Development of a Stratified Sampling Design for Maryland Inland Waters

FY 2011 Proposal

Linda Barker
Created: 05/13/2015

1. Overview

1.1. Sponsor

1.2. Focus Group
Survey Design and Evaluation

1.3. Background
In 1981, NOAA Fisheries implemented two independent but complementary surveys that include a telephone survey of fishing effort and an access-site intercept survey of angler catch. Data from these two independent surveys are combined to estimate catch by species. Sampling and estimation are stratified by sub-region, state, fishing mode (shore, private/rental boat, party and charter boats), fishing area, for a 2-month ‘wave’ period.Although partitioned into fishing areas, MRFSS assumes a homogeneous distribution of fish and fishing within a fishing area. However, several states have geographically distinct areas within a defined MRFSS “fishing area” where neither the fish nor the fishing is homogeneously distributed. In Maryland for example, the Chesapeake Bay, and the coastal bays on the inshore side of the coastal barrier islands (Assateague and Fenwick Islands) are both grouped as part of the inland area. States with similar distinctions between fishing areas are New York, Maryland, Virginia, North Carolina and Florida.This project seeks to improve accuracy of Maryland inland catch estimates by developing survey changes to support stratification of the Maryland “inland” catch into separate Chesapeake Bay and coastal bays estimates.Although the inland area is randomly sampled, the access-site intercept survey contains few sample sites and sample days per wave in the coastal bays (typically 2 sites and 10 days), largely because the Chesapeake Bay is so much larger in area than the coastal bays. Furthermore, because there are so few coastal bays sampling sites, sampling often occurs where interviewers are likely to find fishing activity, possibly leading to biased results. Given that catch rates are developed using state-wide effort, it follows that mean value calculations for species that are found predominately in the coastal bays include a few high values and lots of zeroes. This form of data is always associated with inflated variance. Therefore, estimates of several species are very imprecise, and may also be biased.

1.4. Project Description
The goal of the project is to improve the catch and effort estimates in areas that are not stratified by the current MRFSS design but are geographically or biologically stratified. We will develop a stratified sampling design for Maryland inland waters based on the pilot project conducted in North Carolina. Other states that can benefit from a similarly modified survey design are New York, Virginia and Florida.The MRIP pilot project conducted in North Carolina tested the new and improved sampling methodology for the access-point angler intercept survey (APAIS) that determines catch rate. NMFS’ goal is to begin implementing the revised sampling design as quickly as possible. Implementation of the new methodology will require significant redesign of the survey sampling frame, which is a comprehensive list of fishing access sites (site register). This project will support implementation of the revised APAIS sampling design in Maryland by updating and expanding the site register. The site register will be updated to ensure complete coverage of all publicly-accessible fishing access sites, reflect current fishing activity (fishing pressure) at each site, describe the characteristics of each site, and support modifications needed for the revised APAIS sampling design (including information on night fishing activity). In order to support separate estimates for the coastal bays, additional sites must be added, along with estimates of fishing pressure. In addition to catch rate, effort estimates must be stratified as well. In addition to determining the distribution of current fishing pressure among Maryland’s inland waters, we will analyze the historical Coastal Household Telephone Survey (CHTS) data to quantify the distribution of historical effort among Maryland inland waters.The current telephone survey only asks the county in which the trip ended, which does not provide sufficient resolution to distinguish Chesapeake Bay from coastal bays for some counties, nor does the survey specifically ask where fish were caught. Therefore, we will add questions to the telephone survey to determine area fished.Development of the stratified design will include application of information developed in the background analyses to determine sample sizes needed in the intercept and telephone effort surveys.We see Maryland as the “test state” for development of a new stratified survey design that will be fully integrated into MRIP method. Therefore this project will have coastwide applicability to states such as New York, Virginia and Florida.

1.5. Public Description

1.6. Objectives
• Updated, expanded MD APAIS sampling frame (site register);• Determination of the historical distribution of fishing effort between MD Chesapeake Bay and coastal bays;• Modified telephone survey to determine area fished.

1.7. References

2. Methodology

2.1. Methodology
1. Update and QC Maryland intercept survey site register (sample frame) and add coastal bays sites to support stratification (MD

Fisheries). A large part of this project section is outreach to local experts to provide their input. The site register information (location, directions, description, angler use by month and day type) will be linked to an interactive map through a Google Maps application. Additional features of the maps will allow modifications to the proposed values for angler use. Input to update and expand this information will come from a combination of traditional outreach techniques and newer social media techniques. Face-to-face outreach will be conducted through a partnership with the Maryland Saltwater Sportfisherman's Association (MSSA). Workshops conducted at local member meetings will obtain information on sites from local anglers. MDNR Fisheries biologists will also being contacted and asked to provide input. Social media will be used to invite input from the general fishing public. The interactive map will be posted on the MDNR Fisheries website, with outreach through Twitter, posts on the MDNR Fisheries “Angler Log” website, and other traditional public relations posts and articles and social media outreach. We have already conducted one radio interview on a local outdoors show. The project will have a booth at the Maryland Seafood Festival in September. Field visits will provide verification of site information. 2. Analyze historical Coastal Household Telephone Survey (CHTS) data to quantify the distribution of historical fishing effort among inland water bodies (NMFS staff). This information will be used to determine the sample sizes needed to produce reasonably precise domain estimates for Chesapeake Bay and the coastal bays. The CHTS does not currently collect specific water bodies for area fished. County of return can be used as a proxy.3. Add questions to telephone effort survey to determine if inland trips occurred in Chesapeake Bay or coastal bays (MD Fisheries and NMFS staff). This information will be used to produce domain estimates for the specific water bodies. 4. Compilation of the information and development of a final report on the updated site register.

2.2. Region
Mid-Atlantic

2.3. Geographic Coverage
Maryland

2.4. Temporal Coverage
March 2011- Dec 2012

2.5. Frequency
Daily from March through October, 2011. Weekly in 2012.

2.6. Unit of Analysis
Site, fishing area, state.

2.7. Collection Mode
Face-to-Face workshops, phone, website, email, field visits (paper form, electronic form).

3. Communication

3.1. Internal Communication
Monthly conference calls between MDNR and NMFS project staff (Barker, Andrews, Sminkey). Information will be shared/distributed among project team members by email and posting materials to the MRIP Collaboration Tool.

3.2. External Communication
Input to update and expand this information will come from a combination of traditional outreach techniques and newer social media techniques. Face-to-face outreach will be conducted through a partnership with the Maryland Saltwater Sportfisherman's Association (MSSA). Workshops conducted at local member meetings will obtain information on sites from local anglers. MDNR Fisheries biologists will also being contacted and asked to provide input. Social media will be used to invite input from the general fishing public. The interactive map will be posted on the MDNR Fisheries website, with outreach through Twitter, posts on the MDNR Fisheries “Angler Log” website, and other traditional public relations posts and articles and social media outreach. We have already conducted one radio interview on a local outdoors show. The project will have a booth at the Maryland Seafood Festival in September. Monthly updates and notification of Angler workshops will be provided to Forbes Darby of the MRIP communications team. Monthly reports and a detailed final report will be submitted to the MRIP Operations Team.

4. Assumptions/Constraints

4.1. New Data Collection
Y

4.2. Is funding needed for this project?

4.3. Funding Vehicle

4.4. Data Resources
In order to quantify the distribution of fishing effort among inland water bodies, we will analyze historical Coastal Household Telephone Survey (CHTS) data. The CHTS does not currently collect specific water bodies for area fished, so the county in which an angler returned from a trip will be used as a proxy for area fished.

4.5. Other Resources
• MD Fisheries contractual employee, for site visits to update the Maryland site register through on-site verification of site locations, conditions and fishing pressures.• NMFS staff time for background analyses.

4.6. Regulations
Open fishing seasons for summer flounder and black sea bass.

4.7. Other

5. Final Deliverables
5.1. Additional Reports

5.2. New Data Set(s)
Updated, expanded Maryland site register with associated site fishing pressures.

5.3. New System(s)
Updated and expanded Maryland site register, re-designed APAIS to support stratification.

6. Project Leadership
6.1. Project Leader and Members

First Name	Last Name	Title	Role	Organization	Email	Phone 1	Phone 2
Rob	Andrews	Dr.	Team Member	NMFS	rob.andrews@noaa.gov	301-713-2328	
Linda	Barker	Dr.	Team Leader	Maryland Fisheries Service	lbarker@dnr.state.md.us	410-260-8284	
Jason	Didden		Team Member	MAFMC	jdidden@mafmc.org	302-526-5254	
Andrea	Hoover		Team Member	Maryland Fisheries Service	ahoover@dnr.state.md.us	410-260-8323	

7. Project Estimates
7.1. Project Schedule

Task #	Schedule Description	Prerequisite	Schedule Start Date	Schedule Finish Date	Milestone
1	Develop interactive map with sites and site information, linked to database for corrections	Receive existing site register and map of sites.	05/02/2011	08/26/2011	Y

Task #	Schedule Description	Prerequisite	Schedule Start Date	Schedule Finish Date	Milestone
5	Add questions to telephone effort survey to determine trip location.	Receive telephone survey questions.	11/07/2011	12/30/2011	Y
2	Workshops through partnership with MSSA and other angler groups	Develop site register information as handouts, make contacts with organizations	04/07/2011	10/28/2011	
7	Evaluation and Development of Final Report	6	03/06/2012	04/30/2012	
3	Post interactive map on MDNR website, traditional PR and social media outreach	Develop interactive map and corrections database and link them. Obtain IT permissions.	08/29/2011	09/12/2011	Y
4	Analyze historical CHTS data to quantify distribution of historical fishing effort	obtain CHTS data	08/15/2011	10/28/2011	Y
6	Analyze site data and formulate updated and expanded site register	1,2,3	01/02/2012	03/05/2012	Y

7.2. Cost Estimates

Cost Name	Cost Description	Cost Amount	Date Needed
Contractual support	1 part-time contractual employee @ $12.50/hr x 360 hrs	$4500.00	06/01/2011
Md Fisheries staff support	staff @ $35/hr x 300 hrs	$10500.00	05/01/2011
TOTAL COST		$15000.00	

8. Risk

8.1. Project Risk

Risk Description	Risk Impact	Risk Probability	Risk Mitigation Approach
Loss or limitation of support from MDNR Fisheries Database/WEB staff will delay or interrupt development of online site register survey tool.	Inability to obtain input from general public on site register information, since we will not be able to complete development of the online interactive map.	Low	Communication with MDNR Fisheries management to ensure support.

