch data.

1.4. Project Description

Puerto Rico - The current and historic sampling design and estimation of the Puerto Rico MRFSS survey will be reviewed and evaluated in a workshop held in Puerto Rico that will include Puerto Rico DNER staff involved in the on-going MRFSS project, representatives from NOAA NMFS SERO and SEFSC offices who work with recreational fisheries data and/or management, MRIP staff, a representative of the CFMC and the Gulf States Marine Fisheries Commission (GSMFC), and the MRIP statistical consulting team. The MRIP consultants will be responsible for producing a report reviewing the current and historic sampling design and methods of estimation, assessing if the current survey design and sampling program are meeting the needs of MRIP and federal and local fishery management agencies, and making recommendations on improving survey design, sampling, and estimation methods as required. NMFS, CFMC and PR-DNER will provide documents/data files to all the workshop attendees prior to the review workshop. The review and evaluation workshop will be held in Puerto Rico. MRIP consultants will produce a report of the workshop within 2.5 months after the workshop for review and approval by workshop members and MRIP. The recommendations of the report will be incorporated into future MRIP proposals/surveys. US Virgin Islands - A workshop will be held in the US Virgin Islands to evaluate previous US Virgin Islands surveys of recreational fishers, assess regional data needs, and evaluate survey options for obtaining recreational fishing data. Prior to the workshop, the necessary documents/data files will be provided to workshop participants by NMFS, CFMC, DFW and local contractors. Workshop participants will include VI-DPNR staff, representatives from NOAA NMFS SERO and SEFSC offices who work with recreational fisheries data and/or management, MRIP staff, a representative of the CFMC and the GSMFC, the chairs of the VI Government St. Croix and St. Thomas/St. John Fisheries Advisory Committees (FAC) and the MRIP statistical consulting team. The focus of the workshop will be to develop one or more survey designs appropriate to the USVI to obtain recreational fishing data needed for federal and local fisheries management. A report detailing appropriate survey design options will be produced by the MRIP consultants and reviewed and approved by workshop participants. Based on the survey design(s) developed during this project, a proposal for a pilot study will be submitted to MRIP for funding. It is anticipated that the methodology adopted to sample the fishery will be refined and become the format for a continuous recreational fishery sampling program in the U.S. Virgin Islands that is compatible with the data collection of the Marine Recreational Information Program.

1.5. Public Description

1.6. Objectives

Puerto Rico - 1) Evaluate the current MRFSS sampling design, methods of estimation and regional data needs; 2) identify issues with any component of MRFSS; 3) provide recommendations for the redesign of the any components that need improvement; and 4) incorporate sampling of recreational catches of queen conch (*Strombus gigas*) and lobster (*Panulirus argus* and *P. guttatus*). The new survey designs, sampling strategies, etc. will be incorporated in future MRIP proposals/surveys. US Virgin Islands - 1) Evaluate the historic recreational surveys; 2) based on previous USVI recreational studies and regional data needs, design an MRIP survey for collecting recreational fisheries data for reef fish, HMS species (including dolphinfish and wahoo), queen conch (*Strombus gigas*) and spiny lobster (*Panulirus argus* and *P. guttatus*); 3) write a proposal for a pilot study based on the survey design developed during this project; and 4) submit the proposal to MRIP for funding.

1.7. References

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2. Methodology

2.1. Methodology

Puerto Rico - Reviews of the Puerto Rico recreational fishing survey design will be conducted primarily by a team of MRIP statistical consultants in consultation with DNER, CFMC and NMFS staff knowledgeable about local recreational fisheries and the ongoing MRFSS recreational survey. DNER staff will provide documentation on the current MRFSS methods used in PR and will take the lead in presenting the methods and sampling issues to the consultants. An initial review of the current PR- MRFSS program will be conducted via internet and conference calls to ensure that all documentation is available to the consultants and participants and basic questions on the information in the documents and reports are answered. Subsequently, a workshop will be held in Puerto Rico to undertake a final review of the sampling design and provide draft recommendations for improvements to the sampling design to address issues arising prior to or during the workshop and to incorporate queen conch and lobster into the survey. The MRIP consultants will submit a report no later than 2.5 months after completion of the workshop for review and approval by workshop participants. US Virgin Islands - A review of prior studies of recreational fisheries in the US Virgin Islands will be conducted primarily by a team of MRIP statistical consultants in consultation with DFW, CFMC and NMFS staff and local VI fisheries consultants knowledgeable of local recreational fisheries in the USVI. VI consultants will take the lead, in conjunction with DPNR/DFW and CFMC, and provide references describing the local recreational fishery and estimations of fishing effort. An initial review of the documentation and any questions that the consultants or other workshop members may have will be answered via email or conference calls. A workshop will be held in the USVI to review the available recreational fisheries information, determine the data needs of fisheries managers, and discuss recreational fisheries survey designs appropriate to the US Virgin Islands that meet the requirements of MRIP and the needs of DPNR/DFW and NMFS. The survey design(s) should incorporate data collection for recreationally caught reef fish, pelagic species (including HMS), queen conch and spiny lobster. The MRIP consultants will submit a report no later than 2.5 months after completion of the workshop for review and approval by workshop participants.

2.2. Region

Caribbean

2.3. Geographic Coverage

Puerto Rico and the St. Thomas/St. John and St. Croix Districts of the US Virgin Islands

2.4. Temporal Coverage

Puerto Rico: review of MRFSS 2000 to present, USVI - new project

2.5. Frequency

n/a

2.6. Unit of Analysis

n/a

2.7. Collection Mode

Puerto Rico: Through marine fishing tournament, intercept and household telephone surveys.

3. Communication

3.1. Internal Communication

Communication among team members will be done mostly by email with follow up phone calls as required. Conference calls with key people will be organized through Dave Donaldson, Gulf States Marine Fisheries Commission as needed.

3.2. External Communication

Monthly reports will be submitted using the MRIP monthly reporting template.

4. Assumptions/Constraints

4.1. New Data Collection

Y

4.2. Is funding needed for this project?

4.3. Funding Vehicle

MRIP

4.4. Data Resources

Puerto Rico - MRFSS data from 1999 to present.US Virgin Islands - The U.S. Virgin Islands is considered data-poor in terms of a long-term, statistically sound recreational fishery dataset. An attempt to collect MRFSS data in 2000 was unsuccessful. Funding and manpower shortages preclude the Government of the Virgin Islands from collecting recreational fisheries data with the exception of tournament data for primarily coastal pelagic and pelagic species. The Department of Planning and Natural Resources, Division of Environmental Enforcement, conducts annual vessel registration and maintains a dataset on recreational vessels in the Virgin Islands. A total of 8,052 recreational vessels were registered in 2011. This dataset is available through inter-departmental request.The Department of Planning and Natural Resources, Division of Fish and Wildlife, maintains historical files (hardcopy and/or electronic) of recreational fishery surveys conducted in the Virgin Islands. The Department of Planning and Natural Resources, Division of Fish and Wildlife, will participate as a member partner in the project (Dr. Roy Pemberton, Director, personal communication).

