

**Review of Recreational Economic Data at the National Marine Fisheries
Service**

For the Center for Independent Experts

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Kenneth McConnell (chair)

Executive Summary

This report summarizes the reviews solicited by the Center for Independent Experts (CIE) at the University of Miami. The summary review assesses recreational economic data gathered by the National Marine Fisheries Service (NMFS) since 1994.

The review addresses five questions dealing with the economic data based in part on add-ons from the Marine Recreational Fisheries Statistics Survey (MRFSS). These questions relate to the principal types of analysis performed with the economic data: estimation of revealed preference models, conjoint analysis of recreational fishing choices, and economic impact analysis.

- The review finds surveys based on the MRFSS components to be an effective means of gathering data. The surveys suffer the shortcomings inherent in MRFSS, but there is no evidence that these are severe. To make the economics potentially more useful for fisheries management, we recommend targeting specific areas and species where conflicts are likely to arise. To improve timeliness of results, we recommend research that tests the validity of some streamlined research methods.

- Chapter 5 of the National Research Council (NRC) report had three basic recommendations about economic data. First, the recommendation to focus more narrowly to improve economic data for management is useful and can be seen in the conjoint work by NMFS. Second, the recommendation for an independent national trip and expenditure survey is infeasible given the budget. A national survey without a national license frame is not affordable. It is unlikely to constitute effective use of funds if they were available. Finally, the NRC recommendations concerning augmenting the national site list with site characteristics is useful to the extent that sites can serve as the basis for estimating revealed preference models.

- The suite of models used in the analysis of the economic data has been quite appropriate, as evidenced by the peer reviewed papers published from the research. Given what has been learned from basic models, this appears to be a fruitful time to modify the research direction to provide greater understanding of some strategic species and to develop models that can be brought directly to management and allocation decisions. To a certain extent, this shift is reflected by the increased support for conjoint analysis. It is appropriate that some greater attention be given to conceptual issues related to management of recreational fisheries. Similarly national and state economic impacts have been estimated, but these efforts could now be directed to more specific management actions and more useful at the local level.

- The use of economic add-ons to MRFSS is quite cost-effective and indeed the only feasible way to gather substantial amounts of data. It makes sense to continue the use of add-ons but to focus surveys more narrowly to improve usefulness of research for management.

- With reasonable expectations about the growth of marine recreational fishing, greater research funds will have to be allocated to meet increased management needs. Increases in funding should be used to solve empirical research issues related to revealed preference and conjoint methods, many of which are recognized by the NMFS economists using the data, and to focus economic analysis on the specific issues that arise in the allocation of fish stocks. The reviewers doubt that funds for large-scale national surveys would be the most effective use of limited financial resources.

Background

This report summarizes the reviews that have taken place in response to a request from the Center for Independent Experts (CIE) at the University of Miami. The summary review considers the collection of recreational economic data and the research based on the data at the National Marine Fisheries Service (NMFS) since 1994. The review is partially in response to the National Research Council (NRC) report on the collection of recreational fishing statistics (*Review of Recreational Fisheries Survey Methods*). Chapter 5 of the report (Human Dimensions) addressed the recreational economic survey data and raised several issues pertaining to the data. The current review assesses the relevant chapter of the NRC report as well as other issues related to NMFS' data gathering and research on recreational fisheries economics.

The review began with a workshop on October 24th and 25th in Silver Spring, MD, as well as preparation prior to the workshop. The workshop itself involved presentations by many NMFS economists who have utilized the economic data gathered by NMFS as well as presentations by academic economists who have used the economic data and MRFSS data. More details about the workshop are provided in the statement of work attached. There followed two days during which the reviewers met and discussed the workshop and materials provided by CIE for the review. Reviewers continued their work after the conference, reading the ample materials provided for the reviewers and conferring with each other. The reviewers had good access to NMFS economists and academics knowledgeable about the NMFS recreational economics program. The reviewers then provided their reports, which form the basis of this summary review.

The review process was quite compatible with a full understanding of the recreational economics activities. All materials necessary for a full review were available. And perhaps most important, all NMFS economists associated with the recreational economic data gathering were fully cooperative with the process.

This summary report combines the full reports by Ragnar Arnason and Daniel Talhelm (attached as appendices) as well as a separate review by Kenneth McConnell, who has written this summary document and served as chair of the review committee. This summary report may therefore be considered the joint product of the three economists who worked on the review. The conclusions and recommendations were discussed as we proceeded and are jointly held. Because of the general concurrence about the conclusions and recommendations, no effort has been made to attribute individual components of the summary report to individual reviewers, except when useful for more details.

Recreational Fisheries Economics at NMFS

Research on recreational fisheries takes place under the Division of Social and Economic Analysis, which is part of the Office of Science and Technology in NMFS. The research is led by Brad Gentner. Aside from salaries, the research has an annual budget of about \$460,000 over the period 2000-2006. This budget has been allocated about 25% for analysis and 75% for data gathering. NMFS economists in regional offices and science centers around the country sometimes participate in the recreational

research when the issues are sufficiently relevant or important enough to engage them. Some funds are allocated for research by consultants, typically academic economists. Consequently, this is a small function in NMFS with a limited budget and personnel. Recommendations about program achievements and changes must take into account the constraints imposed by this size.

Economic analysis within NMFS responds to a variety of statutory obligations that come from the Magnuson-Stevens Act, National Environmental Policy Act, Executive Order 12866, the Regulatory Flexibility Act, Marine Mammal Protection Act and others legislation. In addition to the statutory requirements, economic analysis of marine recreational fishing provides data and analytical support on an informal basis for natural resource damage assessment (NOAA Office of Response and Restoration). It also supports research efforts such as the work on evaluating the health of estuaries (Bricker *et al.*, 2006). These obligations can be partially met by estimating the economic impacts and the changes in equivalent income (willingness to pay or consumer surplus) of fishery management decisions. But economists may also be required to assess the impact of regulatory decisions on local communities as well as on small businesses.

The statement of work required the review team to address five issues pertaining to the recreational data collection and economic analysis at NMFS. These items are addressed in A through E below. Where appropriate, we identify strengths and weaknesses, and provide recommendations. We recognize that in almost every case the recommendations entail an opportunity cost to reallocate resources in a program area with meager resources. Nevertheless, we believe that the steady long run growth in marine recreational fishing brought by growth in population, income, and leisure time will create much greater need for management of recreational fisheries, including allocations between commercial and recreational users within season and over time. Consequently, it is not unreasonable to foresee the need for an increase in research resources available for the recreational economics function at NMFS.

NMFS has gathered recreational fishing catch and effort data since 1981 in coordinated surveys of anglers contacted on-site and random households contacted by phone. These surveys are jointly known as the Marine Recreational Fishing Statistical Survey (MRFSS). MRFSS surveys are conducted in all coastal states except Texas, California, Oregon, and Alaska, which use license frames instead. The angler survey, designed to estimate catch per angler, is based on intercepting anglers at sites selected from the national site list. This is the MRFSS intercept survey. Households are contacted by random digit dialing (RDD) for the purpose of learning about participation and effort in recreational fishing—the MRFSS RDD survey. For the past 12 years, supplementary data gathered from anglers and households contacted through the MRFSS have provided the sample for much of the recreational fisheries economic data at NMFS. These economic surveys are called add-ons because they take advantage of the expensive task of locating anglers, primarily in the MRFSS intercept survey, and are then added on to the survey. As we discuss below, there is a huge cost advantage in being able to interview respondents who have already been identified as anglers. However, the reliance on add-ons means that NMFS' economic data inherits the shortcomings in data identified in the NRC report.

The five items are addressed below in A-E. Each item begins with the charge given by the CIE.

A. Evaluate the NMFS expenditure, valuation, and conjoint surveys. Reviewers should cite the surveys in Task I, Item 1. Reports shall include an analysis of strengths and weaknesses of survey methods, potential biases and recommendations for improvement.

Expenditure surveys are added on to the MRFSS intercept and phone surveys. The chief source of expenditure data comes from anglers who are contacted in the MRFSS intercept survey. Some data are gathered on-site while more detailed data are gathered in a follow-up telephone survey or, in 2006, a mail survey. An add-on to the random digit dialing survey of the MRFSS provides a basis for testing and correcting for endogenous sample bias inherent in selecting anglers on-site. The full details of the expenditure surveys are provided in the accompanying reports, or in one of the original reports such as that by Steinback and Gentner (2002).

Valuation studies done with revealed preferences have almost exclusively used the MRFSS intercept survey. This survey provides information about where anglers have actually fished. Past intercept surveys are the source of historic catch data that can be used in random utility models. Conjoint instruments have been delivered by mail using anglers contacted through some component of the MRFSS.

Strengths

For all three purposes, expenditure analysis, revealed preference valuation and stated preference or conjoint analysis, the cost of reaching anglers is a significant determinant of sampling costs. This is because only about 10% of the general population participates in marine recreational fishing (Thunberg et al., 1999), so that one either samples anglers on-site or absorbs the cost of sampling 10 individuals from the general population for every angler sampled. For this reason, it is generally useful to exploit the two components of MRFSS for economic data, as the add-on surveys do. The expenditure surveys are add-ons to the MRFSS intercept survey. They are probably as cost-effective as is feasible. Given that the MRFSS will be carried out regardless of the expenditure add-on, one can regard the extra cost of the expenditure add-on survey as its full cost. Based on this hypothesis, it appears that a stand-alone expenditure survey would be considerably more than twice as expensive as the MRFSS intercept add-on. The same is true for the revealed preference valuation and conjoint studies. Given that the goal is to obtain a reasonably representative sample using probability based methods, MRFSS provides a cost-effective platform for sampling for economic data.

Weaknesses

The use of the MRFSS as a source of additional samples for economic analysis has inherently the same weaknesses that are reported for using these sampling methods for estimating catch and effort. It is subject to undercoverage in the MRFSS intercept and random digit dialing. The intercept survey does not sample anglers who fish from private docks or at night. The MRFSS RDD does not attempt to contact households who live more than 25 miles from the coast. As well, the intercept survey has a natural endogenous stratification in which the more avid anglers have a higher probability of

being sampled on site. NMFS economists are aware of these weaknesses and attempt to mitigate them where feasible.

There are additional weaknesses with the data for economic studies. Almost always the sample sizes at the level of MRFSS intercept sites are too small to serve as destinations in random utility models, so that aggregation to the county or group of county levels is necessary. When more disaggregated data can support the estimation of discrete choice and demand models, parameter estimates are more likely to be consistent. A higher sampling rate at the site level would permit the analysis of individual sites rather than aggregates (such as counties or groups of counties). However, it is not otherwise useful to model site choice because these geographical locations are too small for relevance in fishery management decisions. The fact that there are frequently fairly small numbers of trips taken to sites and even to counties makes it difficult in general to estimate revealed preference models for trips targeted at particular species. This makes the estimation of random utility models less useful for fishery management such as council allocation decisions, where the focus is likely to be on individual species, and not groups of species such as currently is estimated.

For economic impacts, the occasionally small number of interviews at the county level makes it difficult to conduct impact analysis at any level of aggregation less than the state level. One of the statutory obligations for economic analysis is to assess the economic impact of regulatory decisions on communities. Economic impact at the community level will be relatively crude with the current level of sampling effort. However, the gains from increasing sampling effort for improving impact analysis will be slight and probably not worth the expenditure. Instead, it is more cost-effective to rely on county level disaggregation of the state input/output models currently used by NMFS, paired with separate estimates of local changes in angler expenditure.

Recommendations

For valuation studies, some of the weaknesses can be overcome by investigating species with especially dense sampling, and by enhancing sampling for some species in some areas. Given the resource constraints, this would entail sacrificing sample survey breadth, for sampling depth and more analysis. As an example, it would be reasonable to substitute an in-depth study of a few individual species for estimating random utility models for broad regions such as the middle Atlantic. Particular suggestions for more in-depth surveys include developing a small panel of anglers and embarking on some experimental methods for understanding recreational fishing behavior. This would supplement both conjoint and revealed preference models. To a degree, NMFS has already begun to focus on important species. For example, the conjoint studies cover snapper-grouper in the Gulf (Gentner, 2004), summer flounder in the northeast (Hicks, 2002) and bottom fish-salmon in the Pacific Northwest (Lee, 2006). Data collection approaches that would respond quickly to short run policy issues with very short deadlines include benefit transfer methods, ‘quick and dirty’ survey methods using stated preference protocols, and intensive interviews with very small samples—essentially focus groups.

A good example of the gains from a quick and dirty data collection approach is provided by Harrison and Lesley (1993). They chose a convenience sample of students and reweighted according to the population proportion of demographics.

Applying the same contingent value survey instrument, they estimated approximately the same damages for the Exxon Valdez oil spill as a probability survey conducted by Carson *et al.* (1992) that cost \$3 million. The Harrison and Lesley study cost about \$2,500 and could be completed quite quickly, even by the timetables of fisheries management.

The paper by Harrison and Lesley illuminates the cost issues for stated preference models. The chief components are instrument development and probability sampling of anglers. It is clear that short cuts cannot be taken with instrument development. However, it is worth investigating the importance of probability-based sampling for all fishery management decisions. It is critical that the MRFSS continue with its probability-based sampling but the investigation of quick and dirty approaches should not be curtailed by the fact that they would not be probability-based. As Harrison and Lesley point out, the fact that a convenience sample would not be representative of anglers at large can be corrected by regression methods using appropriate demographic weights for anglers.

B. Evaluate the degree to which NMFS recreational economic data collections from 2000-2006 meet the NRC recommendations included in "Chapter 5 Human Dimensions" of the NRC Report Review of Recreational Fishing Survey Methods.

The NRC report makes four basic recommendations (pp. 104-106):

1. Add-on surveys should be focused more narrowly to target specific management needs.
2. There should be periodic updating of lists and descriptions of fishing locations and sites.
3. There should be an independent national trip and expenditure survey that would support valuation, impact analysis and other social studies.
4. The national site database should be enhanced to support economic and social analysis.

1. Add-on surveys

Concerning targeting of add-on surveys, to the extent that this is feasible, targeting is a good research strategy. Breadth of coverage is desirable when it provides broadly applicable results. But breadth can be sacrificed when narrow targeting provides more useful results. This conclusion reinforces our comments in part A above about the need for some acute focusing, both for policy purposes and for further understanding of behavior and models.

During the period 2000 to 2006, the recreational economics fisheries group has consistently improved its use of add-ons. The applications have been cognizant of the need to account for endogenous stratification (i.e., overrepresentation of avid anglers) that occurs with on-site sampling. Current research is investigating the impact of endogenous stratification in revealed preference models. The impact of on-site sampling has also been studied in the expenditure surveys. While truncating the phone survey at 25 miles may result in undercoverage, this too has been studied with no significant sampling implications.

Increased targeting is also evident in the conjoint analyses, which have focused on a few salient species. See the studies by Gentner (2004), Hicks (2002) and Lee (in process). These studies reflect the understanding by NMFS economists that a narrower focus will make results more useful for management.

2 & 4. Periodic updating of lists and descriptions of fishing locations and site, and enhancement of national database

Items 2 and 4 in the NRC recommendations refer to the national site list that serves for sample allocation for the MRFSS intercept survey. The historic data on catch and effort are also available at the site level. For economic purposes, the site data are typically aggregated to counties or groups of counties. Attributes at the site level may be of minimal use because of this essential aggregation. The national site list itself is kept and updated by the statistical operations component of the MRFSS in those states where MRFSS surveys are conducted. It is clear however that revealed preference models using aggregates of sites need to account for local attributes that attract or discourage fishing trips. These attributes can most fruitfully be gathered from non-NMFS sources. Increasingly social science measures are geocoded and use of these measures may help estimate revealed preference models.

3. An independent national trip and expenditure survey

The wisdom of an independent national trip and expenditure survey may be argued. There is no national frame such as a license base as suggested in the NRC report, nor does the development of such a base seem imminent. License frames are present in a number of states but the coverage and integrity of the frames varies dramatically. In the absence of such a frame, the costs of an independent survey would likely exceed the full budget of the recreational economics program, without a corresponding return in benefits. For example, the economic add-on for 2006 cost approximately \$750,000, funds that were sequestered over several years, but this add-on survey did not include the costs of locating anglers in the general population, which is implied in an independent national survey (except in the non-MRFSS states).

Recommendations

The emphasis of the NRC report on targeting is reasonable and to an extent has been pursued. We have endorsed narrow targeting in various cases in addressing the issues in item A. NMFS economists have generally recognized the value of targeting as a way of making economic results more useful for policy and management and have moved research in that direction in conjoint studies.

C. Assess whether the suite of economic models currently employed by NMFS addresses management information needs and evaluates the degree to which NMFS' recreational surveys support these models.

The recreational fisheries economics program of NMFS now conducts two basic forms of analysis: Valuation through its revealed preference studies and conjoint analysis and economic impact through its expenditure studies and input-output analysis. The

study of valuation supports the goals of assessing gains and losses to various parties from fisheries management regulation. There are two issues: whether the empirical analysis now performed satisfies the obligations of providing economic analyses for marine recreational fishing in NMFS; and whether the forms of analysis are sufficient to deal with the principal issues that will arise as fisheries management contends with increases in recreational fishing.

Empirical studies of economic impact of recreational fishing, such as Steinback (1999) and Kirkley (2006), have typically employed input-output models. These studies both used IMPLAN, a proprietary input-output model that is appropriate for the task. The level of aggregation often seems greater than would be useful to assess economic impact at the community level. The studies by Steinback and by Kirkley measure economic impact at the state level. This is a problem of the data and not of the appropriateness of the models, however. Consequently it is fair to say that the *models* used to assess economic impact are appropriate but the ability to apply the models at the community level, as is sometimes required, is constrained by the insufficiency of data at the community level. However, it is not clear that the benefits exceed the costs of much greater disaggregation for economic impact studies. Instead, IMPLAN is capable of estimating impacts at the county level if changes in local spending in the appropriate categories can be supplied.

Recommendations.

The recommendations to improve models useful to the various policy and management needs of fisheries management deal with some empirical issues, timing of the availability of empirical models, and with additions and improvements on conceptual models employed in managing recreational fisheries.

We begin with empirical issues with random utility models. Revealed preference studies have been advanced chiefly by estimating random utility models. The purpose of these models has been to estimate the income equivalent to changes in catch rates and loss of access to recreational fishing sites. Model estimation and timeliness have improved considerably since the original versions. On the whole, however, these models have not been useful for fisheries management because they are typically not estimated at the species level. This is a consequence of the thinness of catch data at the site or county level. There are two further and closely related estimation problems that persist in the random utility models.

One concerns the endogenous stratification that is a consequence of on-site sampling. Failure to account for this aspect of the sampling procedure means that the parameter estimates may just as easily reflect the sampling effort in the MRFSS intercept survey as reflect angler preferences. Economists in the NMFS recreational economics program are well aware of this issue.

A second empirical issue concerns the robustness of estimates of the parameters of random utility models on catch rates. This holds even when using aggregates to the group levels, such as small game, big game, etc., as has traditionally been done with these data. The parameter estimates may not be consistent because of the absence of site characteristics other than catch rates. It may be that catch rates are not correlated with omitted site attributes but this would need to be established empirically. The catch rate

parameters in the random utility models are also contaminated by the first problem, the failure to account for endogenous stratification.

These two empirical problems can be attacked jointly. First the empirical weights of sampling pressure used to allocate the MRFSS intercept survey can be used to understand the degree of contamination caused by endogenous sampling and perhaps to correct for it. This can be supplemented by extensive use of alternative specific constants that help account for unobserved site characteristics. These constants can be judiciously used at the regional or state level. It would be worthwhile to investigate whether more alternative-specific constants can be feasibly estimated using the Murdoch's (2006) adaptation of Berry, Levinsohn and Pakes (1995). NMFS economists are aware of these issues too.

These comments relate to the application of random utility models to fishing behavior. It can be fruitful to consider the application of other models—for example the product approach of Talhelm *et al.* (1997).

Economic and econometric analysis in support of policy needs to be timely. Some policy issues can be seen far in advance, and planned for in empirical research. Other no less important policy issues may arise suddenly. Applications of revealed preference models are now estimated within weeks, which is a vast improvement. Nevertheless, the revealed preference models, specifically random utility models, do not have the flexibility to address the variety of management tools used to restrict harvest. Further there are only a few species for which random utility models can be estimated without aggregation. Stated preference models, more likely to address the precise kinds of issues that arise in policy allocation decisions, often take many months or years to execute. It makes sense to investigate and test some “quick and dirty” methods of valuation, as discussed in Part A. A reasonable research strategy would be to continue to develop conjoint analysis in depth, where feasible coupled with revealed preference models as in Hicks (2002), and at the same time test the ability of quick and dirty methods with convenience samples to replicate the conjoint type models.

There is need for conceptual developments to complement the empirics. Empirical research based on the data gathered from the economic add-ons, especially the revealed preference studies, has focused on estimating the value of access to fishing sites and the value of improving catch rates. Conjoint analysis has expanded the scope of empirical questions. Yet the framework for judging the efficiency of allocation remains fairly primitive (Anderson, 1983; Bishop and Samples, 1980; McConnell and Sutinen, 1979). Distinctions between bag limits, size limits and other types of policies have been addressed in stated preference studies but not dealt with in conceptual models. There is a middle ground of applying conceptual models to stock allocations between commercial and recreational fishing and between current and future recreational fishing that can be fruitfully addressed. Recreational fisheries management and allocation decisions will have to answer the conceptual issues of how regulations affect catch, effort and economic value and how changes in fish stocks influence recreational behavior and value. These relationships will have to be incorporated into dynamic analysis to answer the full range of management questions. (See the response of Arnason on item C.)

D. Evaluate, given current budget or other constraints, whether the approach NMFS is using for recreational economic data collection is providing “best value”, i.e., for a given level of investment in data collection and assessments, NMFS provides the most timely, and accurate management advice on the economic value of recreational fishing and the economic effects of regulatory actions.

The challenge to provide ‘timely and accurate management advice’ is substantial. It is clear that given the budget allocated for recreational economic statistics, the use of add-ons to MRFSS is quite cost-effective and indeed the only feasible way to gather economic data. And until recently these economic data have been employed in estimating a variety of models for understanding the value of changes in catch rates and access to fishing sites. This research has provided broad insight into the potential gains and losses that might arise as resources are allocated among fishing sectors. The studies in conjoint analysis have expanded the set of questions addressed. Yet it is not so obvious that this research is precisely the management advice that is needed now or in the future. As we have noted above, the random utility models, while well executed and revealing state of the art methods, may not be useful for management because they deal with aggregated species groups.

Many short run management needs will require a more narrow focus of data gathering and a finer tailoring of research methods. We have argued this in response to items A and C. This may mean that less funding would be spent on data gathering and more on improving empirical methods, exploring conceptual issues and experimenting with other methods to estimate trade-offs, including experimental methods. For issues related to timing, quick and dirty methods have a strong appeal. It will be essential to test the accuracy of these methods. While there is a need to try new methods, researchers should not abandon the laudatory record of subjecting their research to peer review by continuing to publish research results. This applies not only to NMFS economists but also to economists who work on projects with research support from NMFS.

E. Evaluate NMFS’ budget allocation. Reviewers shall specifically identify the inclusion or exclusion of any unmet NRC recommendations in their evaluation of program funding priorities. Reviewers shall provide recommendations on program priorities assuming level funding and a 5% increase in funding.

It is reasonable to expect that recreational fishing will continue to grow. This growth is induced by population increases, income growth, greater leisure time and by the relatively higher growth rates of the population near the coast. The MRFSS RDD supports this assertion. From 1983 to 2005, the total number of trips taken on the Atlantic coast grew from 34.8 million to 50 million (3-year moving average). On the Pacific coast, the total number of trips grew from 7.1 million in 1995 to 9.2 million in 2003 (3-year moving average). This growth implies a large increase in recreational value and in catch. Such growth cannot be expected in the commercial fishing sector, where the growth in aquaculture maintains downward pressure on price of fish products and hence effort and harvest. The recreational growth also suggests greater resource conflicts in the future.

With reasonable expectations about the growth of marine recreational fishing, greater funds will have to be allocated to meet management needs. Increases in funding should be used to solve empirical research issues related to revealed preference and conjoint methods, many of which are recognized by NMFS economists currently using the data, and to focus economic analysis on the conceptual issues that arise in the allocation of fish stocks. These issues have been addressed above, especially in items A and C.

Concerning the recommendations from the NRC, the development of more focused add-on surveys is reasonable and has been pursued, especially in conjoint studies but also with revealed preference studies. Funds for large national surveys would not be a fruitful use of resources.

