Ocean Policy Advisory Council's Scientific and Technical Advisory Committee

Technical Workshop on Economic Data and Analysis of Marine Reserves

Oct 21-22 2008

Library Seminar Room

Hatfield Marine Science Center Newport, OR*

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* Report submitted to OPAC March 24, 2009. Report adopted by the Scientific and Technical Advisory Committee on 17 March 2009. It has not yet been adopted by the Ocean Policy Advisory Council.

** Workshop participants reviewed and commented on the first draft of the report, but did not review the final report. Hanna and Sampson developed the draft and final text, and are responsible for report contents.

Acknowledgements: The workshop participants acknowledge the critical support provided by Julie Howard in making meeting arrangements and by Juna Hickner and Chris Cusak in note taking.

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EXECUTIVE SUMMARY

In its January 2008 meeting, the Ocean Policy Advisory Council (OPAC) requested that the Scientific and Technical Advisory Committee (STAC) provide information on the social and economic impacts of marine reserve implementation. A workshop addressing economic issues was held in October 2008. The objective of the economics workshop was to assess the status of economic data and analysis useful to decision makers regarding economic aspects of the siting and management of marine reserves in Oregon waters. This report summarizes available economic information and details workshop discussions, findings, and recommendations.

The objectives developed by the OPAC for marine reserves in Oregon are primarily protective in intent. They include protecting biodiversity and abundance of marine organisms and their key habitats as well as protecting coastal communities from the adverse impacts of prohibiting extractive activities in the reserves. The objectives also involve research, monitoring, and support of nearshore management.

There are a number of general economic questions relevant to Oregon's marine reserve objectives. These pertain to existing ocean uses, marine reserve costs and benefits, community impacts, behavioral response to spatial exclusion, adaptive management, and the appropriate time frame for analysis.

One criterion for evaluating proposed marine reserve sites is the minimization of significant adverse impacts to ocean users and coastal communities. The workshop identified a number of gaps in the economics data that need to be addressed if economic impacts are to be analyzed.

Workshop participants worked sequentially through a series of topics related to the economic analysis of Oregon marine reserves: OPAC objectives for marine reserves, economic elements of marine reserves, economic analytical methods, examples of models and software, economic data needs, existing economic data, and gaps in these data. A number of findings and recommendations emerged from these discussions.

General Findings

Finding 1: OPAC's marine reserves objectives require the assessment of economic impacts on ocean users and coastal communities.

Finding 2: The assessment of economic impacts (both positive and negative) of marine reserves has several dimensions: documenting existing ocean uses and their economic contribution to people and communities, predicting human behavioral responses, and identifying benefits and costs. Marine reserves may be complementary to fishery regulations already in effect in Oregon's Territorial Sea.

Finding 3: Executive Order 07-08 lists ocean users and coastal communities as the focus of impact assessment for marine reserves; however, depending on their scale and placement, marine reserves may also have impacts beyond coastal areas.

Finding 4: Several methods and models are appropriate for analyzing economic impacts of marine reserves.

Specific Findings and Recommendations

Finding 5: Existing economic data are limited in their geographic specificity and are therefore inadequate to analyze the impacts (both positive and negative) of Oregon marine reserves on ocean users and coastal communities. There are fundamental gaps in baseline data, spatially explicit data, recreational fishery data, coastal community economics, public valuation of marine reserves, and public valuation of other marine activities in the Territorial Sea.

Finding 6: There is no coherent, comprehensive documentation of the spatial uses of the Territorial Sea, the value they produce, or their economic contribution to coastal communities. The absence of a pre-reserve baseline severely restricts the ability to quantify post-reserve implementation effects. Most of the existing data are on fishery uses, but these data have limited information about exact harvesting locations, ports where the catch is delivered, or residency of fishing industry workers. Spatially explicit economic data are needed for effective marine reserve implementation and for management to ameliorate adverse effects.

> ***Recommendation 6.1*:** OPAC should highlight the inadequacy of economics data needed to support its marine reserve objective for avoiding significant adverse economic impacts on ocean users and coastal communities and for estimating the potential of positive, long-term economic impacts.
>
> ***Recommendation 6.2*:** In the short term, OPAC should recommend the collection of spatially explicit economic data for specific marine reserve sites through expert opinion methods that involve ocean users and managers. The collected data should be cross-checked with available data and judged verifiable before being incorporated into the decision-making process.
>
> ***Recommendation 6.3*:** In the short term, OPAC should recommend the collection of information about likely user group and community response to spatial exclusion through surveys of affected groups. The collected data should be cross-checked with available data and judged verifiable before being incorporated into the decision-making process.
>
> ***Recommendation 6.4*:** As the lead agency for marine reserves, ODFW should create a Web space to host the economic information they fund, with links to other pertinent marine economic information, to enhance its circulation and application.

Finding 7: State-level marine economics data are collected. However, the process of data collection is *ad hoc*, incomplete, and uncoordinated.

> ***Recommendation 7.1*.** For the long-term economic assessment of marine reserves and other uses of the Territorial Sea, OPAC should recommend the formation of an Oregon Marine Economics Data Work Group charged with defining an ongoing core economic data collection program.

Recommendation 7.2. The Oregon Marine Economics Data Work Group should consider methods to involve ocean users and coastal communities in data collection, including incentive-based programs.

Recommendation 7.3. OPAC should recommend state funding of the core data program developed by the Oregon Marine Economics Data Work Group.

Finding 8: Economic impacts are one element of marine reserve performance. There are opportunities to learn about economic impacts of marine reserves by investing in economic data and research.