Risk Description	Risk Impact	Risk Probability	Risk Mitigation Approach
Loss of primary MDNR support staff	Loss of Linda Barker will move primary responsibility for the project to Andrea Hoover, who is working at 60% time, and delay completion of the project.	Low	Look both ways before crossing the street.
Loss of NMFS support staff to perform analysis of distribution of historical fishing effort between Chesapeake Bay and Maryland coastal bays.	Delay or inability to complete this section of the project.	Low	Hope Rob Andrews and Tom Sminkey look both ways before crossing streets.

9. Supporting Documents

"Final Report", page 1

Development of a Stratified Sampling Design for Maryland Inland Waters

Final Report

Prepared by
Linda S. Barker, Maryland Fisheries Service

July 31, 2013

EXECUTIVE SUMMARY

In Maryland, the Marine Recreational Information Program's (MRIP) "inland" area consists of two geographically distinct regions - the Chesapeake Bay and the much smaller Coastal Bays in Worcester County. Maryland fisheries management and stakeholders have agreed that some management strategies should be different for Chesapeake Bay and the Coastal Bays, but it has never been possible to distribute Maryland inland harvest estimates between the two areas. Because the Access Point Angler Intercept Survey (APAIS) has traditionally assigned a small proportion of sampling to the Coastal Bays, there is concern that if inland harvests were to be separated into Chesapeake and Coastal Bay estimates, the precision would be insufficient for confident management.

Summer flounder is a key species of concern for both areas, but in particular for the Coastal Bays. Historical inland harvest estimates have not met the minimum standard of 15 PSE (percent standard error) recommended for management by the Summer Flounder Technical Committee of the Atlantic States Marine Fisheries Commission (ASMFC), so stratified estimates would have even lower precision. The goal of this project was to develop and test a stratified sampling design for Maryland inland waters, to determine the feasibility of producing harvest estimates for both inland areas with reasonable levels of precision.

The first phase of the project was to update the MRIP site register. Maryland obtained site information and typical usage patterns from local angler groups, Maryland Department of Natural Resources (MDNR) fisheries biologists and MDNR Natural Resources Police. Approximately 40 new sites were suggested, bringing the total number of public fishing access sites to 261. All information was entered, checked and verified by September 30, 2012.

The 2004-2011 MRIP Survey Data "catch" and "trip" datasets were used to develop harvest and associated variance estimates for ASMFC-managed recreational species that are found in Maryland's inland waters - Bluefish, Atlantic Croaker, Spot, Striped Bass, Summer Flounder and Weakfish. Sample sizes necessary to achieve 15, 20, 25 and 30 PSE were calculated for the complex of species by inland region and fishing mode. The primary sample unit (psu) for the APAIS is the site/day and was used as the sample size in the analysis.

The analysis demonstrated that historical sampling levels are significantly lower than the current precision target set for management. In order to achieve 30 PSE across all fishing modes for this complex of species, an overall increase of approximately 5 times the historical number of interviews is estimated. In order to achieve 15 PSE across all fishing modes for this complex of species, an overall increase of 20 times the historical number of interviews is estimated.

This analysis was done in terms of site-day assignments, but the new APAIS design is conducted by assignments in 6-hour time blocks at a cluster of 1-3 sites. The exact relationship between the number of interviews obtained by site-day and 6-hour time blocks is yet to be determined.

INTRODUCTION

Background

In 1981, the National Marine Fisheries Service (NMFS) implemented two independent but complementary surveys that include a telephone survey of fishing effort and an access-site intercept survey of angler catch. Data from these two independent surveys are combined to estimate catch by species. Sampling and estimation are stratified by sub-region, state, fishing mode (shore, private/rental boat, party and charter boats), fishing area (federal waters, state waters of the Atlantic Ocean, inland) for each 2-month 'wave' period.

In general, neither the fish nor the fishing effort are homogeneously distributed within state waters. Although the MRIP surveys make no assumptions about the distribution of fish, and sampling is allocated in proportion to expected fishing, precision may be improved by identifying strata that are likely to be more homogeneous. In Maryland, the "inland" area consists of two distinct regions - the Chesapeake Bay and the Coastal Bays on the inshore side of the coastal barrier islands (Assateague and Fenwick Islands). States with similar distinctions between fishing areas are New York, Virginia, North Carolina and Florida.

The goal of the project was to improve the precision of catch and effort estimates for species whose distribution of harvest is geographically stratified within an MRIP area. There is a complex of species managed through ASMFC that are found in Maryland's "inland" waters – Bluefish, Atlantic Croaker, Spot, Striped Bass, Summer Flounder and Weakfish. Maryland fisheries management and stakeholders have agreed that management strategies should be different for Chesapeake Bay and the Coastal Bays, but it has never been possible to distribute the "inland" harvest estimates among the two areas. Summer Flounder is of particular concern because it is a key recreational species in the Coastal Bays of Maryland but very few are caught in Chesapeake Bay and the precision of historical inland harvest estimates has been poor.

Project Description

The original design of this project was to develop and test a stratified sampling design for Maryland "inland" waters. The project was to be conducted as preparation, design, implementation and evaluation over the period of March 2011 – July 2013.

The project objectives were to:

1. Update and expand Maryland's APAIS site register (March-December 2010);
2. Determine the historical distribution of fishing effort among Maryland "inland" waters;
3. Modify the telephone survey to determine area fished;
4. Determine sample sizes necessary to support stratified estimates;
5. Conduct the stratified APAIS and modified telephone effort survey (2012); and
6. Evaluate stratified estimates (January-June 2013).

The project did not complete the final two objectives within the specified time frame due to delays in the implementation of Objective 1 and the inability to modify the telephone survey. The

focus of the project became the determination of appropriate sample sizes to support a stratified design.

METHODS

Objective 1. Update and expand Maryland's APAIS site register .

The first phase of the project was to update the MRIP site register, anticipating that new sites may have been needed in the Coastal Bays area. In 2010, we began meeting with local Maryland Saltwater Sportfishing Association (MSSA) angler groups to request site pressure information and began development of a web-based application to request information from the general public. Information provided by NMFS in 2011 indicated that the site register updates were to be provided at a finer time scale than requested previously, that site information was also going to be requested, and that the time frame for implementation of the new APAIS had been delayed by at least a year. In February 2012, NMFS provided a website to be used by all states to update the MRIP site register. This website requested site usage information in 6-hour time increments as well as detailed site information. All site usage and lat/long information (over 70,000 values) was requested by July 1, 2012, and all other information was requested by October of 2012.

In order to provide this information within such a short time, we abandoned the web-based application and requested support from three groups with local fishing knowledge. We contacted members of local MSSA angler groups that were supportive of the project from our initial contacts in 2010, we asked DNR fisheries biologists to provide information about fishing sites where they live (and fish), and we partnered with Maryland DNR Natural Resource Police to obtain information from the officers with expertise in their patrol areas.

Almost 50 individuals volunteered to share their expertise based on years of experience with their local fishing access sites. Approximately 40 new sites were suggested, bringing the total number of survey sites to 261. A DNR intern obtained site information that was not supplied by our partners through internet searches (map-based information, marina websites, MDNR boating ramps website and fishing blogs) and site visits.

All site information was gathered and entered into excel spreadsheets, then each value had to be entered by hand in the NMFS website. Our efforts in the months of June and July of 2012 were primarily focused on QA/QC of the data. The Maryland site register update was completed in September of 2012.

Objective 2. Determine the historical distribution of fishing effort among Maryland "inland" waters.

In order to determine the sample sizes needed to produce reasonably precise estimates for Chesapeake Bay and the Coastal Bays (Objective 4), it was necessary to develop and examine the relationship between sample size and precision of harvest estimates for targeted species. In order to develop harvest estimates, estimates of effort were necessary.

The original project proposal planned to accomplish this through an analysis of historical Coastal Household Telephone Survey (CHTS) data but it was accomplished through the use of published MRIP Survey Data datasets and code developed by NMFS and made available to the public in July 2012 at http://www.st.nmfs.noaa.gov/st1/recreational/MRIP_SAS_Data/. These data sets are based on both APAIS and CHTS data and the MRIP weighted estimation design. APAIS sample weights are post-stratified to reflect the total state effort estimate derived from the CHTS such that the sum of all sample weights is equal to the total effort estimate.

The SAS code provided in Appendix A was applied to the MRIP Survey Data "trip" datasets for 2004 - 2011. The data were subset to the inland area (variable "AREA_X" coded as "5"). The "inland" data were then assigned to regions – Chesapeake Bay or the Coastal Bays. The Coastal Bays region was defined as Worcester County, exclusive of sites on Chesapeake Bay (#9 Pocomoke State Park Shad Landing Marina, #818 Milburn Landing at Pocomoke State Park and #925 Byrd Park). The Chesapeake Bay region was defined as all remaining "inland" sites. The SAS "Proc Surveymeans" analysis was used to calculate the number of trips in each region by fishing mode. The code and sample SAS output are provided in Appendix A.

Objective 3. Modify the telephone survey to determine area fished.

The purpose of this objective was to produce a method to provide distinct effort estimates for Maryland Chesapeake Bay and Coastal Bays in future recreational management decisions. By asking anglers the location of their trip, a stratified effort estimate could have been calculated as a post-stratification of "inland" effort estimate. However, due to practical difficulties associated with survey changes (Office of Management and Budget approval), NMFS suggested that future stratified effort estimates be produced as a post-stratification of the APAIS using the published MRIP Survey Data, the same technique used to accomplish Objective 2.

Objective 4. Determine sample sizes necessary to support stratified estimates.

We used the 2004-2011 MRIP survey data to develop harvest and associated variance estimates for ASMFC-managed recreational species that are found in Maryland's "inland" waters - Bluefish, Atlantic Croaker, Spot, Striped Bass, Summer Flounder and Weakfish. The SAS code provided in Appendix A was applied to both the MRIP Survey Data "trip" datasets and the MRIP Survey Data "catch" datasets for 2004 - 2011.

The primary sample unit (psu) for the APAIS is the site/day of assigned interviews and was used as the sample size unit in the analysis. Completed intercepts were not used because they cannot be predicted or controlled.

Calculations were performed for each fishing mode and "inland" region. Results from each analysis included harvest, standard deviation (which was the standard error of the harvest) and sample size (the number of annual APAIS site-days).

