

SUPPORTING STATEMENT
SURVEY OF SHORE-BASED NON-COMMERCIAL FISHING ON ST. CROIX,
U.S. VIRGIN ISLANDS
OMB CONTROL NO. 0648-xxxx

B. COLLECTIONS OF INFORMATION EMPLOYING STATISTICAL METHODS

1. Describe (including a numerical estimate) the potential respondent universe and any sampling or other respondent selection method to be used. Data on the number of entities (e.g. establishments, State and local governmental units, households, or persons) in the universe and the corresponding sample are to be provided in tabular form. The tabulation must also include expected response rates for the collection as a whole. If the collection has been conducted before, provide the actual response rate achieved.

Sample---Catch & Fisher Attribute Data

Respondent Universe and Sample Size Estimation

The potential study universe for the present data collection effort includes any person on St. Croix, USVI who engages in shore-based, non-commercial fishing from October 1, 2013 to September 30, 2014. In the USVI, non-commercial fishers are not generally required to secure a fishing permit or license to engage in the activity. Presently, non-commercial fishers are only required to secure permits when collecting baitfish in two marine reserves or harvesting shrimp in two public fishing areas, Altona Lagoon and Great Pond. Because fishing licenses are not required, the total number of fishers in the potential respondent universe is unknown.

However, based on a household survey conducted from December 1998 to July 1999, Ivan Mateo¹ estimated that the number of recreational anglers on St. Croix was 3,294. According to Mateo², on St. Croix, approximately 1,976 recreational anglers (60%) fish exclusively from shore, while and estimated 691 anglers fish from the shore as well as from a boat (21%). Thus, per the 1999 figures, there are approximately 2,667 residents of St. Croix who engage in shore-based, non-commercial fishing and comprise the potential universe.³

We expect to survey approximately 5 fishers per day in 183 sampling days for a minimum sample size of 915 fishers surveyed. A response rate of 90% has been typical of MRIP access-point angler intercept surveys. Thus, we anticipate a similar response rate for the present data

¹ Mateo R.I. 2004. Survey of Resident Participation in Recreational Fisheries Activities in the US Virgin Islands. P.p. 205-222 in the Proceedings of the Fifty-fifth Annual Gulf and Caribbean Fisheries Institute. XelHa, Mexico.

² Mateo (2004) reported a 75% response rate for St. Croix.

³ In caveat, however, according to the U.S. Census Bureau, total population on St. Croix declined by 4.9%, from 53,234 to 50,601 between 2000 and 2010. Much of this population reduction occurred in the Fredericksted and Northcentral subdistricts, which are reportedly areas of high fishing pressure by non-commercial fishers. Any impact this change in population may have had on the number of fishers on St. Croix is not evident.

collection; a non-response rate of 10% is assumed. To accommodate 10% non-response rate, a target sample size of 915 has been set:

N	Target Sample	Response Rate	Expected Sample
2667	915	0.9	824

Sample Selection

St. Croix, USVI poses a particularly challenging sampling context for shore-based, non-commercial fishers. Firstly, in the absence of a program for registration of non-commercial fishers, there is no readily identifiable sample frame. Secondly, the shoreline of St. Croix is relatively easy to access across much of the island, meaning that there are many locations where fishers may walk to and along the shoreline to engage in fishing activity. There are only a few places on St. Croix where fishers are prohibited from accessing the shoreline, such as on particular types of private property or where natural features impede access. In other words, access to the shoreline is largely open as opposed to being limited to just a few points where access-point intercept surveys could be reliably conducted. This circumstance makes execution of a stationary access-point survey inappropriate because many shore-based fishers would be missed if survey stations were set up at only a limited number of fishing access points.

Roving surveys and counts are ideally suited to locations where fishers may easily access a body of water from many different points.⁴ Additionally, roving surveys and counts are appropriate when researchers are interested in a particular body of water or a geographically bounded area, such as an island, lake or stretch of river. Consequently, we propose to collect survey and count data using a roving survey design. This data collection will utilize a spatiotemporal frame for sampling.

The sampling design is a multi-stage cluster sampling design. In the first stage, a sample of day units, the primary sampling units (PSUs), will be selected. Days will be stratified by weekday (M – F) and weekend/holiday⁵ (SAT-SUN, holidays). Day units, both weekday and weekend/holiday, will be sampled for each month during the 12 month study, October – September. Each month, half of the weekdays, or 50% coverage of all weekdays, will be sampled using equal probability sampling without replacement. Likewise, each month half of the available weekends, or 50% coverage of all weekend/holiday days, will be sampled using equal probability sampling without replacement.