***Recommendation 8.1*:** OPAC should ensure that economic performance indicators are a component of the monitoring and periodic performance review of marine reserves. Economic and ecological monitoring should be coordinated and complementary.

***Recommendation 8.2*:** OPAC should recommend that cooperative research be funded to learn from existing and ongoing studies of marine reserves on the U.S. West Coast and elsewhere, and to enhance the ability to understand and interpret economic impacts of reserve creation and operation.

Finding 9: Economic data are also needed for the planning and analysis of other uses of Oregon's Territorial Sea, such as wave and wind energy.

***Recommendation 9.1*:** OPAC should recommend that the economic data collection program to be designed by the Oregon Marine Economics Data Work Group include the full range of uses of the Oregon Territorial Sea.

1.0 Introduction

The state of Oregon is considering the establishment of a system of fewer than 10 marine reserves as part of an overall strategy to manage marine waters and submerged lands. The Oregon Ocean Policy Advisory Council (OPAC) has been charged with recommending up to nine marine reserve areas for the Territorial Sea, which extends three nautical miles from shore and from offshore islands (OPAC 2008a).

At its January 2008 meeting, the OPAC approved a request to its Scientific and Technical Advisory Committee (STAC) for information on (1) the preferred size and spacing of marine reserves and (2) the social and economic impacts of marine reserve implementation (OPAC 2008a).

In response to this request, the STAC has sponsored two workshops to date. The first workshop, held in April 2008, addressed biological, ecological, and physical issues surrounding size and spacing of marine reserves (Heppell and Reiff 2008). The second workshop, addressing economic issues of marine reserves, is the subject of this report. A third workshop on social issues may follow.

The objective of the economics workshop was to assess the status of economic data and analysis useful to decision makers regarding economic aspects of the siting and management of marine reserves in Oregon waters. This report details workshop discussions, findings, and recommendations on a range of topics related to this objective. It also summarizes information extracted from the published literature and the Internet. For each major topic, the report first presents information from the published literature and Internet sources, then summarizes the workshop discussions related to that topic.

The format of the workshop was a sequential consideration of the following topics:

- economic elements of marine reserves;
- economic analytical methods relevant to marine reserves in Oregon;
- data needed to support economic analyses of Oregon marine reserves;
- computer models and systems for the analysis or collection of economic data;
- inventory of existing economic data;
- economic data gaps for Oregon marine reserves; and
- findings and recommendations.

The workshop was open to the public, but discussions were limited to invited participants. A list of workshop participants is provided in Appendix A. Public comment periods were held at the end of each morning and afternoon session. A list of members of the public attending the workshop is provided in Appendix B. A summary of public comments is contained in Appendix C. The workshop agenda is provided in Appendix D.

2.0 Definition, Goal, Objectives, Principles, and Guidelines for Oregon's Marine Reserves

Dave Fox (Oregon Department of Fish and Wildlife) described the Oregon process and timelines for marine reserves to the workshop.

2.1 Definition

The OPAC adopted a working definition of marine reserves in August 2008. "A marine reserve is an area within Oregon's Territorial Sea or adjacent rocky intertidal area that is protected from all extractive activities, including the removal or disturbance of living and non-living marine resources, except as necessary for monitoring or research to evaluate reserve condition, effectiveness, or impact of stressors." (OPAC 2008c)

2.2 Goal and Objectives

The goal for marine reserves adopted by OPAC is to "protect and sustain a system of fewer than ten marine reserves in Oregon's Territorial Sea to conserve marine habitats and biodiversity;

provide a framework for scientific research and effectiveness monitoring; and avoid significant adverse social and economic impacts on ocean users and coastal communities."

A system is defined as a collection of individual sites that are representative of marine habitats and that are ecologically significant when taken as a whole (OPAC 2008c).

The OPAC developed a set of objectives for the proposal, selection, implementation, and management of marine reserves (2008c). These objectives address biodiversity, habitat, system properties, research, and management (Fox 2008).

- *Biodiversity*: Protect areas important to the natural diversity and abundance of marine organisms.
- *Habitat*: Protect key types of marine habitat in multiple locations to enhance resilience of nearshore ecosystems.
- *System properties*: Site fewer than 10 marine reserves and design the system in ways that are compatible with the needs of ocean users and coastal communities.
    - Reserves should be large enough to allow scientific evaluation of ecological effects.
    - Reserves should be small enough to avoid significant adverse social and economic impacts on ocean users and coastal communities.
- *Research*: Use marine reserves as reference areas for conducting research and monitoring.
- *Management*: Use the research and monitoring information in support of nearshore resource management and adaptive management of marine reserves. Monitor and reevaluate at least every five years.

2.3 Principles and Guidelines

The OPAC also developed a set of principles and guidelines for the proposal, selection, implementation, and management of marine reserves (OPAC 2008c).

- Involve the public in the proposal, selection, regulation, monitoring, compliance, and enforcement of marine reserves.
- Conduct outreach and public engagement as an ongoing part of planning and implementation.
- Use science and local knowledge in planning.
- Encourage coordinated and collaborative proposals from communities of place or interest.
- Give priority consideration to proposals developed by coastal and ocean groups.
- Account for existing regulatory regimes and existing and emerging ocean uses in design and siting.

- Use size and spacing guidelines developed by the STAC.
- Avoid significant adverse social and economic impacts.
- Seek positive social and economic effects.
- Develop management plans for individual sites.
- Ensure adequate enforcement.
- Collect baseline data prior to excluding extractive activities.
- Conduct monitoring and evaluation.