With level funding, we recommend more studies that attempt to bridge the gap between empirical models and management needs. Some of these studies will be conceptual in nature while others will address current empirical roadblocks. Modest increases in funding would be allocated in a similar fashion. The emphasis should be on in-depth studies. This would likely preclude geographical coverage at the regional or national level.

In closing, we would like to endorse two ideas. First, the importance of peer-reviewed publications from the research cannot be exaggerated. Without the steady testing of ideas in the peer review process, the long run shape of the recreational economics program may lack the scientific fundamentals essential to supporting the fisheries management process. Second, we recommend outreach programs to elucidate the appropriate role for different types of benefits and costs.

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Appendix I: Statement of Work

RECREATIONAL FISHERIES ECONOMICS REVIEW

Background

NOAA Fisheries (NMFS) has collected socioeconomic data from recreational anglers every year since 1994 (see NMFS Recreational Fisheries Economics Program FAQ Sheet and survey instruments). Data collection has rotated across regions and primarily includes three types of surveys, each of which addresses a different management issue: trip expenditure surveys, which are used to determine economic activity (sales and employment) generated by recreational fishing; economic value surveys, which are used to assess the value of access to the resource, conduct damage assessments, and measure the benefits of improving fishing quality; and stated preference surveys, which are used to assess angler preferences for management options. Other surveys include for-hire cost and earnings surveys, participation surveys, subsistence surveys, an oyster habitat valuation survey, and an on-water fishing location choice survey. All surveys collect demographic data on survey respondents.

Recently, NMFS requested the National Research Council (NRC) to review its recreational fisheries monitoring program. The report, issued March 2006, included a review of NMFS' recreational fisheries economics program (see "Chapter 5 Human Dimensions" of the NRC report, *Review of Recreational Fisheries Survey Methods*." This review included a summary of NMFS' recreational fisheries economics data collection holdings, recommendations of the types of data NMFS should be collecting on anglers for management purposes, and recommendations on survey platform (currently, NMFS primarily collects its economic data as an add-on to its catch and effort monitoring program).

Requirements for this Review

The Center for Independent Experts (CIE) shall conduct a thorough examination of the appropriateness of NOAA Fisheries recreational fisheries economics data collections and analytical methods used for providing timely, accurate management advice on the economic value of recreational fishing, and the economic effects of regulatory actions.

The CIE shall provide a three-person review committee (Review Committee) composed of one individual who will serve as the chair (Chair) of the Review Committee and two individuals who will serve strictly as reviewers (Reviewers). Those selected to serve on the Review Committee should have experience with recreational survey design and modeling experience with impact assessments, random utility models (RUM) and conjoint methods. Experience in all areas is preferred, but, at a minimum, the RUM experience is essential.

The information is to be examined by the CIE Review Committee at a two-day workshop (Workshop) in Silver Spring, Maryland on October 24-25, 2006. In the two days

following the workshop, the two reviewers will begin to draft independent review reports, which the Chair shall use to begin to write the Recreational Fisheries Economics Summary Report (Summary Report).

The duties of the reviewers shall occupy a maximum of 14 days per person (i.e., several days prior to the meeting for document review; travel; two days to attend the Workshop; two days following the Workshop to participate in the preparation of the individual and summary reports; and several days following the Workshop to draft their independent review reports and to contribute to the Summary Report).

The Chair's duties shall occupy a maximum of 17 days (i.e., several days prior to the meeting for document review; travel; two days to attend the Workshop; two days following the Workshop to lead the preparation of the individual and summary reports; and several more days after the Workshop to finalize the Summary Report).

Specific Activities and Responsibilities

NMFS shall provide the CIE all the documents required for this review (see Annex I).

Task I. Workshop Preparation.

1. All committee members shall review the NMFS recreational fisheries economics overview, funding history, and the following surveys, which are illustrative of the surveys conducted under each survey category:

- a. Expenditure Surveys:
 - i. 2006 National Expenditure Survey
 - ii. Southeast Expenditure Survey: 1999
- b. Valuation Surveys:
 - i. Northeast Valuation Surveys: 1994, 1996, 1998, 1999, 2000
- c. Conjoint Surveys
 - i. 2000 Survey of Northeast Recreational Anglers: Preferences for Fishing and Management Alternatives
 - ii. 2000 Alaska Saltwater Sport Fishing Survey
 - iii. 2004 Saltwater Sportfishing Survey
 - Mail Survey
 - Telephone Survey
 - Intercept Survey

NMFS will provide survey instruments for the vast majority of surveys conducted between 1994 and 2006 (omissions noted in Annex I). Upon request, NMFS will provide the few survey instruments that have been omitted, as well as any data desired by reviewers. **Note:** Only the surveys specified above need to be reviewed; however, reviewers should be familiar with the implementation of each survey type.

2. All committee members shall read Chapter 5, “Human Dimensions” of the NRC report, “*Review of Recreational Fisheries Survey Methods.*”
3. All committee members shall become familiar with literature using NMFS recreational economic data in order to evaluate the ability of these data collections to support economic models used to characterize the economic importance of recreational fishing and to provide management advice on the economic consequences of management alternatives. NMFS will provide journal articles and other published reports using NMFS recreational economic data from 1996 through 2006 (Annex I).

Task II. Workshop.

All committee members shall participate in the Workshop on October 24-25. A tentative schedule is presented below. The workshop will be held in the Hilton in Silver Spring, 8727 Colesville Road, Silver Spring, MD, 20910 (phone: 301-589-5200; fax: 301-588-1841). During each presentation, all reviewers will be encouraged to ask questions at any time. At the end of each presentation, additional time will be allotted for questions and discussion. At the end of the two-day period, time will be allotted for the reviewers to ask additional questions.

The CIE’s committee Chair shall serve as the chair of the workshop. Duties include: coordinating presentations and discussion during the Workshop; ensuring all tasks are reviewed and adequately covered; and assessing areas of agreement and disagreement within the Review Committee on the key findings, by task and issue, and reporting any discrepancies among Review Committee members.

Day 1: NMFS Recreational Economic Data Collections

1. Program Overview:
 - a. History
 - b. Mandates and goals
 - c. Timeline
 - d. General methodological overview
 - e. Challenges
2. NRC Report
 - a. Summary of findings and recommendations
 - b. NMFS’ recent activities
3. Expenditures Surveys:
 - a. Objectives
 - b. Methods
 - c. Survey statistics
4. Valuation Surveys:
 - a. Objectives
 - b. Methods
 - c. Survey statistics
5. Conjoint Surveys:
 - a. Objectives

- b. Methods
- c. Survey statistics

Day 2: NMFS Recreational Economic Analyses

1. Input/Output Modeling:
 - a. Overview
 - b. Results
2. Valuation Models:
 - a. Overview
 - b. Results
3. Conjoint Models:
 - a. Overview
 - b. Results
4. Applications:
 - a. Fisheries Policy Analysis – Red Snapper Amendment
 - b. Natural Resource Damage Assessment Center – case studies
 - c. Valuation of Ecosystem Services – Environmental Protection Agency
5. Survey Funding:
 - a. Review of survey implementation history in conjunction with funding availability
 - b. Discussion of budget driven trade-offs, criteria used for establishing funding priorities

Task III. Reports.

After the Workshop, the review committee shall meet at the Hilton on October 26-27 to discuss workshop findings, and to draft individual reviews and the Summary Report. NMFS staff will be available to answer any questions that may arise.

The individual and summary reports shall address the following issues.

- A. Evaluate the NMFS expenditure, valuation, and conjoint surveys. The reviewers should cite the surveys cited in Task I Item 1 in their reports. The reports shall include an analysis of strengths and weaknesses of the survey methods, potential biases, and recommendations for improvement.
- B. Evaluate the degree to which NMFS recreational economic data collections from 2000-2006 meet the NRC recommendations included in “Chapter 5 Human Dimensions” of the NRC report, *“Review of Recreational Fisheries Survey Methods.”*
- C. Assess whether the suite of economic models currently employed by NMFS address management information needs and evaluate of the degree to which NMFS’ recreational economic surveys support these models. In their reports, reviewers shall cite at least one article from the scientific literature provided in

Task I Item 3 in each of the modeling categories: input/output models, valuation models, conjoint models.

- D. Evaluate, given current budget or other constraints, whether the approach NMFS is currently using for recreational economic data collection is providing “best value,” i.e., for a given level of investment in data collection and assessments, NMFS provides the most timely, accurate, and complete management advice on the economic value of recreational fishing and the economic effects of regulatory actions. (NMFS will provide budget information during Day 2 of the Workshop).
- E. Evaluate NMFS’ budget allocation. Reviewers shall specifically identify the inclusion or exclusion of any unmet NRC recommendations in their evaluation of program funding priorities. Reviewers shall provide recommendations on program priorities assuming level funding and a 5% increase in funding.

During the Workshop, additional questions that are not in this Statement of Work, but that are directly related to recreational fishing assessment, may be raised. Comments on these questions shall be included in a separate section at the end of the independent report produced by each Review Committee member.

Each Reviewer shall prepare an independent review report addressing the above issues (see Annex II for outline). These independent review reports shall be included as appendices in the Summary Report. These reports need to specify whether each issue was thoroughly addressed during the Workshop.

The Chair shall prepare a document summarizing the background to the work to be conducted as part of the Review Committee process and summarizing whether the process was adequate to complete tasks assigned herein. If appropriate, the Chair shall include suggestions on how to improve the process. This document shall constitute the introduction to the Summary Report.

The Chair shall facilitate development of the Summary Report during the 2-day period following the Workshop (see Annex II for outline). The entire Review Committee shall participate in preparing the main body of the Summary Report. Each member of the committee shall read both of the independent review reports to determine whether their opinions can be summarized into a single conclusion for each issue. The Chair’s objective during this Summary Report development process shall be to identify or facilitate the finding of an agreement, rather than to force the reviewers to reach an agreement if one does not exist (i.e., no consensus is required). For issues where agreement exists, the Summary Report shall contain a summary of this opinion. In cases where multiple and/or differing views exist on a given issue, the Summary Report shall note that there is no agreement and shall summarize the different opinions and the reason(s) for the differences.

The draft contents of the Summary Report shall be approved by the entire Committee prior to the Committee’s dismissal and departure. The Chair shall complete all writing

and editorial and formatting changes prior to submitting the Summary Report to the CIE. The Chair shall consult with the reviewers as the Chair deems necessary. The Chair shall provide the other committee members with a final copy of the final Summary Report provided to the CIE.

All reports will undergo an internal CIE review before they are considered final.

Delivery of Reports

The reviewers and Chair shall send their reports to Dr. David Sampson, via e-mail at david.sampson@oregonstate.edu and to Mr. Manoj Shivilani via e-mail at mshivilani@rsmas.miami.edu.

Schedule

The milestones and schedule are summarized in the table below. The Review Committee shall begin writing their independent review reports as items are completed during the Workshop and shall work on drafting the Summary Report on site when the Workshop is concluded. Note that the schedule for delivering the individual and summary reports is offset by a week, to allow the Chair sufficient time to incorporate material from the individual reports into the Summary Report.

Milestone	Date
Workshop at the Hilton, Silver Spring, MD	October 24-25, 2006
Chair and reviewers meet at the Hilton to draft individual reviewer and summary reports	October 26-27, 2006
Reviewers provide draft individual reports to the CIE and to the Chair	November 13, 2006
Chair provides the draft Summary Report to the CIE and to the reviewers	November 20, 2006
CIE provides individual reviewer reports to NMFS COTR for approval and to the Chair	November 30, 2006
CIE provides Summary Report to NMFS COTR for approval	December 7, 2006
COTR provides final Summary Report in pdf format to ST contacts cited below and the ST Office Director.	December 14, 2006

The Office of Science & Technology’s Economics & Social Analysis Division Chief and staff will assist the Chair with logistics and to ensure that documents are distributed in a timely fashion.

Contacts:

Dr. Rita Curtis, Division Chief, Economics & Social Analysis, 301-713-2328 ext.110, Rita.Curtis@noaa.gov

Brad Gentner, Recreational Economist, 301-713-2328 ext. 215, Brad.Gentner@noaa.gov

Submission and Acceptance of CIE Reports

According to the above schedule, the CIE shall provide via e-mail the final individual reports and the Summary Report to the COTR, Dr. Stephen Brown (stephen.k.brown@noaa.gov) for approval, based on compliance with this Statement of Work. Following the COTR's approval, the CIE will provide the final Summary Report in pdf format to the COTR.

Appendix II: Arnason review report

Recreational Fisheries Economic Review Report

by

Independent Reviewer: Ragnar Arnason

Contents

1. Executive summary
 2. Background
 3. Review activities
 4. Findings
- References
Appendix 1. Bibliography of material
Appendix 2. Statement of work

Acronyms

MRFSS	Marine Recreational Fisheries Statistics Survey
NMFS	National Marine Fisheries Service
NMFS-ESSP	NMFS Economics and Social Sciences Program
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
RFEP	Recreational Fisheries Economics Program

1. Executive summary

- The RFEP (Recreational Fisheries Economic Program) has quite limited resources consisting of one full time employee and a financial budget of under \$500,000 annually.
- Given these rather meager resources, I find the RFEP's scientific production quite impressive. By coordinating with the MRFSS data collection surveys and collaborating with outside researchers, the RFEP has managed to generate useful output far in excess of what is suggested by its budget.
- It may be the case that the RFEP's data collection effort would be more productive if it were, to a certain extent, shifted from the current large-scale survey add-ons to smaller-scale data collection designed to meet recreational management needs. [See A]
- The RFEP's data collection effort already meets some of the recommendations made by the NRC (2006) report. Other recommendations are not feasible under the current budgetary constraints of the RFEP. [See B]
- The RFEP's research is of a good standard and its models and methods are representative of the state-of-the-art in the field of recreational fisheries economics. However, as currently designed I don't think they can meet recreational management needs. For that purpose some redesign and reallocation of effort needs to be carried out. [See C]
- I find the RFEP's approach to recreational data collection quite reasonable and highly cost-effective. The current data collection, however, does not fully meet recreational fisheries management data needs. It is possible that a "better value" could be obtained by refocusing the data collection to better accommodate these needs. [See D].
- The current RFEP budgetary allocation is reasonable. However, I think it might be the case that RFEP's activities would better serve the requirements for recreational fisheries management if (i) a larger proportion of the budget were allocated to analytical and statistical improvements and (ii) relatively more emphasis were placed on obtaining lesser quantities of more high quality data for management purposes. [See E].

1. Background

On October 15, 2006, I contracted with the University of Miami to serve as a member of a three person review committee to carry out a review of the document entitled “NOAA Fisheries recreational fisheries economics data collection and analytical methods used to provide timely, accurate management advice on the economic value of recreational fishing and the economic effects of regulatory actions.” More precisely, the members of the review committee were requested to address the following issues:

- A. Evaluate the NMFS expenditure, valuation and conjoint surveys.
- B. Evaluate the degree to which NMFS recreational data collection from 2000-2006 meet the NRC recommendations.
- C. Assess whether the suite of economic models currently employed by the NMFS address management information needs and evaluate [of] the degree to which NMFS’ recreational economic surveys support these models.
- D. Evaluate, given current budget or other constraints, whether the approach NMFS is currently using for recreational data collection is providing the “best value”.
- E. Evaluate the NMFS’ budget allocation.

Further details of my obligations under this contract are set out in the Statement of Work, a copy of which is found in appendix 2 of this report.

In interpreting these tasks, I agreed with the other members of the review committee that this review should pertain primarily to the NMFS’ Recreational Fisheries Economics Program (RFEP) and only peripherally to the NMFS’ Marine Recreational Fisheries Statistics Survey (MRFSS), which has already been thoroughly reviewed by the NRC (2006) study.

The following report describes my findings.

2. Description of Review Activities

This review work was carried out during the period October 15-November 15. It is based on a number of documents obtained from NMFS Office of Science and Technology (see bibliography), the NRC Review of Recreational Fisheries Survey Methods (NRC, 2006), various scientific publications and a range of other sources. As a part of my data collection activities, I participated in a two-day workshop conducted in Silver Springs, Maryland on October 24-25, 2006, which outlined the data collection activities and studies on marine recreational fishing conducted by NMFS Recreational Fisheries Economics Program (RFEP). During and following this workshop I had several conversations with NMFS personnel having to do with recreational fishing and obtained from them additional documentation. I wish to state that all my requests for data and documentation were promptly and efficiently completed.

During the Workshop in Silver Springs and the following two days I had the opportunity to consult with my fellow review committee members. This report, however, contains exclusively my own assessments and evaluations.

In further detail my review activities proceeded as follows:

- October 15-23. Study the documentation supplied. In particular I reviewed the survey methods and statistical inference and analytical work undertaken by RFEP.
- October 15-23. Review the economic and statistical science employed in recreational fishing research. In particular the available economic theory— basically valuation techniques — and the state-of-the-art econometric methodology to estimate the relevant concepts and relationships was examined. Some references to the sources examined are listed in the bibliography.
- October 24-25. Attend the Recreational Economics Program Review in Silver Spring.
- October 26-27. Further data collection at NOAA’s headquarters in Silver Spring Meeting with the other members of the Review Committee.
- October 28 to November 7. Prepare my draft review report.
- November 7-15. Review and complete my review report.

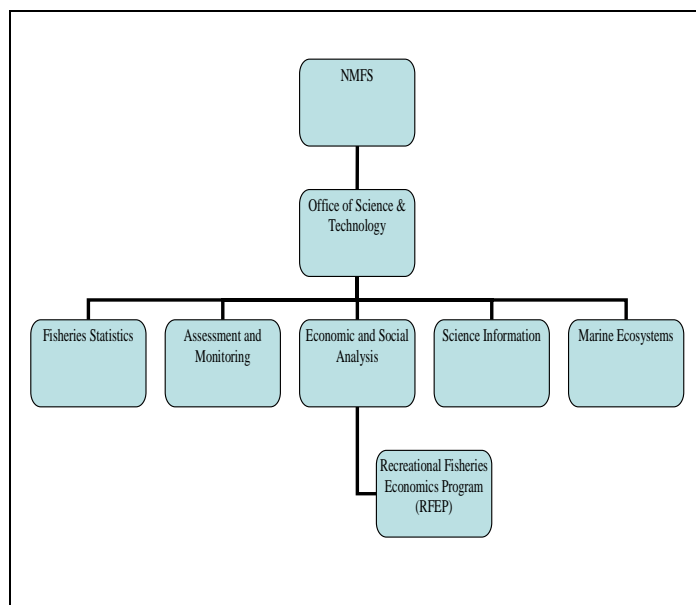
3. Findings

To respond usefully to the issues for review (points A-E in the SOW) it is necessary to be clear about (i) the placement of the RFEP (Recreational Fisheries Economics Program) within the organization of NMFS, (ii) the manpower and financial resources allocated to the RFEP, and (iii) the activities of RFEP under these constraints.

The establishment of the RFEP was approved in 1999 and it commenced operations in 2001. Its mandate is broadly to collect data and do research on the economics of recreational ocean fisheries.

The RFEP is placed within the Office of Science and Technology, under the Department of Economic and Social Analysis (see organizational chart). The MRFSS, by contrast, is under Department of Fisheries Statistics of the same office (see organizational chart).

The RFEP is probably



better described as a function than a department or sub-department. There is only one full-time employee (Brad Gentner). However, various employees from other NMFS departments provide part time work for the RFEP on an ad hoc basis. The RFEP has also managed to involve personnel from the NMFS' and individual states' regional fisheries offices and science centers as well as university academicians to participate in its research projects.

Apart from fixed salaries, the RFEP has had an average annual budget of just under \$500,000. Since 2001 about 75% of these funds have been spent on data collection and about 25% on analysis with considerable variations from year to year (Curtis 2006).

Most of the RFEP's data collection activities take place as add-ons to the MRFSS' intercept, telephone and mail surveys. It follows that these data are subject to at least the same weaknesses as those identified in the NRC-review (NRC 2006). The reason for this procedure, however, is entirely the cost. A typical MRFSS' survey with some several thousand completed interviews is easily \$250,000 - 800,000. While an independent economic and social survey of recreational fisheries would cost a similar amount, the cost of a set of add-on economic and social questions only amounts to a fraction (perhaps 1/10) of these amounts. It is clear that under its current budget, the RFEP is not in a position to conduct an independent large-scale recreational fisheries survey for economic and social analysis purposes.

The data collected by the RFEP are used to estimate important economic relationships, the most prominent of which have been:

- Recreational fisheries economic impact analysis; which primarily takes the form of input output analysis.
- Recreational fisheries economic valuation. Various methods have been used for this, but recently conjoint methods seem to have become the methodology of choice.

These two research areas are designed to indicate (i) the economic importance of recreational fishing in local and regional economies, and (ii) assess the value of recreational fishing to recreational fishermen. The latter can in principle be used to infer the impact costs to recreational fishers of altered recreational management restrictions. However, there do not seem to have been significant studies of the medium to long-term costs and benefits of alternative management tools. Similarly, the enforcement aspects of fisheries management tools and the costs of managing to the management authority do not seem to have been specifically researched. As a result, RFEP's work to date is not well suited to assess the net benefits of alternatives for recreational fisheries management.

A. *Evaluation of NMFS' expenditure, valuation and conjoint surveys*

Over the years NMFS has conducted a number of major surveys of recreational fishing including the 2006 National Expenditure Survey, the 1999 Southeast Expenditure Survey, the Northeast Recreational Valuation Surveys in 1994, 1996, 1998, 1999 and 2000 and a series of conjoint surveys in 2000-2004. As explained above, these surveys are primarily based on add-on questions to MRFSS' intercept, telephone, and mail surveys. This entails at least the same statistical weaknesses as those identified in the NRC-review (NRC 2000), including lack of standardization, sampling biases and response biases. In addition, since the sought-after economic and social data no doubt exhibit different characteristics with respect to the ideal sampling and interview strategy, further data problems inevitably arise. Without an in-depth study, however, it is not possible to assess to what extent these problems distort the estimation results or diminish the opportunity for useful analysis. My feeling, however, is that compared to other problems of statistical estimation, functional specification, and economic analysis, these data deficiencies are unlikely to constitute the most pressing problem.

It appears that with its budget the RFEP is not in a position to conduct its own data collection surveys of the scale conducted by the MRFSS. For that to be possible this budget would have to at least double. Given this constraint it is therefore of limited use to speculate about the optimal design of an independent RFEP survey. This does not mean, however, that there may not be more productive ways than those currently employed to obtain useful economic and social data or that large-scale surveys along the MRFSS lines would necessarily be the most efficient if the funds were available. Among the possibilities for smaller, less expensive and potentially more useful data collection the following may be mentioned:

- A few small scale (less than a few dozen respondents) intensive interviews of recreational fishermen.
- Develop simple ("quick and dirty") survey procedures to answer specific questions.
- Construct and maintain a panel of perhaps 200 recreational fishermen for conjoint data purposes.
- Examine the possibility of conducting experiments. This would be particularly useful for management purposes.
- Develop correction factors to transfer local/regional valuation and conjoint results onto a larger, perhaps national scale. If this can be done, the need for large-scale surveys is correspondingly reduced.

B. *Evaluation of the extent to which NMFS recreational economic data collection 2000-2006 meet the NRC (2006) recommendations*

The NRC (2006) report makes several good points regarding the collection of recreational economic (and social) data (see NRC 2006, chapter 5). However, some of its basic recommendations appear to be slightly misplaced or misinformed. The report seems

to make four key recommendations concerning recreational economic data collection (pp104 – 106), which may be summarized as follows:

- (1) Survey add-ons for social and economic data should be made more focused to target management needs.
- (2) A periodic updating of lists and descriptions of recreational fishing locations should be carried out.
- (3) An independent data collection survey for economic and social data purposes should be developed.
- (4) The national database on marine recreational fishing sites should be enhanced to support social and economic analyses.

Regarding these basic recommendations the following comments are in order:

- (1) Since its commencement in 2001, the RFEP has devoted considerable effort to the honing of the social and economic add-on questions, and they have become increasingly focused to the needs of subsequent economic valuation and analysis (see e.g. the Alaska Saltwater Northeast Valuation Survey 2000, the 2004 Saltwater Sportfishing Survey, the 2006 Expenditure Survey and Lee (2006)). It is of course always possible to improve survey questions (just as any other aspects of the survey). However, it is clear that a process of improved focus has been taking place and it seems to me, at least, that the most recent survey add-ons are up to a quite reasonable standard in this respect.

I agree, however, that the add-on data collection is perhaps not sufficiently focused on management needs. However, my reasons for this view are not necessarily the ones mentioned in the NRC-review — (see issue C below). It is important to realize is that this is not easy to accomplish with the add-on questions. Management of most marine recreational fisheries has been minimal and it obviously poses specific data quality problems to ask respondents about hypothetical situations. Recent management measures in some fisheries, mainly bag and size limits, are quite specific and clearly not examples of management tools in general. Also, it is totally unclear what management tools, if any, are going to be imposed on marine recreational fisheries in the future. So, while it would be desirable to be able to gauge recreational fishers response to potential management tools, to do that via the survey add-ons does not appear to be particularly promising.