The sample size analysis was based on the relationship between standard error, sample size and standard deviation. Since by definition,

$$SE = \frac{S}{\sqrt{n}} \quad (1)$$

where SE is standard error, S is standard deviation and n is the sample size. Standard error can be expressed as a percent of harvest (X), known as percent standard error or PSE,

$$PSE = 100\frac{SE}{X} \quad (2)$$

so the sample size necessary for a level of precision, *p*, can be calculated as

$$n_p = \frac{S^2}{p\hat{X}} \quad (3)$$

The sample sizes necessary to achieve various levels of precision were calculated for each species by "inland" region and fishing mode for all years of the available time series. The mean value over all years (2004-2011) for each level of precision was used to develop the relationship between precision and sample size, from which graphs were developed for each fishing mode and region.

The ASMFC Addendum XVII to the Summer Flounder, Scup and Black Sea Bass Fishery Management Plan (Summer Flounder Recreational Management) recommends a precision of 15 PSE for summer flounder management. Therefore, we estimated the sample sizes needed to achieve 15, 20, 25 and 30 PSE and determined the proportional increase over mean historical sample sizes that would be required to achieve target PSE for each species. These increases were compared against the relative proportion of harvest to develop appropriate sampling levels for the complex of species. Weighting based on proportion of total harvest reduced the effect of least important species on recommended sampling levels. For example, low precision for a region (Coastal Bays) and fishing mode (charter boat) in which there is very low harvest will not affect management of that species.

RESULTS and DISCUSSION

Objective 1. Update and expand Maryland's APAIS site register .

All information was entered, checked and verified by September 30, 2012. Detailed information on the site register update is presented in Appendix B.

Objective 2. Determine the historical distribution of fishing effort among Maryland "inland" waters.

Based on analysis of 2004-2011 data, the Coastal Bays account for approximately 20% of "inland" fishing trips in Maryland (Figure 1a). However, APAIS sampling is stratified by fishing mode, so the comparison of interest is between the areas within a fishing mode. The Coastal Bays typically accounted for 63% of party boat angler trips, 33% of shore angler trips, 13% of the private and rental boat angler trips and approximately 2% of charter boat angler trips (Figure 1b).

Objective 3. Modify the telephone survey to determine area fished.

This objective was eliminated because NMFS staff determined that the legal requirements for modification of the MRIP telephone survey were excessively burdensome, and that post-stratification could provide the same information.

Objective 4. Determine sample sizes necessary to support stratified estimates.

Depending on fishing mode, 2-63% of total "inland" samples have been assigned in the Coastal Bays (Figure 1b). This sample distribution has produced estimates with between 15 and 100 PSE, depending on species, mode and area (Figures 2 – 5).

The determination of the relationship of sample size and precision involved several steps. The historical statistics provided a time series of sample size vs. standard deviation. A detailed example of this calculation for Summer Flounder, private/rental boat fishing mode, Chesapeake Bay region is presented in Table 1. Mean values over the time series were used describe the relationship between precision and mean sample size for each species (Table 2). Table 3 presents the sample sizes as proportional increase over historical sampling levels for four levels of precision (30, 25, 20 and 15 PSE). The graphical representation of these relationships is provided by area and fishing mode in Figures 6-13. A detailed discussion of these results follows, organized by fishing mode and "inland" region.

Shore Mode Fishing

Chesapeake Bay (Figure 6)

Bluefish, Croaker, Spot and Striped Bass are regularly caught from shore in Chesapeake Bay but only Bluefish and Spot have greater than 5% of the total species "inland" harvest (13% and 14%). The historical precision has been approximately 50 PSE. A 3-fold increase over historical sampling is estimated to achieve 30 PSE for these two species, but further improvements in precision are less efficient (4-fold for 25 PSE, 7-fold for 20 PSE, and 12-fold for 15 PSE).

Coastal Bays (Figure 7)

Summer Flounder and Bluefish are the only species regularly caught from shore in the Coastal Bays but only Summer Flounder has harvest is greater than 5% of the total species "inland" harvest (19%). Precision has been very low (80 PSE). An 8-fold increase over historical

sampling is estimated to achieve 30 PSE, but further improvements in precision are less efficient (11-fold for 25 PSE, 17-fold for 20 PSE, and 31-fold for 15 PSE).

Party Boat Mode Fishing

Chesapeake Bay (Figure 8)
Spot is the only species caught from party boats in Chesapeake Bay with greater than 5% of the total "inland" species harvest (7%). Precision has been approximately 53 PSE. A 3-fold increase over historical sampling is estimated to achieve 30 PSE, but further improvements in precision are less efficient (4-fold for 25 PSE, 7-fold for 20 PSE, and 12-fold for 15 PSE).

Coastal Bays (Figure 9)
Party boat harvest for all studied species in the Coastal Bays is negligible, since there are very few party boats operating in that area.

Charter Boat Mode Fishing

Chesapeake Bay (Figure 10)
All species but Summer Flounder show more than 5% of their "inland" harvest from charter boats in Chesapeake Bay. The precision varies by species, from 15 PSE for Striped Bass to 100 PSE for Weakfish. A 5-fold increase over historical sampling is estimated to achieve 30 PSE for Bluefish, Croaker and Spot, but further improvements in precision are less efficient (9-fold for 25 PSE, 12-fold for 20 PSE, and 22-fold for 15 PSE). To include weakfish at these levels of precision would require double these levels of sampling.

Coastal Bays (Figure 11)
Charter boat harvest for all species in the Coastal Bays is negligible, since there are very few charter boats operating in that area.

Private/Rental Boat Mode Fishing

Chesapeake Bay (Figure 12)
All species are regularly caught from private and rental boats in Chesapeake Bay (Figs 2a-6a) with significant portions of the harvest from this sector (32-85%). Historical sample sizes have produced good precision for Striped Bass (18 PSE) and would produce 30 PSE for Bluefish, Croaker and Spot. To bring Summer Flounder to 30 PSE would require a 6-fold increase in sampling, and Weakfish would require a 9-fold increase in sampling. Further improvements in precision are fairly linear for the Bluefish/Croaker/Spot complex (2-fold for 25 PSE, 3-fold for 20 PSE, and 5-fold for 15 PSE). To achieve these levels of precision for Summer Flounder would require approximately 4 times these levels of sampling.

Coastal Bays (Figure 13)
Only Summer Flounder has more than 5% of harvest in this sector (45%). Precision has been approximately 50 PSE. A 3-fold increase over historical sampling is estimated to achieve 30 PSE, and further improvements in precision are fairly linear (4-fold for 25 PSE, 6-fold for 20 PSE) unless 15 PSE is desired (11-fold increase).

CONCLUSION

This work provided guidance for levels of sampling required to achieve desired levels of precision to support regional management in Maryland's "inland" area. The analysis demonstrated that historical sampling levels are significantly lower than what is needed for currently required management-level precision, given the observed level of variance. In order to achieve 15 PSE across all fishing modes for this complex of species, an overall increase of 30 times the historical number of interviews is estimated (Table 4). In order to achieve 30 PSE across all fishing modes for this complex of species, an overall increase of approximately 5 times the historical number of interviews is estimated (Table 4). These results are consistent with the experience of states such as North Carolina, that fund more than 5 times the basic level of MRIP sampling in order to reach precision acceptable for management (personal communication, Doug Mumford, NC Division of Marine Fisheries).

These predicted increases in sampling effort are dependent on several factors beyond the scope of this analysis. Changes in species abundance and fishing effort will affect variance of catch rates and effort estimates. The use of recreational saltwater angler registry might also positively affect PSEs of catch estimates by reducing variance of effort estimates, reducing the required number of samples for a selected level of precision. Finally, this analysis was done in terms of site-day assignments, but the new APAIS design is conducted by assignments in 6-hour time blocks at a cluster of 1-3 sites. The exact relationship between the number of interviews obtained by site-day and 6-hour time blocks is yet to be determined.

As clearly seen from our results, the best precision (low PSE) has been achieved for the most abundant and most popular target species - Striped Bass in Chesapeake Bay and Summer Flounder in the Coastal Bays. With changes in other species abundance, catch rates and precision estimates will vary accordingly. However, achieving equal levels of precision for all species does not seem to be practical or possible. Therefore, the focus should be on the most important recreational species.

REFERENCES

Atlantic States Marine Fisheries Commission, August 2005. Addendum XVII to the Summer Flounder, Scup and Black Sea Bass Fishery Management Plan, Summer Flounder Recreational Management.

"Final Report", page 11

TABLES

Table 1. Sample Size Analysis for Summer Flounder, Private/Rental Fishing Mode, Chesapeake Bay Region

YEAR	N	HARVEST	SE	S	N_{60PSE}	N_{45PSE}	N_{30PSE}	N_{20PSE}	N_{15PSE}
2004	167	25,170	8,928	115,369	58	104	233	525	934
2005	117	49,672	40,263	435,511	214	380	854	1,922	3,417
2006	105	4,964	3,116	31,931	115	204	460	1,034	1,839
2007	109	27,599	12,959	135,296	67	119	267	601	1,068
2008	105	4,618	2,990	30,636	122	217	489	1,100	1,956
2009	144	20,521	8,688	104,253	72	127	287	645	1,147
2010	143	1,766	1,766	21,114	397	706	1,589	3,575	6,356
2011	174	207	207	2,732	483	859	1,933	4,350	7,733
mean	***133***				***191***	***340***	***764***	***1,719***	***3,056***

Table 2. Relationship between Precision and Sample Size by "Inland" Region, Species, and Fishing Mode

Species	Chesapeake Bay						Coastal Bays					
	$N_{2004-2011}$	N_{60PSE}	N_{45PSE}	N_{30PSE}	N_{20PSE}	N_{15PSE}	$N_{2004-2011}$	N_{60PSE}	N_{45PSE}	N_{30PSE}	N_{20PSE}	N_{15PSE}
Shore Fishing Mode												
Bluefish	58	46	81	182	410	728	20	65	116	260	585	1,040
Croaker	58	106	188	423	952	1,693	20	43	77	172	388	689
Spot	58	37	66	148	333	591	20	92	163	367	825	1,467
Striped Bass	58	64	113	255	574	1,021	20	47	84	189	425	756
Summer Flounder	58	139	247	556	1,250	2,222	20	39	68	154	347	616
Weakfish	58	N/A	N/A	N/A	N/A	N/A	20	N/A	N/A	N/A	N/A	N/A
Party Boat Fishing Mode												
Bluefish	20	19	34	77	173	307	40	47	83	186	419	744
Croaker	20	14	24	54	123	218	40	60	106	239	538	957
Spot	20	16	28	63	141	251	40	N/A	N/A	N/A	N/A	N/A
Striped Bass	20	27	48	107	241	429	40	72	127	287	645	1,146
Summer Flounder	20	59	105	236	531	944	40	12	21	48	108	193
Weakfish	20	26	47	105	237	422	40	N/A	N/A	N/A	N/A	N/A
Charter Boat Fishing Mode												
Bluefish	69	15	27	60	136	242	3	N/A	N/A	N/A	N/A	N/A
Croaker	69	94	166	374	842	1,496	3	N/A	N/A	N/A	N/A	N/A
Spot	69	38	67	151	341	605	3	N/A	N/A	N/A	N/A	N/A
Striped Bass	69	4	8	17	38	68	3	6	10	22	50	89
Summer Flounder	69	163	290	653	1,469	2,611	3	5	9	20	45	79
Weakfish	69	186	331	744	1,675	2,978	3	N/A	N/A	N/A	N/A	N/A
Private/Rental Boat Fishing Mode												
Bluefish	133	46	81	183	411	730	15	28	50	111	251	446
Croaker	133	44	79	178	400	712	15	29	52	118	265	471
Spot	133	30	47	120	271	481	15	37	66	148	333	592
Striped Bass	133	12	21	48	108	192	15	41	72	162	365	649
Summer Flounder	133	191	340	764	1,719	3,056	15	10	18	41	91	162
Weakfish	133	285	506	1,138	2,561	4,553	15	53	94	211	475	844

"Final Report", page 12

Table 3. Proportional Sampling Increase for 30, 25, 20 and 15 PSE by "Inland" Region, Domain, Species, and Fishing Mode
(Species with more than 5% of total species harvest in this area and fishing mode are denoted by bold print.)