4.5. Other Resources

Consultant labor and travel will be needed to perform the reviews, provide reports of recommendations, and support development of new project proposals to address those recommendations. Partners' (NMFS, VI Consultants, FAC Chairs) travel (airfare, accommodation, per diem, mileage - as appropriate) will be needed for participants to attend the workshop on the review and evaluation of current sampling methods (PR), revision of current sampling methods (PR), and design of a new recreational survey (USVI). VI Consultants will need to be compensated for preparing for the workshop(s), attending the workshop(s), reviewing the consultants' report, and preparing a proposal for submission to MRIP. FAC chairs attending the workshop will need to be compensated for the days they attend the workshop.The USVI consultants have an intimate knowledge of the resources, fisheries, fishermen and U.S. Virgin Islands in general. Dr. Barbara Kojis was previously Director of the Division of Fish and Wildlife and retired after 15 years of government service. William Tobias was a fisheries biologist for the Division of Fish and Wildlife and retired after 31 years of service. Tobias and Dupigny (2009) completed a successful telephone survey of recreational vessels used in the billfish and pelagic fishery.

4.6. Regulations

Territorial Regulations:Puerto Rico - Commonwealth regulations for recreational fishing in Puerto Rico are identified in Puerto Rico Fisheries Regulations 2004 and Fisheries Regulation 7949 passed in 2010. The purpose of Puerto Rico's fishing regulation is to administer the fishery within jurisdictional waters, which in this case extend out to 9 nautical miles. In general, recreational fishing is allowed using rod and reel, or handlines, or spears if used with snorkel gear, but not electric or hydraulic reels. Recreational fishers may catch baitfish with castnets and freshwater shrimp with traditional traps. Seasonal and area closures apply for various species and length limits and daily quotas are also applicable to recreational fishers. Tarpon, bonefish, permit and palometas are catch and release only for recreational and commercial fishers. Recreational fishing licenses are mandated by law, and design of the system is in a very advanced stage, however, the system has not yet been implemented. Recreational fishers are required to provide information on their catch and effort to authorized persons, and may not sell their catch. U.S. Virgin Islands - Territorial regulations for recreational fishing in the U.S. Virgin Islands are largely identical to commercial fishing regulations. There is no recreational licensing program, except for the harvest of shrimp from Altona Lagoon and Great Pond on St. Croix. Size limits have been established for lobster, conch and whelk, but not for reef fish. Seasonal closures and bag limits exist for conch and whelk. Also, seasonal species closures exist for mutton and lane snapper, yellowfin grouper, red, black, tiger, and yellowedge grouper, and deepwater snapper species (St. Thomas/St. John District only for the latter). Bonefish and tarpon are recreational gamefish, catch and release only. The take of Nassau and goliath grouper are prohibited. The Fisheries Advisory Committees of St. Croix and St. Thomas/St. John worked diligently to develop recommendations for a recreational fisheries program that includes licensing and regulations with the Department of Planning and Natural Resources, Division of Fish and Wildlife. The Caribbean Fishery Management Council provided funding for the project. A draft document on the Virgin Islands recreational fisheries regulations and licensing program was completed (Tobias 2010); however, it has not received government support.Federal Regulations:In both PR and USVI federal waters, seasonal closures, size limits and bag limits exist for conch, area or seasonal closures exist for mutton and lane snapper; red hind; yellowfin, red, black, tiger, and yellowedge grouper; and deep water snappers. A size limit exists on yellowtail snapper. Also, the Department of Commerce (DOC) has

recently approved a number of regulations pertaining to the recreational fishing sector. The regulations require a recreational fishing license in federal waters for HMS species and bag limits in federal waters for the recreational harvest of reef fish, spiny lobster and queen conch. It is anticipated that the DOC will request that the governments of the USVI and Puerto Rico establish compatible recreational regulations.

4.7. Other

5. Final Deliverables

5.1. Additional Reports

MRIP statistical consultants' reports: one for PR and one for USVI. USVI proposal for pilot survey.

5.2. New Data Set(s)

5.3. New System(s)

6. Project Leadership

6.1. Project Leader and Members

First Name	Last Name	Title	Role	Organization	Email	Phone 1	Phone 2
Rob	Andrews	Fisheries Biologist	Team Member	NMFS Office of Science and Technology	rob.andrews@noaa.gov	301 427 8105	
William	Arnold	Caribbean Branch Chief	Team Member	NOAA NMFSS SERO	bill.arnold@noaa.gov	727 551 5764	727 366 7761
Randy	Blankinship	Southeast Branch Chief	Team Member	NOAA NMFS Atlantic HMS Management Division	randy.blankinship@noaa.gov	727 824 5313	
Harry	Clinton	Chair	Team Member	St. Thomas/St. John Fisheries Advisory Committee		340 776 3164	340 344 7898
David	Donaldson		Team Member	Gulf States Marine Fisheries Commission	ddonaldson@gsmfc.org		
Graciela	Garcia Moliner	FMP and Habitat Specialist	Team Member	CFMC	Graciela_cfmc@yahoo.com	787 766 5926	
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First Name	Last Name	Title	Role	Organization	Email	Phone 1	Phone 2
Grisel	Rodriquez Ferrer	Biologist/M RFSS project leader	Team Member	PR DNER Marine Resources Division	torneo_pr@yahoo.com	787 230 4967	
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Andy	Strelcheck	Fish and Wildlife Administrator	Team Member	NOAA NMFS SERO	andy.strelcheck@noaa.gov	727 824 5374	727 204 6677
William	Tobias		Team Leader	Consultant	williamjtobias@hotmail.com	340 773 4512	340 226 9734
Steve	Turner	Division Chief	Team Member	NOAA NMFS SEFSC	Steve.turner@noaa.gov	305 361 4482 x 482	

7. Project Estimates

7.1. Project Schedule

Task #	Schedule Description	Prerequisite	Schedule Start Date	Schedule Finish Date	Milestone
10	VI - MRIP consultants produce draft report containing MRIP compatible survey design	9	09/17/2012	11/19/2012	Y
1	PR - Prepare documents & compile data needed for review of current MRFSS sampling strategy.		07/01/2012	09/05/2012	
5	PR - Workshop participants review draft report	4	11/20/2012	11/30/2012	Y

Task #	Schedule Description	Prerequisite	Schedule Start Date	Schedule Finish Date	Milestone
12	VI - MRIP consultants produce final report with survey design(s) for VI rec fish sampling program	11	12/03/2012	12/14/2012	Y
13	VI - VI consultants write and submit proposal for a pilot rec fish survey to MRIP	12	12/17/2012	01/30/2012	Y
7	VI - Prepare documents and compile data needed for review		07/01/2012	09/05/2012	
9	VI - Hold workshop in September 2012	8	09/10/2012	09/13/2012	Y
4	PR - MRIP consultants in consultation with PR members produce draft report of recommendations	3	09/17/2012	11/19/2012	Y
3	PR - Hold workshop in early September 2012	2	09/13/2012	09/14/2012	Y
6	PR - MRIP consultants submit final report	5	12/03/2012	12/14/2012	Y
11	VI - Review of draft report by VI workshop participants	10	11/20/2012	11/30/2012	Y
2	PR - Conduct initial review of PR MRFSS via internet, phone & conference calls. Plan workshop.	1	07/01/2012	08/31/2012	
8	VI - Conduct review of reference material via internet, phone & conference calls. Plan workshop.	7	07/01/2012	08/31/2012	