The secondary sampling unit (SSU) will be a combination of shoreline unit and time interval, shoreline-time segment. Each fishing day (0700 to 2200) will be divided into 3-hour increments: 0700 to 1000; 1000 to 1300; 1300 to 1600; 1600 to 1900; and 1900 to 2200.

⁴ Malvestuto, S.P. et al. 1978. An Evaluation of the Roving Creel Survey with Non-Uniform Probability Sampling. *Transactions of the American Fisheries Society*. 107:255-262.; Pollock, K. et al. 1994. *Angler Survey Methods and Their Application in Fisheries Management*. Bethesda, MD: American Fisheries Society.

⁵ In the USVI, there are 15 territorial holidays that fall on a weekday. These days will be grouped with weekend days because fishing pressure on these days is expected to be similar to a weekend day when fishers are off of work, having additional leisure time.

We will divide the accessible coastline uniformly into 1 linear mile segments and then cluster these segments based on the following criteria:

- Fishing pressure—Each segment will be ranked numerically from 1 to 10, with 10 representing high fishing pressure and 1 representing low or none fishing pressure. Ranking will be based on:
 - number of known fishing access points and;
 - historic fishing pressure as reported in previous research and by territorial resource managers based on their local knowledge of the shore-based, non-commercial fishery.
- Sites with pressure codes of 8, 9 or 10 will not be clustered with other sites.
- Sites with a ranking of 7 or less will be clustered with up to two additional sites.
- Sites with a ranking of 3 or less will always be clustered with a site ranked 4 to 7. This is to ensure that each cluster contains at least one site with a positive degree of fishing pressure.
- To minimize driving time for the survey across the island, sites clustered will be located on the same shore of the island (i.e., north, south, east, or west).
- Stretches of coastline that are not accessible or available to shore-based fishers because of social (e.g., where shore-based fishing is prohibited by law or on private/restricted access property) or ecological (e.g., coastline characterized by sheer cliffs) factors will be excluded from the sample. Therefore, inferences derived from this study cannot be extended to these excluded areas.

Previous research findings and anecdotal information from territorial resource managers indicated that, generally speaking, fishing pressure on St. Croix is not intense for shore-based, non-commercial fishing, with the exception of certain holidays (e.g., Easter). Therefore, we propose to census the shore-based, non-commercial fishers who are present at the survey site once the surveyor arrives. In other words, after arriving at the survey site, the surveyor will interview every fisher encountered as he or she proceeds along the shoreline segment. Per survey period, assuming interviews take approximately 10 minutes to complete, and the fisher volume is sufficient, one surveyor could realistically complete 17 to 18 surveys during the survey period (3 hours). Should fishing pressure be extremely high during an assignment, meaning that a survey site has more than 17 fishers at the time of the survey, the surveyor will systematically sub-sample fishers for inclusion by selecting every k th fisher for the survey instead of completing a census. To determine the k interval to be used, the surveyor will count or estimate the total number of fishers within sight at the survey site. For sites with 17 to 37 fishers visible, the surveyor will sample every 2nd fisher for survey. For sites with more than 37 fishers visible, the surveyor will sample every 3rd fisher until the survey period has concluded. We expect the sampling scenarios to be necessary only occasionally, if at all.

Weights for Selection of Time of Day and Shoreline Unit

The SSU will be weighted so as to increase efficiency in sampling and to reflect expected fishing pressure. Previous research and anecdotal information from territorial resource managers indicates that fishing pressure is highest in the afternoon (1400 to 1700) and evening hours (1700 to 2100) for both weekdays and weekend days. Consequently, time of day will be weighted based on anticipated fishing pressure defined as the number of fishers expected by time of day (i.e., morning, mid-day, afternoon and evenings), with 1 representing low or no fishing pressure

and 2 representing high fishing pressure⁶, as follows:

Time Segment	Weight
0700 to 1000	1
1000 to 1300	1
1300 to 1600	2
1600 to 1900	2
1900 to 2200	2

Rankings are based on documented, historic fishing pressure patterns.⁷

Weights for shoreline unit will be based on expected fishing pressure. Each segment will be ranked numerically from 3 to 15, with 15 representing high fishing pressure and 3 representing low fishing pressure. Rankings will be based on:

- number of known fishing access points (Scale: 1 to 5)⁸;
- historic fishing pressure as reported in previous research (Scale: 1 to 5)⁹; and
- proximity to the midpoint of the segment in miles (Scale: 1 to 5)¹⁰ to the nearest population center, Christiansted or Fredericksted.¹¹

For each 1 mile segment, the weights for each factor will be summed. Rankings for shoreline segments within shoreline units (i.e., clusters) will be averaged, resulting in the final weight for each shoreline unit, for example:

Shoreline Unit ID	Weight
1	9
2	10
3	11
4	10
5	12
6	12
7	14
8	15
9	14

⁶ The pressure categories correspond to the range of fisher numbers expected by time of day on weekdays and weekend days, based on work by Mateo (2000): 2 = 6 or more fishers or 1 = 0 to 5 fishers.