Species	Chesapeake Bay								Coastal Bays							
	Mean Harvest 2004-2011	% of Species Total Inland Harvest	Mean PSE 2004-2011	Mean N 2004-2011	N_{30PSE} : $N_{2004-2011}$	N_{25PSE} : $N_{2004-2011}$	N_{20PSE} : $N_{2004-2011}$	N_{15PSE} : $N_{2004-2011}$	Mean Harvest 2004-2011	% of Species Total Inland Harvest	Mean PSE 2004-2011	Mean N 2004-2011	N_{30PSE} : $N_{2004-2011}$	N_{25PSE} : $N_{2004-2011}$	N_{20PSE} : $N_{2004-2011}$	N_{15PSE} : $N_{2004-2011}$
Shore Fishing Mode																
Bluefish	**52,228**	**13**	**52**	**58**	**3**	**4**	**7**	**12**	23,754	6	100	20	13	19	29	52
Croaker	31,365	4	79	58	7	10	16	29	1,188	0	-	20	9	12	19	34
Spot	**256,287**	**14**	**48**	**58**	**3**	**4**	**6**	**10**	237	0	-	20	18	26	41	73
Striped Bass	**23,634**	**6**	**61**	**58**	**4**	**6**	**10**	**18**	184	0	-	20	9	14	21	38
Summer Flounder	204	0	-	58	10	14	21	38	**10,222**	**19**	**80**	**20**	**8**	**11**	**17**	**31**
Weakfish	0	0	-	58					-	0	-	20				
Party Boat Fishing Mode																
Bluefish	3,149	1	58	20	4	6	9	15	223	0	67	40	5	7	10	19
Croaker	33,700	4	46	20	3	4	6	11	402	0	75	40	6	9	13	24
Spot	**122,979**	**7**	**53**	**20**	**3**	**4**	**7**	**12**	-	0	-	40	0	0		
Striped Bass	996	0	63	20	5	8	12	21	2	0	100	40	7	10	16	29
Summer Flounder	29	0	100	20	12	17	26	47	909	0	34	40	1	2	3	5
Weakfish	259	4	70	20	5	8	12	21	-	0	-	40				
Charter Boat Fishing Mode																
Bluefish	**81,523**	**21**	**29**	**69**	**1**	**1**	**2**	**4**	-	0	-	3				
Croaker	**144,590**	**17**	**71**	**69**	**5**	**9**	**12**	**22**	-	0	-	3				
Spot	**311,914**	**17**	**41**	**69**	**2**	**3**	**5**	**9**	-	0	-	3				
Striped Bass	**168,169**	**41**	**15**	**69**	**0**	**0**	**1**	**1**	28	0	-	3	7	11	17	30
Summer Flounder	326	1	85	69	10	14	21	38	318	1	100	3	7	10	15	26
Weakfish	**791**	**11**	**100**	**69**	**11**	**16**	**24**	**43**	-	0	-	3				
Private & Rental Boat Fishing Mode																
Bluefish	**225,408**	**57**	**34**	**133**	**1**	**2**	**3**	**5**	5,947	2	76	15	7	11	17	30
Croaker	**600,440**	**70**	**34**	**133**	**1**	**2**	**3**	**5**	44,326	5	78	15	8	11	18	31
Spot	**1,118,030**	**61**	**29**	**133**	**1**	**1**	**2**	**4**	9,179	1	100	15	10	14	22	39
Striped Bass	**217,097**	**53**	**18**	**133**	**0**	**1**	**1**	**1**	2,989	1	100	15	11	16	24	43
Summer Flounder	**16,815**	**32**	**67**	**133**	**6**	**8**	**13**	**23**	**23,737**	**45**	**50**	**15**	**3**	**4**	**6**	**11**
Weakfish	**5839**	**85**	**86**	**133**	**9**	**12**	**19**	**34**	-	0	-	15	14	20	32	56

"Final Report", page 13

Table 4. Proportional Increases in Sampling Estimated to Achieve Precision Levels of 15 and 30 PSE for the Maryland "Inland" Species Complex

Fishing Mode	Proportional Increase over Historical Sampling Levels To Achieve 30 PSE		Proportional Increase over Historical Sampling Levels To Achieve 15 PSE	
	Chesapeake Bay	Coastal Bays	Chesapeake Bay	Coastal Bays
Shore	3	8	12	31
Party Boat	3	1	12	1
Charter Boat	5	1	15	1
Private & Rental Boat	6	3	60	11
Total	**4.5**		**30**	

FIGURES

Figure 1a. Mean “Inland” Angler Trips (2004-2011) in Chesapeake Bay vs. Coastal Bays

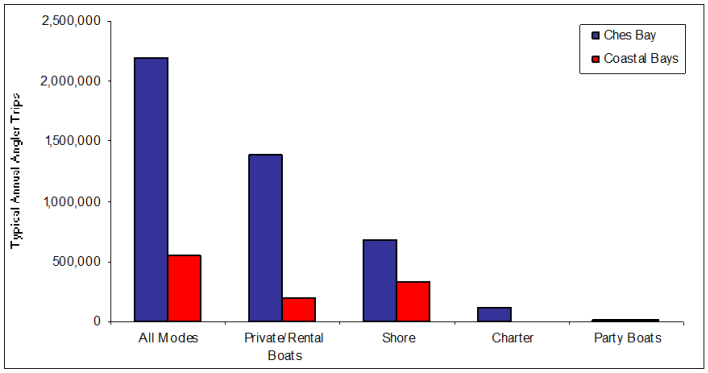


Figure 1b. Percent Mean “Inland” Angler Trips (2004-2011) in Chesapeake Bay vs. Coastal Bays

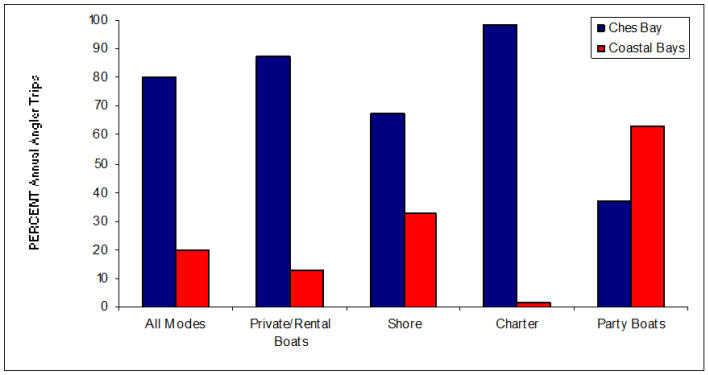


Figure 2. Bluefish Sample Size vs. Shore Harvest PSE and Private/Rental Boat Harvest PSE

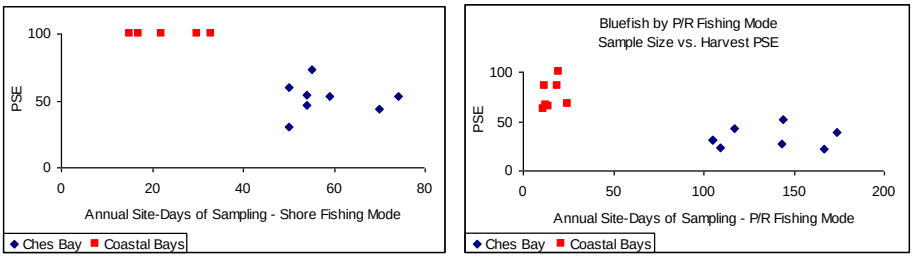


Figure 3. Croaker Sample Size vs. Shore Harvest PSE and Private/Rental Boat Harvest PSE

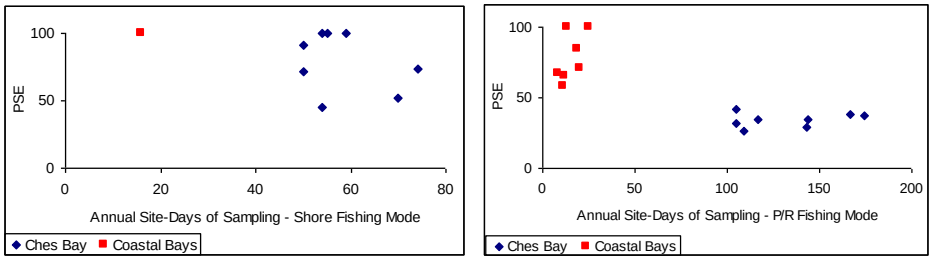


Figure 4. Striped Bass Sample Size vs. Shore Harvest PSE and Private/Rental Boat Harvest PSE

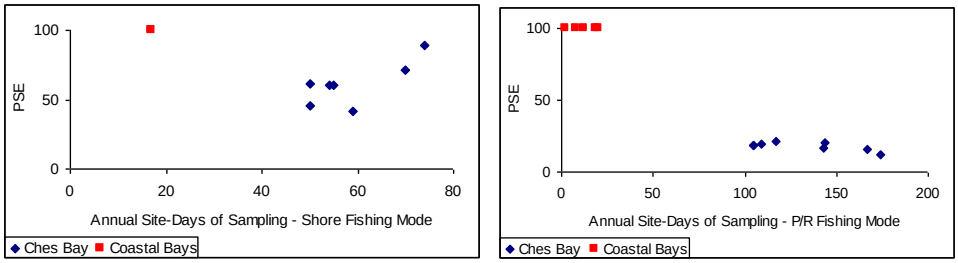


Figure 5. Summer Flounder Sample Size vs. Shore Harvest PSE and Private/Rental Boat Harvest PSE

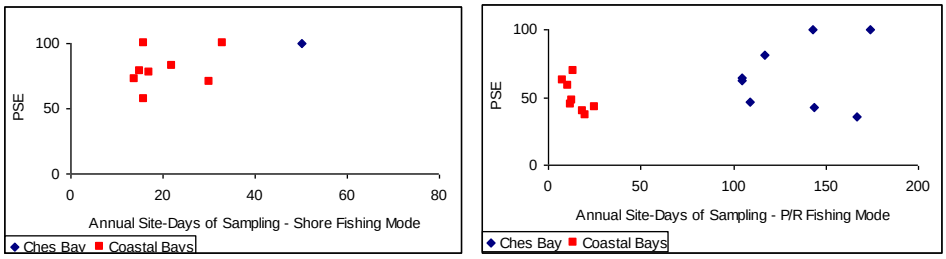


Figure 6. Shore Fishing Mode – Chesapeake Bay. Proportional Sampling Increase over Historical Levels vs. Estimated "Inland" Harvest Precision for Bluefish, Croaker, Spot, Striped Bass and Summer Flounder. (Species with more than 5% of total species harvest in this area and fishing mode are denoted by heavy lines in the graph.)