7.2. Cost Estimates

Cost Name	Cost Description	Cost Amount	Date Needed
GSMFC grant administration	Administration of grant	\$10000.00	06/01/2012
VI Consultant Expenses	Cost of VI Consultant labor	\$20000.00	06/01/2012
Travel for NOAA staff	Travel for approximately six NOAA staff including airfare, per diem, and taxi	\$18500.00	06/15/2012
Travel for VI and PR participants	Travel costs including airfare, per diem, mileage, etc. for PR and VI participants	\$8753.00	06/15/2012
Workshop venue - primarily VI	Cost of meeting room and any necessary equipment / internet access	\$5000.00	07/15/2012
MRIP Contractor Support	Labor and travel (airfare, accommodation and per diem) for 3 consultants	\$52000.00	06/01/2012
TOTAL COST		\$114253.00	

8. Risk

8.1. Project Risk

Risk Description	Risk Impact	Risk Probability	Risk Mitigation Approach
Hurricanes	The workshop is currently scheduled for the peak of the hurricane season in the VI. If a hurricane threatens the islands, the workshop will need to be postponed.	Low	Participants will keep track of storms developing in the Atlantic. However, hurricane development is out of our hands.
Delay in holding workshops due to lack of availability of consultants	Involvement of knowledgeable consultants is extremely important and crucial to the successful completion of this project.	Medium	Following up on a regular basis with MRIP. MRIP is responsible for identifying consultants and providing information on availability.

9. Supporting Documents

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Statistical Consultants' Report: Review of Virgin Islands Sampling Needs

Authors: Breda Munoz¹, Virginia Lesser², Jim Chromy¹,
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1. Introduction

A two days and a half workshop (September 10 to 12th, 2012) was scheduled in St. Thomas, US Virgin Islands (USVI) to discuss the data needs for USVI including the past and current sampling approaches. The objective is to examine data collection methods needed to estimate recreational fish catch and effort. State and federal staff, consultants and stakeholders involved in the USVI fisheries management prepared presentations and provided access to references describing previous studies designed to estimate catch and effort for different species. In this report we focus on USVI, we describe what we learned from USVI fishing activities, data needs, past and current data collection efforts, perceived challenges for implementing sampling design and our recommendations. From the workshop presentations, clarifications from workshop members, and the references we learned that:

- Recreational fishing is important for USVI locals and it is considered an important tourist attraction (Toller et al, 2005).
- Commercial fishing licenses are mandatory in St. Thomas, St. John and St Croix since 1972.
- There are no recreational fishing licenses required (Garcia-Moliner, 2009), except for shrimp on St. Croix and bait and line fishing in the Great St. James Marine Reserve, St. Thomas.
- Tourists, who fish, primarily participate in charter or private boat fishing (Adams et al, 1996).
- Some of the recreational fishing targeted non-game species (e.g. conch and spiny lobster) in St Croix years ago (Tobias, 1985). These targeted non-game species are still currently of interest to recreational fishers in both St. Thomas/St. John District and St. Croix District.
- Three fishing sectors are well defined in USVI: offshore pelagic and deepwater snapper, inshore pelagic, and reef fish fisheries. Each sector targets different species, for example, deep water in excess of 2,000 meters is available 400 meters off the north coast of St. Croix and constitutes a good location for fishing large pelagic gamefish such as blue marlin, white marlin, tuna, dolphin and wahoo (Tobias, 1995; Toller et al, 2005; Tobias and Dupigny, 2009). Inshore species include great barracuda, cero mackerel, little tunny and numerous jack species (e.g. crevalle jack, bar jack and blue runner). Reef fisheries include snappers, groupers, grunt, triggerfish, and squirrelfish (Toller et al, 2005).

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- Historically, over 60% of the recreational boats fishing in USVI during marlin season originate from the US mainland, Puerto Rico, Dominican Republic, Bahamas and British Virgin Islands, while the remaining percent of boats are owned by local residents (Brandon, 1986). These vessels participate in one of the St. Thomas International Game Fish Association (IGFA) blue marlin tournaments.
- The blue marlin tournament season extends from mid-June to mid-September in St. Thomas.
- Dolphin and wahoo are two of the most important species for USVI recreational and commercial fishers (Toller et al, 2005; Tobias and Dupigny, 2009).
- Recreational fishing is estimated to be around 10% of commercial fishing (Jennings, 1992; Mateo, 2004). No territorial license is required for recreational fishing. By federal law a recreational angler cannot sell their catch.
- A High Migratory Species (HMS) angling permit or HMS Charter/Headboat permit is required for highly migratory species (HMS – billfishes, tunas, swordfish, and sharks) in federal waters.
- All vessels located in USVI territorial waters for more than 60 days are required to be registered in the USVI. Documented US and foreign vessels must register in the USVI if present longer than 60 days. These vessels will keep their documentation number as their territorial registration number and must display the USVI registration sticker on the port side of the vessel. The maximum stay of 60 days need not be consecutive days in the territory.
- Most species of fish in the estuarine inshore areas and open waters are harvested by both recreational and commercial fishers.
- The Magnuson Fishery Conservation and Management Act (1976) mandates the collection of data for both commercial and recreational marine fisheries to end and prevent overfishing through the use of annual catch limits (ACLs) and accountability measures (AMs).

An expected outcome of this report is a list of recommendations or guidelines for a cost-efficient sampling design to collect data for establishing recreational annual catch limits (ACLs) for St Croix, St. Thomas and St. John.

It was clear to the consultants that the workshop attendees were aware of the challenges involved in the collection of catch and effort data given the widespread recreational fishing activity carried out in several modes. These fishing modes include pier and shore fishing, private vessels, for-hire rentals, charters vessels, dive charters and diving.

2. Data Needs

Data needs were determined by workshop attendees and include

- Total catch and effort estimates to determine ACLs and to better manage fisheries at different levels:
 - Geographic: St. Thomas/St. John and St. Croix.
 - Species.

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- Across time to evaluate trends.
- Total catch and effort estimates by mode (e.g. charter, private vessel, shoreline).
- Biological data (e.g. tissue, age, size and growth) is required to estimate maturity. This is particularly useful for species such as conch and spiny lobsters to determine if recreational fishers are harvesting legal sizes of these species.
- Estimates of the total number of recreational fishers in each island and type of gear.
- Estimates of the frequency of fishing trips and spatial (location) and temporal distribution (e.g. time of day, days of week) of fishing activities.
- Estimates of the total and size of catch per fishing trip by species.
- Effort by species and fishing mode are needed to better manage the different fish stocks.
- Estimates of landings and effort data on recreational high migratory species (HMS), billfish, tuna and shark species.
- Estimates of release (alive and discarded) and bycatch data.
- Estimates of invertebrates landed.

3. Past data collection efforts and lessons learned.

Early federal attempts to collect catch and effort data were made from 1979 to 1981 when the National Marine Fisheries Service (NMFS) conducted data collection in the USVI as part of the Marine Recreational Fisheries Statistics Survey (MRFSS) effort. However by 1982, the MRFSS in USVI was discontinued for lack of sufficient funds. In 1999, the NMFS and USVI Department of Fish and Wildlife reinitiated efforts to collect recreational fisheries data. The data collection occurred in 2000, but it was discontinued again in 2001. Several issues were identified in these past data collection efforts as possible factors that might influence the success of future sampling efforts for collecting recreational fisheries data in USVI. For example, there was some difficulty to recruit, hire and retain field interviewers, thus there is a need for better selection, training and compensation of field interviewers, especially if the number of intercepts of recreational fishers are low as appeared to be the case in 2000-2001¹.