- (2) In fact, regular updating (two month intervals) of the database on recreational fishing sites has been taking place for some time.
- (3) The conduct of an independent survey for social and economic study purposes is beyond RFEP's current means. Such a study, even if only on a regional basis, with a coverage approaching that of the MRFSS studies would probably cost several hundred thousand dollars. In addition, even if sufficient additional funds, approximately \$500K, were forthcoming, I seriously doubt that these funds would

be well spent on a large-scale survey of this kind (see above comments under A and below). In any case, without a comparative cost-benefit study it seems to me unwise to unequivocally recommend the large-scale survey approach.

- (4) A regularly updated database of recreational fishing sites is maintained and it can be, and is, used to support social and economic analyses. It is true, however, that this database could be enhanced by the addition of measures along more dimensions of site characteristics. Since many of these change slowly, this should be a relatively easy matter to do. It is another matter whether these additions to the database would help much in gauging the response of recreational fishers to management.

C. Assess whether the suite of economic models currently employed by the NMFS address management information needs and evaluate the degree to which NMFS' recreational economic surveys support these models

Obviously, to conduct this assessment the purpose of management needs to be specified. On a fairly general level, the objective of recreational fisheries management is presumably to arrange recreational fisheries so that their contribution to the welfare of the US population is maximized. This may be expected to entail (i) the maintenance of fish stock populations and their ocean habitat at desired levels, (ii) the appropriate adjustments to external effects, and (iii) the introduction and operation of an institutional structure to attain (i) and (ii). The information necessary to achieve this may be seen as the management information needs.

The methods and models used by the RFEP to understand and explain recreational fisheries seem fairly representative of the state-of-the-art in this field. Two main approaches are used; (1) economic impact studies and (2) economic valuation studies. The former approach is fundamentally based on regional input-output analysis supplementing available economic sectoral measurements with recreational fisheries data obtained from recreational expenditure and valuation surveys (see e.g. Steinback 1999, Kirkley 2006). These studies basically attempt to assess the value-added, generated by recreational fisheries and their impact on employment and other indicators of economic activity. This approach, however, is subject to well known limitations, which are clearly realized by the RFEP. Most importantly it cannot reveal the “real” impact of any industry in the sense of telling what would happen if that industry were removed. The latter approach, consisting of valuation studies, employs standard economic valuation methodology, both of the revealed and stated preference variety, to assess the economic value of the recreational activity to recreational fishermen (see e.g. Gentner and Lowther 2002). Recently the conjoint methodology has been much used for this purpose (Hicks 2002, Gentner 2005, Oh et al 2005).

Neither approach can or does provide the necessary management information. The input-output studies can at best estimate the economic impact of recreational fishing. They do not provide information for management purposes. The conjoint (and other valuation)

studies basically attempt to estimate the indirect utility function of recreational fishers. This, in principle, could comprise the impact of management tools on benefits, especially if there is empirical experience of such tools (which incidentally is quite limited). The problem is that recreational valuation only looks at the benefit side of recreational fishing. It cannot provide information on crucial management relationships such as management costs or the impact of recreational fishing on fish stocks and other environmental variables in limited supply.

A little formalism may clarify the problem. Benefits from recreational fishing may fairly generally be expressed as a function of environmental states, exogenous variables, recreational activity and management controls. This can be expressed as $V(\mathbf{x}, \mathbf{z}, \mathbf{q}, \mathbf{u})$, where: \mathbf{x} represents a vector of environmental states including both living resources, marine habitat variables and other environmental variables; \mathbf{z} is a vector of exogenous variables including prices; \mathbf{q} a vector of recreational activity, and; \mathbf{u} the vector of possible management controls. The evolution of the environmental state variables may be represented in a simple fashion by the system of differential equations $\dot{\mathbf{x}} = \mathbf{G}(\mathbf{x}) - \mathbf{F}(\mathbf{q})$, where the $\mathbf{G}(\cdot)$ and $\mathbf{F}(\cdot)$ functions represent vectors of natural regeneration and recreational extraction, respectively. Finally, there must be a function mapping management controls into recreational actions, such as $\mathbf{H}(\mathbf{q}, \mathbf{u}) = 0$. Now, the recreational management problem is to find the time path of the vector \mathbf{u} which maximizes the present value of $V(\cdot, \cdot, \cdot, \cdot)$ subject to the functions mentioned above and other constraints of the problem. Valuation studies, however extensive and well done can only throw light on the objective function $V(\cdot, \cdot, \cdot, \cdot)$ — the light thrown on this function by the studies conducted so far is actually quite limited. Sensible recreational management, however, also needs information on the $\mathbf{G}(\cdot)$, $\mathbf{F}(\cdot)$ and $\mathbf{H}(\mathbf{q}, \mathbf{u})$ functions. Little or no work seems to be conducted by the RFEP to obtain this information.

The recreational economic surveys (the add-ons) are designed to provide data to estimate the function $V(\cdot, \cdot, \cdot, \cdot)$. They do so to a certain, but limited extent. The add-on surveys are simply too limited in scope to provide all the data necessary to obtain good estimates of the function $V(\cdot, \cdot, \cdot, \cdot)$. The data collected in these surveys, moreover, provide little help in the estimation of the other functions. Different data collection and possibly data generation methods (e.g. experiments, comparative studies etc) are needed for that.

So, the conclusion is that the economic models and data collection activities employed by the RFEP do not fulfill the needs of recreational fisheries management. Having come to this conclusion, the reader should be reminded that the resources needed to develop and implement the necessary models and to obtain the corresponding data far exceed the resources that have so far been allocated to RFEP. Much of the theoretical details, and most likely some of the statistical methodology needed for this task, are currently not available and need to be developed. The data requirements also demand new data collection processes that in all likelihood need to be distinct from those conducted by the MRFSS surveys, as, indeed, suggested by the NRC review (NRC 2006). At present the RFEP simply does not have the manpower or financial resources to carry out this task. In fact, given the relatively meager resources allocated to the RFEP,

its output in terms of valuable data and empirical results seems quite impressive to this reviewer.

D. *Evaluate, given current budget or other constraints, whether the approach NMFS is currently using for recreational data collection is providing the “best value”*

My response to this request is restricted to the allocation of funds within the RFEP, i.e. it ignores the funding for MRFSS and other economic and social sciences spending by the NMFS.

Since the year 2000, the RFEP’s budget, apart from permanent personnel salaries, has averaged about \$460,000 (Curtis 2006). Of this amount about 75% has been allocated to data collection and 25% to “analysis”, i.e. the use of these data for estimation and interpretation purposes (Curtis 2006). Compared to the task of providing “timely, accurate and complete management advice” in a complex and poorly understood area of economic activity (see item C above), this funding is, in my opinion, totally inadequate.

It seems to me that regarding recreational data collection, the approach chosen, namely add-ons to the MRFSS’ surveys, is quite reasonable and extremely cost effective per unit of data collected. I think it unlikely that the same data can be collected at lower cost. What I am not so sure of, however, is whether smaller quantities of more useful data for recreational management purposes might not be collected at the same or smaller cost. I have already argued that the current data collection cannot meet recreational management needs. For that, other types of data have to be collected as well. The question is whether useful data on environmental responses to recreational activities and recreational activity responses to management tools, both of which are needed for management purposes, in addition to more focused valuation data can be collected within the current budget. I think it probably can, especially if spread over a number of years. This, if actually feasible, would require systematic rethinking and redesign of the current data collection strategy. Moreover, if this more small-scale approach would be adopted wide geographical coverage will probably have to be sacrificed.

Related to this is the question of balance between data collection and analytical work. Given my understanding of recreational management needs and the current state of the economic theory in the field and possible improvements in statistical estimation procedures, it might well be the case that RFEP’s meager resources would be better used by temporarily spending more on theoretical developments and less on data collection.

E. *Evaluate the NMFS’ budget allocation.*

As regards the allocation of funds within the RFEP, it seems to me that it might be more in accordance with recreational management needs to (a) allocate relatively more funds to theoretical improvements and the development of more finely tuned statistical estimation techniques and (b) cut back on the large-scale survey add-on question effort in favor of

smaller-scale, more focused data collection specifically for management purposes. For arguments regarding this conclusions see issue D. above.

The NRC review (NRC 2006) recommends, among other things, the adoption of (i) more focused survey add-ons and (ii) independent national trip and expenditure surveys. Regarding the former, I believe that the add-on questions have actually become more focused over the years and are still being improved (see e.g. Lee 2006). In other words, the essential point of this particular recommendation is being met. As regards the second recommendation, it has already been pointed out above (issues A, B and C) that independent surveys of the type recommended by the NRC report far exceed the financial resources of the RFEP. In addition, even if the funds were available, I believe they would be more productively used to collect much smaller quantities of high quality, data designed specifically to meet management needs, more careful analysis of existing data, the development of the economic theory of recreational fishing and, on that basis, statistical methods to estimate the relationships suggested by the theory. Better data could for instance be collected by intensive interviews, experiments, careful studies of comparative experiences under different conditions (natural experiments) and so on. In short, I very much doubt that it would be a good idea to follow the second NRC recommendation, even if it were financially feasible.

With unchanged overall funding, I recommend the following:

- (i) Some diversion of MRFSS funds to data collection specifically for recreational fisheries management purposes.
- (ii) Some diversion of RFEP funds for data collection from the usual add-on questions to more focused small-scale data collection for management purposes especially data designed to fill current gaps in the necessary data for sensible recreational fisheries management.
- (iii) Some diversion of RFEP funds from data collection to analytical work — developments in the economic theory of recreational fishing and improvements in statistical methodology.

A 5% increase in RFEP funding only amounts to some \$25,000 annually which is totally insignificant and doesn't change the above recommendations.

Bibliography

This bibliography consists of a selection of material supplied by the NMFS and relevant readings from the general literature on environmental economics and recreational fishing. In addition, some material presented at the Recreational Fisheries Economics Program Review Workshop October 24-5 2006 is included. Finally, for completeness, references to the main surveys conducted in recent years are included.

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Surveys

CONJOINT SURVEYS

- 2000 Survey of Northeast Recreational Anglers: Preferences for Fishing and Management Alternatives
- 2000 Alaska Saltwater Sport Fishing Survey
- 2004 Saltwater Sportfishing Survey
 - Mail Survey
 - Telephone Survey
 - Intercept Survey

VALUATION SURVEYS

	Northeast	1994, 1996, 1998, 1999, 2000
	Southeast	1997, 2000, 2004
.	Pacific Coast	1998

EXPENDITURE SURVEYS

.	National	2006
.	Northeast	1998
.	Southeast	1999
.	Pacific Coast	2000

OTHER SURVEYS & LITERATURE

	Chesapeake Bay	2001 - oyster habitat valuation survey
	Northeast	2004 - subsistence survey
	Northeast	2004 - participation survey
	Gulf of Mexico	2002 – for hire cost and earnings survey

Statement of Work

RECREATIONAL FISHERIES ECONOMICS REVIEW

Background

NOAA Fisheries (NMFS) has collected socioeconomic data from recreational anglers every year since 1994 (see NMFS Recreational Fisheries Economics Program FAQ Sheet and survey instruments). Data collection has rotated across regions and primarily includes three types of surveys, each of which addresses a different management issue: trip expenditure surveys, which are used to determine economic activity (sales and employment) generated by recreational fishing; economic value surveys, which are used to assess the value of access to the resource, conduct damage assessments, and measure the benefits of improving fishing quality; and stated preference surveys, which are used to assess angler preferences for management options. Other surveys include for-hire cost and earnings surveys, participation surveys, subsistence surveys, an oyster habitat valuation survey, and an on-water fishing location choice survey. All surveys collect demographic data on survey respondents.

Recently, NMFS requested the National Research Council (NRC) to review its recreational fisheries monitoring program. The report, issued March 2006, included a review of NMFS' recreational fisheries economics program (see "Chapter 5 Human Dimensions" of the NRC report, *"Review of Recreational Fisheries Survey Methods."* This review included a summary of NMFS' recreational fisheries economics data collection holdings, recommendations of the types of data NMFS should be collecting on anglers for management purposes, and recommendations on survey platform (currently, NMFS primarily collects its economic data as an add-on to its catch and effort monitoring program).

Requirements for this Review

The Center for Independent Experts (CIE) shall conduct a thorough examination of the appropriateness of NOAA Fisheries recreational fisheries economics data collections and analytical methods used for providing timely, accurate management advice on the economic value of recreational fishing, and the economic effects of regulatory actions.

The CIE shall provide a three-person review committee (Review Committee) composed of one individual who will serve as the chair (Chair) of the Review Committee and two individuals who will serve strictly as reviewers (Reviewers). Those selected to serve on the Review Committee should have experience with recreational survey design and modeling experience with impact assessments, random utility models (RUM) and conjoint methods. Experience in all areas is preferred, but, at a minimum, the RUM experience is essential.

The information is to be examined by the CIE Review Committee at a two-day workshop (Workshop) in Silver Spring, Maryland on October 24-25, 2006. In the two days

following the workshop, the two reviewers will begin to draft independent review reports, which the Chair shall use to begin to write the Recreational Fisheries Economics Summary Report (Summary Report).

The duties of the reviewers shall occupy a maximum of 14 days per person (i.e., several days prior to the meeting for document review; travel; two days to attend the Workshop; two days following the Workshop to participate in the preparation of the individual and summary reports; and several days following the Workshop to draft their independent review reports and to contribute to the Summary Report).

The Chair's duties shall occupy a maximum of 17 days (i.e., several days prior to the meeting for document review; travel; two days to attend the Workshop; two days following the Workshop to lead the preparation of the individual and summary reports; and several more days after the Workshop to finalize the Summary Report).

Specific Activities and Responsibilities

NMFS shall provide the CIE all the documents required for this review (see Annex I).

Task I. Workshop Preparation.

1. All committee members shall review the NMFS recreational fisheries economics overview, funding history, and the following surveys, which are illustrative of the surveys conducted under each survey category:

- d. Expenditure Surveys:
 - i. 2006 National Expenditure Survey
 - ii. Southeast Expenditure Survey: 1999
- e. Valuation Surveys:
 - i. Northeast Valuation Surveys: 1994, 1996, 1998, 1999, 2000
- f. Conjoint Surveys
 - i. 2000 Survey of Northeast Recreational Anglers: Preferences for Fishing and Management Alternatives
 - ii. 2000 Alaska Saltwater Sport Fishing Survey
 - iii. 2004 Saltwater Sportfishing Survey
 - Mail Survey
 - Telephone Survey
 - Intercept Survey

NMFS will provide survey instruments for the vast majority of surveys conducted between 1994 and 2006 (omissions noted in Annex I). Upon request, NMFS will provide the few survey instruments that have been omitted, as well as any data desired by reviewers. **Note:** Only the surveys specified above need to be reviewed; however, reviewers should be familiar with the implementation of each survey type.

2. All committee members shall read Chapter 5, “Human Dimensions” of the NRC report, “*Review of Recreational Fisheries Survey Methods.*”
3. All committee members shall become familiar with literature using NMFS recreational economic data in order to evaluate the ability of these data collections to support economic models used to characterize the economic importance of recreational fishing and to provide management advice on the economic consequences of management alternatives. NMFS will provide journal articles and other published reports using NMFS recreational economic data from 1996 through 2006 (Annex I).

Task II. Workshop.

All committee members shall participate in the Workshop on October 24-25. A tentative schedule is presented below. The workshop will be held in the Hilton in Silver Spring, 8727 Colesville Road, Silver Spring, MD, 20910 (phone: 301-589-5200; fax: 301-588-1841). During each presentation, all reviewers will be encouraged to ask questions at any time. At the end of each presentation, additional time will be allotted for questions and discussion. At the end of the two-day period, time will be allotted for the reviewers to ask additional questions.

The CIE’s committee Chair shall serve as the chair of the workshop. Duties include: coordinating presentations and discussion during the Workshop; ensuring all tasks are reviewed and adequately covered; and assessing areas of agreement and disagreement within the Review Committee on the key findings, by task and issue, and reporting any discrepancies among Review Committee members.

Day 1: NMFS Recreational Economic Data Collections

6. Program Overview:
 - a. History
 - b. Mandates and goals
 - c. Timeline
 - d. General methodological overview
 - e. Challenges
7. NRC Report
 - a. Summary of findings and recommendations
 - b. NMFS’ recent activities
8. Expenditures Surveys:
 - a. Objectives
 - b. Methods
 - c. Survey statistics
9. Valuation Surveys:
 - a. Objectives
 - b. Methods
 - c. Survey statistics
10. Conjoint Surveys:
 - a. Objectives

- b. Methods
- c. Survey statistics

Day 2: NMFS Recreational Economic Analyses

- 6. Input/Output Modeling:
 - a. Overview
 - b. Results
- 7. Valuation Models:
 - a. Overview
 - b. Results
- 8. Conjoint Models:
 - a. Overview
 - b. Results
- 9. Applications:
 - a. Fisheries Policy Analysis – Red Snapper Amendment
 - b. Natural Resource Damage Assessment Center – case studies
 - c. Valuation of Ecosystem Services – Environmental Protection Agency
- 10. Survey Funding:
 - a. Review of survey implementation history in conjunction with funding availability
 - b. Discussion of budget driven trade-offs, criteria used for establishing funding priorities

Task III. Reports.

After the Workshop, the review committee shall meet at the Hilton on October 26-27 to discuss workshop findings, and to draft individual reviews and the Summary Report. NMFS staff will be available to answer any questions that may arise.

The individual and summary reports shall address the following issues.

- A. Evaluate the NMFS expenditure, valuation, and conjoint surveys. The reviewers should cite the surveys cited in Task I Item 1 in their reports. The reports shall include an analysis of strengths and weaknesses of the survey methods, potential biases, and recommendations for improvement.
- B. Evaluate the degree to which NMFS recreational economic data collections from 2000-2006 meet the NRC recommendations included in “Chapter 5 Human Dimensions” of the NRC report, *“Review of Recreational Fisheries Survey Methods.”*
- C. Assess whether the suite of economic models currently employed by NMFS address management information needs and evaluate of the degree to which NMFS’ recreational economic surveys support these models. In their reports, reviewers shall cite at least one article from the scientific literature provided in

Task I Item 3 in each of the modeling categories: input/output models, valuation models, conjoint models.

- D. Evaluate, given current budget or other constraints, whether the approach NMFS is currently using for recreational economic data collection is providing “best value,” i.e., for a given level of investment in data collection and assessments, NMFS provides the most timely, accurate, and complete management advice on the economic value of recreational fishing and the economic effects of regulatory actions. (NMFS will provide budget information during Day 2 of the Workshop).
- E. Evaluate NMFS’ budget allocation. Reviewers shall specifically identify the inclusion or exclusion of any unmet NRC recommendations in their evaluation of program funding priorities. Reviewers shall provide recommendations on program priorities assuming level funding and a 5% increase in funding.

During the Workshop, additional questions that are not in this Statement of Work, but that are directly related to recreational fishing assessment, may be raised. Comments on these questions shall be included in a separate section at the end of the independent report produced by each Review Committee member.

Each Reviewer shall prepare an independent review report addressing the above issues (see Annex II for outline). These independent review reports shall be included as appendices in the Summary Report. These reports need to specify whether each issue was thoroughly addressed during the Workshop.

The Chair shall prepare a document summarizing the background to the work to be conducted as part of the Review Committee process and summarizing whether the process was adequate to complete tasks assigned herein. If appropriate, the Chair shall include suggestions on how to improve the process. This document shall constitute the introduction to the Summary Report.

The Chair shall facilitate development of the Summary Report during the 2-day period following the Workshop (see Annex II for outline). The entire Review Committee shall participate in preparing the main body of the Summary Report. Each member of the committee shall read both of the independent review reports to determine whether their opinions can be summarized into a single conclusion for each issue. The Chair’s objective during this Summary Report development process shall be to identify or facilitate the finding of an agreement, rather than to force the reviewers to reach an agreement if one does not exist (i.e., no consensus is required). For issues where agreement exists, the Summary Report shall contain a summary of this opinion. In cases where multiple and/or differing views exist on a given issue, the Summary Report shall note that there is no agreement and shall summarize the different opinions and the reason(s) for the differences.

The draft contents of the Summary Report shall be approved by the entire Committee prior to the Committee’s dismissal and departure. The Chair shall complete all writing

and editorial and formatting changes prior to submitting the Summary Report to the CIE. The Chair shall consult with the reviewers as the Chair deems necessary. The Chair shall provide the other committee members with a final copy of the final Summary Report provided to the CIE.

All reports will undergo an internal CIE review before they are considered final.

Delivery of Reports

The reviewers and Chair shall send their reports to Dr. David Sampson, via e-mail at david.sampson@oregonstate.edu and to Mr. Manoj Shivilani via e-mail at mshivilani@rsmas.miami.edu.

Schedule

The milestones and schedule are summarized in the table below. The Review Committee shall begin writing their independent review reports as items are completed during the Workshop and shall work on drafting the Summary Report on site when the Workshop is concluded. Note that the schedule for delivering the individual and summary reports is offset by a week, to allow the Chair sufficient time to incorporate material from the individual reports into the Summary Report.

Milestone	Date
Workshop at the Hilton, Silver Spring, MD	October 24-25, 2006
Chair and reviewers meet at the Hilton to draft individual reviewer and summary reports	October 26-27, 2006
Reviewers provide draft individual reports to the CIE and to the Chair	November 13, 2006
Chair provides the draft Summary Report to the CIE and to the reviewers	November 20, 2006
CIE provides individual reviewer reports to NMFS COTR for approval and to the Chair	November 30, 2006
CIE provides Summary Report to NMFS COTR for approval	December 7, 2006
COTR provides final Summary Report in pdf format to ST contacts cited below and the ST Office Director.	December 14, 2006

The Office of Science & Technology’s Economics & Social Analysis Division Chief and staff will assist the Chair with logistics and to ensure that documents are distributed in a timely fashion.

Contacts:

Dr. Rita Curtis, Division Chief, Economics & Social Analysis, 301-713-2328 ext.110, Rita.Curtis@noaa.gov

Brad Gentner, Recreational Economist, 301-713-2328 ext. 215, Brad.Gentner@noaa.gov

Submission and Acceptance of CIE Reports

According to the above schedule, the CIE shall provide via e-mail the final individual reports and the Summary Report to the COTR, Dr. Stephen Brown (stephen.k.brown@noaa.gov) for approval, based on compliance with this Statement of Work. Following the COTR's approval, the CIE will provide the final Summary Report in pdf format to the COTR.

Appendix III: Talhelm review report

Review of NMFS Recreational Fisheries Economics Program

Daniel R. Talhelm (talhelmd@msu.edu)

12/15/2006

Executive Summary

Impetus and Goals for the Review

The NMFS' Marine Recreational Fisheries Economics Program (RFEP) has collected socioeconomic data from recreational anglers every year since 1994. Data collection has rotated across regions and includes three primary types of surveys, addressing two aspects of fisheries management: trip expenditure surveys, which are used to estimate economic activity (sales and employment) devoted to recreational fishing; and two types of economic value surveys, revealed preference (RP) and stated preference (SP) surveys, which are used to estimate the value of access to the resource, conduct damage assessments, and estimate the benefits of fisheries management actions, such as improving angling quality. Other surveys include for-hire cost and earnings surveys, participation surveys, subsistence surveys, an oyster habitat valuation survey, and an on-water fishing location choice survey. All surveys collect demographic data on survey respondents.

Recently, NMFS requested the National Research Council (NRC) to review its recreational fisheries monitoring program. The report, issued March 2006, included a review of NMFS' recreational fisheries economics program (see "Chapter 5 Human Dimensions" of the NRC report, "Review of Recreational Fisheries Survey Methods." This review included a summary of NMFS' recreational fisheries economics data collection holdings, recommendations of the types of data NMFS should be collecting on anglers for management purposes, and recommendations on the survey platform (currently, NMFS primarily collects its economic data as an add-on to its catch and effort monitoring program).

The purpose of this review is to conduct a thorough examination of the appropriateness of NOAA Fisheries recreational fisheries economics data collections and analytical methods used for providing timely, accurate management advice on the economic value of recreational fishing, and the economic effects of regulatory actions.

The Review Committee attended a two-day workshop in Silver Spring, Maryland on October 24-25, 2006 reviewing NMFS recreational fisheries economics program. This report is one of two independent reports by review committee members. A third report, by the committee chair, will summarize these two independent reports and the chair's conclusions.