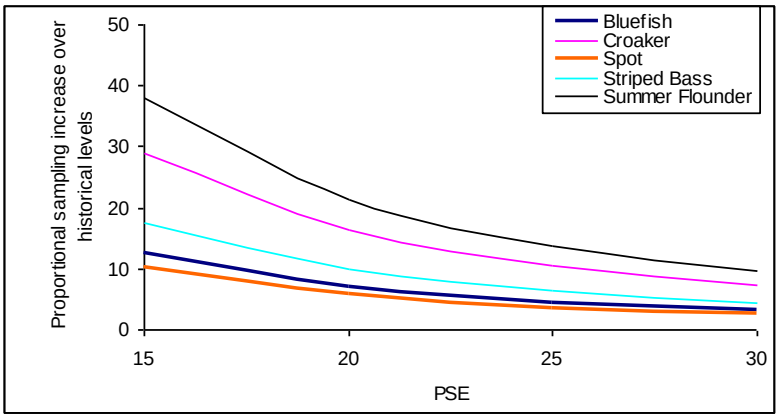


Figure 7. Shore Fishing Mode – Coastal Bays. Proportional Sampling Increase over Historical Levels vs. Estimated "Inland" Harvest Precision for Bluefish, Croaker, Spot, Striped Bass and Summer Flounder. (Species with more than 5% of total species harvest in this area and fishing mode are denoted by heavy lines in the graph.)

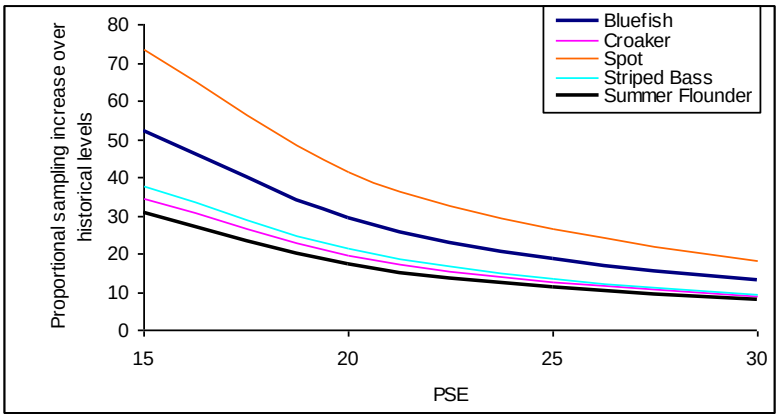


Figure 8. Party Boat Fishing Mode – Chesapeake Bay. Proportional Sampling Increase over Historical Levels vs. Estimated "Inland" Harvest Precision for Bluefish, Croaker, Spot, Striped Bass and Summer Flounder.
(Species with more than 5% of total species harvest in this area and fishing mode are denoted by heavy lines in the graph.)

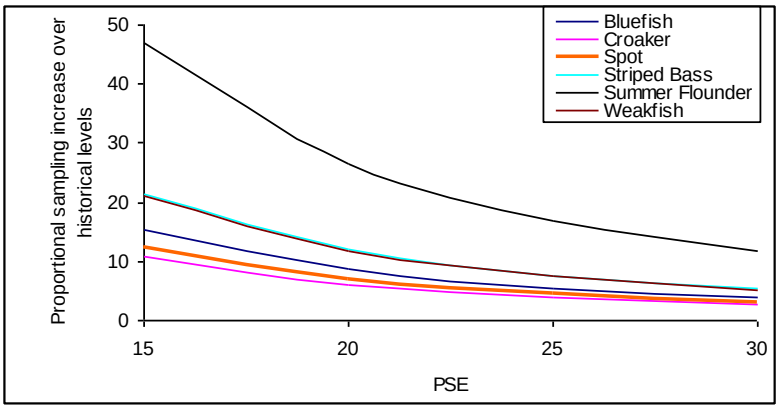


Figure 9. Party Boat Fishing Mode – Coastal Bays. Proportional Sampling Increase over Historical Levels vs. Estimated "Inland" Harvest Precision for Bluefish, Croaker, Spot, Striped Bass and Summer Flounder.
(Species with more than 5% of total species harvest in this area and fishing mode are denoted by heavy lines in the graph.)

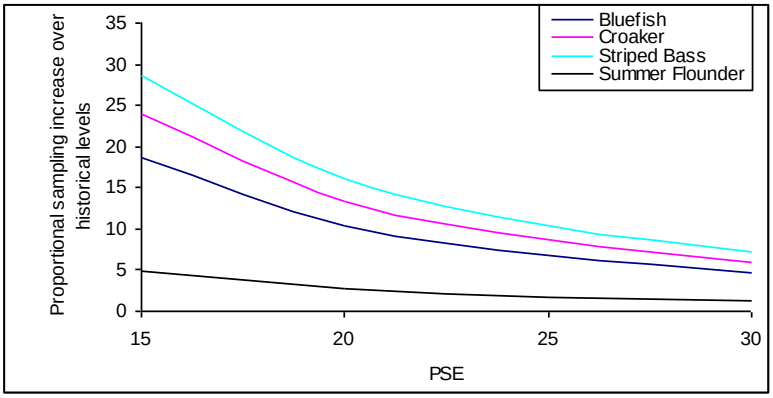


Figure 10. Charter Boat Fishing Mode – Chesapeake Bay. Proportional Sampling Increase over Historical Levels vs. Estimated "Inland" Harvest Precision for Bluefish, Croaker, Spot, Striped Bass and Summer Flounder.
(Species with more than 5% of total species harvest in this area and fishing mode are denoted by heavy lines in the graph.)

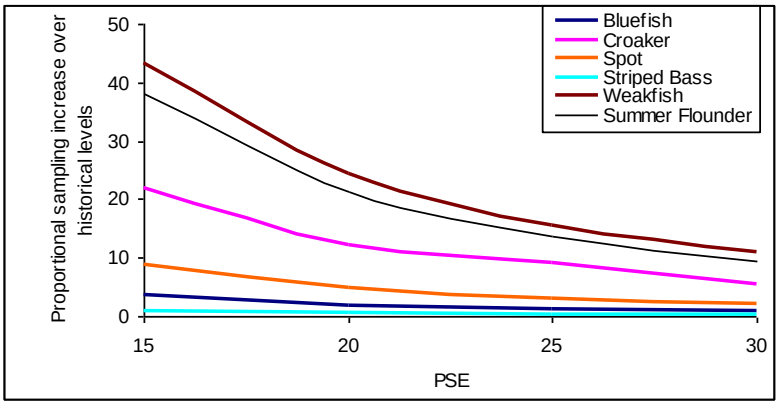


Figure 11. Charter Boat Fishing Mode – Coastal Bays. Proportional Sampling Increase over Historical Levels vs. Estimated "Inland" Harvest Precision for Bluefish, Croaker, Spot, Striped Bass and Summer Flounder.
(Species with more than 5% of total species harvest in this area and fishing mode are denoted by heavy lines in the graph.)

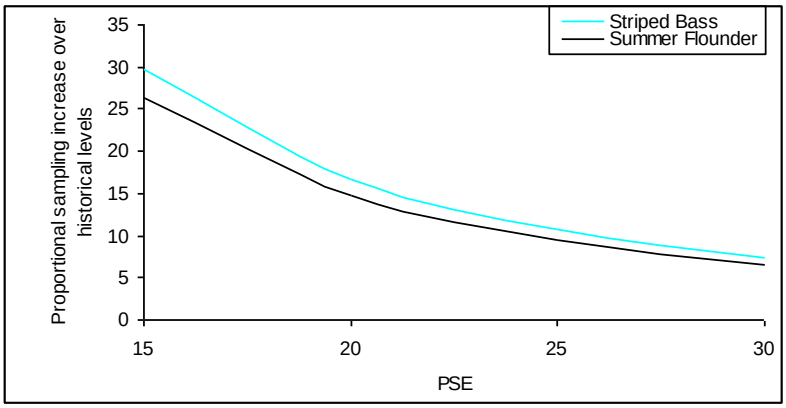


Figure 12. Charter Boat Fishing Mode – Chesapeake Bay. Proportional Sampling Increase over Historical Levels vs. Estimated "Inland" Harvest Precision for Bluefish, Croaker, Spot, Striped Bass and Summer Flounder.
(Species with more than 5% of total species harvest in this area and fishing mode are denoted by heavy lines in the graph.)