2.4 Workshop Discussion of Definition, Goal, Objectives, Principles, and Guidelines

The workshop discussed definitional issues. The first was with the definition of a marine reserve (MR) as an area protected from all extractive activities and whether OPAC will also be considering less-restrictive versions of marine protected areas (MPAs). OPAC has established sideboards for considering MPAs (1) if they are in conjunction with a proposed marine reserves site and (2) if the marine reserve site by itself is inadequate to meet the competing goals of ecological significance and economic impact minimization. Of the proposals received by OPAC, three included MPAs that met these sideboards (Fox 2009).

Discussion also clarified the definition of "marine" as restricted to the Territorial Sea (shoreline out to three miles), including the intertidal zone in rocky areas but not in sandy areas, where the regulatory limit is extreme low tide. Estuaries are not included.

A question was raised as to the interpretation of "significant" related to adverse social and economic impacts of marine reserves on ocean users and coastal communities. Significance has not been specifically defined. To date, significance has been determined through community and user-group collaborations in MR design. If agreement can be reached that the impacts are acceptable, then the standard of avoiding significant adverse social and economic impacts is deemed to have been met (Fox 2009). However, as the process of marine reserve development moves forward, the absence of a more quantitative definition will pose a problem for the analysis of adverse economic impacts, and is likely to be a source of contention.

The Governor's Executive Order 08-07 (State of Oregon 2008) specifically lists "ocean users and coastal communities" as the focus of impact assessment for marine reserves. The word "community" is defined to include both communities of place and communities of interest. This means that "ocean users" may include fishermen who do not live in a particular coastal community but are part of a community of interest affected by a particular marine reserve site.

3.0 Economic Elements of Marine Reserves

Economic elements permeate all stages of marine reserve development from design to site selection, implementation, monitoring, and enforcement. The economic analysis of marine reserves stems from three general concepts: 1. effectiveness—how well a MR meets its goals; 2. efficiency—the economic surplus (benefits less costs) produced by the MR; and 3. equity—the distribution of costs and benefits among different groups. Effectiveness, efficiency, and equity

are the fundamental considerations faced by marine resource managers. At the basis of each is the concept of economic value.

3.1 Economic Value

Marine ecosystems provide a range of values to people, whether they are exploited or not (National Research Council 2001). Economic value is measured by the amount people are willing to pay for a good or service, or the amount they are willing to accept as compensation for not using the good or service. The concept of total economic value (TEV) includes an array of different values generated by marine resources. These values fall into two main categories: "use" and "nonuse." Use values typically involve some human interaction with the resource and include value produced through both direct and indirect use. Nonuse values are current or future potential values that rely on the continued existence of a resource, and do not rely on human use. Nonuse values are further divided into "existence" and "bequest" values (Figure 1) (FAO 2003; Dziegielewska 2007).

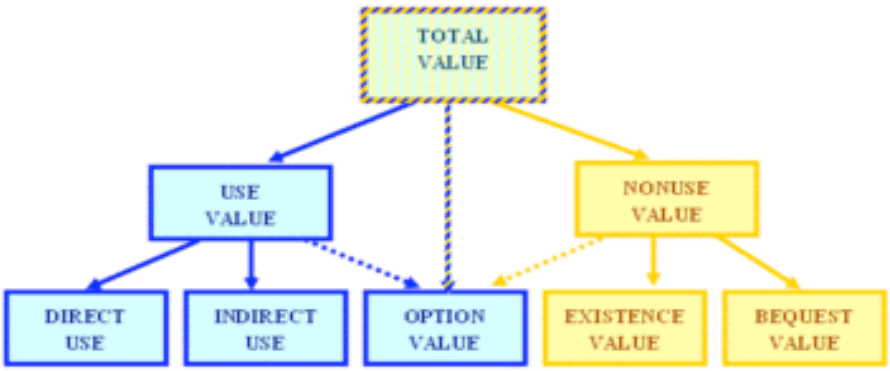

Figure 1. Components of Total Economic Value.
Source: Dziegielewska 2007

Use value can be generated through direct use, indirect use, or option for future use (Figure 1).

- Direct use: value from actual use of a good or service, such as catching fish or kayaking.
- Indirect use: value related to special functions, such as the habitat utilized by fish in the marine ecosystem or the knowledge generated through using a MR as a research site.
- Option: value of the option to have ecosystem goods or services available in the future. Option value is considered by different economists as both a use and nonuse component, depending on the context. For example, option value could represent the future production of fish (use) or of marine biodiversity (nonuse).

Nonuse values, sometimes called "passive use" values, include option, existence, and bequest values.

- Option: as described above.
- Existence value: value from knowing that a certain good or service exists, for example, the protection of endangered species against extinction, regardless of whether they are ever seen.
- Bequest value: value from ensuring that certain goods will be preserved for future generations.

For goods and services exchanged on a market, value is revealed through market transactions. The market is best at revealing direct-use value through consumers' and producers' willingness to pay for a benefit or accept compensation for a cost. Indirect-use values are difficult to quantify and are often ignored in resource-management decisions. However, markets are now emerging based on nonuse values such as water temperature, endangered species habitat, and carbon sequestration.

The division of economic value into "use" and "nonuse" categories is one way of characterizing the tradeoffs associated with marine reserves, but economic issues also extend beyond valuation. Economic choices are about tradeoffs among different mixes of ecosystem services that combine ecological, economic, and social dimensions of marine reserve design and implementation. The empirical assessment of these tradeoffs is an emerging area of analysis to support decision making (Fisher et al. 2009; Whitmarsh and Palmieri in press).