This report addresses the following issues:

- A. Evaluate the NMFS expenditure, valuation, and conjoint surveys. The reviewers should cite the surveys cited in Task I Item 1 in their reports. The reports shall include an analysis of strengths and weaknesses of the survey methods, potential biases, and recommendations for improvement.
- B. Evaluate the degree to which NMFS recreational economic data collections from 2000-2006 meet the NRC recommendations included in “Chapter 5 Human Dimensions” of the NRC report, “*Review of Recreational Fisheries Survey Methods.*”
- C. Assess whether the suite of economic models currently employed by NMFS address management information needs and evaluate the degree to which NMFS’ recreational economic surveys support these models. In their reports, reviewers shall cite at least one article from the scientific literature provided in Task I Item 3 in each of the modeling categories: input/output models, valuation models, conjoint models.
- D. Evaluate, given current budget or other constraints, whether the approach NMFS is currently using for recreational economic data collection is providing “best value,” i.e., for a given level of investment in data collection and assessments, NMFS provides the most timely, accurate, and complete management advice on the economic value of recreational fishing and the economic effects of regulatory actions.
- E. Evaluate NMFS’ budget allocation. Reviewers shall specifically identify the inclusion or exclusion of any unmet NRC recommendations in their evaluation of program funding priorities. Reviewers shall provide recommendations on program priorities assuming level funding and a 5% increase in funding.

Main Conclusions and Recommendations

Issue A: Evaluate Surveys

Evaluate the NMFS expenditure, valuation, and conjoint surveys. The reviewers should cite the surveys cited in Task I Item 1 in their reports. The reports shall include an analysis of strengths and weaknesses of the survey methods, potential biases, and recommendations for improvement.

- I find that the current surveys are highly cost-effective means of collecting the data required to meet RFEP-mandated tasks. Expenditure data could be collected at least as effectively and with fewer biases in license-frame surveys, but at a much higher cost. License frame personal interview or mail surveys are generally most effective for collecting conjoint stated preference (SP) data. Current surveys collecting revealed preference (RP) data have been useful, but not intensive enough to facilitate detailed analyses that would be even more useful. At current levels of survey intensity, license-frame surveys could collect RP data as effectively but at a higher cost. However, site-based RP

surveys could be much more effective if sampling effort were intensified, and most cost-effective if intense sampling were limited to selected locations and times.

RFEP surveys are predominantly based on the annual NMFS Marine Recreational Fisheries Statistical Surveys (MRFSS). Overall, the cost advantage of this MRFSS-based sampling clearly seems to outweigh its disadvantages relative to alternative means of estimating expenditures. This advantage permits more intensive sampling for the same cost, or permits additional spending on other useful projects. Though less expensive, the MRFSS-based approach is subject to the same advantages and disadvantages as MRFSS: primarily the disadvantages of avidity bias, undercoverage (omitting night and private dock anglers) and limitations on the number of questions that may reasonably be asked (in the intercept survey), and the advantages of minimal recall error, minimal response bias and rapid availability of survey data for analysis or follow-up. Avidity bias and undercoverage can be reasonably addressed with information obtained in MRFSS random digit dialing (RDD) surveys of coastal residents.

The primary limitation of use of add-ons to MRFSS for economic data collection is that the intercept surveys are not intensive enough to support the requirements of detailed evaluation of angling quality in revealed preference analyses. I recommend occasionally conducting more intensive intercept surveys in selected locations to support such analyses.

The primary alternative to the add-on approach is a license frame survey. License frame surveys have the advantage of providing an identified population of anglers from which to sample. They can be “more defined and efficient” than other methods (NRC, p. 34). However, several practical disadvantages currently hinder their use, including (1) undercoverage (some anglers not needing licenses, such as pier and charterboat anglers in California and some other states, and military personnel, handicapped, seniors, and others in various states), (2) overcoverage (licenses covering more than just saltwater angling), (3) delayed availability of the current population of license receipts for purposes of drawing samples and possible inclusion of out-of-date licenses in the sampled population, (4) unreadable or inaccurate recording of license holder names and addresses, (5) duplication via overlapping types of licenses, and (6) undercoverage of names and addresses of license holders (e.g., California only provides space for recording addresses on about 10% of license receipts). These drawbacks can be corrected by techniques such as telephone screening surveys of license holders to identify active saltwater anglers, which NMFS uses for Washington and Oregon. This doubles the survey cost. I find that license frame surveys also have the disadvantage that anglers cannot be expected to report their specific angling sites more accurately than at the county level, which is not detailed enough to support the full potential of revealed preference (RP) surveys.

I also find that if costs were equal, license frame estimation would probably be preferred as more direct and more accurate than intercept surveys for estimating expenditures and stated preference (SP) and conjoint estimation, but not for RP estimation. However, I also find that current state license requirements and recording procedures present many practical barriers to expenditure surveys.

Conjoint surveys are usually too complex to be asked in telephone surveys, and generally require mail surveys or relatively lengthy personal interviews. Generally the most critical and difficult aspect of SP surveys is survey instrument design and verification.

I recommend continued regular peer reviews of SP and conjoint survey instruments, as a means of continuous quality control. Finally, I recommend exploring panel surveys and internet formats for use in combination with other survey types.

Issue B: Has 2000-2006 Data Collection Met NRC Recommendations?

1. *Evaluate the degree to which NMFS recreational economic data collections from 2000-2006 meet the NRC recommendations included in "Chapter 5 Human Dimensions" of the NRC report, "Review of Recreational Fisheries Survey Methods."*

NRC Recommendation 1: Focus add-on surveys for economic models to target specific management needs. ("With respect to the economic models, add-on surveys for human dimensions should be continued, but in a more focused way than is done currently to target specific management needs and to supplement the national data as needed.")

- I find that the MRFE program has met this recommendation, using add-on surveys quite effectively from 2000 to 2006, minimizing survey costs while effectively targeting specific management needs.

Since 2000, one national expenditure survey was completed with the addition of the west coast regions, and a nationwide expenditure survey is underway. The survey methods seem appropriate and cost effective for this purpose, and suitable models have been used for economic impact estimation. Add-ons greatly reduce survey costs because reaching anglers for sampling is a major cost component. However, I find that state and national economic impact assessments, while a good start, are insufficient to meet mandates for community impact assessment. IMPLAN can help estimate county-level impacts, but it or other, more user-friendly tools have not yet been provided to facilitate use of economic impact information at the local level by analysts who do not have access to the IMPLAN analyses.

Since 2000, all five valuation surveys have used MRFSS intercept add-on surveys to collect information about trip purpose and time costs. This information is paired with angler origin-destination (O/D) estimates from MRFSS and previously-estimated travel cost functions to provide complete sets of data for estimating RP random utility model (RUM) and travel cost models. NMFS-sponsored RP models have been limited in their ability to account for changes in angling quality mainly because estimates of angler behavior (O/D patterns) are not detailed enough. I find that the primary limitation is O/D data insufficiency for model estimation rather than economic data collection mode or RP model type. I also find that new approaches, combining both RP and conjoint models to model angler behavior are potentially very useful for verifying the findings of each (RP and SP) and to more thoroughly model angler preferences and behavior.

Since 2000, conjoint surveys have been conducted in the Northeast (2000), Alaska (2004), Southeast (2004), and Washington and Oregon (2006). Conjoint surveys are complex, and thus quite demanding for respondents, so intensive personal interviews are best by far. Stand-alone mail survey instruments are the next best alternative, and much

less expensive than intensive personal interviews. I find that conjoint surveys are highly targeted to meet management needs. The three completed studies evaluated critical fisheries management options that managers were actively considering, were developed in cooperation with managers, and successfully evaluated the targeted questions in a manner apparently helpful to managers.

NRC Recommendation 2: Periodically update lists and descriptions of fishing locations and access sites. (“To ensure adequate coverage of the recreational fishery, a periodic updating of lists and descriptions of fishing locations and access sites is needed.”)

- I find that this recommendation has partially been met. Existing descriptions of access sites are updated regularly, but additional data needs to be assembled for access sites in support of RP valuation studies that model angler responses to site quality variables.

Certainly it is important to maintain the list and descriptions of fishing locations and angling sites to obtain a thorough, efficient sample of angling effort. However, I find that for most practical purposes this is a moot point for economic surveys. Generally only RP studies rely on site quality data. When data are aggregated for entire counties for the entire year for purposes of estimation of angling participation, it is very difficult to precisely characterize the quality of angling at any given location. I also find that if some future surveys were to be conducted intensively enough to enable estimation of angling effort at specific sites for specific seasons or shorter periods, then current angling site information would become more critical to the associated analyses. I recommend doing both together to support valuation model estimation.

NRC Recommendation 3: Develop an independent national trip and expenditure survey. (“An independent national trip and expenditure survey should be developed [around a national registry or license frame, independent of MRFSS] to support economic valuation studies, impact analyses, and other social and attitudinal studies.” Seven specific procedures or targets were recommended.)

- I find that this recommendation has been met except the first specific procedure recommending an independent survey based on a national registry. I also find that that particular recommendation is unnecessary. It would probably not reduce costs and would have few advantages. I recommend a feasibility study before proceeding in this direction.

I see no compelling reason to develop an independent national survey for economics surveys. For a national registry or license frame to be consistent across all coastal states would require virtually all states to reformulate their fishing license requirements. While this could be done, it would be expensive and politically and socially wrenching. RP valuation studies would still have to rely on MRFSS or special stand-alone site surveys for accurate O/D estimates, especially if they were to use angling-site information to facilitate the use of angling site quality data in valuation analyses as NRC and I recommend. It would be quite impractical to estimate the use of specific angling sites via a license frame survey because I believe many anglers would have difficulty reporting their specific fishing sites.

NRC Recommendation 4: Enhance the national database of marine recreational fishing sites. (“The national database on marine recreational fishing sites and their characteristics should be

enhanced to support social, economic, and other human dimensions analysis.” Seven specific procedures or targets were recommended, including periodically updating, addressed above.)

- I find that this recommendation has partially been met, and I agree that the remaining portions are needed. An enhanced national database of marine recreational fishing sites would be useful, particularly in facilitating intensified RP analyses (as I recommend) and applying their findings to other angling sites.

NMFS currently maintains a nation-wide database on marine recreational fishing sites for MRFSS sampling purposes, though it does not include sites in Texas, Alaska, or US territories, and it is unclear whether the databases for California, Oregon and Washington have been updated since MRFSS was discontinued there in 2002. Inventory information is regularly updated as needed by MRFSS survey personnel. I find that detailed site information would be useful for estimating angler response to qualitative factors, especially if such studies were enhanced by increased O/D observations.

Issue C: Do Models/Surveys Address Management Information Needs

Assess whether the suite of economic models currently employed by NMFS address management information needs and evaluate of the degree to which NMFS’ recreational economic surveys support these models. In their reports, reviewers shall cite at least one article from the scientific literature provided in Task I Item 3 in each of the modeling categories: input/output models, valuation models, conjoint models.

- I find that the economic impact model, IMPLAN, is technically an excellent choice, and meets some mandated information needs, except that it is generally inaccessible for estimating local economic impacts. I recommend some additional work to make it more accessible to analysts untrained in IMPLAN use, and thus more able to estimate local economic impacts. I find that present surveys adequately support this model.
- I find that the RP models are appropriate and reasonably state-of-the-art, and relevant to management information needs, but that some issues and opportunities for improvement remain. I also find that RP models are limited by insufficient observations of angler O/D patterns in MRFSS. They are also inherently limited to observed behavior in the real world, so they are unable to estimate the values of some potential fishery management options and of unobservable fishery resource conditions. These limitations provide opportunities for improving their relevance for management, so I recommend further exploring ways of overcoming these limitations.
- I find that SP and conjoint models are appropriate, MFRE applications have advanced the state-of-the-art, and are highly responsive to management information needs. I also find that some technical issues remain, providing opportunities for improvement. Survey methods are critical to these models, and conjoint surveys require considerable design work. Therefore, other NMFS surveys and state license frames provide limited support for these models. I find that improvements in state license requirements and data handling would improve their ability to support the surveys required for these models, though I

do not recommend requiring these changes unless it can be demonstrated that the benefits of doing so outweigh the costs.

- I recommend exploring other, less expensive options for addressing management needs, such as “quick and dirty” procedures to address immediate needs. Possibilities included benefits transfer methods; smaller scale but intensive studies exploring model development; maintaining reference panels available to assess reactions to new conditions or management options, or to respond to conjoint questions; and the use of experimental economics.
- I recommend continued regular peer reviews of project studies and findings as a means of continuous quality control.

IMPLAN as used by NMFS is quite adequate for assessing the economic impacts of recreational fisheries at the county, state and national levels for fishery resource management purposes (e.g., see Steinback, et al., 2004). In this role, IMPLAN has three minor disadvantages: (1) the economic sectors do not match angler expenditure categories, (2) it is always slightly out of date, and (3) it is based on *average* relationships, whereas the impacts we wish to estimate are *marginal* changes. A fourth, more serious disadvantage, is that appropriate impact information is not readily available to fishery managers or to community or business leaders. I find that estimates of statewide impacts, while a useful first step, provide insufficient guidance for the required estimates of local impacts. I recommend that NMFS develop tools to facilitate estimation of the local economic impacts of management options impacting marine recreational fisheries, similar to those available for estimating the impacts of visitor spending at individual national parks nationwide. I also recommend explicitly acknowledging the economic impacts of fishery management expenditures, and eventually including these expenditures in impact assessments as NMFS budget permits. Finally, I recommend NMFS consider the feasibility of and need for using panel surveys, perhaps with the use of internet reporting, to track trends in expenditures, participation and preferences over time.

RP models estimate angling values by observing angler behavior. They could be more accurate if they could capture variation across individual sites, seasons and angling mode. Then they might be able to include other qualitative factors such as fish size, species mix, and congestion by mode of fishing. They could also specify angling costs more accurately. Again, the primary limitation is O/D data insufficiency rather than model type. I recommend intensifying MRFSS sampling at particular times and locations to support occasional estimation of RP models. Results should be transferable to other locations within the same regions. Second, I recommend exploring a variety of RP approaches to better model angling quality and thus better meet management needs. Finally, I recommend explicitly reconsidering three specific technical decisions used in estimating RP models: (1) the time frame for considering angler costs, (2) allocating angler costs between trip purposes, and (3) specifying the value of trip time. I view the current choice of analytical standards in these cases as leading to conservative estimates of angling values, underestimating true values.

SP and conjoint studies are typically designed to respond to management needs by estimating the values of unobservable angling conditions of interest to managers. A most

critical and difficult aspect of SP and especially conjoint surveys is survey instrument design and verification. I recommend continuing to carefully plan and test each conjoint survey instrument. Second, I find that in previous studies, conjoint studies of angler choice have not been directly compatible with angling demand behavior, thus compromising their ability to predict angler behavior and associated values. Current conjoint instrument design work for surveys in Washington and Oregon includes exploring ways to make them more compatible. I recommend considering this issue explicitly in the 2006 Oregon and Washington surveys.

Issue D: Do Methods Provide “Best Value” Under Present Constraints?

Evaluate, given current budget or other constraints, whether the approach NMFS is currently using for recreational economic data collection is providing “best value,” i.e., for a given level of investment in data collection and assessments, NMFS provides the most timely, accurate, and complete management advice on the economic value of recreational fishing and the economic effects of regulatory actions.

- I find that the MRFE program has been performing at the highest level one could reasonably expect under current budget and other constraints, and that the program will need to continue to evolve to continue performing at this level. While faced with significant budget constraints, the program first established basic estimates of expenditures and economic values nationwide in response to a variety of mandates and management needs. Since providing the initial basic estimates, the program has progressively improved the accuracy and applicability of its subsequent findings, and is continuing to do so. My review has found several opportunities for furthering these improvements, but little or no basis for suggesting that the accomplishments so far have been inadequate. I have been most favorably impressed with the quantity and quality of the work so far.

The marine recreational fisheries economics research program has been funded at \$487,000 to \$500,000 for the last 4 years (not including approximately 26 FTE economists currently assigned to various programs throughout the nation, 5 to 7 of which in aggregate are usually assigned to marine recreational fisheries economics), with \$400,000 or more of that per year allocated to surveys. Half of this 4-year survey budget was allocated to the 2006 national expenditure survey, which leaves little else for other work. Considering the opportunities for improving all areas of marine recreational fisheries economics research to make it more relevant to management information needs, I find that this level of funding is inadequate and constraining. I find that NMFS Economics and Social Sciences Program have done an admirable job of obtaining the most useful information for marine recreational fisheries management purposes within these constraints. It has produced a large body of economic value and impact information relevant to management information needs in a timely fashion, and has helped advance the state of the art as needed to increase survey and analytical effectiveness. Its use of add-ons to MRFSS is quite cost-effective and time-saving.

My assessment shows several opportunities for improvement, but nearly all of these involve either conducting additional research, increasing sample sizes at particular times and places to support particular RP efforts, or perhaps decreasing the scope of some

projects to focus on more intensive model development and estimation. I find that the opportunities for improvement are primarily in increasing the type of work this program is already doing, rather than refocusing present work. That said, it is distressing to note that the program budget has remained about level when a major survey, the 2006 national expenditure survey, was due. A better approach would be to either allocate more funds specifically for such large projects or to add enough funds to support a regular program of larger projects.

Issue E: Budget Allocation and Recommended Funding Priorities

Evaluate NMFS' budget allocation. Reviewers shall specifically identify the inclusion or exclusion of any unmet NRC recommendations in their evaluation of program funding priorities. Reviewers shall provide recommendations on program priorities assuming level funding and a 5% increase in funding.

- I find that NMFS' budget allocation to the MRFE program has been inadequate.
- I find that the primary unmet NRC recommendations are improvements to the recreational fishing site database and switching to an independent national trip and expenditure survey based on a national registry. There is no national registry or license frame. Even if it were available, it would not be cost effective to conduct MRFE surveys independently on such a sampling frame. Fishing site database improvements have not been needed yet, but could be in the future to support more-concentrated RP studies.
- I recommend that program priorities continue to evolve in response to methodology improvement and management information needs, and that program support for such evolution should itself be an important budgetary priority. For instance, some extensive data collection efforts could evolve into less frequent, more concentrated efforts in representative locations; and new methods could be developed to improve the accuracy, relevance, accessibility, and timeliness of program findings.
- I would recommend allocating a 5% increase in funding to exploring methodological improvements as recommended in the previous paragraph.

There is an obvious need for additional funding to support major efforts like the national expenditure survey without starving other efforts. Additional funding is also needed to solve several survey and modeling issues. More intense MRFSS-type sampling at angling sites is needed to support particular RP studies, though it would not be needed every year nor throughout the entire nation or region. I recommend that MRFSS be reduced at other times if necessary to support occasional more-intensive sampling in support of particular RP studies.

In summary, I find that the most glaring concerns with the MRFE program are its underfunding of research projects, particularly in years in which large surveys are needed. Its allocation between economic impacts, valuation and conjoint efforts and supporting surveys has changed over time as conjoint surveys have proven more useful in

meeting management needs. Overall I find the MRFE program allocation is effectively enabling it to meet its assigned tasks as best it can within its limited budget.

Introduction

NOAA Fisheries (NMFS) has collected socioeconomic data from recreational anglers every year since 1994. Data collection has rotated across regions and primarily includes three types of surveys, each of which addresses a different management issue: trip expenditure surveys, which are used to determine economic activity (sales and employment) generated by recreational fishing; economic value surveys, which are used to assess the value of access to the resource, conduct damage assessments, and measure the benefits of improving fishing quality; and stated preference surveys, which are used to assess angler preferences for management options. Other surveys include for-hire cost and earnings surveys, participation surveys, subsistence surveys, an oyster habitat valuation survey, and an on-water fishing location choice survey. All surveys collect demographic data on survey respondents.

Recently, NMFS requested the National Research Council (NRC) to review its recreational fisheries monitoring program. The report, issued March 2006, included a review of NMFS' surveys in support of its recreational fisheries economics program (see "Chapter 5 Human Dimensions" of the NRC report, "Review of Recreational Fisheries Survey Methods"). This review included a summary of NMFS' recreational fisheries economics data collection holdings, recommendations of the types of data NMFS should be collecting on anglers for management purposes, and recommendations on the survey platform (currently, NMFS primarily collects its economic data as an add-on to its catch and effort monitoring program).

The purpose of this review is to conduct a thorough examination of the appropriateness of NOAA Fisheries recreational fisheries economics data collections and analytical methods used for providing timely, accurate management advice on the economic value of recreational fishing, and the economic effects of regulatory actions.

The Review Committee attended a two-day workshop in Silver Spring, Maryland on October 24-25, 2006 reviewing NMFS recreational fisheries economics program. This report is one of two independent reports by review committee members, or review panelists. A third report, by the committee chair, will summarize these two independent reports and the chair's conclusions. The other panel members are review panelist, Dr. Ragnar Arnason, University of Iceland economist, and panel chair, Dr. Kenneth E. McConnell, University of Maryland economist.

We were asked to address the following issues:

- A. Evaluate the NMFS expenditure, valuation, and conjoint surveys. The reviewers should cite the surveys cited in Task I Item 1 in their reports. The reports shall include an analysis of strengths and weaknesses of the survey methods, potential biases, and recommendations for improvement.
- B. Evaluate the degree to which NMFS recreational economic data collections from 2000-2006 meet the NRC recommendations included in "Chapter 5 Human Dimensions" of the NRC report, "Review of Recreational Fisheries Survey Methods."
- C. Assess whether the suite of economic models currently employed by NMFS address management information needs and evaluate the degree to which NMFS' recreational economic surveys support these models. In their reports, reviewers shall cite at least

one article from the scientific literature provided in Task I Item 3 in each of the modeling categories: input/output models, valuation models, conjoint models.

- D. Evaluate, given current budget or other constraints, whether the approach NMFS is currently using for recreational economic data collection is providing “best value,” i.e., for a given level of investment in data collection and assessments, NMFS provides the most timely, accurate, and complete management advice on the economic value of recreational fishing and the economic effects of regulatory actions.
- E. Evaluate NMFS’ budget allocation. Reviewers shall specifically identify the inclusion or exclusion of any unmet NRC recommendations in their evaluation of program funding priorities. Reviewers shall provide recommendations on program priorities assuming level funding and a 5% increase in funding.

I sincerely appreciate the considerable effort that all of the workshop presenters put into producing a clear, thorough, and interesting review of the work of the marine recreational fisheries economics program. Their Powerpoint presentations continued to be quite useful references in producing this report. I also particularly appreciate the extra effort Dr. Brad Gentner and Dr. Rita Curtis have provided during and after the workshop to promptly answer my requests. Finally, I sincerely appreciate the courtesy shown to me by all attendees at the workshop, and again, particularly Brad Gentner and Rita Curtis. They were fine hosts.

I and my report have also benefited from discussions with the other members of the review committee (Drs. Arnason and McConnell), from their constructive comments on my drafts of this report, and from reviewing their draft reports. However, all conclusions and recommendations in my report are my own, for which I assume complete responsibility.

Review of Information used in the Assessment

Description of Review Activities

Our formal review activities consisted of the following:

Task I. Workshop preparation

Task II. Workshop

Task III. Reports

These tasks are described below in the first appendix, “Statement of Work,” in the section on “Specific Activities and Responsibilities.” In addition, the review team met for two days following the workshop to plan our reporting activities and begin our reports. During that time and since, Brad Gentner, Rita Curtis and others have answered a variety of questions the reviewers have posed, and provided other related information.

Findings and Recommendations for the Five Reference Issues:

Issue A: Evaluate NMFS' MRFE Survey Methods

Evaluate the NMFS expenditure, valuation, and conjoint surveys. The reviewers should cite the surveys cited in Task I Item 1 in their reports. The reports shall include an analysis of strengths and weaknesses of the survey methods, potential biases, and recommendations for improvement.

- My general conclusion is that the current surveys are highly cost-effective means of collecting the data required to meet RFEP-mandated tasks. Expenditure data could be collected at least as effectively and with fewer biases in license-frame surveys, but at a much higher cost. License frame personal interview or mail surveys are generally most effective for collecting conjoint stated preference (SP) data. Current surveys collecting revealed preference (RP) data have been useful, but not intensive enough to facilitate detailed analyses that would be even more useful. At current levels of survey intensity, license-frame surveys could collect RP data as effectively but at a higher cost. However, site-based RP surveys could be much more effective if sampling effort were intensified, and most cost-effective if intense sampling were limited to selected locations and times.