⁷ Mateo, I et al. Activity and Harvest Patterns in the US Virgin Islands Recreational Fisheries. Report submitted to the US Fish and Wildlife Service, December 31, 2000. St. Thomas, USVI: USVI Department of Natural Resources.

⁸ Access Point Ranking: 5 = 4+ access pts; 4 = 3 access pts; 3 = 2 access pts; 2 = 1 access pts; 1 = 0 access pts

⁹ Fishing Pressure Ranking: (Estimated # of fishers per fishing day): 5 = 20+ fishers; 4 = 15 to 19; 3 = 11 to 14; 2 = 5 to 10; 1 = 0 to 4

¹⁰ Proximity to Population Ranking: 5 = 0 to 1.99 mi; 4 = 2.0 to 3.99 mi; 3 = 4.0 to 5.99 mi; 2 = 6.0 to 7.99 mi; 1 = 8.0 + mi

¹¹ Adams, A. et al. 1996. Activity and Harvest Patterns in the U.S. Virgin Islands Recreational Fisheries. Final Report to the U.S. Fish and Wildlife Service, Sports Fish Restoration Program. St. Thomas, USVI: USVI Department of Planning and Natural Resources, Division of Fish and Wildlife, 18pp.

10	13
11	16
12	16
13	6
14	7
15	6
16	7
17	7
18	9
19	10
20	10
21	9
22	8
23	8
24	5
25	8
26	10
27	11
28	10
29	10
30	10
31	10

The shoreline units and time segments will be combined to create 155 shoreline-time units. Weights for each shoreline unit will be summed with the corresponding weight for each of the 5 time segment units. For example, below is the weighting summary for Shoreline Unit 1 by each of the time segments:

Shoreline Unit ID	Time Segment	Shoreline Weight	Time Segment Weight	Total Weight for Shoreline-Time Segment Unit
		3 to 15	1 to 2	(Shoreline Weight + Time Segment Weight) 4 to 17
1	0700 to 1000	9	1	10
1	1000 to 1300	9	1	10
1	1300 to 1600	9	2	11
1	1600 to 1900	9	2	11
1	1900 to 2200	9	2	11

SSU will be selected using unequal probability sampling without replacement.¹² The probability of a shoreline-time segment unit being selected into the sample is:

$$P(ST_i) = \frac{W_{ST_i}}{\sum_{i=1}^{155} W_{ST_i}}$$

Where:

ST_i shoreline-time segment unit, with a range of $ST_1 \dots ST_{155}$

W_{ST_i} weight of shoreline-time segment unit, ST_i

¹² Pollock et al (1994).

Sample Selection—Effort Data

Data necessary to calculate fisher effort will be collected based on instantaneous fisher counts. The count portion of the project will be undertaken independently of the survey portion of the project and will not include collection of data directly from people. It will be based solely on observation. The sample for counts will be selected using same sampling protocol as for the selection of survey units.

2. Describe the procedures for the collection, including: the statistical methodology for stratification and sample selection; the estimation procedure; the degree of accuracy needed for the purpose described in the justification; any unusual problems requiring specialized sampling procedures; and any use of periodic (less frequent than annual) data collection cycles to reduce burden.

Statistical Methodology for Stratification

The PSU is day units. Sampling will be stratified by month and day of the week type. First, the sampling time period (12 months) will be stratified by month. A sample of days will be drawn at random for each month from October 2013 to September 2014. Within each month, we will stratify type of day, meaning weekday or weekend/holiday day. Each month, 0.50 of the weekdays, or 50% coverage of all weekdays, will be sampled using equal probability sampling without replacement. Likewise, each month 0.50 of the weekends/holidays, or 50% coverage of all weekend/holiday days, will be sampled using equal probability sampling without replacement.