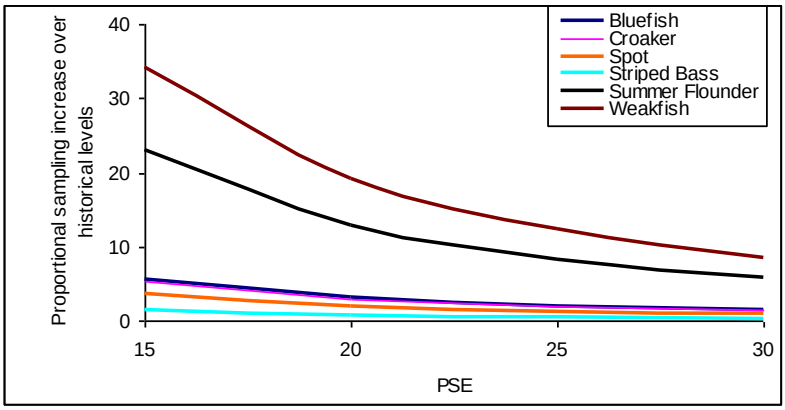
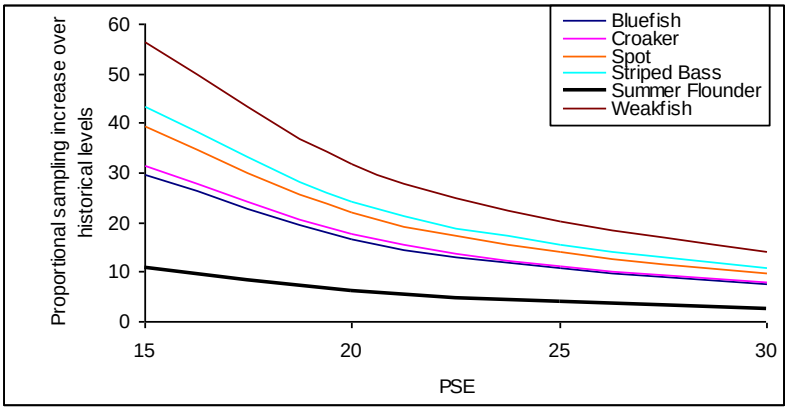


Figure 13. Charter Boat Fishing Mode – Coastal Bays. Proportional Sampling Increase over Historical Levels vs. Estimated "Inland" Harvest Precision for Bluefish, Croaker, Spot, Striped Bass and Summer Flounder.
(Species with more than 5% of total species harvest in this area and fishing mode are denoted by heavy lines in the graph.)



APPENDIX A – Domain Estimation SAS Code

```
For ANNUAL estimates by inland domain;
* Trip files ;
DATA ONE;
SET BARKER.TRIP_20112 BARKER.TRIP_20113 BARKER.TRIP_20114 BARKER.TRIP_20115  BARKER.TRIP_20116 ;
if st=24;
* Subset the inland area;
IF AREA_X=5;
KEEP YEAR CNTY AREA_X MODE_FX INTSITE  STRAT_ID PSU_ID  WP_INT  ID_CODE;
RUN;
DATA TRIP;
SET ONE;
dtrip=1;
* Divide inland area into Chesapeake and Coastal Bay domains;
if CNTY IN (47) AND intsite NOT in (9,818,925) THEN AREA_ID = 'IB' ;
IF CNTY IN (47) AND INTSITE IN (9,818,925) THEN AREA_ID='CB';
IF CNTY NOT IN (47) THEN AREA_ID='CB';
run;
* Determine the number of trips in each domain;
PROC SORT DATA = TRIP;
BY STRAT_ID PSU_ID ID_CODE;
RUN;
proc surveymeans DATA = TRIP nobs ncluster sum missing;
strata strat_id;
cluster psu_id;
weight wp_int;
domain area_id;
var dtrip;
run;
* Catch files ;
DATA CATCH;
SET BARKER.CATCH_20112 BARKER.CATCH_20113 BARKER.CATCH_20114 BARKER.CATCH_20115 BARKER.CATCH_20116 ;
if st=24;
* Subset the inland area;
IF AREA_X=5;
KEEP COMMON STRAT_ID PSU_ID YEAR MODE_FX AREA_X ID_CODE SUB_REG  WAVE  KOD  SP_CODE  WP_INT  TOT_CAT
LANDING ;
RUN;
PROC SORT DATA=CATCH;
BY STRAT_ID PSU_ID ID_CODE;
RUN;
* Merge the data  ;
DATA MERGED;
MERGE TRIP CATCH ;
BY STRAT_ID PSU_ID ID_CODE;
RUN;
*  Determine harvest for each species  ;
DATA FISH;
SET MERGED;
IF COMMON EQ 'SUMMER FLOUNDER' then land=landing;
ELSE land=0 ;
RUN;
* Add the term ncluster to get the number of site-days  ;
proc surveymeans DATA = FISH nobs ncluster sum missing;
strata strat_id;
cluster psu_id;
weight wp_int;
domain area_id area_id*mode_fx ;
var LAND;
run;
```

Sample Output (Results for Striped Bass, 2011)

The SURVEYMEANS Procedure
Data Summary

Number of Strata	71
Number of Clusters	396
Number of Observations	3443
Sum of Weights	2629256.56

Statistics

	Variable	N	Clusters	Sum	SD
	dtrip	3443	396	2629257	121709

Domain Analysis: AREA_ID

AREA_ID	Variable	N	Clusters	Sum	SD
CB	dtrip	2559	319	2296138	126598
IB	dtrip	884	77	333118	69887

The SURVEYMEANS Procedure
Data Summary

Number of Strata	71
Number of Clusters	396
Number of Observations	4438
Number of Weights	3373484

Statistics

Variable	N	Clusters	Sum	Std
land	4438	396	15200	7004

Domain Analysis: AREA_ID

AREA_ID	Variable	N	Clusters	Sum	Std
CB	land	3366	319	207	207
IB	land	1072	77	14993	7002

Domain Analysis: MODE OF FISHING (FISHERMAN COLLAPSED)*AREA_ID

MODE	AREA_ID	Variable	N	Clusters	Sum	Std
3	CB	land	531	70	0	0
	IB	land	210	15	6129	4818
4	CB	land	358	20	0	0
	IB	land	641	44	438	140
5	CB	land	542	55	0	0
	IB	land	14	4	1186	742
7	CB	land	1935	174	207	207
	IB	land	207	14	7240	5025

Domain Analysis: MODE OF FISHING (FISHERMAN COLLAPSED)

MODE	Variable	N	Clusters	Sum	Std
	land	4438	396	15200	7004
3	land	741	85	6129	4818
4	land	999	64	438	140
5	land	556	59	1186	742
7	land	2142	188	7447	5027

“Cluster” is the value for sample site-days, and used as sample size in graphic analysis.

APPENDIX B - Site Register Update Detailed Methods & Analysis

INTRODUCTION

The purpose of this project was to provide information to update the NMFS site registry. The updated registry is a key element for implementation of the new MRIP access intercept survey which gathers data for the catch rate portion of the estimation of recreational catch.

Although the site usage information includes information on expected numbers of anglers at a site in a given day, this information will only be used by NMFS to develop probability-based survey assignments. NMFS will NOT use this information in any calculations of effort.

METHODS

Data Collection

Site attributes were obtained either from anglers familiar with the site or through an internet search.

Fishing pressure information was supplied by a combination of local angler groups, NRP officers, and DNR Fisheries biologists who live and fish in an area or who have experience conducting creel surveys at particular sites. There were usually two independent sources of information. Values for fishing pressure were compared by the project manager and final values assigned. In all cases there was generally good agreement.

Site information was divided into two categories - site attributes and fishing pressure.

Figure 1. Site attributes entry for Elk Neck State Park

SITE INFO			
Site Name	ELK NECK STATE PARK		
County	CEC		
Site ID	128		
LAT	39 27 35		
LONG	-76 00 22		
Address	4395 Turkey Point Rd		
City	NORTH EAST		
State	MD		
Zip	21901		
Contact	Elk Neck Sstate Park		
Phone	4102875333		
Directions	I-95 exit 100 to Rt. 272 S, 14 miles past North East to Elk Neck St Pk, entrance on right		
Notes	Heavy spring fishing from the rip-rap shoreline South of the beach		
		Yes	No
	Shop, store, or other building onsite that sells fishing tackle with or without bait.		x
	Fish Cleaning Stations		x
	Retail Bait		x
	Boat Storage		x
	Boat Maintenance/Repair		x
	Fuel Dock		x
	Restaurant (Onsite/Immediate Vicinity)		x
	Lodging (Onsite/Immediate Vicinity)		x
	Fishing Activity Affected by Tide		x
	Major Tournaments		x
	Private Access		x
	Can We Interview?	x	
	Lighting At Night		x
	Is Site Safe For 2 Samplers At Night?	x	
	Is Fee Charged To The Public For Use Of Site?	x	
	Headboat Only		x
	# of Boat Slips	0	
	# of Car Parking Spaces	50	
	# of Trailer Parking Spaces	0	
	# of Ramps	0	
	# HB Using Site	0	
	# CB Using Site	0	
	Shore Mode A		
	Inland	x	
	Ocean		
	Both		
	N/A		

Site fishing pressure information provided the number of anglers expected at a site, by

- Month
- Kind of day (weekday, weekend)
- 6-hour time period (0200 – 0800, 0800 – 1400, 1400 – 2000, 2000 – 0200)
- Fishing Mode (charter boat, private/rental boat, shore)
- Fishing Pressure (None, 1-4 anglers, 5-8 anglers, 9-12 anglers, 13-19 anglers, 20-29 anglers, 30-49 anglers, 50-79 anglers, 80+ anglers)

Note that this information does not include party boat/headboat fishing, since these interviews are conducted through another survey.

Figure 2. January–March fishing pressure data for Elk Neck State Park

These data indicate only shore fishing in March. On March weekdays, there are 5-8 anglers on site between 8am and 10pm. On March weekend days, there are 9-12 anglers on site between 8am and 10pm.

			FISHING PRESSURE CATEGORIES		
			Eligible anglers expected during a 6-hour period		
			9 = none	2 = 9-12 Anglers	5 = 30-49 Anglers
			0 = 1-4 Anglers	3 = 13-19 Anglers	6 = 50-79 Anglers
			1 = 5-8 Anglers	4 = 20-29 Anglers	7 = 80+ Anglers
Month	Kind of Day	Time Period	Charter Boat Anglers	Private/Rental Boat Anglers	Shore Anglers
JAN	WEEKDAY	0200-0800	9	9	9
JAN	WEEKDAY	0800-1400	9	9	9
JAN	WEEKDAY	1400-2000	9	9	9
JAN	WEEKDAY	2000-0200	9	9	9
JAN	WEEKEND	0200-0800	9	9	9
JAN	WEEKEND	0800-1400	9	9	9
JAN	WEEKEND	1400-2000	9	9	9
JAN	WEEKEND	2000-0200	9	9	9
FEB	WEEKDAY	0200-0800	9	9	9
FEB	WEEKDAY	0800-1400	9	9	9
FEB	WEEKDAY	1400-2000	9	9	9
FEB	WEEKDAY	2000-0200	9	9	9
FEB	WEEKEND	0200-0800	9	9	9
FEB	WEEKEND	0800-1400	9	9	9
FEB	WEEKEND	1400-2000	9	9	9
FEB	WEEKEND	2000-0200	9	9	9
MAR	WEEKDAY	0200-0800	9	9	9
MAR	WEEKDAY	0800-1400	9	9	1
MAR	WEEKDAY	1400-2000	9	9	1
MAR	WEEKDAY	2000-0200	9	9	9
MAR	WEEKEND	0200-0800	9	9	9
MAR	WEEKEND	0800-1400	9	9	2
MAR	WEEKEND	1400-2000	9	9	2
MAR	WEEKEND	2000-0200	9	9	9

Development of Angler Trips

Although the fishing pressure data are the result of subjective opinion, they represent the result of long-term presence at a site. We therefore conducted an exploratory analysis with these data to profile fishing activity in Maryland by geographic area, season, and mode of fishing.