Expenditure Surveys

1. Mandates

The NOAA Fisheries Economics and Social Sciences Program is tasked with conducting analyses mandated required under several public laws and executive orders (www.st.nmfs.noaa.gov/st5/ExecutiveLegislativeMandates.html). One such mandate is assessing the economic impacts of recreational fisheries on communities. In particular, the Magnuson-Stevens Fisheries Conservation and Management Act (P.L. 94-265), under National Standard 8, requires fisheries “conservation and management measures” to “take into account the importance of fishery resources to fishing communities in order to ... minimize adverse economic impacts on such communities.” Further, Executive Order 12866 requires federal executive agencies to assess the distributive impacts and equity, among other impacts, of regulatory alternatives. More details regarding these mandates are available at the above internet site.

The term *economic impact* refers to the relative amount of economic activity—sales (a measure of the production of goods and services), personal income and employment—in a particular location attributable to a particular action or activity. Thus the economic impact of a fishery management action on a community would be the change in sales, income and employment within the community attributable to the action. Benefits and costs are not directly counted as economic impacts, though some portions of benefits and costs may also involve sales, income and employment. The benefits to recreational anglers of management actions are especially likely to differ greatly from the economic impacts of the action (benefits in this case are measured in terms of willingness to pay rather than in actual monetary payments). *Distributive impacts* and *economic equity* typically refer to the distribution of income and employment opportunities between identifiable groups of people, so they are usually estimated with economic impact data.

One could also consider the distribution of benefits and costs between such groups to be a component of economic distribution and equity, but that is rarely done in practice.

Therefore, these mandates require the NOAA Fisheries Economics and Social Sciences Program to estimate (1) the magnitude and locations of sport fishing-related spending patterns, (2) how these spending patterns would be impacted by conservation and management measures, and (3) how these spending patterns impact specific “fishing communities” in terms of sales, income and employment.

This section of this report addresses the survey methods used to estimate angler spending patterns. Other parts of this program requirement are discussed below under issues C, D and E.

2. Survey Methods

NMFS initially estimated marine sport fishing related spending nationwide in three separate surveys: the 1998 survey of Northeastern coastal states, the 1999 survey of Southeastern coastal states (except Texas), and the 2000 survey of Pacific coastal states (except Alaska and Hawaii). NMFS is currently conducting the 2006 marine sport fishing expenditure survey of all coastal states. Unless otherwise noted, the survey descriptions below are based on Steinback (2006) and copies of the actual questionnaires.

The initial three surveys (1998, 1999 and 2000) were each conducted in three phases, (1) an *angler intercept survey* add-on to the annual MRFSS intercept survey, (2) a *telephone follow-up survey* of anglers encountered in the intercept survey, and (3) a *random digit dial (RDD) survey* add-on to the annual MRFSS RDD survey of households within 25 miles of the coast. The annual marine recreational fisheries statistics survey (MRFSS) is a combination intercept survey and RDD household survey. The intercept survey interviews anglers regarding their catch at some 6000 defined angling sites along the Atlantic and Gulf coasts; excluding Texas. In 2000 similar MRFSS surveys were conducted in California, Oregon and Washington as well. Most surveys were conducted in six two-month “waves,” and asked anglers to report effort and most expenditures only for the most recent two months. On the east coast from Georgia to Maine only five waves were conducted annually, rather than six, with the first (winter) wave covering 4 months. All other surveys were conducted in six two-month waves. Each wave is in effect a separate sample of current anglers (intercept and follow-up economics surveys) or of households (RDD survey). (MRFSS are also described and evaluated in detail in NRC, 2006.)

Specific survey questions and some division of content between the intercept and follow-up surveys varied slightly from year to year in an effort to improve accuracy. The 1999 intercept add-on survey consisted most importantly of questions about trip information, income level, pay foregone and follow-up contact information for phase 2; the telephone follow-up survey collected detailed trip expenditure data, details of expenditures on fishing equipment and durable goods used for marine angling; and the RDD add-on collected information similar to that of the telephone follow-up survey. The RDD survey is used mainly to evaluate biases in expenditure estimates from the angler intercept add-on and telephone follow-up surveys. The expenditure questions were added to the RDD

surveys at no cost to the Fisheries Economics and Social Sciences Program. None of the three initial surveys asked about personal vehicle travel costs, including gasoline, parking fees and tolls, though the 2000 survey asked about parking fees. These expenditures were estimated from secondary data (Gentner, pers. comm., 2006).

The 2006 National Expenditure Survey includes a similar “add-on” to the MRFSS intercept survey in all states in which MRFSS is currently conducted (i.e., all but Alaska, California, Hawaii, Oregon, Texas, and Washington). The intercept add-on collects all of the information about trip costs, including auto fuel costs and contact information for the follow-up survey. The intercept survey is followed-up by a mail survey of anglers encountered in the intercept survey to collect information about equipment and durable goods expenditures, sport fishing activities and socioeconomic information. The non-MRFSS coastal states do not conduct angler intercept surveys, so their data are collected via separate mailed surveys of license holders except in Hawaii, which has no recreational fishing license. Many recreational anglers in Hawaii hold commercial fishing licenses, so the questionnaire is sent to a sample of those license holders. In addition, sign-up sheets are circulated in Hawaii requesting anglers to volunteer to receive the questionnaire. It is sent to all volunteers. In California, Oregon, and Washington, randomly selected samples of saltwater license holders are surveyed, but holders of multiple purpose licenses (combining saltwater angling with other forms of angling or hunting) were screened first by phone to determine whether they have fished in salt water in the past two months. The questionnaire is mailed only to a sample of those who have. Further, since California does not require saltwater pier or charter anglers to have a license, names and addresses are collected from samples of these anglers for the survey. The license frame surveys are conducted in the same waves as the other surveys, in this case independently sampling the current populations of license holders as the population grows through the year. To investigate non-response bias, 10% of non-respondents to both the MRFSS-related surveys and the license frame surveys will be sampled.

3. Strengths, Weaknesses and Biases

Overall, the cost advantage of a MRFSS-based sampling frame clearly seems to outweigh its disadvantages relative to alternative means of estimating expenditures. This advantage permits more intensive sampling for the same cost, or permits additional spending on other useful projects.

3.a. Intercept add-on

The MRFSS survey methods and their advantages and disadvantages are described in detail in NRC (2006), so this information will only be briefly described here in connection with the use of MRFSS in expenditure surveys.

The add-on approach, involving adding questions to the MRFSS intercept and RDD surveys, was utilized because its total cost was about half that of mounting a separate survey. For instance, the expenditure survey add-on to MRFSS costs about an additional \$1.50 per useable response (2006 expenditure survey intercept), the telephone follow-up survey costs about \$19 per useable response (Pacific 2000 expenditure survey), and the mail follow-up survey in place of the telephone follow-up survey costs about \$25 per

useable response (2006 MRFSS-based expenditure survey) (Gentner, B., pers. comm., 2006). A stand-alone mail survey plus screening survey of license holders costs about \$46 per useable response (2006 license frame expenditure survey) . The MRFSS intercept survey without any add-on costs about \$25 to \$65 per useable response, depending on the wave/mode/location combination. The 1998, 1999 and 2000 expenditure surveys also included expenditure add-ons to the corresponding RDD surveys, conducted without charge to the fisheries economic and social science program. RDD surveys are not being utilized in the 2006 expenditure survey.

Though less expensive, the add-on approach is subject to the same advantages and disadvantages as MRFSS: primarily the disadvantages of avidity bias, undercoverage (omitting night and private dock anglers) and limitations on the number of questions that may reasonably be asked (in the intercept survey), and the advantages of minimal recall error, minimal response bias and rapid availability of survey data for analysis or follow-up. Avidity bias was corrected via simultaneous random digit dialing (RDD) surveys of coastal residents, discussed below in item 3.c. An unpublished comparison of private dock anglers (a major component of undercoverage) to other anglers found no significant difference in expenditure rates, so undercoverage of expenditures was corrected via simple multipliers. Response bias is the impact of respondents avoiding or refusing to complete the questionnaire. The limitation on the number of questions necessitates longer follow-up surveys to collect additional data.

Two other limitations of intercept surveys are important in estimating expenditures and economic values. First, anglers are interviewed at each site as they complete their angling occasions, but before they return home. Anglers are obviously unable to report actual expenditures for any portions of their trips that are not complete at the time of interview. The 1998, 1999 and 2000 expenditure intercept and follow-up surveys did not request automobile operating expenses, and relied on the follow-up surveys to estimate other trip expenses. Automobile operating expenses were attributed at the government mileage reimbursement rate. The 2006 intercept surveys ask anglers to estimate total trip expenditures by category, including actual expenditures by that time on their trips and estimated additional expenditures on the remainder of their trips, and including expenses for automobile gasoline. It is unclear whether the error and bias introduced by respondent prediction is greater or less than the recall bias of post-trip mail or telephone surveys.

The second limitation is that the MRFSS sampling rate is generally insufficient to accurately estimate participation and expenditures by season, site (below the county level), species sought and angling mode (i.e., shore, pier, private boat, etc.). A few states, such as North Carolina and Florida, pay for supplemental intercept sampling effort, enabling such finer estimation. This limitation does not seriously impact the usefulness of expenditure survey results because economic impacts are usually estimated for entire states or for the nation, rather than for smaller locations, and usually for the entire year rather than by season. Community and seasonal economic impacts are usually estimated as fractions of statewide annual impacts, though economic impact estimating models are available for individual counties or other sub-state regions. This limitation much more seriously impacts the estimation of various kinds of valuation models.

3.b. Follow-Up Surveys

The 1998, 1999 and 2000 telephone follow-up expenditure surveys, and the 2006 mail follow-up expenditure surveys have strengths, weaknesses and biases similar to those of the intercept add-on surveys. That is, survey costs are lower, and because the subjects are identified in the intercept surveys, the subjects can be contacted relatively quickly after the intercept (lower recall periods can lower recall error and response bias), but they have avidity bias and undercoverage or overcoverage. They are also limited by sample rates that are too low to permit accurate estimates by site, season, species and angling mode. Again, the later limitation is more critical for valuation surveys than for expenditure surveys.

For the 2006 expenditure survey NMFS switched follow-up survey modes from telephone to mail. While telephone surveys initially had higher response rates (70% by telephone vs. 50% to 60% by mail) and thus lower costs per useable response, telephone response rates have been falling and respondents seem to be becoming less representative as people adopt telephone call screening methods and switch from land-based to cellular telephones (Gentner, 2006). The literature recommends a mail survey to collect expenditures for items with long recall periods (Steinback, 2006). Finally, the mail survey form permits asking more detailed questions about purchases. Both mail and telephone follow-up surveys are being conducted in Florida as part of the 2006 national survey to permit the two methods to be compared in more detail.

3.c. Random Digit Dialing

The 1998, 1999 and 2000 random digit dialing (RDD) add-on surveys were utilized primarily to investigate avidity bias and undercoverage in the expenditure estimates of the intercept and follow-up surveys. (Avidity bias and undercoverage are treated as a single bias for practical reasons, and generally referred to simply as avidity bias.) Intercepted anglers fished an average of 9.34 days in the previous two months before intercept, whereas RDD respondents fished an average of only 5.49 days, significantly different at the 0.05 probability level. Further, regression analysis and analysis of variance tests showed that (at the 0.05 probability level) more avid anglers spend more than less avid anglers for all fishing equipment, semi-durable and durable items except taxidermy fees, magazines and club dues. Therefore, weights were developed following Thomson (1991) to correct for avidity bias and undercoverage in expenditure estimates and in the associated variance estimates. Unpublished RDD data have also shown that angler expenditure patterns for private-access anglers omitted in the intercept surveys, do not differ significantly from those of other corresponding anglers that were encountered in the intercept surveys (Gentner, 2006).

The advantages of the RDD surveys are that they are not subject to avidity bias and do not omit night anglers or private-access anglers, thus it is well suited to investigate those errors. They have the disadvantage of being limited to coastal areas where the method is more cost effective because a higher proportion of households fish in saltwater. Their samples also appear to be growing less representative as more coastal households adopt telephone call screening methods and switch from land-based to cellular telephones (Gentner, 2006).

The RDD surveys are not used in the 2006 expenditure surveys because the add-on expenditure questions would no longer be free to the Economics and Social Sciences Program, because it is becoming less representative, and because previous studies can provide adequate corrections to intercept survey estimates.

3.d. License Frame Surveys

The license frame surveys have the advantage of providing an identified population of anglers from which to sample. They can be “more defined and efficient” than other methods (NRC, p. 34). However, several practical disadvantages currently hinder their use, including (1) undercoverage (some anglers not needing licenses, such as pier and charterboat anglers in California and some other states, military personnel, handicapped, seniors, and others in various states), (2) overcoverage (licenses covering more than just saltwater angling), (3) delayed availability of the current population of license receipts for purposes of drawing samples and possible inclusion of out-of-date licenses in the sampled population, (4) unreadable or inaccurate recording of license holder names and addresses, (5) duplication via overlapping types of licenses, and (6) undercoverage of names and addresses of license holders (e.g., California only provides space for recording addresses on about 10% of license receipts).

Many of these disadvantages can be corrected for a cost, but as a result the method becomes less cost effective than some alternatives. For instance, (1) California is collecting names of shore, pier and charter anglers for inclusion in the license frame survey to correct an obvious undercoverage. (2) Holders of combination licenses in California, Oregon and Washington are screened by telephone to determine whether they have fished in saltwater in the previous two months, so the questionnaire can be sent only to active saltwater anglers. The cost of screening is about half of the total mail survey cost in these states. (3) Some states have adopted electronic recording of license receipts to maintain instantaneous databases of the entire license holder population. License dealers register licenses electronically in a central database via electronic cardreaders in a manner similar to electronic verification of credit cards. This greatly facilitates sampling current angler populations in waves.

3.e. Other Survey Methods

NRC (Chapter 3) discusses alternative sampling designs and survey methods. Promising methods include (1) using a consistent, complete sampling frame nationwide, such as a “national registry frame,” (2) using panel surveys in conjunction with other methods, and (3) using internet based surveys.

A nationwide sampling frame is not available at present, and there is no prospect of one in the foreseeable future. While such a frame would increase consistency from state to state, it would be very difficult to utilize such a frame to obtain current harvest data rapidly and accurately (in terms of species identification) to respond to managers’ needs to limit overharvesting of critical species during an angling season. While such timeliness and accuracy are not usually required for expenditure and other economic estimates, the need for harvest data would lead NMFS to continue intensive intercept surveys, so the economic surveys would probably have to stand alone. Timeliness could become more important in the future for damage assessment or for evaluating time-sensitive management issues as economic assessments become more common and managers learn

more about their usefulness. As long as intercept surveys are available and capable of inexpensively providing a sampling frame for economic surveys, they will probably continue to be more cost effective for economic surveys than license frame surveys, at least until the many practical difficulties of today's license frame surveys are reduced.

Panel surveys could be used with license frame or other survey methods to improve their timeliness for management purposes, and perhaps to help solve species identification issues in self-reporting surveys. Data from representative panels could be tabulated quickly and correlated with other survey findings to permit preliminary estimates well in advance of final estimates. Panels could also be useful for research purposes. For example, small-scale studies using panel data in the form of angler diaries could potentially be used for estimating recall bias for angler expenditures.

Wide-scale internet-based random surveys are infeasible at present because too many anglers do not have ready internet access, though they are being successfully used in voluntary follow-up surveys. Further, many research organizations now obtain panel data via internet, apparently reducing panel survey costs and decreasing response times.

4. Recommendations for Expenditure Surveys

The 2006 national expenditure survey combines MRFSS add-on and mail follow-up surveys in MRFSS states, license frame mail surveys (with telephone screening) in non-MRFSS states, and studies of non-response bias in all of the mail surveys. I find that this plan appears to be the most cost-effective and practical approach to estimating expenditures currently available. Avidity bias and undercoverage in MRFSS will be corrected with factors found in previous surveys, undercoverage in license frame surveys will be addressed in special studies and via secondary information, and the response bias studies will help address that source of bias. The remaining biases and similar estimation issues should be relatively small.

As the NRC report noted, the costs of expenditure and other economic surveys would be significantly reduced if all saltwater anglers could be directly identified from license rolls, and if license information were complete, timely, accurate and easy to use, though not without biases. If so, the cost of license frame estimates would approximately equal the cost of the MRFSS based estimates. I find that if costs were equal, license frame estimation would probably be preferred as more direct and more accurate for expenditure surveys (though not for RP surveys, as explained below). However, I also find that current state license requirements and recording procedures present many practical barriers to expenditure surveys, as explained above.

Finally, I recommend exploring panel surveys and internet formats for use in combination with other survey types.

Revealed Preference Valuation Surveys

Revealed preference (RP) valuation surveys are intended to provide estimates of angler choices in response to the characteristics of the available set of angling alternatives, non-angling substitutes for angling, and the costs to anglers of each option. The basic idea is

that anglers' choices reveal their preferences. Anglers' willingness to pay for particular *kinds* of angling (i.e., angling with particular attributes of interest to the anglers, such as catch rates of particular species, the sizes of fish caught, and other qualitative aspects of the angling experience) reveals their preference between all other uses for money and those kinds of angling. In aggregate, under conditions of perfect knowledge of the available options for spending money, such willingness to pay estimates measure society's preferences for the various kinds of angling (in this case) relative to other goods, under current conditions of income distribution and the availability of the options. Economists refer to the aggregate willingness to pay in exchange for something under such conditions as its *economic value*, or its net *economic benefit* to anglers. *Economic value*, the willingness to pay in exchange for obtaining or using something, differs fundamentally from *economic impact*, the change in economic activity associated with some change. This explanation simplifies several important concepts, but is intended to describe the basic principles defining the economic values of sport fishing.

1. Mandates

In addition to the economic impact mandates discussed under *Expenditure Surveys*, above, the NOAA Economics and Social Sciences Program is tasked with estimating the economic values or benefits of marine recreational fisheries in several contexts (www.st.nmfs.noaa.gov/st5/ExecutiveLegislativeMandates.html). The Magnuson-Stevens Fisheries Conservation and Management Act requires conservation and management measures to “achieve ... optimum yield from each fishery ...” and to “consider efficiency in the utilization of fishery resources....” Optimum yield is defined in MFCMA Section 3 (21) as “the amount of fish a) which will provide the greatest overall benefit to the Nation, with particular reference to food production and recreational opportunities; and b) which is prescribed as such on the basis of the maximum sustainable yield from such fishery, as modified by any relevant economic, social, or ecological factor.” This requires knowledge of the economic values of various fishery yields, among other things. The Marine Mammal Protection Act, the Endangered Species Act, Executive Order 12866, and the National Environmental Policy Act all require that managers consider the economic values or benefits of sport fishing in decision making.

This section of this report addresses the survey methods supporting RP modeling and value estimation. Other parts of this program requirement are discussed below under issues C, D and E.

2. Survey Methods

Valuation methods usually model relationships between the quantity of angling occasions and the costs to anglers of angling. They also examine the choices anglers make between different varieties of angling, given the travel cost and other costs of angling associated with each variety of angling. The accuracy of valuation depends on precisely identifying (1) the most relevant (from the angler's viewpoint) qualitative attributes of each site choice available to anglers, (2) the quantity of angling at each site chosen by anglers from each origin, (3) the costs anglers from each origin face for fishing at each site, and (4)

accurate representation of anglers' decision processes in all three of these types of decisions. Analytical methodology decisions determine which data to collect and which survey methods are most appropriate.

For quantity information, valuation models usually require estimates of the quantity of angling trips or angler days from each angler origin at each destination, known as "origin-destination" (O/D) data. To estimate the influences of angling quality on angling value, the angling destinations must be defined specifically enough to permit characterization of the quality of angling at each destination and yet differentiate it from the quality of angling at the other destinations. Further, many models require separate O/D estimates by angling mode (e.g., boating, shore fishing), by species sought, by season or other time period during which angling quality is relatively stable, and/or by other segments of the population of angling trips. Separate analysis of each segment permits more accurate specification and modeling of angler choices and preferences. O/D is estimated annually in MRFSS, but with sample sizes often too small to reliably provide separate O/D estimates for individual sites, let alone to segment those estimates by mode, species sought, season and/or other criteria. More intensive sampling is needed occasionally to support estimation of appropriate models, and probably only for sub-regional areas.

For angling cost information, valuation models usually require data similar to the data needed for economic impact models, though they use the data differently. Valuation analyses try to model the money and time costs anglers must give up in exchange for their angling trips. Angling costs are a function of travel distance, length of stay, angling mode, purpose of trip, and the value of time spent traveling and angling. Three important analytical issues impacting cost data collection are (1) the time frame for modeling angler costs, (2) allocating costs between trip purposes, and (3) how to estimate the value of time allocated to the trips. The time frame issue involves determining which costs are relevant to the angler's immediate angling decisions. For example, suppose an angler decides she prefers angling by boat some of the time, so she purchases a fishing boat, motor, trailer and associated equipment to facilitate that angling, figuring that the large cost would be allocated over many fishing trips for several years. While the boating-related cost of any individual trip clearly includes boat fuel and other operating costs expected during the trip, it is not clear whether or to what degree depreciation or "wear and tear" costs enter into her trip decision. Part of her trip decision was made when she decided to purchase the boat and equipment, perhaps years earlier. Otherwise boat angling might not even be an option. Thus we can be fairly certain that she considered the boat fuel cost, and perhaps she also considered depreciation and wear. From a longer-term perspective she surely considered all of the costs, perhaps in different stages at different times. The analyst must determine which costs are relevant and how to count the longer term costs.

The trip purpose issue involves estimating which portions of the trip cost are attributable to angling in instances in which the trip has multiple purposes. For instance, the cost of angling is lower if part of the reason for traveling is, say, visiting relatives in the area, and the cost of angling at any one site is lower if the purpose of the trip is to visit two sites. Even if the analyst decides not to include multi-purpose trips, the survey user must still determine trip purpose. If costs are to be allocated by purpose, respondents would

probably also be asked to allocate costs by purpose. Similarly, boats used for fishing are commonly used for other purposes as well, thus lowering their cost attributable to fishing.

Time costs may also be difficult to define and may require information that would not ordinarily be collected in expenditure surveys. We can be quite certain that income directly forgone (in the form of foregone wages) for the purpose of angling is a cost of that angling, and this is NMFS' approach. From another perspective, people often have a variety of choices between work and leisure, including accepting or rejecting full time and part time employment, doing household repairs vs hiring someone else to do it, or studying to qualify for better jobs. From this perspective, all leisure time has some marginal value. However, in practice it is difficult to even approximate individual time values, so many analysts simply estimate it as a fraction of personal income. This issue is discussed further below, under Issue C, part 2, Revealed Preference Valuation Models.

NMFS conducted valuation surveys in the Northeast in 1994, 1996, 1998, 1999 and 2000, in the Southeast in 1997, 2000 and 2004, in the Pacific in 1998 and 2001, and in the Caribbean in 2003. The Northeast surveys are considered in detail here. The 1994 Northeast valuation survey included an add-on to the MRFSS intercept survey, a telephone follow-up survey, and an add-on to the MRFSS RDD survey of coastal residents. The intercept add-on collected information about trip length, travel and lodging costs (not fishing costs), travel time and whether they would have made the trip if they did not go fishing. The telephone follow-up asked whether anglers targeted and/or caught various study species, angling frequency, charter and rental fees paid, avidity, one of four versions of stated preference questions asking willingness to pay for higher bag limits on striped bass and willingness to pay to avoid lower bag limits on bluefish, boating activity, socioeconomic data, employment and salary/pay type, whether wages were foregone by taking the trip and how much they would have earned instead. The RDD add-on first asked screening questions about whether anyone in the household fishes, if so, in the last 12 months and last 2 months. All were asked about socioeconomic information, and active (last two months) anglers were asked about species targeted, number of trips in the last 12 months, and fishing boat ownership. The 1996, 1999 and 2000 valuation surveys consisted of intercept add-ons only. The 1998 survey was part of the expenditure survey and was described above. The 1996 survey asked whether the trip involved an overnight, whether they would have made the trip if they did not go fishing, work week hours and flexibility, income, and household fishing boat ownership. The 1999 and 2000 surveys asked whether they took time off work without pay to make the trip (in place of the work flexibility question).

The intercept add-on is used to identify anglers on multi-day trips and those who would have traveled even if they could not have fished on their trips. For most valuation studies these anglers were excluded. It also estimates the value of work foregone for the trip. Other information needed for revealed preference studies is available either from the MRFSS (O/D estimates), MRFSS sample site information (angling quality), or from related studies (trip costs as a function of distance and mode). Therefore, with existing information, revealed preference models (travel cost demand and random utility models) can be estimated with only a short intercept add-on costing \$.50 to \$1.50 per completed interview. Virtually all marine recreational fisheries economics surveys conducted by NMFS, regardless of primary purpose, are designed to be useable for RP valuation

studies by adding this (or similar) small set of questions about the most recent (within two months) saltwater angling trip (i.e., number of angling days included on the trip, trip purpose, whether work income was foregone for the trip and its value). However, since angling costs can be expressed as a function of travel distance, mode, and similar factors, and are probably stable over time, they only need to be estimated every few years, perhaps in conjunction with national expenditure studies. The RP intercept add-on could usually be restricted to trip purpose and number of angling days on the trip, and perhaps even those items could be eliminated.