The population size, stratum weight and stratum sample size are provided below:

Month	Day of Week Type	Stratum Population Size- Day Unit (N_h)	Stratum Weight ($W_h = N_h/N$)	Sample Size per Stratum -Day unit (n_h)
October				
	Weekday	20	0.0546448 1	10
	Weekend/ Holiday	11	0.0300546 4	6
November				
	Weekday	19	0.0519125 7	10
	Weekend/ Holiday	11	0.0300546 4	6
December				
	Weekday	20	0.0546448 1	10
	Weekend/ Holiday	11	0.0300546 4	6

January				
	Weekday	19	0.0519125 7	10
	Weekend/ Holiday	12	0.0327868 9	6
February				
	Weekday	21	0.0573770 5	11
	Weekend/ Holiday	9	0.0245901 6	5
March				
	Weekday	20	0.0546448 1	10
	Weekend/ Holiday	10	0.0273224	5
April				
	Weekday	19	0.0519125 7	10
	Weekend/ Holiday	12	0.0327868 9	6
May				
	Weekday	21	0.0573770 5	11
	Weekend/ Holiday	9	0.0245901 6	5
June				
	Weekday	22	0.0601092 9	11
	Weekend/ Holiday	8	0.0218579 2	4
July				
	Weekday	19	0.0519125 7	10
	Weekend/ Holiday	12	0.0327868 9	6
August				
	Weekday	22	0.0601092 9	11
	Weekend/ Holiday	8	0.0218579 2	4
September				
	Weekday	21	0.0573770 5	11
	Weekend/ Holiday	10	0.0273224	5

		N=366		n=183
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The population mean for the stratified population is

$$\bar{Y} = \sum_{h=1}^L W_h \bar{y}_h$$

while the stratified estimator (\bar{y}_{st}) and the variance are, respectively,

$$\bar{y}_{st} = \sum_{h=1}^L W_h \bar{y}_h$$

and

$$Var(\bar{y}_{st}) = \sum_{h=1}^L W_h^2 \frac{s_h^2}{n_h} \left(\frac{N_h - n_h}{N_h} \right)$$

where

L = number of strata

N_h = total number of units in stratum h ($h = 1, \dots, L$)

n_h = sample size in stratum h

W_h = stratum weight

y_{hi} = the value of the i th unit of for each stratum h

$\bar{y}_h = \left[\sum_{i=1}^{n_h} y_{hi} \right] / n_h$ is the mean for stratum h

s_h^2 = variance of stratum h .

Statistical Methodology for Sample Selection

We will employ a two stage cluster, unequal sampling design for this data collection. For each stratum, as described above, first, we will select the *day units* using simple random sampling without replacement. We will then select the *shoreline-time segment unit*, weighted for both shoreline unit and time segment, for which we will use unequal probability sampling (probability proportional to size) without replacement.

The Estimation Procedures

The following procedures will be used to calculate fishing effort, catch rate and total catch.

These procedures are appropriate for studies employing instantaneous counts to collect data for effort and on-site interviews of incomplete fishing trips to collect data for catch.¹³

Notation:

E total effort for the population

C total catch for the population

R catch rate for the population

¹³ Pollock et al (1994).

N	number of sampling units in the population
n	number of sampling units in the sample
n _h	number of sampling units for stratum <i>h</i>
e _i	fishing effort for the <i>i</i> th sampling unit
c _i	catch for the <i>i</i> th sampling unit
L _i	incomplete trip
I _i	instantaneous count of fishers in the <i>i</i> th sampling unit
π _i	inclusion probability

Fishing effort will be estimated by calculating fisher-hours, the sum of all hours fished by all fishers in the St. Croix shore-based, non-commercial fishery. Data from the fisher counts will be used to calculate effort:

$$\hat{E} = \sum_{i=1}^n (\hat{e}_i / \pi_i)$$

Catch rate will be calculated using the ratio of means estimator, as follows:

$$\hat{R}_2 = \frac{\frac{\left(\sum_{i=1}^n c_i \right)}{n}}{\frac{\left(\sum_{i=1}^n e_i \right)}{n}}$$

We will use the Horvitz-Thompson (HT) estimator for unequal probability sampling having a stratum population total of

$$\hat{Y}_{HT} = \sum_{i=1}^n y_i / \pi_i$$

a total population estimate of

$$\hat{Y}_{HT} = \sum_{i=1}^n y_i / \pi_i$$

and a variance of

$$\text{Var}(\hat{Y}_{HT}) = \sum_{i=1}^N \frac{(1 - \pi_i)}{\pi_i} y_i^2 + 2 \sum_{i=1}^N \sum_{j>i}^N \left[\frac{(\pi_{ij} - \pi_i \pi_j)}{\pi_i \pi_j} \right] y_i y_j$$

where π_{ij} is the probability of *i*th and *j*th units being sampled, *y_i* is the value for the *i*th primary unit and *y_j* is the value for the *j*th secondary unit.