Transformation from Categorical to Numerical data

The raw data of "expected anglers during a 6-hour period" were recorded as a category.

Table 1. Expected anglers by category in June at 3rd St. Bulkhead in Ocean City, by KOD (Kind of Day) and Interval (6-hour time period).

County	Site	Month	KoD	Interval	Charter	Private	Shore	Site Name
WOR	0912	6	WEEKDAY	0200-0800	9	9	2	3RD ST BULKHEAD
WOR	0912	6	WEEKDAY	0800-1400	9	9	2	3RD ST BULKHEAD
WOR	0912	6	WEEKDAY	1400-2000	9	9	2	3RD ST BULKHEAD
WOR	0912	6	WEEKDAY	2000-0200	9	9	1	3RD ST BULKHEAD

These values were transformed to "number of expected anglers" as the category median value, except for the highest category ("80+ anglers"), for which the minimum value of 80 anglers was used.

Table 2. Number of anglers used for each category of fishing pressure

Category	Anglers	Median
9	0	0
0	1-4	2.5
1	5-8	6.5
2	9-12	10.5
3	13-19	16
4	20-29	25
5	30-49	40
6	50-79	65
7	80+	80

Table 3. Median number of anglers in June at 3rd St. Bulkhead in Ocean City.

County	Site	Month	KoD	Interval	Charter	Private	Shore	Site Name
WOR	0912	6	WEEKDAY	0200-0800	0	0	10.5	3RD ST BULKHEAD
WOR	0912	6	WEEKDAY	0800-1400	0	0	10.5	3RD ST BULKHEAD
WOR	0912	6	WEEKDAY	1400-2000	0	0	10.5	3RD ST BULKHEAD
WOR	0912	6	WEEKDAY	2000-0200	0	0	6.5	3RD ST BULKHEAD

Calculation of Angler Trips

Total expected anglers were transformed to angler trips by month, fishing mode and kind of day. This transformation used the typical days per month as follows.

Table 4. Typical number of weekday (WD) and weekend (WE) days per month

Month	WD	WE
J	22	8
F	20	8
M	22	9
A	21	9
M	23	8
J	21	9
J	22	9
A	23	8
S	20	10
O	23	8
N	22	8
D	21	10

Example 1. *Calculation of June weekday 8am-2pm shore angler trips at 3rd St. Bulkhead in Ocean City (categorical values shown in Figure 5)*

10.5 anglers/weekday (8am-2pm, shore mode) * 21 weekdays/month
= 220.5 anglers/month

The site fishing pressure data were therefore transformed to typical angler trips for each 6-hour time interval, by month and Kind Of Day.

Table 5. June weekday angler trips at 3rd St. Bulkhead, by time period.

County	Site	Month	KoD	Interval	Charter	Private	Shore	Site Name	Ch_trips	Pr_trips	Sh_trips
WOR	0912	6	WEEKDAY	0200-0800	0	0	10.5	3RD ST BULKHEAD	0	0	220.5
WOR	0912	6	WEEKDAY	0800-1400	0	0	10.5	3RD ST BULKHEAD	0	0	220.5
WOR	0912	6	WEEKDAY	1400-2000	0	0	10.5	3RD ST BULKHEAD	0	0	220.5
WOR	0912	6	WEEKDAY	2000-0200	0	0	6.5	3RD ST BULKHEAD	0	0	136.5

With angler trips at this scale, a pivot table was used to produce angler trips by site, county, month, mode and kind of day.

Table 6. *Pivot table excerpt for number of June angler trips in Worcester County, by mode and Kind Of Day.*

		JUN	
		WD	WE
WOR	CHARTER	3,266	1,679
	PRIVATE	5,754	3,258
	SHORE	9,608	5,319

RESULTS

Information Supplied to NMFS

Statistics -

- 262 sites in the 16 counties surrounding Chesapeake Bay
- 8,250+ values for site attributes
- 74,500+ values for fishing pressure

The information was downloaded into MRIP's site register website. Because the data were required to be input by hand, we expected over 1,000 errors (at a 2% error rate.) QA/QC was performed by comparing downloads of the website entries (provided by NMFS) against our records. This was repeated until no mis-matches were detected (3 "rounds").

Number and Distribution of Trips by Fishing Mode

Summing across all sites, these data indicate approximately 1.25 million annual angler trips in Maryland from charter boats, private and rental boats and shore fishing (headboat and party boat fishing is not included). Approximately 50% of trips are private and rental boat anglers.

Table 7. Trips by Fishing Mode

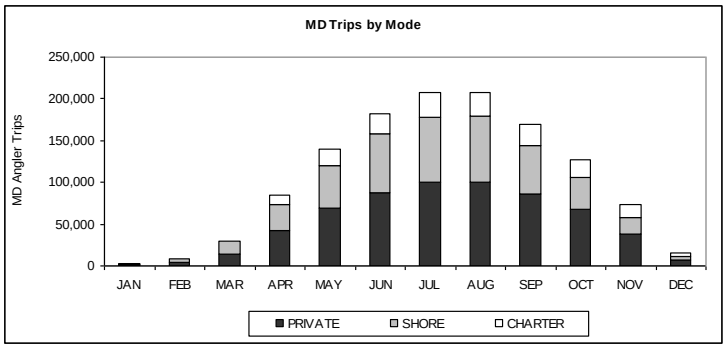
Trips by Mode		
	Trips	%
CHARTER	179,871	14
PRIVATE	619,074	50
SHORE	450,297	36
TOTAL	**1,249,241**	

Temporal Distribution of Trips

Trips are distributed symmetrically throughout the year.

Shore fishing accounts for more trips in the first part of the year (40-60% Jan-Jun, 40-20% June-Dec) and charter boat fishing accounts for more trips at the end of the year (0-10% Jan-Jun, 20-30% July-Dec).

Figure 3. Trips by Month



Trips by Kind of Day

Although most trips occur on weekdays, there are twice as many trips taken on weekend days.

Table 8. Trips by Kind of Day

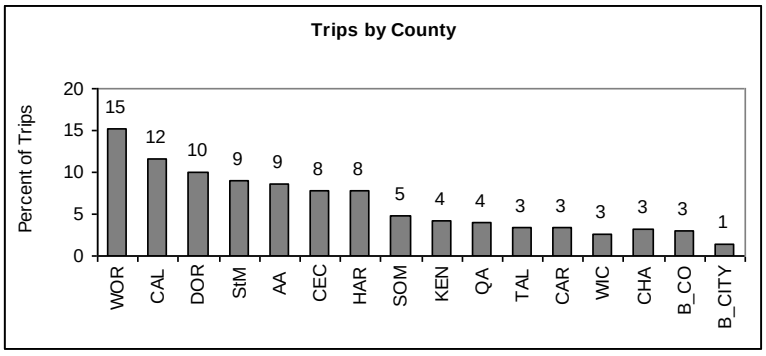
Trips by KOD				Trips per Day	
WD	WD%	WE	WE%	WD	WE
111,553	14	68,318	14	429	657
374,111	48	244,963	51	1,439	2,355
286,510	37	163,788	34	1,102	1,575
772,174		477,068		2,970	4,587

Geographic Distribution of Trips

As a single county, Worcester County is the fishing capitol, with 15% of trips.

Taken together, the three southern MD counties (Calvert, St. Mary's and Charles) account for the largest concentration of fishing, with 26% of trips

Figure 4. Trips by County



There are clear "hot spots" for fishing in Maryland. Seven sites (2.7%) account for 10% of fishing activity, and 20 sites (7.8%) account for 25% of fishing activity.

Table 9. Trips by Site

	Co	Site	Annual Angler Fishing Trips	10% of MD trips	25% of MD trips
1	AA	Sandy Point St. Pk. Shore Fishing	21,943		
2	CAL	Chesapeake Beach Rod N Reel Dock and Jetty	21,786		
3	HAR	Conowingo Fisherman's Park	20,461		
4	CAL	Solomons Boat Ramp & Fishing Pier	18,384		
5	CEC	Anchor Marina	16,909		
6	CEC	Northeast Community Park	16,331		
7	WOR	Worcester Public Ramp	16,140		
8	CAL	Harbor Id Marina	15,450		
9	HAR	Havre de Grace City Yacht Basin	15,160		
10	DOR	Taylor's Id Family Campground	14,904		
11	StM	Drury's Marina	14,521		
12	HAR	Lapidum Landing	14,231		
13	CAL	Calvert Marina	14,051		
14	StM	Point Lookout State Park	13,657		
15	WIC	Nanticoke Harbor	12,870		
16	QA	Mattapeake County Pk	12,866		
17	DOR	Bill Burton Fishing Pier	12,781		
18	WOR	Sunset Marina	11,975		
19	WOR	Assateague Id. Public Landing	11,962		
20	HAR	Glen Cove Marina and Ramp	11,917		
21	WOR	BAHIA MARINA	11,906		