The 2001 National Research Council study of marine reserves notes that several elements of marine reserves have both costs and benefits associated with them: fishery yield, fishing industry displacement, enforcement, management, economic activity, and nonmarket values. Attaching monetary value to these costs and benefits requires significant data collection and research (National Research Council 2001).

3.2 Economic Literature

Looking at marine reserves – or, more broadly, marine protected areas – in place worldwide, it is clear that they are intended to serve one or a combination of three general policy goals: biodiversity protection, sustainable fisheries management, and support of non-extractive uses. The three general policy goals for marine protected areas vary in the extent to which they have received analytical attention in the economics literature (Ablan et al. 2006).

Biodiversity protection is analyzed by a limited economics literature. Existing analyses focus on the benefits of goods and services produced by marine protected areas or marine reserves. These goods and services provide value in nonuse as "option values," which are the benefits people derive from ensuring that a natural resource is available for future use, even if there are no present plans to use it.

Sustainable fisheries management accounts for the bulk of the economics literature. This area of analysis focuses on the benefits of restoring overfished stocks and the application of

precautionary tools against management uncertainty. It is characterized by the application of bioeconomic models that consider both single and multiple species. Some assume homogeneous distributions of fish and fishermen; others are spatially explicit, assuming patchy distributions of fish and fishermen. Other models focus on the behavioral responses of fishermen and are based on an understanding of the costs and revenues of fishing.

Support of non-extractive uses such as recreation and ecotourism is the subject of a growing literature. Economic analysis of the market value of recreation and tourism focuses on the economic impacts of the industries that support these activities. Analysis of the nonmarket values that derive from direct and indirect use of a marine protected area focus on development of monetary proxies such as "willingness to pay" or "willingness to be compensated" for these uses.

In sum, the policy support provided by economic analysis in the assessment of marine protected areas takes many forms. The application of economic analysis to the question of marine reserves can help Oregon managers identify several pieces of information key to their decision making:

- economic profiles of ocean user groups and coastal communities;
- spatial use patterns of the Territorial Sea and their economic linkages;
- use values of Territorial Sea spaces;
- nonuse values of Territorial Sea spaces;
- direct and indirect economic impacts of marine reserves over time;
- distributional impacts of specific marine reserve sites' design, size, and placement;
- balance of benefits and costs of specific marine reserve sites;
- description of tradeoffs among the multiple goals involved in multi-use management; and
- description, analysis, and prediction of human dynamics of decision making and response to regulation.

3.3 Workshop Discussion on Economic Elements of Marine Reserves

The objectives developed by OPAC for marine reserves are primarily protective in intent. They include protecting biodiversity and abundance of marine organisms and their key habitats and at the same time protecting coastal communities from adverse impacts of these protections. The objectives also involve research, monitoring, and support for management of the nearshore marine ecosystem. Sustainable fisheries management and support of non-extractive uses are not among the Oregon marine reserve objectives.

The workshop discussion identified a number of general economic questions relevant to Oregon's marine reserve objectives.

Existing uses: What are the existing uses of the proposed marine reserve area? What economic benefits are generated for current user groups and coastal communities by the proposed area? What types of displacement are likely to occur with the implementation of the marine reserve?

Identification of costs: What are the costs of marine reserve implementation? How do costs relate to size and location? What are the displacement effects on commercial and recreational fishing? Are there other ocean-user displacement effects? What are the direct and indirect costs incurred by coastal communities? A related question is the relative cost effectiveness of marine reserve sites. Do we assume that marine reserves meeting the ecological criteria and of similar size will have comparable ecological benefits? If so, what are the least-cost options to siting marine reserves?

Identification of benefits: Marine reserves provide economic benefits as well as costs. These benefits include the insurance value (use or nonuse) of ecosystem services (e.g., species sanctuary, nutrients, water quality) provided by the marine reserve as well as the non-extractive existence values of increased biodiversity, protected habitat, and protected species. What are the major ecosystem services and other nonmarket values of Oregon marine reserves? How do these vary by size and location? What are the key areas of uncertainty about the effect of Oregon's marine reserves? What is the improvement in knowledge generated by research and monitoring of ecological function and economic response to marine reserves? What is the value of this information? What is the cost to acquire it? What is the public willing to pay for the additional insurance benefits, ecosystem services, and ecological knowledge that might be provided by marine reserves?

Disproportionate community impacts: Are there changes in coastal income that result from marine reserves, and are these changes distributed proportionately across income levels and demographic categories? Are income impacts disproportionate to certain geographic areas or social groups?

Appropriate time frame for analysis: How will the costs and benefits of marine reserves be distributed over time? They are likely to be distributed differently, with costs more concentrated in the short term and benefits more concentrated in the long term. Should the expected future benefits and costs of marine reserves be discounted to their present value? If so, what discount rate should be applied?

Human behavioral responses: The stochastic (unpredictable) nature of marine ecosystems and economic systems creates uncertainty that affects human behavior. What will be the behavioral response of fishery users and coastal communities to the impacts of marine reserves over time and space? For example, what are the effects of marine reserves on redistributing fishing effort? What are the costs and benefits of effort displacement? Are there cumulative effects? How do we determine which behavioral responses are specifically in response to marine reserves in contrast to more general economic change?

Accounting stance of economic analyses: Executive Order 07-08 lists ocean users and coastal communities as the focus of impact assessment for marine reserves. Depending on their scale and placement, marine reserves may also have impacts beyond coastal areas or beyond the state. This is illustrated by the likely case of existence values that people throughout Oregon would hold for the knowledge that marine reserve protections are in place. From what perspective should marine reserves be analyzed?