A number of problems were discovered in the frames used to collect effort and catch data. There is a concern that the past and current sampling designs for the intercept survey may not capture "subsistence fishing" which is considered relevant in some regions of the USVI; subsistence sites may not have been included in the site registry or were almost never selected. A thorough update of the USVI site registry to reflect more reliable pressure estimates (defined as the average number of fishers in the site) for each wave is needed to increase sampling efficiency and productivity. In the past, MRFSS selected many access sites with very low activity (i.e. low pressure measures) resulting in very low numbers of intercepts at these sites (i.e. low productivity). In order to obtain better

¹ Barbara Kojis, personal comment.

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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 (Osborn and Lowther, 2002).

In addition, the fishing activity in USVI has evolved over time and newly targeted species and types of gears have emerged (e.g. diving). Some fishers use several types of gears during the same trip, making it difficult to separate the effort corresponding to each type of gear.

The coastal geography of the different islands makes it challenging to implement the standard data collections approaches. For example in St. Croix, many open spaces that provide easy access to the water for fishing purposes create a challenge for field interviewers and survey planning. Private sites and marinas and safety issues in particular for night fishing result in under-coverage of certain populations of anglers.

There is a mandatory internet/telephone reporting system in USVI for all billfishes, swordfish, and bluefin tuna. Although bluefin tuna are not found in the USVI territorial or federal waters, this system provides information on any landing of bluefin tuna, non-tournament billfish and swordfish within 24 hours of landing. However, the numbers that are discarded dead, bycatch data, and the catch and release information is not currently collected in the HMS reports. In addition, there is a suspicion of under reporting of the HMS landings.

Tournaments data are well covered in USVI. Reported tournament data include landing by species, number of vessels, and weight and size. USVI Division of Fish and Wildlife monitors tournaments to collect data on number of landings. However, tournament boats occasionally do not return to the tourney site if no targeted fish were caught. For tournament boats that either do or do not return to the tourney site, the non-targeted species may not be provided at dockside for weigh-in.

All HMS tournaments operators are required to register their tournament with the HMS Management Division of NMFS. The NMFS Southeast Fisheries Science Center notifies tournament operators if the tournament has been selected for reporting. All billfish tournaments are selected for reporting.

4. Recommendations

- Clear Statement of Objectives***

Development of a large scale data collection program requires a clear statement of objectives. This also includes an understanding of the priorities to be placed on the objectives if all cannot be achieved at a reasonable cost. While total effort and catch are understood to be key data

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requirements, priorities are needed to determine the importance of obtaining estimates by island, by species, by mode, and by other dimensions. It is common in practice for the cost of a survey to not depend on the size of the whole population as much as it depends on the number of subpopulations and domains within it for which estimates are desired. It is likely that the same is true for a USVI recreational fisheries survey.

• *Understanding of the basic requirements for a data collection process.*

The project team needs to identify the most pressing needs for recreational fishing data and develop proposals to address those needs. The USVI may require several pilot studies to build up the basic pieces needed to carry out a data collection process: 1) determination of study goals, 2) develop the study frame, 3) develop and pretest the data collection instrument, 4) formulate a sample design, 5) establish data collection protocols and procedures, 6) produce plans for data quality control and management, 7) develop the estimation process and data analysis procedures.

Proposals do not have to address every question and data needs that have been discussed. Pilot studies can be developed gradually or in simultaneous studies, allowing the project team to learn from each pilot study. Based on lessons learned at each step, further pilot studies can then be proposed to evaluate alternative approaches and solutions to the problems observed. For example, a data collection design for catch/effort might be very different from a data collection design for biological data. Similarly, the design of a finfish survey might not be appropriate for the conch/spiny lobster.

• *Coordination of Effort and Catch Estimates*

Typically, MRFSS surveys separate the estimation of effort (e.g. as number of fisher-days by mode or number of intercepts per day and mode) and catch by mode within each survey wave. For example, effort is estimated by telephone surveys of residents and boat captains. Population surveys of residents, usually by telephone, provide estimates of the number of fisher days or fishing trips during a survey wave (typically 2 months). Intercept surveys provide more detailed data on catch per fisher day or fishing trip. Intercept surveys also provide estimates by species, by size, and by biological measures (e.g. based on scale samples or otoliths). Catch data from vessel trip intercepts is sometimes aggregated over all fishers on the vessel, but a count of fishers is required in those cases. However, even if the main catch and effort data are collected separately, there are many ways in which both surveys can be adjusted to account for coverage issues, take advantage of complementarity between them or are replaced for specific subpopulations. For instance in the Eastern US mainland surveys, both effort and catch from "for hire" vessel trips are identified separately since the effort data are obtained from vessel captains and excluded from the resident surveys.

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For the USVI, the high volume of fishing by visitors (nonresidents) will make it necessary to separate effort and catch by resident status. For visitors, the intercept survey may be the only approach to obtain effort, as well as catch, information. For tournaments, questions on the data collection form to identify residents and nonresidents are necessary to distinguish catch and effort by residency. The general methodology for multiple frame sampling (e.g., multiple frames may include a list of resident's addresses, a list of resident's phone numbers, a list of permanent USVI registered vessels and a list of visiting vessels) can be utilized to increase coverage (including coverage of visitors) while avoiding double counting. In a multiple frame scenario, a single frame will not cover the entire population (e.g. a list of resident addresses will not include visitors). However, an alternate frame may be available (e.g., list of visiting vessels) that covers a subpopulation that might not be covered by the first frame (e.g., a list of resident addresses). For example Tucker et al. (2007) estimated that 46.4% of households have only telephone, 6% have only cell phones, 42.2% have both, and 5.4% have neither. Therefore a survey of all residents of VI may consider a combination of phone and mail data collection modes to improve coverage of USVI residents.

• ***Effort Estimation***

One approach to obtain effort estimates (e.g. average number of fisher trips) in the USVI that has been used for MRFSS is a telephone or mail survey of households. If the law to enforce the requirement of angler licenses passes, then this angler list can be used as the frame for a mail or phone survey to collect information on effort. If such listing is not available, then a telephone and/or mail survey of residents can be used instead. Borrowing from existing studies (e.g. MRFSS), a questionnaire can be designed to collect effort information about fishing trips and sites. The questionnaire used on the mainland would be modified to include the unique features of USVI, including the geography and targeted species (e.g., conch). Additional items about the area of fishing (e.g. island) can be included, and a map showing labeled grids can help the respondent identify the fishing area. For this mail/phone survey, it will be necessary to revise and update any phone frame or mailing address frame for the different islands. With the increasing use of cellular phones, any telephone survey would need to include numbers from a telephone landline and cellular frame. In the mainland, ABS (address based sampling) frames of household addresses have been providing an excellent frame of households with nearly complete coverage. This should be explored to determine coverage rate of this frame in the USVI.