Table 10. List of Sites by County

County	Site
Anne Arundel	Anchor Yacht Basin
	Beechwood Park
	Ft. Smallwood Park
	Happy Harbor Marina
	Harbour Cover Marina
	Herrington Harbor North
	Herrington Harbor South
	John Downs Memorial Park
	Jonas Green State Park
	Liberty Yacht Club & Marina
	Mayo Ridge Marina
	Ook Grove Marina
	Pier 7 Marina
	Sandy Point State Park - Boat Rental
	Sandy Point State Park - Ramps
	Sandy Point State Park - Shore Only
	South River Marina
	Tir State Marine (J & J Tackle Shop)
	Truxten Park Public Landing
	Turkey Point Marina
	Wayson's - Patuxent Wetland Park
	White Rock Yachting Center
Baltimore City	Broening Park Public Launch
	Canton Waterfront Park
	Ft. Armistead Park
	Hanover St. Bridge
	Middle Branch Park
Baltimore County	Beacon Light Marina
	Cox's Point County Park
	Dundee Creek Marina - Gunpowder Falls State Park
	Gunpowder St. Park - Dundee Fishing Area
	Merritt Point Park
	North Point State Park
	Patapsco Valley State Park
	Rocky Point Beach Landing County Park
	Turner's Station Park
	Wilson Point Ramp
	Stansbury Yacht Basin
Calvert	Abner's Marina
	Breezy Point Beach & Campground
	Breezy Point Halle Marina
	Bunky's Charter Boats
	Calvert Marina
	Chesapeake Beach Jetty / Rod N Reel Dock
	Chesapeake Ranch Club
	Hallowing Point Public Ramp
	Harbor Island Marina
	Kenwood Beach and Pier
	King's Landing Park
	Len's Marina & Ramp
	Lower Marlboro Road Fishing Pier
	North Beach
	Rod 'N Reel Marina West
	Solomon's Boat Ramp & Fishing Pier
	Solomon's Boat Rentals
	Beacon Marina @ Comfort Inn
Caroline	Choptank Boat Ramp and Marina
	Federalsburg Recreation Park and Marina
	Federalsburg VFW
	Ganey's Wharf County Ramp
	Hunting Creek Wooden Bridge
	Stony Point
	Two Johns Landing
Cecil	Anchor Marina
	ACE Ramp @ Chesapeake City Cove
	Bohemia River Bank @ 213 Bridge
	Charlestown Public Boat Ramp
	C&D Canal Mooring Basin at Chesapeake City
	Conowingo Creek Landing
	Duffy Creek Marina
	Elk Neck St. Pk. / Rogue's Harbor Facility
	Elk Neck State Park
	Elk River Park
	Fredericktown Public Landing
	Hack's Point Marina & Boatyard
	Norhteast Community Park
	NW Chesapeake City Community Pier
	Perryville Community Boat Ramp
	Perryville Community Park
	Port Deposit Town Marin and Park
	Richmond's Marina
	Sassafras Harbor Marina
	Stemmer's Run Ramp

"Final Report", page 31

County	Site
Charles	Allen's Fresh
	Aqualand Marina Boat Ramp
	Benedict Bridge - Patuxent River
	Captain John's Crab House
	Desoto's Landing Benedict Ave.
	Friendship Farm Park (Nanjemoy Creek)
	Goose Bay Marina & Campgrounds
	Goose Landing (Benedict Marina)
	Mallows Bay Park
	Mattingly Park Ramp
	Neale Sound on & under bridge
	Port Tobacco Marina
	Saunder's Marina
	Shymansky's Marina & Seafood
	Sweden Point Smallwood Park
Dorchester	Bestpitch Ferry Boat Ramp
	Bill Burton Fishing Pier (Choptank Fishing Bridge)
	Crocheron Public Ramp
	Elliott Public Ramp
	Franklin Street Ramp (Cambridge Public Ramp)
	Golden Hill Boat Ramp
	Gootee's Marina
	Great Marsh Park Choptank River
	Hoopersville Public Ramp
	Kirwin's Wharf
	Langrells Creek Public Boat Ramp
	Long Wharf Park
	Madison Bay Marina & DNR Public Ramp
	Purple Canoe Trail (G. Reese Todd Public Landing)
	Ragged Point
	Secretary Public Boat Ramp
	Shorter's Wharf (G. Reese Todd Public Landing)
	Slaughter Creek Marina (Taylor's Is. Marina)
	Smithville Bridge
	Taylor's Island Family Campground
	Taylor's Island Public Ramp
	Trneton St. Marina & Boat Ramp
	Tyler's Cove Public Ramp (Honga River)
	Vienna Public Ramp
Harford	Broad Creek Public Landing
	Bush River Pullover
	City Yacht Basin
	Conowingo Fishernan's Park
	Flying Point Marina
	Flying Point Park
	Frank J. Hutchins Memorial Park
	Glen Cove Marina and Ramp
	Gunpowder Cove Marina
	James Run Rt 40 Bridge
	Jean S. Roberts Memorial Park
	Lapidum Landing
	Mariner Pt. Park
	Mout of Deer Creek / Susquehanna St. Park
	Otter Point Public Landing & Marina
	Glen Cove Marina and Ramp
	Broad Creek Public Landing
	Gray's Run
Kent	Bay Shore Campground
	Bayside Landing Park - Kent Co. Ramp
	Betterton Public Landing & Beach
	Bogel's Public Landing
	Chester River Bridge
	Chestertown Marina
	Cliff City's Public Landing
	East Neck Boat Rental
	Eastern Neck Island Bridge
	Fairlee Creek Public Landing
	Freestate Landing & Cains Marina
	Green Lane Public Landing
	High St. Pier
	Piney Neck Public Landing
	Rock Hall Marine Railway
	Shipyard Landing
	Skinner Neck Landing
	Tolchester Marina
	Turner's Creek Park
Queen Anne's	Goodhand Creek Public Ramp
	Kent Narrows Public Landing
	Kentmorr Marina
	Litlle Creek Public Landing
	Matapeake County Park & Public Fishing
	Queen Anne's Marina
	Rolph's Wharf Marina
	Romancoke Fishing Crabbing Pier
	Shipping Creek Landing
	Thompson Creek Landing
	Wharf Road Marina

"Final Report", page 32

County	Site
Somerset	Colbourn Creek County Ramp
	Crisfield Fishing Pier & Pavilion
	Crisfield Public Ramps
	Deal Is. Harbor
	Delmarva Fish & Duch Marina (Wenona)
	Goose Creek Marina/Som Co Ramp
	Headboat Launch @ Sommers Cove
	Janes Island State Park
	Jenkins Creek Public Boat Ramp
	Messick Rd Public Boat Ramp (Dames Quarter)
	Mt. Vernon - Som Co Ramp
	Raccoon Point
	Rumbley Ramp
	Shelltown - Som Co Public Ramp
	Small Boat Harbor
	Sommers Cove Fishing Center Marina
	St. Peter's Creek County Ramp
St. Mary's	Abells Wharf County Park
	Blackstone Marina
	Boatel California
	Buzz's Marina
	Cedar Cove Marina
	Chaptico Wharf Recreation Area
	Chesapeake Bay Fishing Parties
	Clarks Landing
	Colton's Point Marina and Boat Ramp
	Drury's Marina
	Forest Landing Recreational Area
	Greenwell State Park
	Myrtle Point County Park
	North Patuxent Beach Road
	Patuxent NAS Cedar Point
	Piney Point Rec. Area
	Point Lookout Marina
	Pt. Lookout State Park
	Robert E. Pogue Memorial Park
	Scheibles Fishing Center
	Tall Timbers Marina County Park
	Week's Marina

County	Site
Talbot	Bay Hundred Restuaurant Knapps Narrow
	Bellevue Ferry Terminal Public Ramp
	Bill Burton Fishing Pier (Rt 50 Bridge)
	Black Walnut Point
	Claiborne Old Ferry Terminal
	Harrison Chesapeake House
	Neavitt Public Landing
	Oxford Public Ramp / Town Creek Marina
	Talbot Co. Public Landing
	Talbot Co. Public Landing - Wye Island
	Talbot Co. Public Landing - Dogwood Harbor
	Talbot Co. Public Landing - Cummings Creek
	Tuckahoe County Ramp
	Easton Point Landing
Wicomico	Cedar Hill Park & Marina
	Nanticoke Harbor
	Roaring Point County Park
	Sandy Hill Family Campground and Beach
Worcester	3rd St. Bulkhead
coastal bays sites	9th St. Fishing Pier
	Assateague Is. Nat'l Seashore
	Assateague Is. State Public Landing
	Bahia Marina
	Boat Ramp & Mumford's Landing
	Castaways Campground (Eagle's Nest Campground)
	Convention Hall in Back on Bay
	DNR Ramp - Gum Point Road
	Fisherman's Marina
	Harbor Island Marina
	Homer Gudelsky Park (Stinky Beach)
	Inlet Jetty & Beach
	Ocean City Fishing Center & Marina
	Ocean Pier
	Ocean Pines Marina
	Oceanic Pier
	Old Town Marina
	Porters Crossing Bridge
	Public Landing
	Rt 50 Bridge
	sunset Marina
	Talbot St. Pier & Angler Pier
	Taylor Landing Ramp
	white Marlind Marina
	Worcester Boat Ramp
	Gum Point Road DNR Ramp
	South Point County Boat Ramp
Ches. Bay sites	Byrd Park
	Milburn Landing (Pocomoke State Park)
	Shad Landing Marina (Pocomoke State Park)

Comparison with NMFS Effort Estimates

Annual estimates of effort by mode and wave are available through the NMFS recreational data query website (http://www.st.nmfs.noaa.gov/st1/recreational/queries/index.html). These estimates can be sorted by area and fishing mode. We queried the website for estimates of angler trips by charter, private and rental boat and shore anglers for the past 4 years. Mean values were considered comparable to angler trips derived from Maryland angler information.

The 4-year mean NMFS effort estimate is approximately 2.5 times higher than the Maryland estimate.

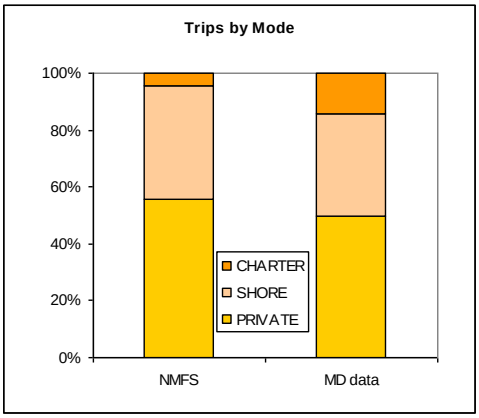
Table 11. Comparison of Trips derived from Md Angler Data and NMFS Survey Data

	NMFS	MD Data	NMFS %	MD Data %
CHARTER	128,067	172,029	4	15
PRIVATE	1,648,497	578,880	56	50
SHORE	1,177,608	397,022	40	35
TOTAL	2,954,173	1,147,931		
PARTY	46,287			
TOTAL w/HB	3,000,460			

The Maryland estimates match the distributions of trips by fishing mode and season estimated by the NMFS survey-based data, only the scale is altered.

NMFS estimates the same relative proportion of private/rental boat and shore anglers but a slightly lower proportion of charter boat angler trips than the Maryland estimate.

Figure 5. Comparison of Trips by Fishing Mode



NMFS estimates the same temporal distribution of trips as our Maryland estimate.

Figure 6. Comparison of Trips by NMFS Recreational Fishing Wave (2-month period)