Adaptive management: OPAC defines adaptive management as "a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs." Adaptive management of marine reserves will happen during the implementation stage, related to the specified five-year performance review. How would adaptive management be structured? What are the costs and benefits of the adaptive management approach? Will some sites have a higher "value" because they provide a greater opportunity to gain insights?

4.0 Economic Analytical Methods Relevant to Marine Reserves

4.1 Contribution of Economic Research to Marine Reserve Policy

The NOAA Web site "Social Science for Marine Protected Areas" identifies five avenues through which social science can contribute to the assessment and management of marine protected areas (marine reserves, in the Oregon case): assessment, feedback, prediction, mitigation, and acceptance (NOAA 2005). These avenues apply equally to the economic analysis of Oregon marine reserves.

Assessment: Baseline information provides information on pre-implementation. Incorporating economics into assessments can identify affected groups and potential areas of conflict. Early economic assessment can help predict potentially avoidable problems.

Feedback: Ongoing economic monitoring can help in evaluating the effectiveness of management over time. Research can identify the economic components of effectiveness and provide the public an opportunity to suggest management changes.

Prediction: A range of economics methods can be used to predict the outcomes of management actions, thereby helping to identify potential problems before they develop.

Mitigation: Understanding the economic positions and motivations of user groups and coastal communities may help reduce, or even avoid, conflicts associated with marine reserve implementation.

Acceptance: Economic analysis can be used to understand public concerns, particularly with regard to the distribution of impacts. Concerns can be addressed through targeted outreach and education programs, which may in turn lead to better design of marine reserves and increased public support.

4.2 Methods of Economic Analysis of Marine Reserves

The same NOAA Web site (NOAA 2005) identifies a range of social science research approaches appropriate to the analysis of marine protected areas, several of which are used in economic analysis. Methods of economic modeling of marine protected areas are also illustrated by a special issue of the journal *Natural Resource Modeling* edited by Sumaila and Charles (2002). These methods can be grouped into categories reflecting their primary, but not exclusive, application. The categories are to enhance understanding of economic context, human interactions, costs and benefits, and economic impacts. Some or all of these methods could be

used to evaluate the status of proposed marine reserve sites in Oregon. Formal survey work could provide the needed economic data to support the application of these methods.

4.2.1 Understanding the Economic Context

Case Study Research: An in-depth investigation of economic attributes and impacts associated with specific issues and locations.

Content Analysis: A review of information sources such as newspapers, books, manuscripts, Web sites, etc. to identify key words or phrases that help identify patterns and trends in discussions about marine reserves. Content analysis is used more frequently in non-economics social sciences than in economics, but it can be used to understand the context for economic impacts and values.

Demographic Analysis: A study of the characteristics of human populations, such as size, growth, density, and distribution in coastal communities.

Rapid Rural Appraisal: A broad-level evaluation, usually through consultation with experts and stakeholders, that provides a general overview of the economic relationship between people and marine resources and identifies areas of concern about marine reserves as a precursor to planning.

4.2.2 Understanding Human Interactions

Focus Groups: A group interview about a specific topic, for example fishery operating costs. Focus groups can also be used to identify economic motivations, styles of interaction, or perceptions of risk.

Observation: Personal observation and recording of patterns of resource use, interaction, and behavioral response.

Surveys: Primary economic data collection (by telephone, mail, or in person) through scientific sampling methods.

Predictive Modeling: Simulation of real-world situations to predict future conditions; for example, the long-term impacts of marine reserve size and spacing.

- *Bioeconomic modeling*: The integration of biophysical information and ecological processes with economic decision behavior to analyze the possible effects of policies such as marine reserves on economic and resource welfare (cf Anderson 2002).
- *Spatially explicit bioeconomic modeling*: addresses questions of economic and biological interactive effects of marine reserves, with spatial effects explicitly taken into account, for example a spatial bioeconomic model to examine how various marine reserve options affect fishermen participating in limited-entry fisheries (Sanchirico and Wilen 2002).

- *Game theory*: modeling of strategic interactions among agents based on economic motivations, for example, a model of distributional and efficiency effects of marine protected areas to understand the effect of cooperative behavior in MPA management (Sumaila and Armstrong 2006).

Econometric Analysis: The application of statistical methods and empirical data to the testing of economic theories, for example, the testing of hypotheses about the economic response of fishermen to marine reserve implementation.

Secondary Data Analysis: Use of existing data and information (e.g., census data, fishery data, survey data) to identify characteristics of a group or analyze a particular issue.

4.2.3 Understanding Costs and Benefits of Marine Reserve Sites

Cost-Benefit Analysis: A tool for comparing the benefits of proposed projects (e.g., alternative marine reserve sizes or sites) with the costs to identify the alternative with the maximum net benefit (benefits minus costs).

Nonmarket Valuation: Methods to estimate indirectly an economic value that is not usually quantified in the typical markets where goods and services are exchanged for money, such as the value of recreation or other ecosystem services (National Ocean Economics Program 2008). Various methods have been used for conducting nonmarket valuations.