In the 1994 surveys, travel costs (excluding angling costs) were estimated from the intercept add-on and the follow-up survey. The RDD survey explored avidity bias in the intercept survey, but did not collect expenditure data so it was not possible to examine the relationship between avidity and expenditures. The surveys did not ask about short term or long term angling costs other than travel costs and time values.

3. Strengths, Weaknesses and Biases

The strengths, weaknesses and biases in the intercept add-on surveys of revealed preference valuation data are about the same as those discussed above under *Expenditure Surveys*. The obvious disadvantages of avidity bias and undercoverage of night anglers and private access anglers can be corrected. A far more serious shortcoming is insufficient sample size to segregate O/D estimates into fine enough categories when needed to facilitate more accurate modeling of angler decisions. Intercept surveys are suitable only for a small number of add-on questions, and are not as well suited as license frame surveys at supporting economic models of decisions whether or not to fish. Their advantages include very low survey cost, low trip recall error, and ease of identifying anglers for more-detailed follow-up surveys.

The strengths, weaknesses and biases in license frame surveys of revealed preference valuation data are also about the same as those discussed above for that type of survey. They are more expensive than most other survey methods because they have several practical disadvantages. They are well suited to provide data for modeling decisions whether or not to fish and do not require follow-up surveys to collect detailed angler information. Their greatest limitation in supporting valuation studies is that it is difficult for respondents to specify precisely where they fished at levels finer than counties. This limits the specification of site quality in angler choice models to county-level qualitative differences, which is inadequate for some RP analyses.

4. Recommendations for Revealed Preference Valuation Surveys

Recommendations for revealed preference valuation surveys are similar to those for expenditure surveys. License frame surveys have a more fatal flaw for valuation purposes: inability to support fine specification of angling quality decisions. The similar flaw in MRFSS O/D estimation can be, and is in some states, remedied with additional sampling effort when and where needed to support particular RP model estimation projects. I find that much of the travel cost data collected in intercept add-ons is not needed and could be replaced by travel cost functions estimated every few years or so.

Finally, the use of panel surveys and internet formats should be explored for use in combination with other survey types to facilitate data collection to support modeling of angler decisions.

Stated Preference and Conjoint Surveys

Stated preference (SP) and conjoint surveys have the same general purpose as revealed preference (RP) surveys: to estimate the economic values or benefits to anglers of given changes in marine recreational fisheries. Therefore SP and conjoint surveys respond to the same mandates as those for RP surveys, described above. This section of this report addresses the survey methods supporting SP and conjoint modeling and value estimation. Other parts of this program requirement are discussed below under issues C, D and E.

1. Survey Methods

Some economists are still skeptical about whether it is possible to design accurate SP and conjoint surveys, basically because potential respondents are not accustomed to paying for the use of angling resources, so they might not be capable of answering such questions (Diamond and Hausman, 1994). However, the economics literature contains a variety of experiments that show that SP studies tend to overstate willingness to pay, but can predict economic behavior “reasonably” accurately if posed carefully (Arrow, et al., 1993, Bishop, et al., 1983, Loomis, et al., 1996)

SP and conjoint analytical methods differ from RP analytical methods, so their corresponding survey methods differ as well. RP methods model observable angler choice behavior and derive apparent economic values as revealed in models of choice behavior. Surveys supporting RP models collect data on O/D patterns, angling costs incurred, qualitative attributes of angling sites, and other factors thought to influence angler behavior such as bag limits and fish size limits. In contrast, SP and conjoint methods directly or indirectly ask anglers to state their economic values: their willingness to pay for changes to their marine angling opportunities. Surveys supporting SP and conjoint models are intended to elicit well thought out and unbiased estimates by anglers of their direct or indirect willingness to pay for specific changes to their marine angling opportunities. The data requirements for a variety of RP analytical models are nearly identical; the difficult part is precisely modeling angler choice behavior in ways that reveal the appropriate, desired values. In contrast, the challenge in SP surveys is to design a survey instrument that will facilitate respondents’ realistic statements of willingness to pay for the appropriate, desired choices. The subsequent analyses of SP data are relatively straightforward.

Most SP surveys use contingent valuation methods to either directly or indirectly ask respondents to state a specific maximum dollar amount they would be willing to pay (or minimum dollar amount they would be willing to accept in compensation) under given conditions for a given option. For example, how much would you be willing to pay to “buy a special license that would increase your daily [striped bass] bag limit from 1 to 2 fish...?” (part of a 1994 Northeast valuation telephone follow-up survey question). Such questions are now more commonly asked as a referendum, such as “would you be willing

to pay \$40 to buy a special license....” with each respondent being asked one of several specific dollar amounts. Conjoint surveys, also known as stated preference choice experiments (SPCE), ask respondents to state their preferences between each combination of levels of a set, such as each combination of a set of levels of angling quality attributes, e.g., three catch per day levels for two fish species defining choices between each pair of the nine possible combinations in a factorial design. Including angling cost as one of several attributes is an indirect way of asking respondents to state their willingness to pay for angling opportunities with each combination (or a subset of each combination) of a set of attributes. For example, the 2004 Southeast conjoint survey asked anglers to choose between subsets of all possible combinations of 7 factors plus one quasi-factor (combination of other factors): (1) target species, (2) total target species catch per trip, (3) target species bag limit, (4) target species minimum size limit, (5) target species catch number over minimum size, (6) trip cost, and (7) number of non-target fish caught and allowed to keep (Figure 1). The quasi-factor is number of target species caught and legally allowed to keep (item 5 as constrained by item 3). This survey tested only a highly selected subset of the total factorial set; just enough to efficiently estimate the relevant values. Each respondent was asked to choose between eight paired combinations of these factors. They were only indirectly asked willingness to pay, in the form of trip cost as one of the factors. Since anglers are accustomed to spending money for fishing trips, they should have relatively little difficulty estimating willingness to pay in this form.

The NMFS Economics and Social Sciences Program conducted conjoint surveys in the Northeast and Alaska in 2004, and in the Southeast in 2004. Those will be reviewed here. It is also currently (2006) conducting conjoint surveys in Oregon and Washington, and is planning to conduct them in Alaska and California in 2007. Other stated preference surveys were conducted in the Northeast in 1994 (reviewed here), in the Southeast in 1997, in the Pacific region in 1998, and in the Chesapeake Bay area in 2001.

The 1994 Northeast SP survey was part of the valuation telephone survey described above under *Revealed Preference Valuation Surveys*. Among other things, each respondent was asked one of four versions of an SP question set directly asking willingness to pay for higher bag limits on striped bass and willingness to pay to avoid lower bag limits on bluefish. As is common practice, this questionnaire first asks respondents about fishing activities and attitudes toward fishing resources and management practices before asking the SP questions. The purpose of this practice is in part to help the respondent think about some of the issues and record some of his/her preferences before facing the more difficult SP questions. This may help reduce strategic bias: respondents answering unrealistically to purposely try to skew results in hopes of influencing real outcomes based on the survey results, or to protest or express opinions about the survey or about unrelated issues such as recent unpopular fishery management actions.

The conjoint surveys are all mail surveys based on contact data obtained either in MRFSS intercepts (Atlantic and Gulf Coasts) or from saltwater angling licenses (Alaska and West Coast). The license frame surveys also first used telephone surveys to screen license holders to determine which anglers to include in the mail surveys. The mail surveys also asked about saltwater angling activities and attitudes as well as socioeconomic

information. The key conjoint questions in all three surveys have formats similar to that of the Southeast 2004 survey (Figure 1). Two possible trip choices are described in terms of the factors being investigated, in this case seven factors and one quasi-factor. Respondents were then asked to choose one of the two or “no trip.” The factor levels and combinations were carefully chosen, considering several criteria (following Lee’s (2006) description of steps used to design the 2006 Oregon and Washington surveys, though the others were developed similarly (see Hicks, 2002)). First, the factors most relevant to current fisheries management issues were selected, one of which was angling cost because the objective is to estimate the value of each change in each attribute, singly or in combination. Then, two to four widely separated but realistic levels of each factor were chosen to keep the number of possible combinations of factors as low as possible while fully evaluating each factor (e.g., red snapper size limits of 16” [current level], 15”, 14” and 13”). All combinations of levels of each factor were considered, and the most “unreasonable” or unrealistic combinations were eliminated. Statistical programs (e.g., SAS) were used to help design the choice set to be most statistically efficient, optimally pairing trip choices and reviewing factor correlations and frequencies. Optimal pairing minimizes the variance of the resulting parameter estimates, but more important is identifying effects which are only weakly significant (Lee, 2006). Researchers refined the entire survey instrument, including different choice specifications, via several focus groups and one-on-one interviews to identify problem areas, test for consistency and interpretation, and to assess survey time and cognitive burdens on respondents.

2. Strengths, Weaknesses and Biases

Issues of sample selection, such as avidity bias, timeliness and costs, are essentially the same as discussed earlier. Single stated preference questions may be short enough to be asked in telephone interviews, but even short questions can be complex and difficult to follow in telephone interviews, particularly since people are not accustomed to being asked to pay for the use of angling resources. Conjoint surveys are usually too complex to be asked in telephone surveys, and generally require mail surveys or relatively lengthy personal interviews.

Generally a most critical and difficult aspect of SP surveys is survey instrument design and verification. The design process for SP and conjoint studies is comparable in time, effort and cost to the analysis phase of RP studies. This is particularly true for conjoint surveys. Though NMFS has conducted several conjoint surveys for which the general format is similar to that illustrated in Figure 1, the content of each is unique.

Appropriately, considerable time and effort was devoted to instrument design in each case, involving several focus groups, consultation with client groups, trial interviews, statistical analysis of simulated data, and various other tests. The survey instrument must be precisely designed to elicit accurate responses or the entire findings will be misleading in unknown ways. Most survey design issues depend on the analytical framework for which the surveys are designed, so will be discussed below under Issue C, in which particular models are evaluated.

SP and conjoint survey methods have two distinct advantages over RP methods in their ability to support fishery management decisions with estimates of economic values and

benefits. First, though survey instrument development can be time consuming, analysis of survey results usually is relatively straightforward and rapid. The results can relatively quickly be available for consideration in management decisions. Second, the values and benefits of many management-related concerns can only be estimated with SP or conjoint methods. RP studies can only estimate the values of choices that can be observed in the real world, whereas fishery managers often would like to know in advance the values of new management actions they are considering. For instance, if all states have a daily bag limit of two of a particular species, RP studies cannot directly estimate the values of increasing or decreasing the bag limit. Angler responses to such alternatives cannot be observed (revealed) if the alternatives do not already exist. SP and conjoint studies are typically designed to respond to management needs of this kind by estimating the values of unobservable (and observable) differences of interest to managers.

3. Recommendations for Stated Preference and Conjoint Surveys

The most difficult and critical step in SP and conjoint surveys is designing and testing the survey instrument. Each survey instrument is unique even if it follows a common format, so each particular instrument must be considered and tested in detail even though the process is costly and time consuming. Evidence from my review is that NMFS is taking appropriate design and testing steps in current surveys. It is extremely important to resist temptations to reduce the time and monetary costs of this phase in the future. I find that though the conjoint method needs some additional refinements (see discussion under Issue C), it also has great promise for evaluating a variety of management relevant issues. Further, other SP survey methods may be better for limited questions, though the simple, direct SP questions NMFS has used in the past (e.g., 1994 Northeast survey) are considered more subject to potential errors than referendum questions.

In addition to internal review of instrument design and overall survey design, I find that it is important to continue to seek independent review of SP and conjoint surveys. NMFS currently has been obtaining outside reviews as part of survey instrument development, and this practice should be encouraged as a means of continuous quality control. At a minimum, most of these studies should be submitted for publication in peer reviewed journals, and thus receive external review in that form.

Issue B: Has MRFE Data Collection in 2000-2006 Met NRC Recommendations?

Chapter 5 of NRC (2006), "Human Dimensions," recommended four actions regarding survey methods that address human dimensions data needs (www.nap.edu/catalog/11616.html, pp 72-74):

1. **Focus add-on surveys for economic models to target specific management needs.** ("With respect to the economic models, add-on surveys for human dimensions should be continued, but in a more focused way than is done currently to target specific management needs and to supplement the national data as needed.")

2. **Periodically update lists and descriptions of fishing locations and access sites.** (“To ensure adequate coverage of the recreational fishery, a periodic updating of lists and descriptions of fishing locations and access sites is needed.”)
3. **Develop an independent national trip and expenditure survey.** (“An independent national trip and expenditure survey should be developed [around a national registry or license frame, independent of MRFSS] to support economic valuation studies, impact analyses, and other social and attitudinal studies.” Seven specific procedures or targets were recommended.)
4. **Enhance the national database of marine recreational fishing sites.** (“The national database on marine recreational fishing sites and their characteristics should be enhanced to support social, economic, and other human dimensions analysis.” Seven specific procedures or targets were recommended, including item 2, periodically updating, addressed above.)

This portion of this report is intended to evaluate the degree to which NMFS recreational fisheries economic data collections from 2000 to 2006 meet these four recommendations. During this period the following 18 surveys have been conducted, 14 of which utilized add-on surveys:

Expenditure Surveys

Pacific Coast 2000*

Caribbean 2004*

National 2006*

Valuation Surveys

Northeast 2000*

Southeast 2000*

Southeast 2004*

Pacific 2001*

Caribbean 2003*

(all other surveys also collect valuation data)

Conjoint Surveys

Northeast 2000*

Alaska 2004

Southeast 2004*

Oregon and Washington 2006

Other Surveys

Chesapeake Bay oyster habitat CV 2001*

Pacific Coast for hire 2001

Gulf of Mexico for hire 2002

Puerto Rico on-water location choice 2003*

Northeast subsistence 2004*

Northeast participation 2004*

- denotes add-on study

NRC Recommendation 1: Focus add-on surveys for economic models to target specific management needs. (“With respect to the economic models, add-on surveys for human dimensions should be continued, but in a more focused way than is done currently to target specific management needs and to supplement the national data as needed.”)

- I conclude that the MRFE program has met this recommendation, using add-on surveys quite effectively from 2000 to 2006, minimizing survey costs while effectively targeting specific management needs.

The text supporting this recommendation says that (1) onsite samples “make extrapolation to the population of users unreliable,” (2) add-on surveys like the RDD survey “provide a better sampling frame for the choice component of the data,” but this is hampered by sampling only the population within 25 miles of the coast, (3) surveys gathering both biological and economic data are too long for respondents, and make it necessary to design the economic portion around the biological survey needs, and (4) the inventory of marine recreational fishing sites lacks some needed data, which impedes the use of site angling quality information in valuation studies, thereby reducing the ability of the models to support fisheries management needs (NRC, p. 73).

While I find it appropriate to focus survey work on models that target management needs, my investigation found little basis for these supporting reasons. First, intercept samples suffer from avidity bias, undercoverage, and limited interview time for add-on questions, as noted above in the previous section. However, the 1998, 1999 and 2000 RDD survey add-ons provided correction factors for avidity bias and undercoverage, and comparison of RDD and intercept follow-up data showed no significant difference between expenditure patterns of private access anglers and those estimated from the follow-up surveys. Second, limiting the RDD survey to within 25 miles of the coast makes it imperfect for correcting the limitations of intercept data, but it seems to be sufficient for this purpose. Expanding the survey coverage to less than complete coverage, say, to within 100 miles of the coast, would be costly and provide little further advantage, and complete coverage is obviously prohibitive. Third, tying the economic surveys to the biological surveys is limiting, but the data needs for expenditure and RP valuation are not significantly hampered by these limitations. The conjoint surveys are too complex to be added-on to the other surveys, though could potentially be added-on to a mailed (rather than telephone) intercept follow-up survey. Finally, I agree that the current sampling procedures impede the use of angling site quality data in valuation analyses, and that this is a serious problem. I attribute the problem primarily to insufficient sampling intensity in the intercept surveys rather than to the lack of angling site data, though both improvements are needed to support improved valuation analyses.

The remainder of this section reviews the use of add-on surveys in the 2000-2006 period. Overall, I find that the add-on surveys in this period have highly targeted specific management needs as NRC recommended, particularly in conjoint studies. Add-ons greatly reduce survey costs because reaching anglers for sampling is a major survey cost component.

Expenditure surveys: The three expenditure surveys have been conducted in this period to estimate the economic impacts of saltwater angling, all of them using add-on surveys. NMFS is required by mandate to estimate economic impacts, and management agencies are mandated to consider the economic impacts of management choices (discussed above under Expenditure Surveys, Mandates). Economic impacts usually play only a relatively minor role in fisheries management decision making because they usually are peripheral to the central reasons for managing fisheries. The 1998, 1999 and 2000 surveys and analyses together provide a good picture of total economic impacts by state and nation (Steinback and Gentner, 2001; Gentner, Price and Steinback, 2001a and 2001b; Steinback, Gentner and Castle, 2004), and this information is being re-estimated with the 2006 data. This work is essential in meeting management needs for economic impact information, but it stops short of meeting the entire mandate. The Magnuson-Stevens Fisheries Conservation and Management Act mandates considering the economic impacts on communities of changes in recreational fisheries attributable to fisheries management actions, and NEPA requires assessments of local economic impacts of changes in saltwater recreational fisheries when relevant to particular environmental impact assessments. However, user-friendly tools have not been developed to estimate the economic impacts at the community level of changes in marine recreational fisheries. Considerable expertise is required to interpret community impacts of changes in the fishery from the IMPLAN models. To fully meet this mandate, I recommend that NMFS develop tools to facilitate estimation of the local economic impacts of fisheries management options similar to those available for estimating the impacts of visitor spending at individual national parks (see economic impacts discussion under Issue C, below).

Valuation surveys: All five valuation surveys in this period have used MRFSS intercept add-on surveys to collect information about trip purpose, overnight trips, boat ownership, time costs of the trip, income and some other information. This information is paired with O/D estimates from MRFSS and previously-estimated travel cost functions to provide complete sets of data for estimating RP RUM and other travel cost models. Further, all NMFS recreational fisheries economics angler surveys collect the same kind of information collected in the intercept add-ons, and all either estimate O/D patterns or are paired with surveys that estimate O/D patterns, so they are also suitable for estimating valuation models.

The standard economic valuation method for NMFS is the Random Utility Model (RUM), though other models are sometimes used. RUM and other RP models are designed to estimate angling values and participation rates as a function of angling quality, angling costs and other factors. Such models respond to managers' need to

understand the values or changes in benefits of the outcomes of management actions that impact recreational fisheries. They are typically used to estimate the values of given changes in the catch per unit of angling effort of target species at given locations and the associated changes in angling effort. RP models have the advantage and disadvantage of modeling observed angler behavior. This is an advantage because actual choices are direct evidence of social preferences for angling opportunities, but a disadvantage because the methods do not permit estimates of the values of kinds of angling opportunities for which angler choices cannot be observed. Even so, NMFS-sponsored RP models have been limited in their ability to model changes in angling quality mainly because estimates of angler behavior (O/D patterns) are not detailed enough. I find that the primary limitation is O/D data insufficiency for model estimation rather than economic data collection mode or RP model type.

NMFS RP valuation studies have resulted in two publications (Gillig, et. al., 2000 and Gentner and Lowther, 2002) and one report (Haab, Whitehead and McConnell, 2000) since 2000. Two of these use RUM methods, while the other estimates demand functions with negative binomial and poisson forms. This may appear to represent a small level of effort for RP estimation, but considerable effort since 2000 has been devoted to complementary work on SP modeling and to exploration of ways of combining RP and SP models to increase their ability to meet management needs. I find that Hicks' (2002) approach, combining both RP and conjoint models to model angler behavior in the Northeastern summer flounder recreational fishery, is potentially very useful for verifying the findings of each (RP and SP) and to more thoroughly model angler preferences and behavior. This approach is discussed further below under Issue C.

Stated preference/conjoint surveys: Since 2000, conjoint surveys have been conducted in the Northeast (2000), Alaska (2004), Southeast (2004), and Washington and Oregon (2006). The Northeast and Southeast surveys obtained contact information from MRFSS surveys, so were add-ons to that extent. However, all involved separate mail surveys not part of MRFSS, designed specifically to obtain SP and conjoint evaluations from anglers. While the conjoint surveys are not true add-ons, obtaining angler contact information as an add-on lowers survey costs greatly compared to license frame data. In the latter case, either many surveys would have to be sent to anglers who do not fish in saltwater or who do not target the species in question, or screening surveys would have to be used to identify the sample population. The 2001 Chesapeake Bay oyster habitat survey included some SP contingent valuation questions in a telephone follow-up survey to the MRFSS intercept.

Conjoint surveys are complex, and thus quite demanding for respondents, so intensive personal interviews are best by far. Stand-alone mail survey instruments are the next best alternative, and much less expensive than intensive personal interviews. One exception is Hicks' (2002) study, combining both RP and conjoint models to model angler behavior in the Northeastern summer flounder recreational fishery. It combined data from the 2000 conjoint survey, the Northeast 2000 MRFSS survey, and its valuation add-on.

I find that conjoint surveys are highly targeted to meet management needs. The three completed studies evaluated critical fisheries management options that fishery managers

were actively considering, were developed in cooperation with managers, and successfully evaluated the targeted questions in a manner apparently helpful to managers. Such highly-targeted evaluations would have been much more difficult prior to the development of suitable conjoint survey methods by Adamowicz, et al. (1994), Roe, et al. (1996) and others. Conjoint survey results have the potential to be estimated relatively rapidly. Though some analytical issues continue to slow their analyses for now, conjoint surveys are more likely to provide timely answers to management issues after the survey is conducted than typical RP studies. Conducting the surveys as add-ons would further facilitate this process. However, the questionnaire development process is time-consuming, and is likely to remain so for the foreseeable future.

In conclusion, I agree with the NRC that it is useful to focus add-ons to target management needs. I find that the NMFS economic survey add-ons have been highly targeted toward management need during 2000-2006. Some further improvements could be made, but mainly by further improving analytical methods rather than survey methods.

NRC Recommendation 2: Periodically update lists and descriptions of fishing locations and access sites. (“To ensure adequate coverage of the recreational fishery, a periodic updating of lists and descriptions of fishing locations and access sites is needed.”)

- I conclude that this recommendation has partially been met. Existing descriptions of access sites are updated regularly, but additional data needs to be assembled for access sites in support of RP valuation studies that model angler responses to site quality variables.

This recommendation is similar to recommendation 4, below, but is discussed as part of the first recommendation, above. In this context it refers to the fact that access sites change in character over time, plus new sites can develop, old ones disappear, and use levels change at others. MRFSS angling site description files are supposed to be updated with information provided by survey clerks during each survey wave (Gentner, pers. comm., 2006). The extent to which this is actually done in practice is unclear, particularly in west coast states that no longer use MRFSS. Certainly it is important to maintain the sampling frame to obtain a thorough, efficient sample of angling effort. However, I find that for most practical purposes this is a moot point for economic surveys. Generally only RP studies rely on site quality data. When data are aggregated for entire counties for the entire year for purposes of estimation of angling participation, it is very difficult to precisely characterize the quality of angling at any given location. I also find that if some future surveys are conducted intensively enough to enable estimation of angling effort at specific sites for specific seasons or shorter periods, then current angling site information would become more critical to the associated analyses. I recommend doing both together to support particular RP valuation modeling efforts.

NRC Recommendation 3: Develop an independent national trip and expenditure survey. (“An independent national trip and expenditure survey should be developed [around a national registry or license frame, independent of MRFSS] to support economic valuation studies, impact analyses, and other social and attitudinal studies.” Seven specific procedures or targets were recommended.)

I find that this recommendation has been met except the first specific procedure recommending an independent survey based on a national registry. I also find that that particular recommendation is unnecessary. It would probably not reduce costs and would have few advantages. I recommend a feasibility study before proceeding in this direction.

NRC recommended that an independent (of MRFSS) national trip and expenditure survey be developed around a national registry or license frame to support economic valuation studies, impact analyses, and other social and attitudinal studies. NRC recommended seven specific procedures or targets.