Total catch will be estimated by calculating the number of fish caught by all fishers in the St. Croix shore-based, non-commercial fishery for the study period:

$$\hat{C} = \hat{E} * \hat{R}_2$$

Catch variance will be estimated by: $\widehat{Var}(\hat{C}) = \hat{E}^2 \widehat{Var}(\hat{R}) + \hat{R}^2 \widehat{Var}(\hat{E}) + \widehat{Var}(\hat{E}) \widehat{Var}(\hat{R})$

Attribute profiles for fisher activity, demographics and subsistence/dependency will be summarized using basic design-based univariate descriptive statistics. Associations between select independent (i.e., age, St.Croix residence, place of birth, income, employment, number of children in household, etc.) and dependent variables (i.e., satisfaction with access points, main reason for fishing, percentage of household food contribution, etc.) will be examined using the chi-square test and Cochran Mantzel Hansel test for survey data.

Unusual Problems Requiring Specialized Sampling Procedures

There are no unusual problems that require specialized sampling procedures.

3. Describe the methods used to maximize response rates and to deal with nonresponse. The accuracy and reliability of the information collected must be shown to be adequate for the intended uses. For collections based on sampling, a special justification must be provided if they will not yield "reliable" data that can be generalized to the universe studied.

We anticipate at least a 90% response rate for this data collection. We have developed a short survey so that we will not unduly inconvenience fishers. To increase awareness about the study and increase comfort among respondents, we plan to engage in outreach activities prior to the onset of data collection. The goal of these activities is to inform the fishing public about the need for the data, explain its uses, and describe how the interviews will be conducted. We plan to engage with the fishing public directly during two research open house events within the local community where we will talk about the project, demonstrate fish inspection procedures and equipment, and answer any questions that local fishers might have about the project. We have acquired the assistance of a science writer to help us develop informational materials that can be distributed to the fishing community prior to initiating data collection. Finally, we plan to talk with key stakeholder organizations and groups, such as the St. Croix Fishing Advisory Committee, to inform them about the project and answer any questions that they might have.

We will hire a local survey staff person who is familiar with the island, its culture and fishery, to complete the surveys. Our local collaborators indicate that fishers will be more comfortable with a local person and, thus, more willing to participate in the survey. Finally, local staff will be trained extensively on appropriate field interviewing etiquette and protocol.

Having said the above, we have been advised by our local collaborators that questions related to the fisher's income, employment, and subsistence/dependence may be objectionable and, thus, evoke a resistance to provide answers to these specific questions. To address this possibility we will develop a detailed "response to fisher questions" sheet for the surveyor to use when fishers inquire about why information is necessary. The surveyor will be instructed to rely on this set of answers and respond to any fisher questions about why we want such information. This will be done to increase fisher comfort with these questions. Additionally, for the income question, by recommendation of our reviewers, we will use an "income response card" so that a fisher may

point to his or her response of choice. This type of option has been shown to increase a respondent's comfort level when answering income questions because the respondent does not have to state their income level verbally around other people; it is more private. Nevertheless, by design, we have included these questions at the end of the survey in order to maximize the likelihood that the catch and demographic portions of the surveys will be completed prior to engaging the fisher on these items. Prior to data analysis, we will assess the refusal rate for each item on the survey and discard from further analysis any item that is not statistically reliable.

In general, non-response analyses will be undertaken to assess the impact of non-response on data quality per guidance issued via the OMB Standards and Guidelines for Statistical Surveys. Response rates will be calculated for the collection as a whole, for each stratum, as well as for each item on the survey. Where non-response is found to be an issue, we will examine patterns within the data to assess potential for presence of non-response bias in the data.

4. Describe any tests of procedures or methods to be undertaken. Tests are encouraged as effective means to refine collections, but if ten or more test respondents are involved OMB must give prior approval.

The survey was tested by our local collaborators on 5 randomly selected, shore-based, non-commercial fishers on St. Croix. The survey performed very well in that fishers understood and answered questions without concern or difficulty. However, in response to this test, we intend to develop and deploy with the surveyor an answer sheet with standard responses to anticipated questions about the survey and individual items. Surveyors will be instructed to respond to fisher questions about the need and use of subsistence and income questions using the answer sheet. Additionally, during outreach events, we will provide information to the fishing public about the need for data being collected, as well as its intended use.

5. Provide the name and telephone number of individuals consulted on the statistical aspects of the design, and the name of the agency unit, contractor(s), grantee(s), or other person(s) who will actually collect and/or analyze the information for the agency.

We consulted with Breda Munoz, PhD on aspects of the statistical design related to sampling and estimation.

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Theresa L. Goedeke and Peter Edwards will supervise data collection. Data analysis will be completed by Theresa L. Goedeke, Peter Edwards, and Juan Agar.

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