- *Contingent valuation*: Determining willingness to pay (or to be compensated for loss) of a specified environmental resource, for example, a marine reserve or marine reserve enforcement, through analysis of responses to structured questionnaires.
- *Travel cost:* Estimating the value of a marine reserve site or ecotourism services by analyzing the relationship between participation and costs of travel to the reserve sites.
- *Avoided cost*: Estimating the economic value of benefits that a marine reserve provides via the cost of providing those benefits through some other action, for example, rebuilding overexploited fish stocks through reduced fish catch or through artificial propagation.
- *Benefits transfer*: Estimating economic values by transferring existing benefit estimates from another location. The advantage is the avoided cost of a new study, but the disadvantage is the limited extent to which marine reserves in two locations are alike in the benefits they produce.
- *Choice experiments*: Estimating economic values for ecosystem services by asking people to make tradeoffs among sets of ecosystem or environmental services or characteristics. Willingness to pay is inferred from tradeoffs people are willing to make among costly alternatives.
- *Hedonic pricing*: Assessing the value of an environmental feature by examining actual markets where the feature contributes to the price of a marketed good, for example, the monetary contribution of ocean views to home prices.

4.2.4 Understanding Marine Reserve Impacts

Economic impact assessment: The identification of how user groups and coastal people and communities could react to a marine reserve, and the prediction of its probable impacts on regional income and employment and distributional effects among segments of the community.

Input-output analysis: A representation of a regional economy through a description of linkages among industries. Changes on one economic component are traced throughout the economy, for example, a decline in fishery revenue or an increase in tourism revenue in a coastal community.

Comparative research: A comparison of different analyses over attributes, characteristics, or particular treatments across two or more marine reserve sites or within a single reserve site over time to learn what contributes to different outcomes.

Multi-attribute utility analysis: A tool for addressing a decision that has multiple criteria, e.g., quantifying tradeoffs among the many ecological, economic, and social criteria accompanying marine reserve decisions. Proposed reserve sites can be compared and scored using both quantitative and qualitative criteria (cf. Kiker et al. 2005).

Institutional analysis: The analysis of how organizations and people make economic and managerial decisions, for example, the structure and process of stakeholder involvement in decision making.

4.3 Workshop Discussion of Economic Analytical Methods Relevant to Marine Reserves

During the workshop, a question was raised as to whether economics will be part of the ongoing process of marine reserve evaluation or whether it will be reactive to OPAC's decision. Given the time constraints OPAC faces to immediately choose sites for consideration, basic economics research on the full array of potential sites is not possible; economics will have a more restricted role. Priority will be placed on estimating the economic impacts of specific proposed sites as part of the site selection process, except for the Otter Rock Reserve near Depoe Bay and the Redfish Rock Reserve near Port Orford. In the longer term, economic performance indicators should be used in the evaluation of all selected reserves as part of the ongoing process of marine reserve evaluation.

The "community collaboration" component identified in Executive Order 08-07 is being put forward as a proxy for economic assessment for the first selection of potential sites.

The workshop participants identified long-term impacts that include adjustments to displacement effects of marine reserves as an important consideration.

The appropriate level of consideration for the economic analysis of marine reserves was discussed. Is it the individual site and its associated coastal community(ies)? The state? The region? Oregon policy makers ordinarily look at the state level because ocean resources are owned by the state of Oregon. However the Executive Order focuses on coastal communities and users. This is a narrower focus than for other marine resource management issues.

The choice of appropriate discount rate to apply to future benefits and costs of marine reserves was also a point of discussion. The economic analysis of public actions employs an array of different discount rates. The discount rate appropriate to state-level rulemaking is a policy choice that will need clarification. At present, the only requirement is to identify impacts on affected businesses. These impacts are primarily short term, so no discounting is applied. State rulemaking does not follow the federal National Environmental Policy Act (NEPA) process, which requires preparation of a formal Environmental Impact Analysis (EIA). An EIA must include descriptions of the environmental impacts of the proposed action, any unavoidable adverse environmental impacts, alternatives, including no action, the relationship between short-term uses of the environment and maintenance of long-term ecological productivity irreversible and irretrievable commitments of resources, and secondary/cumulative effects of implementing the proposed action.

The economic analysis of marine reserves will need to address the question of what is assumed to be held constant in estimating marine reserve impacts. Many sources of change in ecosystems and coastal economies make it difficult to assign causation between marine reserve implementation and subsequent impacts. It is also the case that the analysis of marine reserve impacts is in comparison to the status quo – how do the benefits and costs generated by marine reserves compare to those of present Territorial Sea management?

One value of a marine reserve is insurance against areas of uncertainty and against the loss of biodiversity or habitat. What is the public willing to pay for this insurance? Any answer to this question relies on understanding the likelihood of losses under specific circumstances. Part of the answer to this question lies in the evaluation of the cost of implementing marine reserves versus the long-term cost of uncertainty. The opportunity cost (the cost of foregone alternative uses) of implementing marine reserves may be low or it may be high, depending on the site. The long-term costs of uncertainty may also be high in terms of the risk of irreversible actions that endanger biodiversity or habitats.

Marine reserves can also generate research knowledge that has value in long-term marine stewardship. The specific requirement to monitor marine reserves to answer key questions should facilitate long-term monitoring, for which funding is often difficult to maintain.

The stated intent of OPAC is to apply adaptive management to marine reserves, but no sideboards have been specified for how this process will be conducted. Monitoring will be conducted and changes made on the basis of what is learned through periodic reviews during the implementation phase. The periodic reviews provide an opportunity to identify economic performance indicators. This “review and adjustment” perspective is different from the commonly accepted concept of adaptive management, which involves deliberate experimentation for the purpose of addressing areas of uncertainty, then adjusting on the basis of what is learned.

A final topic of discussion was the cost effectiveness of marine reserves. Cost-effectiveness analysis assesses the least-cost approach to a given outcome. The appropriateness of this analytical method to marine reserves and whether marine reserves produce given outcomes (known benefits) is an open question. Marine reserves of similar size would have to be assumed

to justify the assumption of similar outcomes. This approach might also forego an opportunity to learn about the properties of marine reserves of different sizes.