I see no compelling reason to develop an independent national survey for the purposes of economic surveys. A national registry or license frame to be consistent across all coastal states would require virtually all states to reformulate their fishing license requirements. While this could be done, it would be expensive and politically and socially wrenching. If the new license frame were formulated in a way that would facilitate economic and social surveys, it would also require states to record license holder information in a timely, accessible manner. Even so, it is unclear that this would be worth the cost. Under optimal conditions a license frame survey would still cost about the same as the corresponding add-on surveys, and would have its own set of biases and related issues. An optimal license frame database would, however, greatly facilitate data collection in California, Oregon and Washington over their present license frames. For instance, survey costs in Oregon and Washington would be cut in half if the need could be eliminated for screening surveys to identify sample populations. Further, RP valuation studies would still have to rely on MRFSS or special stand-alone site surveys for accurate O/D estimates, especially if they were to use angling-site information to facilitate the use of angling site quality data in valuation analyses as the NRC and I recommend. It would be quite impractical to estimate the use of specific angling sites via a license frame survey because I believe many anglers would have difficulty reporting their specific fishing sites. Under optimal conditions, an independent national survey might facilitate conjoint surveys, though they would probably cost at least as much as conjoint surveys that obtain contact information from MRFSS.

The seven specific procedures or targets, and my related findings are:

- Randomly sample from the national registry or license frame independent of catch and effort surveys. As discussed above, my analysis shows that this would be costly and have few benefits.
- Gather data on anglers and their choices (i.e., angler residence and demographics, site-specific angling destination, mode, species, trip time, expenditures, and SP questions). While this is a reasonable list of data needs, it would be quite costly to survey intensely enough to estimate the use of all “important” angling sites, even presuming that most anglers could provide that information on a mail survey. My analysis shows that obtaining this information in this manner would be much more costly than present methods, and would offer little advantage over present methods.
- Conduct the survey continuously and as an annual panel for trip data, and every five years for expenditure data. Other than the panel, this is essentially the present time frame for surveys. I find that panel data could be useful to

track angling trends and obtain longitudinal data about angling behavior which is not presently available, but that it would be unjustifiably costly to maintain a panel large enough to estimate the use of even the most important angling sites.

- Use multiple survey modes—mail, phone, internet, in-person—to gather data. I find that multiple survey modes are appropriate.
- Target response should exceed 50%. I find that 50% is a reasonable target. Most current NMFS marine recreational fishing economics surveys exceed that target.
- Annual sample size of respondents should be at least 1,000 anglers in each fishery council region. This apparently is a goal for the annual angler survey and the five-year expenditure surveys, and it appears to be a reasonable minimum for a national registry or license frame approach.
- Include behavioral response questions for verification and to meet specific policy needs. This is a current practice for NMFS saltwater recreational fisheries economics surveys. SP and conjoint surveys typically have several questions of this type for verification, to meet specific policy needs, and to help respondent understand the setting for the later SP or conjoint questions. Other surveys have behavioral response questions as needed.
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NRC Recommendation 4: Enhance the national database of marine recreational fishing sites. (“The national database on marine recreational fishing sites and their characteristics should be enhanced to support social, economic, and other human dimensions analysis.” Seven specific procedures or targets were recommended, including periodically updating, addressed above.)

- I find that this recommendation has partially been met, and I agree that the remaining portions are needed. An enhanced national database of marine recreational fishing sites would be useful, particularly in facilitating intensified RP analyses (as I recommend) and applying their findings to other angling sites.

NMFS currently maintains a nation-wide database on marine recreational fishing sites for MRFSS sampling purposes, though it does not include sites in Texas, Alaska, or US territories, and it is unclear whether the databases for California, Oregon and Washington have been updated since MRFSS was discontinued there in 2002. Inventory information is regularly updated as needed by MRFSS survey personnel. NRC recommends the database be based on the following points:

- Geo-code sites and define sites at as fine a level as possible. I find this has been done. The current database includes latitude and longitude, county, nearest city and site address or other description. It also contains a code indicating site deactivation as appropriate.
- Gather data on site characteristics (fishing quality, site size, water body, boat ramps, urban/rural setting, beach, pier, facilities, camping, regulations, natural cover, parking). This information could be useful in specifying site angling

quality and in describing the nature of fishing sites. Unfortunately, site angling quality information is of limited use because angling use of individual sites is typically not estimated, but is aggregated to the county level instead. I find that this information would be useful in studies estimating angler response to qualitative factors, especially if such studies were enhanced by increased O/D observations.

- Use multiple resources to gather the data, such as field visits, travel guides, state agency data files. I find this to be a reasonable approach.
- Update the inventory periodically. The current inventory is updated in each sampling wave as needed.
- Coordinate with the survey on catch and species information. This information is currently not available for most survey sites. I find that such information would be useful if accurate catch, species and O/D estimates were available at the same times and places as detailed RP studies.
- Include historic trip counts and fish catch in the database. This information is currently not available for most survey sites. I find that such information would be useful if accurate trip, catch and O/D estimates were available at the same times and places as detailed RP studies.
- Develop an “on-the-water” site inventory (i.e., document where people fish on the water). I find that this information would be useful for specifying angling quality in RP models if it were accompanied with corresponding estimates of angling participation by anglers from each origin.

Issue C: Do MRFE Models and Surveys Address Management Information Needs?

Assess whether the suite of economic models currently employed by NMFS address management information needs and evaluate of the degree to which NMFS’ recreational economic surveys support these models. In their reports, reviewers shall cite at least one article from the scientific literature provided in Task I Item 3 in each of the modeling categories: input/output models, valuation models, conjoint models.

- I find that the economic impact model, IMPLAN, is technically an excellent choice, and meets some mandated information needs, except that it is generally inaccessible for estimating local economic impacts. I recommend some additional work to make it more accessible to analysts untrained in IMPLAN use, and thus more able to estimate local economic impacts. I find that present surveys adequately support this model.
- I find that the RP models are appropriate and reasonably state-of-the-art, and relevant to management information needs, but that some issues and opportunities for improvement remain. I also find that RP models are limited by insufficient observations of angler O/D patterns in MRFSS. They are also inherently limited to observed behavior in the real world, so they are unable to estimate the values of some potential fishery management options and of unobservable fishery resource conditions. These limitations provide

opportunities for improving their relevance for management, so I recommend further exploring ways of overcoming these limitations.

- I find that SP and conjoint models are appropriate, MFRE applications have advanced the state-of-the-art, and are highly responsive to management information needs. I also find that some technical issues remain, providing opportunities for improvement. Survey methods are critical to these models, and conjoint surveys require considerable design work. Therefore, other NMFS surveys and state license frames provide limited support for these models. I find that improvements in state license requirements and data handling would improve their ability to support the surveys required for these models, though I do not recommend requiring these changes unless it can be demonstrated that the benefits of doing so outweigh the costs.
- I recommend exploring other, less expensive options for addressing management needs, such as “quick and dirty” procedures to address immediate needs. Possibilities included benefits transfer methods; smaller scale but intensive studies exploring model development; maintaining reference panels available to assess reactions to new conditions or management options, or to respond to conjoint questions; and the use of experimental economics.
- I recommend continued regular peer reviews of project studies and findings as a means of continuous quality control.

The purpose of this section is to assess whether the suite of economic models—specifically (1) input/output models, (2) valuation models and (3) conjoint models—currently employed by NMFS address fishery resource management needs for economic information, and to evaluate the degree to which NMFS’ recreational economics surveys support these models.

The mandates described earlier (Issue A) and related agency task assignments require NMFS to estimate the economic impacts and economic values or benefits of saltwater recreational fisheries in support of fishery resource management. For purposes of this report, *fishery resource management* primarily refers to conservation and management of marine recreational fisheries, but may also include the following to the extent they are related to marine recreational fisheries: (1) conservation and management of marine mammals and endangered species, and related ecological and environmental quality concerns, (2) assessment of proposed federal regulations and alternatives, and related flexibility analysis, (3) environmental impact assessment of proposed actions/projects, (4) achieving environmental justice in minority and low-income populations, and (5) supporting economic assessments of damages to recreational fishery resources. Currently, fishery management councils and other management agencies are often confronted with issues related to stock depletion and allocation of scarce stocks between recreational and commercial fisheries. These also seem to be primary focal points for NMFS work in recreational fisheries economics, beyond meeting basic mandates such as estimating expenditures and economic impacts.

1. Input/Output Models

Community economic impacts are usually assessed by estimating the changes in sales (i.e., community production of goods and services), personal income and employment expected to result from given actions. A simple, direct approach to estimating the community economic impacts of changes in recreational fisheries is to estimate the associated changes in angler spending patterns in the communities. This in turn can be estimated from (1) the typical spending patterns (amounts and locations) of anglers associated with their angling, (2) the expected changes in angler participation, and (3) the amount of income and employment per unit of retail sales in the relevant communities. However, every part of the economy is related to every other part. For instance, changes in retail sales change wholesale sales, manufacturing activity, transportation, energy use and other economic elements. Those changes impact employee and proprietor income, which in turn further impacts retail sales in the community. Obviously, changes in angler spending patterns are only a small part of the total impact picture.

Given the estimated changes in angler spending, input/output analysis and similar models of the economy can estimate all of these impacts in detail. Input/output models of county, state and national economies are available commercially in a widely used, but sophisticated product called IMPLAN. Other available models include RIMS II and REMI. Given the amount of angler spending in each economic sector within a state or county, IMPLAN estimates the aggregate economic importance of angling in all economic sectors. IMPLAN is quite adequate for assessing the economic roles of recreational fisheries at the county, state and national levels for fishery resource management purposes (e.g., see Steinback, et al., 2004). Counties can also be aggregated into regions.

IMPLAN has four main disadvantages. First, economic sectors in IMPLAN and the other models do not precisely match many sport fishing expenditure categories. For instance, expenditures on fishing equipment are split between NICS categories for “sporting goods, hobby, book and music stores,” “clothing and clothing accessories stores,” “general merchandise stores” and “miscellaneous store retailers.” The multipliers for each of these sectors differ, and none would precisely match those of a hypothetical “saltwater angling equipment” sector. I regard this as a minor source of error.

Second, the economy is constantly changing. Input/output tools like IMPLAN are frequently updated, but are always at least a year or two out of date because economic data for a given year are not available until after the year has ended, and then it takes time to compile it and re-estimate the multipliers and input/output models. Therefore, their predictions of future economic impacts are always subject to error. For many purposes the models are considered out of date in three or four years. Again, I regard this as a minor source of error for most fishery management purposes.

Third, IMPLAN is based on average input/output relationships, whereas impact analysis requires marginal impacts, or the local change in sales, personal income and employment caused by an exogenous change. IMPLAN estimates the average change, rather than the marginal change. I regard this as a minor source of error for most fishery management purposes.

Fourth, and most importantly, the appropriate impact information is not readily available to fishery managers or others at the community level. I find that estimates of statewide impacts, while a useful first step, provide insufficient guidance for the required estimates of local impacts. The Magnuson-Stevens Fisheries Conservation and Management Act mandates considering the economic impacts of fisheries management on communities, and the National Environmental Policy Act requires assessments of local economic impacts of changes in saltwater recreational fisheries when relevant to particular environmental impact assessments. Because each county is unique and each management action or other event that changes angler expenditures is unique, the impacts of each action or event must be estimated separately in each case. Currently someone familiar with IMPLAN would have to estimate the impacts. User-friendly tools have not been developed to permit others to estimate marine recreational fisheries economic impacts at the community level. To fully meet this mandate, I recommend that NMFS develop tools to facilitate estimation of the local economic impacts of management options impacting marine recreational fisheries, similar to those available for estimating the impacts of visitor spending at individual national parks nationwide (see Stynes, 2006). Tools are available on that internet site for (1) extracting multipliers from IMPLAN Pro, and standard sets of sample multipliers are provided for rural areas, small metro areas, large metro areas and larger areas, (2) estimating changes in local spending attributable to park management changes, and (3) using provided Excel spreadsheets for computing economic impacts. It also contains explanations and manuals suitable for lay use for using and interpreting these tools.

Finally, the economic impacts of expenditures of fishery management agencies are often overlooked. Their impacts on fishing communities are part of the total impacts of fisheries resource management. I recommend explicitly acknowledging these impacts, and eventually including these expenditures in impact assessments as NMFS budget permits.

Surveys supporting input/output models. Expenditure surveys are discussed above under Issue A, in which their strengths, weaknesses and biases are evaluated, and improvements recommended. I find that the current survey methods are cost effective and adequate to support IMPLAN or other input/output models. Estimates must be adjusted for avidity bias and undercoverage, but procedures for doing so seem adequate. Perhaps the most significant issue at present is the cost and inaccuracies involved with using the current California, Oregon and Washington license systems as survey frames. I recommend NMFS consider the feasibility of and need for using panel surveys, perhaps with the use of internet reporting, to track trends in expenditures, participation and preferences over time. Tracking expenditure trends in near real time might prove valuable to manufacturers and service providers, but for most purposes, re-estimation of expenditures approximately every five years seems adequate.

2. Revealed Preference (RP) Valuation Models

The standard economic valuation method for NMFS is the Random Utility Model (RUM), though other models are sometimes used. For examples of NMFS-related RUM reports, see Gentner and Lowther (2002), Haab, et al. (2000), and McConnell, et al.

(1995), and see Gillig, et al. (2000) for an example of a negative binomial model. RUM and other RP models are designed to estimate angling values and participation rates as a function of angling quality, angling costs and other factors. Angling quality is itself composed of a variety of elements. Such models respond to managers' need to understand the values or change in benefits of fishery resource management. They are typically used to estimate the values of given changes in the catch per unit of angling effort toward target species at given locations, and/or given changes in other aspects of angling quality, and the associated changes in angling effort. Though RUM studies are largely satisfactory as RP models, they are not well suited for estimating changes in participation or substitution between types of angling. I assume the estimation procedures used have included corrections for avidity bias and undercoverage in intercept-related data.

RP models have the advantage and disadvantage of modeling observed angler behavior. This is an advantage because actual choices are direct evidence of social preferences for angling opportunities, but a disadvantage because the methods do not permit estimates of the values of kinds of angling opportunities for which angler choices cannot be observed. Even so, I find NMFS-sponsored RP models have fallen short of their potential usefulness. They have been limited in their ability to model changes in angling quality mainly because estimates of angler behavior (O/D patterns) are not detailed enough to support individual research efforts. MRFSS estimated O/D patterns for anglers targeting a particular species or species mix are typically reliable only at the county level after aggregating angling use at individual angling sites in the county. These estimates are also aggregated to the annual level rather than separately estimated by season. Therefore, the primary angling quality variable available to these models is annual average catch (of the target species or species mix) per angler day in the county. The models would be more accurate if they could capture variation across individual sites, seasons and angling mode. Then they might be able to include other qualitative factors such as fish size, species mix, and congestion by mode of fishing. They could also specify angling costs more accurately. Again, the primary limitation is O/D data insufficiency rather than model type. I recommend intensifying MRFSS sampling at particular times and locations to support occasional estimation of RP models. Further, some models could be best estimated in locations with a large variety of angling quality in a relatively small area, such as Florida, Delmarva/Chesapeake Bay, Puget Sound or New England. The study area could be selected in ways that increase the probability that the results will be transferable to other locations within the same regions.

There probably is some trade-off between broad, regional analyses, on which the marine recreational fisheries economics program has often focused, and more intensive work on model development and estimation. I recommend exploring a variety of RP approaches to better model angling quality, probably on a smaller scale, and thus better meet management needs in the longer run. The most fruitful approach would probably be obtaining more detailed use estimates to support finer specification of angling quality choices in RUM, as recommended above. This includes exploring different methods of modeling the relationship between angling quality and angler demand behavior in addition to RUM, such as the product approach (Talhelm, et al., 1987). The advantages and disadvantages of SP and conjoint models are opposite those of RP models: They are based on hypothetical rather than actual behavior, but they can estimate the values of

proposed but hypothetical angling circumstances. Therefore, combining both RP and SP models of various types, as did Hicks (2002), appears to be another useful approach to estimating fisheries management relevant values.

Another concern in RP valuation is specification of angling costs. Issues include (1) the time frame for considering costs, (2) allocating costs between trip purposes, and (3) specifying the value of trip time. All three of these issues have been debated in the economics literature on RP models for at least 40 years and are still not entirely settled. All are discussed above as part of Survey Methods for Revealed Preference Valuation Surveys under Issue A. Briefly, the time frame issue involves determining which long-term costs are relevant to the angler's immediate angling decisions. I find that NMFS has generally taken a liberal, though common approach here, counting depreciation costs for auto travel (monetary travel cost is miles traveled times the federal reimbursement rate (Gentner, 2006)) and equipment ownership. Second, the trip purpose issue involves estimating which portion of the trip cost is attributable to angling in instances in which the trip has multiple purposes. NMFS simply excludes all overnight trips and trips the angler would not have taken if he/she did not go fishing. I find that restricting the analysis to single purpose day trips biases any estimates that are expanded to all trips, because the day trippers are clearly responding to a different trip cost structure than overnight trippers and multi-purpose trippers. I suspect this bias is small, and its direction is probably positive. This issue has no clear correct approach, but it would be worthwhile to examine the nature of the bias resulting from NMFS' approach.

Third, time costs are also difficult to define. NMFS' approach is to count only wages actually foregone as reported by anglers. I find that this is a conservative approach, as various studies of the value of leisure time find that people act as if leisure time has a positive value at roughly 25% to 100% of one's wage rate. For example, Feather and Shaw (2000) used contingent valuation methods to elicit the value of leisure time relative to increased or decreased working hours at respondents' jobs. Results varied according to work time flexibility and whether those with inflexible hours would prefer more work or less work, but on average their time values were about 90% of their wage rates. Then, by substituting various time values into a RUM model of river recreation, they found that values per trip were \$6.23, \$9.11, \$16.02 and \$14.17 assuming time values were 0%, 33%, 100% and CV-estimated values of leisure time, respectively. The time values assumed by the analyst clearly influence the magnitude of the estimated values. The method used by NMFS, assuming zero value in all cases except those for which the angler has actually given up time for the angling trip, apparently results in values that are less than half those of those that would be estimated using values stated by the respondents. Counting time costs at about 90% of the wage rate would increase the estimated fishery management values to values corresponding to these results.

Considering these three analytical choices together, I view their effect on value estimation to be conservative, resulting in underestimating the actual values. I recommend explicitly reconsidering all three analytical choices.

Surveys supporting RP models. As discussed here and above under issue A, I find that the main impediment to more accurately modeling angling quality in RUM and other RP models is the lack of detail in supporting O/D estimates. Angling quality is composed of many factors that vary across species targeted, angling mode, angling sites, and season

(or shorter time period). Further, since angling quality is “in the eye of the beholder,” it is probably possible to segment the population of anglers into subgroups (segments) with somewhat more-homogeneous responses to angling quality variables, or in other words, similar angling quality preferences. Currently available O/D estimates are too aggregated to support analyses of all of these factors, but are aggregated because estimation errors are generally too large for finer breakdowns. The obvious solution is a larger sample size as I recommended above. By this, I do not mean to imply increasing sample size each year or for entire regions. It would be far better for economic value estimation purposes to even reduce MRFSS sample size for several years if necessary in order to increase it at particular times and locations in support of particular attempts to estimate RP models and improve methodology. I find that there is a good possibility that such methodological research would help focus future RP estimation efforts.

3. Stated Preference (SP) and Conjoint Models

SP and conjoint methods directly or indirectly ask anglers to state their economic values: their willingness to pay for changes to their marine angling opportunities. Surveys supporting SP and conjoint models intend to elicit well thought out and unbiased estimates by anglers of their direct or indirect willingness to pay for specific changes to their marine angling opportunities. The challenge in SP surveys is to design a survey instrument that will facilitate respondents’ realistic statements of willingness to pay for the appropriate, desired choices. The subsequent analyses of SP data are much more straightforward than analyses of RP data.

While some NMFS SP studies have directly asked respondents their willingness to pay for specific policy choices (Northeast 1994 valuation study, Southeast 1997 valuation study, Pacific 1998 valuation study, Chesapeake Bay 2001 valuation study), conjoint surveys have become the preferred SP approach (Gentner, 2005). These surveys and their strengths, weaknesses and biases are discussed above under Issue A. That discussion concluded that a most critical and difficult aspect of SP and especially conjoint surveys is survey instrument design and verification. The design process for SP and conjoint studies is comparable in time, effort and cost to the analysis phase of RP studies. I recommend continuing to carefully plan and test each conjoint survey instrument.

SP and conjoint survey methods have two distinct advantages over RP methods in their ability to support fishery management decisions with estimates of economic values and benefits. First, though survey instrument development can be time consuming, analysis of survey results usually is relatively straightforward and rapid. The results can relatively quickly be available for consideration in management decisions. Second, the values and benefits of many management-related concerns can only be estimated with SP or conjoint methods. RP studies can only estimate the values of choices that can be observed in the real world, whereas fishery managers often would like to know in advance the values of new management actions they are considering. For instance, if all states have a daily bag limit of two of a particular species, RP studies cannot directly estimate the values of increasing or decreasing the bag limit. Angler responses to such alternatives cannot be observed (revealed) if they do not already exist. SP and conjoint studies are typically designed to respond to management needs of this kind by estimating the values of

unobservable differences of interest to managers. SP and conjoint studies may be the only reasonable way to estimate damages to recreational fishery resources after an oil spill or other resource injury.

NMFS's conjoint studies have taken two similar analytical approaches. Oh et al. (2005) and Gentner (2005) used conditional logit frameworks to model angler preferences and values. Hicks (2002) also used a logit framework, but estimated a similar RP model as well, then tried combining the two to provide a more complete model of angler behavior in the Northeastern summer flounder recreational fishery. The result was not completely successful, but quite promising. I agree with Hicks that it would be worthwhile continuing to explore ways of combining RP and SP models to increase their ability to meet management needs. I recommend doing so. It is potentially very useful for verifying the findings of each (RP and SP) as well as for more thoroughly modeling angler preferences and behavior. I also recommend exploring other RP models besides RUM, such as the product demand approach, for this purpose.

The 2006 Oregon and Washington surveys are further exploring conjoint model development. One promising innovation here is asking respondents to estimate for each conjoint choice question (like that in Figure 1) how many trips of each they would likely take if available. I find that in previous studies, conjoint studies of angler choice have not been directly compatible with angling demand behavior, thus compromising their ability to predict angler behavior and associated values. They are incompatible because conjoint choice questions have asked each angler to make one choice between angling trip A, angling trip B or no trip: One choice per angler. The angler is the unit of observation. In contrast, RUM and demand studies estimate the relationship between angling cost and number of trips of each type. The unit of observation is the trip, with anglers deciding how many trips in response to their cost, their angling quality, the availability of substitutes and other factors. The desired expansion of conjoint choice results would be to total predicted angler days, rather than to total number of anglers or, worse, choice per angler times observed number of angler days. This difference in units might explain why Hicks found the RP results differed from the SP results, but that the two were consistent. I recommend considering this issue explicitly in the 2006 Oregon and Washington surveys.

Surveys supporting SP and conjoint models. Since the survey itself is the primary estimation instrument in these models, the role of surveys in supporting the models is discussed above. Each survey instrument must be carefully constructed to limit the conjoint combinations to the few most efficient choices needed to estimate the models. Conjoint questionnaires are demanding of respondents, so independent mail questionnaires are the most practical survey type.

Issue D: Do MRFE Methods Provide “Best Value” Under Present Constraints?

Evaluate, given current budget or other constraints, whether the approach NMFS is currently using for recreational economic data collection is providing “best value,” i.e., for a given level of investment in data collection and assessments, NMFS provides the most timely, accurate, and complete management advice on the economic value of recreational fishing and the economic effects of regulatory actions.

- I find that the MRFE program has been performing at the highest level one could reasonably expect under current budget and other constraints, and that the program will need to continue to evolve to continue performing at this level. While faced with significant budget constraints, the program first established basic estimates of expenditures and economic values nationwide in response to a variety of mandates and management needs. Since providing the initial basic estimates, the program has progressively improved the accuracy and applicability of its subsequent findings, and is continuing to do so. My review has found several opportunities for furthering these improvements, but little or no basis for suggesting that the accomplishments so far have been inadequate. I have been most favorably impressed with the quantity and quality of the work so far.

In other words, the question here is whether, “for [the current] level of investment in [marine recreational fishing economics (MRFE)] data collection and assessments, NMFS [is providing] the most timely, accurate, and complete management advice on the economic value of recreational fishing and the economic effects of regulatory actions” (Statement of Work).

In monetary terms, the current level of investment in marine recreational fisheries economics research has averaged under \$460,000 from 2000-2006, not including approximately 26 FTE economists currently assigned to various programs throughout the nation, 5 to 7 of which in aggregate are usually assigned to marine recreational fisheries economics as opportunities and needs permit (Curtis, 2006). It has been funded at \$487,000 to \$500,000 for the last 4 years, with \$400,000 or more of that per year allocated to various surveys. Half of the entire 4-year survey budget was allocated to the 2006 national expenditure survey alone, which leaves few funds for other work. Considering the opportunities for improving all areas of marine recreational fisheries economics research to make it more relevant to management information needs, I find that this level of funding is inadequate and constraining.