Standard survey methodology practices include multiple contacts if a phone survey is used or multiple mailings to a household in the case of mail surveys. Multiple mailings and the use of financial incentives are the two most effective approaches to increase the response rate. The information collected would provide effort data on sites/marinas/piers/beach used for shore fishing, different ports for landing (private and public) and offshore areas for fishing.

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• ***Catch and biological data***

A number of sampling methods to collect catch and biological data at the fishing sites or marinas/ports can be considered. For shore fishing, the different islands can be divided in segments of reasonable size and or expected effort; marinas, boat ramps or piers can be clustered by proximity to facilitate survey coverage; marinas or sites with high pressures can be split in sections of manageable size to ensure coverage. As with the current MRFSS design used on the mainland, the intercepts can be performed at different time intervals to estimate effort at different time points.

Anglers returning from their fishing trips can be intercepted and biological data collected. Each angler intercepted can be asked if he/she owns a HMS permit, and detailed information with regard to discard and catch release data for HMS can be collected. Counts of the number of anglers observed at each survey site should be recorded. As discussed earlier, visiting anglers need to be identified to permit estimation of their fishing effort as well as their catch. Counts of anglers at each survey round can also be utilized to update fishing pressure estimates for future rounds of the survey.

• ***Private Boat Registration List***

The recreational vessels license is updated each June and can provide an alternative frame for estimating fishing effort related to vessels (Tobias and Dupigny, 2009). This list will also include non-resident (US and foreign) vessels if present in USVI waters for longer than 60 days. In addition to addressing the under-coverage of non-resident vessels, this list can be considered as a frame for a survey designed to obtain information on number of boat trips, fishing area, gear type, and target species. This information can be used to determine pressure (e.g. average number of trips per week and month) for each vessel and marina. It is possible to match the vessel permit list with the HMS permit list. If the vessel owner has also an HMS permit, a set of questions can be added to a questionnaire to request information on catch and release data for HMS. Rental and dive boats should be identified. A modified questionnaire designed for these groups to capture effort information is needed for these boats. This would provide a baseline to determine the numbers of these boats that do participate in recreational fishing which is currently unknown.

• ***Charter Boats***

Although there are few charter boats in the USVI, it is important to obtain records of catch and effort from this group to assure full coverage of recreational fishing. Charter boats are registered; some charter boats have commercial fishing licenses and are required to submit trip tickets and others may keep recreation catch logbooks, although the use of the logbook is not mandatory. Proposing that submission of the logbooks be mandatory should be considered. Rather than

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requiring mandatory reporting on every trip, a sampling design that selects a random sample of weeks or trips could be considered. Charter boat captains would then report only on this selected sample of weeks/trips. As a quality check, visits to some charter boats should be incorporated into the study design. Charter boat captains can be contacted ahead to determine day of departures, and a sample of charter boats trips would be observed to obtain catch and effort information. A pilot study could validate the charter boat logbook in USVI by comparing intercept with logbook data.

• ***HMS Registration List***

Another list of recreational anglers that can be used to provide separate information on recreational catch is the HMS permit listing. The effectiveness of reporting for billfish (e.g. blue and white marlin, sailfish and spearfish) using the HMS reporting system should be examined given the concerns raised at the meeting about compliance. It is clear that obtaining catch and release of billfish is important, although it is not clear that accurate data are currently being collected.

Separate surveys (phone or mail) of a sample of listed members can be done to assess the under-reporting suspected in the current phone/internet system. Results of pilot studies done elsewhere on catch cards should be examined to determine if methods can be improved to obtain catch estimates.

• ***Tournaments***

Tournaments are extremely important in the USVI and can be considered a separate subpopulation (stratum) in the overall study design. Initially, data collected from the various tournaments should be reviewed and documented. This would help determine what additional information is needed from various tournaments.

All boats registered in the tournament and returning to the marina are intercepted to obtain information on catch. It is critical to record not only the billfish that were caught and released, but also the bycatch. Collaboration with the USVI Department of Fish and Wildlife is important. Data should be recorded for all tournaments to obtain the effort, catch and release data for both the targeted species in the tournament and the bycatch. Additional training should be provided to the observers in the tournament (USVI Department of Fish and Wildlife staff) so that all information can be collected.

• ***Other Options to Obtain Catch and Effort***

Other options discussed briefly at the meeting to collect effort and catch estimates include 1) using an airplane to count the number of anglers on the shoreline and the number of vessels in different

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areas, 2) using a monitoring vessel to patrol the coast and count anglers in the shore and vessels fishing, and 3) a mix of creel surveys with a mail survey (Hoening et al, 1997 and Ditton and Hunt, 2001). The costs associated with these must be also examined to determine if these can realistically obtain the data needed given the cost for these approaches.

• *Other Comments*

- In order to convey the importance of these surveys and to improve participation of USVI residents, it is critical to invest resources into approaches to improve survey participation. For example, public meetings should be scheduled, newspaper articles explaining the need to conduct the survey, fliers posted in fishing clubs, and engagement of stakeholders and universities will bring the message to different sectors. Researchers involved with the proposed study should emphasize the need to obtain reliable catch and effort data and the implications of inaccurate data to the fisheries and USVI economy. Discussing the impact of fishing pressure on various areas of the islands should be covered for anglers to understand that without appropriate estimation and management, the fishery can spiral downwards.
- To further encourage participation, incentives are recommended. Incentives can include token gifts such as caps, T-shirts, a useful recreational fishing item, etc., all displaying the USVI survey logo or other agencies sponsoring the survey. The token gift is used to encourage participation and shows appreciation for the fisher's participation in the survey.
- Focus groups can help researchers understand why there were barriers to telephone communication during the last survey that was done in the USVI. This is important to determine in order to assess the effectiveness of developing either a mail or telephone survey to obtain effort information.
- Data coordination across surveys that are conducted in the region, and data collected across agencies, is critical not only to estimate catch for different species but also to avoid double counting. Figure 1 illustrates the many sources where catch and effort information might be collected in a study of this magnitude. Blue color denotes the ongoing data collection methods, and red denotes new methods (e.g. the use of angler license) or methods that are currently used in mainland that could be used in USVI. For example, effort might be obtained from anglers using random sampling of coastal household telephones or by directly contacting anglers if a license frame is available. Effort for vessels and marinas (defined as average number of vessel trips) can be obtained from a survey of private and charter vessels. Catch may be obtained from the HMS program, tournaments, intercept surveys and the charter logbooks. We recommend a national level coordination of activities in this region, with NMFS supervising these activities. Methods to produce estimators using different types of data (e.g. survey data, report card data, etc.) should be explored.