5.0 Models

As the previous section makes clear, there is a wide array of economic analytical methods available to analyze questions of marine reserves. The choice of a particular method depends on the specific questions being asked and the availability of data to support analysis of those questions.

The workshop heard presentations of two models that are examples of alternate approaches currently used to assess some of the economic impacts of marine reserves and other ocean policy actions. The first presentation, made by Hans Radtke, was on the Fisheries Economic Assessment Model (FEAM), an input-output based model for estimating economic impacts of the commercial fishing industry. The second presentation, by Charles Steinbeck and Sarah Kruse, was on Ecotrust's Ocean Tools software.

5.1 Fishery Economic Assessment Model (FEAM)

The FEAM is a fishery-specific input-output (I-O) model based on the IMPLAN model (http://en.wikipedia.org/wiki/IMPLAN), developed by the USDA Forest Service and modified for coastal counties. FEAM defines the structure of the fishery industry and analyzes the effect of an economic change on fishing and other coastal industries. FEAM is based on employment data which, in the case of the fishing and tourism industries, must be estimated and added to the IMPLAN model.

Inputs into FEAM include definitions of harvesters and processors, species-specific prices and price margins, harvester and processor budgets, and total revenues. The industry-level budgets can be employed to show changes in profitability from different harvesting scenarios.

Outputs from FEAM include the total personal income generated by the fishing industry: directly (crew shares, salaries, profits); indirectly (salaries and profits from supporting industries); and induced (salaries and profits from the general economy). Outputs also include the direct total personal income generated by each species included in the model, the economic status of harvester or processor, and an estimate of employment associated with a change in the fishing industry.

The model is currently used to estimate the share of total personal income in Oregon's coastal counties accounted for by various economic sectors, such as commercial fishing.

More specifically, the model also estimates the share of the fishing industry total personal income accounted for by individual species of fish (OCZMA 2006). The model could be used to identify the personal income impacts of commercial fishing in the Oregon Territorial Sea, which comprise only a small proportion of the total Oregon commercial fisheries. FEAM is appropriate for estimating aggregate as well as individual coastal county impacts.

The FEAM model could be adapted to the recreational fishery (and formerly was, in a version called RECFISH) and could evaluate the specific impact of a marine reserve on that sector. As long as the model can track changes in revenue or cost associated with a marine reserve (e.g., travel costs), it can trace its distributional impacts. FEAM does not have a spatial component for the source of fishery income, however, so a vessel receiving all of its income from a certain reserve area would not be revealed by the model. Nor will the FEAM model reveal "tipping points" for coastal communities affected by marine reserves. A key action prior to modeling is to talk with those who are likely to be affected to gain a deeper understanding of potential impacts and substitution options.

I-O models are static in that they take the existing structure of the economy as given and do not capture changes in technology or dynamic adjustments. The model allows researchers to assess immediate, short-term impacts, but not the longer-term adjustment effects. There are opportunities to sequentially update FEAM with changes in prices, technology, markets, and other variables to estimate impacts over time. An improved approach for large-scale changes in the economy over time would require the application of a computable general equilibrium (CGE) model, which incorporates changes in supply and demand for all economic sectors triggered by movements in market prices.

5.2 OCEAN Tools Software

Ecotrust's "OCEAN Tools" software is a stakeholder-driven decision-support tool that combines fisheries mapping and economic valuation. The fisheries mapping is based on local knowledge of areas used for fishing and their comparative values as well as state agency landing receipts that represent ex-vessel revenues earned from landed catch. The idea is to collect economic data on commercial and recreational fishing (use and values) that is then used by the stakeholders to inform their design processes and to evaluate the economic (gross and net) impacts of any proposal. The software has been applied in California in the siting of marine sanctuaries, but the results can be used for multiple evaluations: wave energy, offshore aquaculture, marine reserves, etc.

The application of this software involves the collection of economic data and the evaluation of impacts. The collection of economic data is supported by outreach, surveys, and quality assurance and control. Outreach on the purpose of data collection and the data collection itself are conducted through meetings with port liaisons and members of the fishing community. The survey design process involves identifying key fisheries with their component fishing strategies (practices or gear configurations), the stratification of the study area into port complexes, and the representation of $\geq$ 50 percent of total landings and at least five fishermen for each fishery for a given time period.

Data collection is done through both desktop computer (commercial and charter fisheries) and online (recreational fisheries) applications. All interviews follow a shared protocol for each fishery in which the interviewee participates. Fishermen are asked to identify all fishing areas/locations that are of economic importance over their cumulative fishing experience, and to rank these using an imaginary "bag of 100 pennies" that they distribute spatially over the fishing grounds. Non-spatial information pertaining to demographics and basic operations (costs) is also collected.

Quality assurance and control are conducted by checking locations with corresponding nautical charts and by providing fishermen the opportunity to review and "ground truth" the mapping results of their individual fishing locations.

The fishing grounds are then analyzed by creating a weighted surface that represents the stated importance of different areas for each fishery. The values are multiplied by the proportion of in-study region landings and ex-vessel revenue per fisherman, specific to each fishery and port, to produce a crude, revenue-based measure. Maps of these values are produced for each fishery at the port and regional level.

Results are used to evaluate the economic (gross and net) impacts of the proposals designed by stakeholders. The results can be used for various spatial policy considerations, including marine reserves, wave energy, and offshore aquaculture. Based on the fishing grounds and cost estimates derived from the data collection effort, decision makers can distinguish between total fishing grounds and fishing grounds in state waters, determine the percentage of area and value that will be affected, identify fishermen likely to experience disproportional impacts, and get an overall picture of the effect of fishery area closures on fishing grounds, both immediately and cumulatively.