Regarding obtaining the most useful information for marine recreational fisheries management purposes within these constraints, I find that NMFS Economics and Social Sciences Program has done an admirable job. It has produced a large body of economic value and impact information relevant to management information needs in a timely fashion, and has helped advance the state of the art as needed to increase survey and analytical effectiveness. Its use of add-ons to MRFSS is quite cost-effective and time-saving.

My assessment, above, has shown several opportunities for improvement, but nearly all of these involve either conducting additional research or increasing sample sizes to support particular RP efforts. I find that the opportunities for improvement are primarily in increasing the type of work this program is already doing, with a small amount of refocusing of present work. That said, it is distressing to note that the program budget has remained about level when a major survey, the 2006 national expenditure survey, was due. It cost \$828,000, well over 1.6 times the annual budget, leaving few funds for the variety of other work needed during the same period. Analytical work was severely underfunded during this period. A better approach would be to either allocate more funds specifically for such large projects or to add enough funds to support a regular program

of larger projects. For the first round of expenditure surveys, each region was surveyed separately, reducing the budget load in any one year. I do not recommend this approach, however, because it hampers a total assessment. The economy changes each year, changing the incidence of the impacts and making it impossible to estimate total impacts or even to compare regional impacts via sampling different locations in different years.

Issue E: Evaluate NMFS' Budget Allocation and Recommend Program Funding Priorities.

Evaluate NMFS' budget allocation. Reviewers shall specifically identify the inclusion or exclusion of any unmet NRC recommendations in their evaluation of program funding priorities. Reviewers shall provide recommendations on program priorities assuming level funding and a 5% increase in funding.

- I find that NMFS' budget allocation to the MRFE program has been inadequate.
- I find that the primary unmet NRC recommendations are improvements to the recreational fishing site database and switching to an independent national trip and expenditure survey based on a national registry. There is no national registry or license frame. Even if it were available, it would not be cost effective to conduct MRFE surveys independently on such a sampling frame. Fishing site database improvements have not been needed yet, but could be in the future to support more-concentrated RP studies.
- I recommend that program priorities continue to evolve in response to methodology improvement and management information needs, and that program support for such evolution should itself be an important budgetary priority. For instance, some extensive data collection efforts could evolve into less frequent, more concentrated efforts in representative locations; and new methods could be developed to improve the accuracy, relevance, accessibility, and timeliness of program findings.
- I would recommend allocating a 5% increase in funding to exploring methodological improvements as recommended in the previous paragraph.

We have not investigated NMFS entire program enough for me to recommend allocation between NMFS program areas. Within the MRFE program, I find there is an obvious need for additional funding to support major efforts like the national expenditure survey without starving other efforts. Additional funding is also needed to solve several survey and modeling issues as described above. More intense MRFSS-type sampling at angling sites is needed to support particular RP studies, though it would not be needed every year nor throughout the entire nation or region. I recommend that MRFSS be reduced at other times and places if necessary to support occasional more-intensive sampling in support of particular RP studies.

Regarding the four specific NRC recommendations (see discussion above under Issue B),

1. I find that the MRFE program is now using add-on surveys quite effectively, minimizing survey costs while effectively targeting specific management needs.

2. I find that existing descriptions of access sites are updated regularly, but additional data needs to be assembled for access sites in support of RP valuation studies that model angler responses to site quality variables.
3. I find that an independent national trip and expenditure survey is unnecessary. It would probably not reduce costs and would have few advantages. I recommend a feasibility study before proceeding in this direction.
4. I find some justification in the NRC's recommendation to enhance the national database of marine recreational fishing sites.

In summary, I find that the most glaring concerns with the MRFE program are its underfunding of research projects, particularly in years in which large surveys are needed. Its allocation between economic impacts, valuation and conjoint efforts and supporting surveys has changed over time as conjoint surveys have proven more useful in meeting management needs. Overall I find the MRFE program allocation is effectively enabling it to meet its assigned tasks as best it can within its limited budget.

A 5% increase in funding for data collection and analysis could be used to begin responding to the many research issues discussed above. However, 5% would be quite inadequate for the entire task. A 20%-30% increase would still be insufficient, but would permit significant progress.

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Appendices

Statement of Work

RECREATIONAL FISHERIES ECONOMICS REVIEW

Background

NOAA Fisheries (NMFS) has collected socioeconomic data from recreational anglers every year since 1994 (see NMFS Recreational Fisheries Economics Program FAQ Sheet and survey instruments). Data collection has rotated across regions and primarily includes three types of surveys, each of which addresses a different management issue: trip expenditure surveys, which are used to determine economic activity (sales and employment) generated by recreational fishing; economic value surveys, which are used to assess the value of access to the resource, conduct damage assessments, and measure the benefits of improving fishing quality; and stated preference surveys, which are used to assess angler preferences for management options. Other surveys include for-hire cost and earnings surveys, participation surveys, subsistence surveys, an oyster habitat valuation survey, and an on-water fishing location choice survey. All surveys collect demographic data on survey respondents.

Recently, NMFS requested the National Research Council (NRC) to review its recreational fisheries monitoring program. The report, issued March 2006, included a review of NMFS' recreational fisheries economics program (see "Chapter 5 Human Dimensions" of the NRC report, "*Review of Recreational Fisheries Survey Methods.*") This review included a summary of NMFS' recreational fisheries economics data collection holdings, recommendations of the types of data NMFS should be collecting on anglers for management purposes, and recommendations on survey platform (currently, NMFS primarily collects its economic data as an add-on to its catch and effort monitoring program).

Requirements for this Review

The Center for Independent Experts (CIE) shall conduct a thorough examination of the appropriateness of NOAA Fisheries recreational fisheries economics data collections and analytical methods used for providing timely, accurate management advice on the economic value of recreational fishing, and the economic effects of regulatory actions.

The CIE shall provide a three-person review committee (Review Committee) composed of one individual who will serve as the chair (Chair) of the Review Committee and two individuals who will serve strictly as reviewers (Reviewers). Those selected to serve on the Review Committee should have experience with recreational survey design and modeling experience with impact assessments, random utility models (RUM) and conjoint methods. Experience in all areas is preferred, but, at a minimum, the RUM experience is essential.

The information is to be examined by the CIE Review Committee at a two-day workshop (Workshop) in Silver Spring, Maryland on October 24-25, 2006. In the two days following the workshop, the two reviewers will begin to draft independent review reports, which the Chair shall use to begin to write the Recreational Fisheries Economics Summary Report (Summary Report).

The duties of the reviewers shall occupy a maximum of 14 days per person (i.e., several days prior to the meeting for document review; travel; two days to attend the Workshop; two days following the Workshop to participate in the preparation of the individual and summary reports; and several days following the Workshop to draft their independent review reports and to contribute to the Summary Report).

The Chair's duties shall occupy a maximum of 17 days (i.e., several days prior to the meeting for document review; travel; two days to attend the Workshop; two days following the Workshop to lead the preparation of the individual and summary reports; and several more days after the Workshop to finalize the Summary Report).

Specific Activities and Responsibilities

NMFS shall provide the CIE all the documents required for this review (see Annex I).

Task I. Workshop Preparation.

1. All committee members shall review the NMFS recreational fisheries economics overview, funding history, and the following surveys, which are illustrative of the surveys conducted under each survey category:

- g. Expenditure Surveys:
 - i. 2006 National Expenditure Survey
 - ii. Southeast Expenditure Survey: 1999
- h. Valuation Surveys:
 - i. Northeast Valuation Surveys: 1994, 1996, 1998, 1999, 2000
- i. Conjoint Surveys
 - i. 2000 Survey of Northeast Recreational Anglers: Preferences for Fishing and Management Alternatives
 - ii. 2000 Alaska Saltwater Sport Fishing Survey
 - iii. 2004 Saltwater Sportfishing Survey
 - Mail Survey
 - Telephone Survey
 - Intercept Survey

NMFS will provide survey instruments for the vast majority of surveys conducted between 1994 and 2006 (omissions noted in Annex I). Upon request, NMFS will provide the few survey instruments that have been omitted, as well as any data desired by reviewers. **Note:** Only the surveys specified above need to be reviewed; however, reviewers should be familiar with the implementation of each survey type.

2. All committee members shall read Chapter 5, “Human Dimensions” of the NRC report, *“Review of Recreational Fisheries Survey Methods.”*
3. All committee members shall become familiar with literature using NMFS recreational economic data in order to evaluate the ability of these data collections to support economic models used to characterize the economic importance of recreational fishing and to provide management advice on the economic consequences of management alternatives. NMFS will provide journal articles and other published reports using NMFS recreational economic data from 1996 through 2006 (Annex I).

Task II. Workshop.

All committee members shall participate in the Workshop on October 24-25. A tentative schedule is presented below. The workshop will be held in the Hilton in Silver Spring, 8727 Colesville Road, Silver Spring, MD, 20910 (phone: 301-589-5200; fax: 301-588-1841). During each presentation, all reviewers will be encouraged to ask questions at any time. At the end of each presentation, additional time will be allotted for questions and discussion. At the end of the two-day period, time will be allotted for the reviewers to ask additional questions.

The CIE’s committee Chair shall serve as the chair of the workshop. Duties include: coordinating presentations and discussion during the Workshop; ensuring all tasks are reviewed and adequately covered; and assessing areas of agreement and disagreement within the Review Committee on the key findings, by task and issue, and reporting any discrepancies among Review Committee members.

Recreational Economics Program Review Workshop Agenda
October 24-25, 2006, Silver Spring, MD

Opening Remarks (John Boreman)

Program Overview (Brad Gentner):

- History
- Mandates and Goals
- Timeline
- General methodological overview
- Challenges
- Discussion

Summary of NRC Findings & Recommendations (Mark Holliday)

- Clearing up misconceptions
- Constructive advice
- Budget and other constraints
- Discussion

Stated Preference Valuation Surveys (Todd Lee):

- Objectives
- Methods
- Survey Statistics
- Discussion

Stated Preference Valuation Modeling (Rob Hicks):

- Overview
- Results
- Discussion

Revealed Preference Valuation Surveys (Cindy Thomson):

- Objectives
- Methods
- Survey Statistics
- Discussion

Revealed Preference Valuation Models (Kristy Wallmo):

- Overview
- Results
- Discussion

Expenditures Surveys (Scott Steinback):

- Objectives
- Methods
- Survey Statistics
- Discussion

Input/Output Modeling (Jim Kirkley):

- Overview
- Results
- Discussion

Applications:

- Fisheries Policy Analysis – Red Snapper Amendment (Brad Gentner)
- Natural Resource Damage Assessment Center (Eric English)
- Valuation of Ecosystem Services – EPA (Matt Massey)

Survey Funding (Rita Curtis):

- Review of survey implementation history in conjunction with funding availability
- Discussion of budget driven trade-offs, criteria used for establishing funding priorities

Task III. Reports.

After the Workshop, the review committee shall meet at the Hilton on October 26-27 to discuss workshop findings, and to draft individual reviews and the Summary Report. NMFS staff will be available to answer any questions that may arise.

The individual and summary reports shall address the following issues.

- A. Evaluate the NMFS expenditure, valuation, and conjoint surveys. The reviewers should cite the surveys cited in Task I Item 1 in their reports. The reports shall include an analysis of strengths and weaknesses of the survey methods, potential biases, and recommendations for improvement.

- B. Evaluate the degree to which NMFS recreational economic data collections from 2000-2006 meet the NRC recommendations included in “Chapter 5 Human Dimensions” of the NRC report, “*Review of Recreational Fisheries Survey Methods.*”
- C. Assess whether the suite of economic models currently employed by NMFS address management information needs and evaluate of the degree to which NMFS’ recreational economic surveys support these models. In their reports, reviewers shall cite at least one article from the scientific literature provided in Task I Item 3 in each of the modeling categories: input/output models, valuation models, conjoint models.
- D. Evaluate, given current budget or other constraints, whether the approach NMFS is currently using for recreational economic data collection is providing “best value,” i.e., for a given level of investment in data collection and assessments, NMFS provides the most timely, accurate, and complete management advice on the economic value of recreational fishing and the economic effects of regulatory actions. (NMFS will provide budget information during Day 2 of the Workshop).
- E. Evaluate NMFS’ budget allocation. Reviewers shall specifically identify the inclusion or exclusion of any unmet NRC recommendations in their evaluation of program funding priorities. Reviewers shall provide recommendations on program priorities assuming level funding and a 5% increase in funding.

During the Workshop, additional questions that are not in this Statement of Work, but that are directly related to recreational fishing assessment, may be raised. Comments on these questions shall be included in a separate section at the end of the independent report produced by each Review Committee member.

Each Reviewer shall prepare an independent review report addressing the above issues (see Annex II for outline). These independent review reports shall be included as appendices in the Summary Report. These reports need to specify whether each issue was thoroughly addressed during the Workshop.

The Chair shall prepare a document summarizing the background to the work to be conducted as part of the Review Committee process and summarizing whether the process was adequate to complete tasks assigned herein. If appropriate, the Chair shall include suggestions on how to improve the process. This document shall constitute the introduction to the Summary Report.

The Chair shall facilitate development of the Summary Report during the 2-day period following the Workshop (see Annex II for outline). The entire Review Committee shall participate in preparing the main body of the Summary Report. Each member of the committee shall read both of the independent review reports to determine whether their opinions can be summarized into a single conclusion for each issue. The Chair’s objective during this Summary Report development process shall be to identify or facilitate the finding of an agreement, rather than to force the reviewers to reach an

agreement if one does not exist (i.e., no consensus is required). For issues where agreement exists, the Summary Report shall contain a summary of this opinion. In cases where multiple and/or differing views exist on a given issue, the Summary Report shall note that there is no agreement and shall summarize the different opinions and the reason(s) for the differences.

The draft contents of the Summary Report shall be approved by the entire Committee prior to the Committee’s dismissal and departure. The Chair shall complete all writing and editorial and formatting changes prior to submitting the Summary Report to the CIE. The Chair shall consult with the reviewers as the Chair deems necessary. The Chair shall provide the other committee members with a final copy of the final Summary Report provided to the CIE.

All reports will undergo an internal CIE review before they are considered final.

Delivery of Reports

The reviewers and Chair shall send their reports to Dr. David Sampson, via e-mail at david.sampson@oregonstate.edu and to Mr. Manoj Shivlani via e-mail at mshivlani@rsmas.miami.edu.

Schedule

The milestones and schedule are summarized in the table below. The Review Committee shall begin writing their independent review reports as items are completed during the Workshop and shall work on drafting the Summary Report on site when the Workshop is concluded. Note that the schedule for delivering the individual and summary reports is offset by a week, to allow the Chair sufficient time to incorporate material from the individual reports into the Summary Report.

Milestone	Date
Workshop at the Hilton, Silver Spring, MD	October 24-25, 2006
Chair and reviewers meet at the Hilton to draft individual reviewer and summary reports	October 26-27, 2006
Reviewers provide draft individual reports to the CIE and to the Chair	November 13, 2006
Chair provides the draft Summary Report to the CIE and to the reviewers	November 20, 2006
CIE provides individual reviewer reports to NMFS COTR for approval and to the Chair	November 30, 2006
CIE provides Summary Report to NMFS COTR for approval	December 7, 2006
COTR provides final Summary Report in pdf format to ST contacts cited below and the ST Office Director.	December 14, 2006

The Office of Science & Technology's Economics & Social Analysis Division Chief and staff will assist the Chair with logistics and to ensure that documents are distributed in a timely fashion.

Contacts:

Dr. Rita Curtis, Division Chief, Economics & Social Analysis, 301-713-2328 ext.110,
Rita.Curtis@noaa.gov

Brad Gentner, Recreational Economist, 301-713-2328 ext. 215, Brad.Gentner@noaa.gov

Submission and Acceptance of CIE Reports

According to the above schedule, the CIE shall provide via e-mail the final individual reports and the Summary Report to the COTR, Dr. Stephen Brown (stephen.k.brown@noaa.gov) for approval, based on compliance with this Statement of Work. Following the COTR's approval, the CIE will provide the final Summary Report in pdf format to the COTR.

Bibliography of All Materials Provided

NOAA FISHERIES RECREATIONAL ECONOMICS REVIEW SURVEYS & LITERATURE

TABLE OF CONTENTS

VOLUME 1

WORKSHOP AGENDA

RECREATIONAL ECONOMICS FAQ SHEET

NRC “Review of Recreational Fisheries Survey Methods: Chapter 5 Human Dimensions”

CONJOINT SURVEYS

1. 2000 Survey of Northeast Recreational Anglers: Preferences for Fishing and Management Alternatives
2. 2000 Alaska Saltwater Sport Fishing Survey
3. 2004 Saltwater Sportfishing Survey
 - Mail Survey
 - Telephone Survey
 - Intercept Survey

CONJOINT PUBLICATIONS

4. Gentner, Brad (2005). Examining target species substitution in the face of changing recreational fishing policies. Accepted publication for 2004 International Institute of Fisheries Economics and Trade Proceedings. July 2004. Tokyo, Japan.
5. Hicks, Rob. (2002). Stated Preference Methods for Environmental Management: Recreational Summer Flounder Angling in the Northeastern United States. Final Report for NMFS Contract No. NFFKS-18
6. Oh, Chi-Ok, Bob Dition, Brad Gentner, and Robin Reichers (In Press). A Stated Discrete Choice Approach to Understanding Angler Preferences and Tradeoffs for Harvest Regulations” Human Dimensions of Wildlife Management.

VALUATION SURVEYS

7. Northeast 1994, 1996, 1998, 1999, 2000
8. Southeast 1997, 2000, 2004
9. Pacific Coast 1998

Omitted: Pacific 2001, Caribbean 2003

VOLUME II

VALUATION PUBLICATIONS

Gentner, Brad and Alan Lowther (2002). "Evaluating Marine Sport Fisheries in the USA." In *Recreational Fisheries: Ecological, and Economic, and Social Evaluation*. T.J. Pitcher and C.E. Hollingsworth eds. Blackwell Science, Oxford. Pp. 186-206.

1. Gillig,D., Woodward, R., Ozuna, T., Jr., Griffin, W.L. (2000) "The Value of the Gulf of Mexico Recreational red snapper Fishery." *Marine Resource Economics* v15,n2 : 127-39

2. Greene, G., Moss,C.B. and Spreen, T. H. (1997) " Demand for Recreational Fishing in Tampa Bay, Florida: A Random Utility." *Marine Resource Economics* v12, n4: 293-305

Haab, T., J. Whitehead, and Ted McConnell. (2000). *The Economic Value of Marine Recreational Fishing in the Southeast United States: 1997 Southeast Economic Data Analysis*. Final Report for NMFS Contract No. 40WCNF802079.

Hicks, R., S. Steinback, A. Gautam, and E. Thunberg. (1999) *Volume II: The Economic Value of New England and Mid-Atlantic Sportfishing in 1994*. NOAA Tech Memo No. NMFS-F/SPO-38.

3. Hicks, R.L., A.B. Gautam, D. Van Voorhees, M. Osborn, and B. Gentner (2000). *Thalassorama: An Introduction to the NMFS Marine Recreational Fisheries Statistics Survey with an Emphasis on Economic Valuation*. *Marine Resource Economics*. v14,n2: 375-385.

4. McConnell, K.E., Strand, I.E., and Blake-Hedges, L. (1995) "Random Utility models of Recreational Models of Recreational Fishing: Catching Fish Using a Poisson Process." *Marine Resource Economics* v10,n3: 247-61

Steinback, S., J. O'Neil, E. Thunberg, A. Gautam, and M. Osborn. (1999). *Volume I: Summary Report of Methods and Descriptive Statistics for the 1994 Northeast Region Marine Recreational Economics Survey*. NOAA Tech Memo No. NMFS-F/SPO-37

5. Whitehead, J.C. and Haab, T.C (1999) " Southeast Marine Recreational Fishery Statistical Survey: Distance and Catch Based Choice Sets." *Marine Resource Economics* v14,n4: 283-98

EXPENDITURE SURVEYS

- | | | |
|----|---------------|----------------|
| 6. | National | 2006 |
| 7. | Northeast | 1998 |
| 8. | Southeast | 1999 |
| 9. | Pacific Coast | 2000 |
| | Omitted: | Caribbean 2004 |

EXPENDITURE PUBLICATIONS

Gentner, Brad, Scott Steinback, and Michael Price (2001). Marine Angler Expenditures in the Southeast Region, 1999. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-F/SPO-48.

Gentner, Brad, Scott Steinback, and Michael Price (2001). Marine Angler Expenditures in the Pacific Coast Region, 2000. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-F/SPO-49.

10. Steinback, Scott. (1999) . "Regional Economic Impact Assessments of Recreational Fisheries: An application of the IMPLAN Modeling System to Marine Party and Charter Boat Fishing in Maine." North American Journal of Fisheries Management, Volume 19 Number 3. pages 724-736.

Steinback, Scott, and Brad Gentner (2001). Marine Angler Expenditures in the Northeast Region, 1998. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-F/SPO-47.

Steinback, Scott, Brad Gentner, and Jeremy Castle. (2004) The Economic Importance of Marine Angler Expenditures in the U.S. NOAA Professional Paper NMFS 2 p. 169.

Omitted:

Thomson, C.J. (1991). Effects of the avidity bias survey estimates of fishing effort and economic value. American Fisheries Society Symposium. 12:356-366.

11. OTHER SURVEYS & LITERATURE

Chesapeake Bay	2001 - oyster habitat valuation survey
Northeast	2004 - subsistence survey
Northeast	2004 - participation survey
Gulf of Mexico	2002 – for hire cost and earnings survey

Omitted:	Pacific Coast	2001 – for hire cost and earnings survey
	Puerto Rico	2003 – on-water fishing location choice
	Northeast	1996, 1997 - subsistence survey
Northeast		1994 - participation survey

Participation Publications

Milon, J.W. (2000). Current and Future Participation in Marine Recreational Fishing in the Pacific U.S. Region. NOAA Tech Memo No. NMFS-F/SPO-45.

Thunberg, E., S. Steinback, G. Gray, A. Gautam, and M. Osborn. (1999). Volume III: Summary Report of Methods and Descriptive Statistics for the 1994 Northeast Region Marine Recreational Fishing Participation Survey. NOAA Tech Memo No. NMFS-F/SPO-39

Omitted:

Milon, J.W. Current and Future Participation in Marine Recreational Fishing in the Southeast U.S. Region. NOAA Tech Memo No. NMFS-F/SPO-44.fo

OTHER MATERIAL PROVIDED IN ADDITION TO THE SURVEYS AND LITERATURE

Powerpoint presentations used by each of the presenters listed above in the workshop agenda (first appendix)

NMFS internet site contents

NMFS Economics and Social Sciences Program:

- Update on Program Planning
- Status Update
- Project budgets 2000-2006

List of workshop attendees

Recent NMFS Marine Recreational Fishery Economics Publications not Provided for Purposes of this Review

- Massey, Matt, Steve Newbold, and Brad Gentner. (2005). The Effects of Water Quality on Coastal Recreation Flounder Fishing. EPA National Center for Environmental Economics Working Paper Series. Working paper number 05-03. March 2005.
- Massey, Matt, Steve Newbold, and Brad Gentner. (2006). Valuing water quality changes using a bioeconomic model of a coastal recreational fishery. *Journal of Environmental Economics and Management*. Volume 52 Issue 1. pp 482-500.
- Gentner, Brad (forthcoming). Sensitivity of Welfare Estimates from a Random Utility Model of Recreational Demand to Definition of Choice Sets. *Fisheries Bulletin*.
- Wallmo, Kristy and Brad Gentner. (forthcoming). The Use of Stated and Revealed Preference Data to Understand Catch and Release Behavior of Saltwater Anglers. *Human Dimensions of Wildlife*.
- Gentner, Brad (Forthcoming). Do Angler's Tell the Truth? Examining Revealed and State Preferences for Conservation. *Proceedings of the 4th World Fisheries Congress*. May 2004. Vancouver, B.C., Canada.
- Gentner, Brad, Robert Hicks, and David Van Vorhees (2000). Economic Data Collection for Marine Recreational Angling: The U.S. Approach. In; *Microbehavior and Macroresults: Proceedings of the Tenth Biennial Conference of the International Fisheries Economics and Trade (IIFET)*.
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- Gentner, Brad (2002). Economic Impacts of Marine Recreational Angling in the U.S.; Selected National Results. *Proceedings of the 2002 biennial IMPLAN User's Conference*.