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Figure 1. Recreational Fish Catch and Effort Data Sources

Data Source	Fisher household address	Fisher phone number	Private boat frame	HMS License list	Tournaments	Charter Logbooks	Intercept (MFRSS)	Coastal Household Phone list	Effort for marinas, HMS landings, visiting anglers (?)	effort for shoreline Sites, HMS Landings (?)	Non tournament landings, catch, size, weight	Catch, Effort charter mode	On site data collection
Data Collection method	Mail	RDD	Mail, RDD, web survey	RDD	RDD	Mail, RDD, web survey	On site data collection	On site data collection	On site data collection	On site data collection	On site data collection	On site data collection	

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Statistical Consultants' Report: Review of Puerto Rico Sampling Needs

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1. Introduction

From September 12th to 14th, 2012, statistical consultants met in San Juan, Puerto Rico with representatives from the Puerto Rico Department of Natural and Environmental Resources (PR DNER), the Caribbean Fisheries Management Council (CFMC), National Oceanic and Atmospheric Administration (NOAA) and Puerto Rico stakeholders, researchers from the University of Puerto Rico, and fisheries consultants to discuss Puerto Rico sampling needs. The goal of this meeting was to listen to presentations and discuss past and current sampling efforts in Puerto Rico, their success and limitations. In addition, the Puerto Rico team presented their data needs to inform stakeholders and policy makers to better manage Puerto Rico fish stocks. The following are some observations of the Puerto Rico fisheries:

- The state waters of Puerto Rico extend from the shore line to 9 nautical miles off shore where the exclusive economic zone (EEZ) begins and extends to 200 nautical miles (Garcia-Moliner, 2009).
- By law, a commercial fishing license is required in Puerto Rico. The PR DNER also requires commercial fishing permits for spiny lobster and queen conch.
- Law 278 (PR Fisheries Law) and Fishing Regulation #7949 of 2010 require a recreational local fishing license, both for freshwater and saltwater. Puerto Rico is developing a system to implement a license process that will be available in 2013.
- There is a federal requirement to obtain a Highly Migratory Species (HMS) Angler permit (Angling or charter/headboat) to fish recreationally for tunas, sharks, billfish, and swordfish.
- Prior to 1998, reporting of commercial fishing harvest was voluntary in Puerto Rico. Starting in 2004 the new fishing regulation requires reporting catch on a trip basis for commercial fishing as a requirement to maintain a commercial fishing license and permits (Garcia-Moliner, 2009).
- There are special permits for recreational anglers that have not been implemented yet. Examples include reef fish, spiny lobster and queen conch (Garcia-Moliner, 2009).
- Corals can only be harvested for scientific purposes or small fragments found on the beach can be collected for art work, with a special permit. They are not considered to be part of the MRIP.
- Since the mid-80's, fishing activities grew at a fast pace in Puerto Rico. In recent years, participation in marine recreational fishing has declined – especially in shoreline fishing. Even so, the supply of private and public facilities and services are considered inadequate. Improvised piers, ramps and

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launching facilities emerged over time along the Puerto Rico shore that provides anglers increased access to the water. Also, a number of coastal residents rent or lease water access and pier space to boaters and recreational anglers (Valdez et al, 1989). These private access sites are likely not included in the MRFSS sampling frame.

- The majority of the harvest in Puerto Rico is from private boats. The majority of the effort is from shoreline fishing (SH mode). Charter boat catch and effort is very minor compared to private and shore modes. No attempt has been made to determine the number of charter boats with a commercial license (Garcia-Moliner et al, 2002).
- In an effort to monitor Atlantic billfish (blue marlin, white marlin, swordfish and sailfish) landings and to follow recommendations from the International Commission for the Conservation of Atlantic Tunas (ICCAT), NOAA Fisheries implemented a mandatory reporting program of all non-tournament billfish, swordfish, and bluefin tuna landings using telephone or internet. However, compliance with this mandatory requirement is suspected to be extremely low in Puerto Rico (MRIP report, 2009; Del Pozo et al, 2012). Non-tournament landings estimates and release estimates for billfish and other highly migratory species (HMS) in Puerto Rico based on NOAA Fisheries surveys are typically imprecise (due to the under reporting) and biased due to survey design issues (MRIP report, 2009).
- The HMS recreational fishery occurs year round in Puerto Rico with peak effort between May through August (MRIP report, 2009).
- There are between 20 to 35 different tournaments annually in Puerto Rico and all are monitored by the PR DNER staff.
- Billfish comprise an important target species groups for recreational and sport fishers in Puerto Rico (Del Pozo et al, 2012).
- Dolphin fish is the number one sought-after species in the marine recreational fishery.
- The improvement in fishing gear and the evolution and adaptability of fishing modes have resulted in an increase in the numbers of catch and catch of larger sizes over the years.
- Queen conch is one of the most important shellfish fishing resources throughout the Caribbean, including Puerto Rico (Garcia-Moliner, 1996).
- PR DNER staff suspect that illegal fishing using beach and gill netting is done at night between 10 pm and 4 am, often occurring in hard to access sites. It is suspected that this activity negatively impacts shoreline mode fishing and inshore (rivers and coastal lagoons) fishing¹. Since this type of effort is not captured by the current MRIP, commercial and recreational harvest totals are suspected to be under-estimated.

1. Puerto Rico data needs.

The following is a list of questions presented to the consultants from the Puerto Rico team during the review:

The primary questions are:

- How to better monitor the fishing effort and catch from private boats?

¹ Craig Lilyestrom comment on Puerto Rico Report.

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- How to improve the current data collection program?

Another set of questions was also asked:

- How to address Puerto Rico needs to collect biological data (tissue) to estimate maturity and age?
- How to obtain trend estimates of catch for different species?
- How can PR DNER staff obtain access to Puerto Rico Marine Recreational Intercept Program (MRIP) data? The current data formats provided by MRIP are not compatible with Puerto Rico DNER data analysis systems.
- There is insufficient information currently collected to determine the location of fishing areas. This will help to establish appropriate Annual Catch Limits (ACLs) within specific locations.
- Long term commercial and Marine Recreational Fisheries Statistics Survey (MRFSS) data conclude that total harvest by weight from commercial and recreational fisheries are similar. These types of fishing focus on slightly different species. While both recreational and commercial fishers target conch, lobster, reef fish, tuna, wahoo, etc., the primary target of recreational fishers in terms of weight is the dolphin fish, while commercial fishers target deep water snapper. Deep water snapper is primarily caught with bandit gear, which is defined as a commercial fishing gear².

2. Past and Current data collection efforts in Puerto Rico

Puerto Rico has a long history of conducting surveys to collect data to inform policymakers so that scientific based regulations can be established to properly manage their fishing resources. A number of these studies have been conducted by the Marine Recreational Fisheries Statistics Survey (MRFSS). Other surveys include pilot studies led by the University of Puerto Rico researchers and the PR DNER to evaluate new or modified data collection methods to improve current data collection for specific species. A few of these survey efforts are described below.

In 2000, the PR DNER established the Marine Recreational Fisheries Program (MRFP) which consists of two major components: the collection of fishing tournament data and the implementation of the MRFSS in Puerto Rico. Currently, biologists from PR DNER collect data at all fishing tournaments. It is suspected that some boats without any catch of the tournament species don't return to the tournament location. This results in under-coverage of some of the Highly Migratory Species (HMS) tournament fishing activities (e.g. non-tournament species) that otherwise is considered adequate. Bycatch and catch/release data are also collected in these tournaments and the MRFSS. However, the MRFSS does not cover all types of fishing modes in Puerto Rico and does not have access to all fishing sites (e.g. some remote or private beaches, private marinas, access-restricted ports, private piers, etc.); this under-coverage of the sampling frame is likely to result in biased survey estimates for some modes and species.

In 2000, a telephone survey conducted by the Caribbean Fisheries Management Council (CFMC) collected information on the charter boat fisheries in Puerto Rico and Virgin Islands (Garcia-Moliner et al, 2002). In addition to identifying ownership of the vessel, the survey collected data on effort and

² Craig Lilyestrom and Barbara Kojis comments on Puerto Rico Report

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catch, length of fishing trips, gear, and operation costs. This survey not only provided estimates about fishing activities of the charter fleet in Puerto Rico and Virgin Islands, but also offered an insight in the rapid turnover of charters and private vessels businesses in Puerto Rican waters. This survey also indicated the need to properly monitor the fishing activity of recreational anglers, since the recreational fishing license system is not yet operational.

Between 2007-2009, the PR DNER and NOAA Fisheries biologists, Puerto Rico Sport Fishing Association leaders, HMS charter boat captains, and Caribbean Fisheries Management Council staff conducted a survey to obtain data on HMS fishing effort, angler characteristics, target species, access site types, fishing times, multiday fishing trips, seasonal trip distribution, and HMS catch. Outreach efforts conducted to increase survey response included meetings between the research team staff and fishing industry representatives, research team staff attended HMS tournaments, notification letters alerting HMS anglers about the survey, and notices about the study were published in sport fishing magazines. A 50% participation rate was obtained. Main results derived from the survey are: data for billfish landings in Puerto Rico are mostly obtained from recreational fishing tournaments and non-tournament landings of billfish are rarely reported through the NOAA Fisheries mandatory reporting system. One of the key factors that affected the participation rate in this survey was the inaccuracy of the contact information in the HMS permit holders list (MRIP HMS Work Group Members, 2009).

An MRIP phone/internet survey was conducted in 2011 with HMS Angling and Charter/headboat category permit holders. The corresponding final report was not finalized at the time this report was completed.

In an attempt to increase billfish landings and improve the accuracy of billfish and swordfish landings data, the University of Puerto Rico Sea Grant College Program (UPRSGCP) and NOAA Fisheries established a pilot HMS Catch Card Pilot Program (CCPP) between May to December, 2011. Reporting stations that provided access to catch cards and landing tags were placed at marinas and nautical clubs. In addition, the reporting stations provided anglers and captains access to outreach materials. Participation in this pilot study was voluntary since the mandatory non-tournament reporting via internet and phone and the mandatory reporting by billfish tournaments were still in effect. In conjunction with the reporting stations, several outreach activities were undertaken to increase participation: letters and emails encouraging participation were sent to HMS permit holders, meetings with the staff of marinas and nautical clubs to discuss the benefits of the program, a booth providing materials explaining the CCPP was set up at every fishing tournament, the creation of an informative web site, the creation of a Facebook group, information about the CCPP was published in newspapers and fishing blogs, and educational brochures and posters were broadly disseminated.

Recommendations from this pilot study include: implement a modified CCPP program to replace the existing phone and internet HMS system in Puerto Rico; make the CCPP program mandatory and enforce compliance; eliminate the reporting stations in marinas and nautical clubs and have NOAA send kits (tags and catch cards) to HMS angling, charter or headboat permit holders; and implement a catch card web data collection system to facilitate data collection (Del Pozo et al, 2012).

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3. Recommendations

Accurate information on catch and effort along with the knowledge of the human dimension of recreational fisheries in Puerto Rico will allow resource managers and policy makers to develop policies and management plans that are in accordance with the social, cultural and economic parameters of this rich and evolving fishery. Puerto Rico is on the right track to properly manage their fisheries resources. We comment below on the three key questions that were asked at the face-to-face meeting.

1. How to cover most of the fishing activity in Puerto Rico?

The new MRIP design covers most of the fishing activity in Puerto Rico. A few modifications are suggested to address some of the fishing activity that may not be covered in the new MRIP design adopted in the mainland.

- *Effort Estimates*

To obtain effort estimates, the revised MRIP design utilizes a telephone interview using a random digit dialing approach to obtain estimates of the number of anglers. Representatives from Puerto Rico indicated it is fairly likely that a mandatory recreational fishing license system will be implemented in Puerto Rico in 2013, in compliance with existing enabling legislation. This will provide an excellent frame to use to obtain effort estimates as well as obtaining estimates of fishing pressure for different locations.

Data on fishing pressure will be helpful to improve the selection of sites for interviewer visits. Procedures need to be established and followed to ensure that collection of basic information from the license applicant frame are 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 may be exemptions for some demographic groups that need not buy a license as well as illegal anglers who refuse to purchase a license. MRIP pilot studies in the mainland have identified a considerable amount of fishing activity (as much as 50% of total effort) by non-licensed anglers. This has been consistent in every state where the MRIP has done pilot studies. Enforcing the license program and appropriate outreach programs must be developed to reduce the number of non-licensed anglers.

In order to obtain an estimate of fishing effort from this group of non-licensed anglers, a sample of random addresses or phone numbers in Puerto Rico is needed. A dual frame approach (using a license frame and a randomized list of residents) has been pilot tested in the mainland. This approach may be considered if there does appear to be a number of potential anglers missing in the license frame. Another list available to PR DNER containing angler information is the HMS permit list. Puerto Rico could use 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 that Puerto Rico compares all frames and if a combination of frames is used, duplicates would be removed prior to sampling. Other pilot studies have compared the use of a mail, rather than telephone, approach to obtain effort. These studies make use of the address-based sample lists. The coverage of both the mailing addresses and

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telephones in Puerto Rico should be examined to assess the level of coverage of all residents on the island and the cost efficiencies of these approaches.

• ***Catch Estimate***

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. It is expected that some anglers on some vessels are visitors to Puerto Rico and not included in any catch/effort survey of Puerto Rico residents. Visitors should be identified on the data collection forms so their catch can be estimated independently of the local effort estimates. The current MRFSS/MRIP catch questionnaire includes questions about residency that are used to develop correction factors to account for nonresident fishing activity. Puerto Rico could use similar procedures to adjust estimates for the nonresident fishing activity.

The site registry needs to be reviewed and updated. The sampling frame should incorporate time of day as well as site location so that the selected sampling units cover the entire population defined spatially and temporally. Coverage of remote island areas with limited access will require construction of special primary sampling units (PSUs) that will allow the selection of a sample of these PSUs over an accessible period of time. Sample allocation proportional to fishing pressures (anglers or catch) should require that these remote areas be sampled only infrequently. One can start sampling for example, every other month. After review of the data, if the estimates don't change, the samples can be further spaced in time, perhaps once every six months.

The revised MRIP design includes sampling sites across the 24 hour period to address the issue of gaps in nighttime fishing. We recommend considering hiring contractors to assist in the interviews that occur on holidays and during nighttime.

Fishing location is also of interest. It may be helpful to conduct focus groups of anglers to investigate how to best obtain this information. It would be useful to compare whether the use of maps or just a description of the location is more suitable.

Continue revising and updating the frame of the MFRSS to include all access sites such as marinas, boat ramps, private and remote beaches, etc. Site closings and very low pressure sites result in low data collection productivity in the current MRIP surveys. Consider obtaining accurate pressure based on catch instead of effort to identify low, medium and high pressure sites by month, type of day and time of day combinations. By having an updated frame for each month of the year, MRIP should be able to adapt the sample size to capture high season and low fishing seasons in the appropriate areas in Puerto Rico.

In Puerto Rico, shoreline fishing mode includes fishing at beach segments and at piers, and also includes 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 fishing, jet ski and small boats. We encourage appropriate testing of any modifications of any existing collection forms. There are sites with high fishing

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activity causing inability to complete all surveying at the site. To address this problem Puerto Rico needs to adjust the sampling frame (e.g. splitting the shoreline in more manageable segments).

• ***HMS Reporting***

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. under reporting) in existing data collection systems (e.g. HMS mandatory reporting) and provided recommendations to improve existing data collection efforts. For example, a catch card system can be used to supplement the mandatory reporting of HMS landings. Based on the pilot study results, the success of the catch card system may increase if permit holders (e.g. vessel captains or vessel owners) have access to kits (e.g. accessible through the marina) containing the needed forms (Del Pozo et al., 2012). A self-paid envelope can be added to the kit to encourage response. Other pilot studies have been conducted on this topic and should be examined for further ideas (e.g. Highly Migratory Species For-Hire Survey – Florida Pilot Study and Massachusetts Bluefin Tuna Pilot). Some of the recommendations from these studies include the enforcing of a catch/card program at the dock to increase compliance rate. In a catch/card program, anglers need to tag landed fish prior to removal from the vessel and any off-loaded fish without a landings tag represents a violation. Similar enforcement has resulted in larger compliance rates in North Carolina and Maryland (MRIP HMS Work Group Members, 2009) when compared to the current phone/internet method. The number of marinas or access sites that harbor HMS vessels is relatively small. PR DNER could establish reporting stations at all marinas with HMS vessels or could also facilitate reporting using phone or internet. To facilitate the process, the form used in the internet or phone system should be the same as the information collected in the catch/card option. This will require an outreach effort by PR DNER emphasizing the importance of the information for the sustainability of the resource. It is worth continuing to investigate cost efficient methods to estimate HMS landings.

In addition, in order to estimate the prevalence of anglers targeting and/or catching HMS without an HMS permit, a question about the HMS permit can be added to the current intercept survey questionnaire. We encourage appropriate testing of any modifications of any existing collection forms.

• ***Tournaments***

Currently, PR DNER collects tournament data. This coverage is not currently considered part of MRIP, but it has been included as part of a new MRIP sampling design pilot tested in the mainland. The coverage of tournaments currently occurring during non-holidays is excellent and it should provide high quality landings data. PR DNER may want to consider hiring a contractor to cover holidays and other days not covered by PR DNER staff. By not covering tournaments on holidays, underestimation of catch and effort for certain species is expected. Data collected in tournaments include species, weight and length as well as bycatch and catch and release. Some vessel specific data collected include 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. Adding questions to the current collection forms and training existing staff can help capture other important data that are not currently collected. For example, PR

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DNER can add a question to identify commercial and recreational vessels that had landings during the tournament. Contact information could be collected (e.g. mailing address, email and phone number) that could be used later in a survey to collect data for estimating effort (e.g. estimate number of fishing trips in a given month or time of day). As mentioned before, we encourage appropriate testing of any modifications of any existing collection forms.

2. *Can the smaller Puerto Rico islands be incorporated into the current design?*

To obtain good quality catch and effort data from the Puerto Rico smaller islands, we recommend a pilot study to explore the most cost efficient method to get these data. Several methods of data collection can be investigated in the study. These include the following:

- 1) ferry intercepts: an interviewer can ride the ferry, intercept passengers and after identifying anglers, hand them a questionnaire that collects catch and effort. The questionnaire is then returned to the interviewer;
- 2) shore sampling: given the mobilization issues between islands, MRIP should consider the selection of weeks instead of days to capture low, medium and high season fishing in the different islands. Interviewers will work on this island for a week and will collect information of fishing modes, catch and effort by intercepting anglers at or near the shore. Under this scenario, Puerto Rico and MRIP will need to adapt the estimation methods to reflect the clustering effect resulting from sampling weeks instead of days, and modify the estimation programs accordingly. Puerto Rico can consider hiring contractors to obtain this information; and
- 3) intercept of vessels returning from the smaller islands to the main island piers and collecting information on fishing trips. Information on timing of arrivals of these boats will be helpful to schedule field interviews.

3. *Are Puerto Rico data needs being met?*

Puerto Rico is currently not obtaining information on some species that are important to their assessment. In order to summarize effort for other species not currently collected in the MRIP questionnaire, options that include conch, whelk and spiny lobster as targeted species should be included in the MRIP questionnaire. Puerto Rico should consider a pilot study on how to best estimate catch (e.g., counts, sizes, counts at different sizes, etc.) for these species.

Kayak fishing, when found on shoreline sites, should be recorded under shoreline fishing. The questionnaire used for the intercept survey should include a box to denote kayak fishing. Puerto Rico should also consider whether to include another question on determining the location of fish caught using kayaks.

• ***Outreach Activities***

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An intensive outreach program needs to be designed and tailored to Puerto Rican anglers to motivate participation in all reporting activities. It is critical that PR DNER motivates the interested parties involved (e.g. Puerto Rico Sport Fishing Association, HMS charter boat captains, and Caribbean Fisheries Management Council) to communicate to anglers the importance of these data for the management of Puerto Rico fisheries. Consider using a focus group of anglers to determine the best methods to improve participation.

- *Training*

NMFS should collaborate with PR DNER in providing continued training of interviewers. In addition, the Gulf States Marine Fisheries Council should provide access and training to PR DNER staff so they can analyze and interpret their data. PR DNER might consider submitting a proposal to obtain assistance in the analysis of data from different sources (e.g., HMS surveys, tournaments, supplemental boat survey).

- *Coordination of data from multiple sources*

Data are collected from a number of different sources and this is expected to continue. Multiple frame sampling methodology exists to combine data from multiple sources (e.g., HMS catch card data, special surveys of HMS license holders, tournament data, regular effort and catch surveys, etc.) (Haines and Pollock, 1998; Iachan and Dennis, 1993; Lohr and Rao, 2006; Skinne and Rao, 1996). This would provide improved estimates of overall catch by applying multiple frame estimation approaches.

We suggest a national level coordination of activities in this region, with MRIP supervising these activities.

4. Summary

Puerto Rico has specified the need for data at different intensities and resolutions (e.g., additional fishing modes, catch and effort on holidays, data for rare species and from different islands), the need for new data (e.g., obtaining the location of catch, collecting biological data such as age or tissue data), and more information on HMS landings (e.g., commercial vs. recreational, bycatch, etc.). Some of these needs can be obtained with additions or modifications to the data collection forms used in current studies. New data collection forms or modifications to current collection forms require pre-testing. In addition, training of the field interviewers is critical to collect accurate data. Other data requirements may necessitate new sampling procedures implemented by the field interviewer (e.g. creel survey) that require the creation of new data collection procedures and additional training. Data collection issues, for example the collection of night data, isolated shoreline and islands, could be resolved by hiring a contractor to perform the data collection. However, measures must be taken to maximize the security of the field interviewers when collecting nighttime data. It may not be feasible to perform night interviews in all areas of Puerto Rico with acceptable security for personnel. Puerto Rico needs to prioritize the data needs, and then perform cost-estimate studies to balance immediate needs with available funding. We encourage appropriate testing of any modifications of existing collection forms or new sampling procedures.

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