The software also enables the identification of the relative gross impacts of proposed marine reserve sites. Marine reserve sites vary across fisheries in terms of the percentage of the total fishing area and value affected and the percentage of the study area fishing grounds and value affected. Net economic impacts can be estimated by adjusting gross revenues by costs (crew and fuel) specific to the fisheries in the region.

The information produced through the application of OCEAN Tools has provided a baseline in the California process. The goal has been to have this type of fishery mapping information provided to inform the iterative process of proposing marine protected area sites. The results have not been verified with fishery logbook data; Wilen and Abbott (2006) attempted to verify the model using logbook data, with only partially successful results. However, the incentives for "gaming" (deliberately misrepresenting the importance of a location to fishery revenues) may be few once aggregate maps are shown to the fishing community for validation, unless the "gamers" are the majority of the fishing community, in which case gaming may not be transparent (Wilen and Abbot 2006; McCay et al. 2006).

This situation contrasts with Oregon where there are opportunities to "game" the mapping process because specific sites are already proposed and where mapping of fishery locations will be done in reference to those sites. In Oregon, the interview challenge will be to convince fishermen that it is in their interest to have as accurate as possible a set of maps showing the valuable fishery locations. Gaming opens the possibility that marine reserves will be placed in some other potentially productive site.

The online data entry for recreational fisheries does present the potential for sampling bias through omission of the recreational or subsistence fishing demographic that is not computer

literate. However, group reviews of aggregate maps help ensure that all fishing grounds are represented.

The mapping of fishing grounds is constrained by the detail of the nautical charts in that region. The fishery can be stratified in whatever way makes sense for the particular analysis, as long as information is available for the chosen strata. The model does not have a behavioral component to understand adjustments to an area closure, but it would be possible to apply the model in multiple rounds to estimate where the next valuable areas are. This capability is currently under development.

6.0 Economic Data Needs for the Analysis of Marine Reserves

Collection of economics data is an area of chronic underinvestment in both state and federal fisheries, as well as in other marine economic sectors.

Economic data are needed for both short-term and long-term analyses. In the short term, minimizing adverse economic impacts of marine reserves on ocean users and coastal communities depends on having an analysis that lays out these impacts in a systematic way. The analysis, in turn, depends on data. In the longer term, Oregon faces many economic issues in Territorial Sea planning associated with an array of existing uses such as fisheries, recreation, and ecotourism, and emerging uses such as marine reserves, wave energy, and wind energy. The assessment of these competing uses and the tradeoffs among them will depend on economic analysis supported by data.

For the immediate future, the focal economic issues will be the economic impacts of marine reserves on ocean users and coastal communities. Many factors determine the type of economic effects a marine reserve will have. A wide range of economic data can be considered in the analysis of impacts. The data types can be grouped into seven categories: (1) community baseline conditions, (2) trends in existing uses, (3) trends outside the reserve area, (4) likely displacement effects, (5) nonmarket values, (6) reserve-related effects, and (7) new data collection. These data categories were described in a handout prepared for the Oregon marine reserve outreach process to help communities identify economic data needed for the analysis of economic impacts (Hanna 2008). The categories are summarized below, with additional notes for elements that were discussed during the workshop. A detailed outline of the economic data elements is included as Appendix E to this report.

6.1 Community Baseline Conditions

Objective information is needed on current conditions, including an accounting of ocean users and shoreside economic activities, to evaluate the potential adverse economic effects on local communities.

Workshop Discussion:

The Territorial Sea Plan requires an inventory of use data, but this has not as yet been conducted.

6.2 Trends in Existing Uses in Proposed Reserve Areas

Revenue and cost information will be required on commercial and recreational fishers and other ocean users.

Workshop Discussion:

Data on commercial fishing revenues in Oregon are routinely collected by agents from the Oregon Department of Fisheries and Wildlife and are readily available from the Pacific Fishery Information Network (PacFIN). Commercial fishery cost data ideally should be acquired by a comparable routine long-term data-collection process. Absent such a data-collection system, the best short-term alternative may be to conduct interviews with individual fishermen or fishery focus groups. Data currently available on the revenues and costs of marine recreational fishing in Oregon are based on limited sampling programs and have very poor spatial resolution.

Although fisheries are often the focus of impact analysis of marine reserves, other marine-based economic activities also contribute to coastal communities and fall within the category of ocean users. The range of non-fishery sectors affected depends to some extent on the interpretation of prohibited extractive uses and disturbances: do these include tide-pooling and marine cables?

With regard to tourism, a critical need is information on why people come to the coast as tourists. What are the components of value in tourism (both positive and negative), from the perspectives of tourists and coastal residents? A related question is, what motivates people to move to the coast? What is their willingness to pay to live in a coastal community? How would marine reserves factor into their location decision?

Data on waterfront infrastructure are needed for analysis of coastal community economic impacts. A related need is to determine critical thresholds that determine the sustainability of fishery-related port infrastructure.

6.3 Trends Outside the Reserve Areas

Factors from outside the reserve area, such as proximity to Rockfish Conservation Area boundaries or other actions by the Pacific Fishery Management Council, are likely to have dissimilar effects on different communities and marine reserve sites.

Workshop Discussion:

The distribution of vessel sizes in a given area is an important consideration, particularly with regard to safety. For example, if a large area of combined marine reserve/marine protected area were closed to trawl gear, in combination with areas closed for black rockfish protection, it could effectively shut off from the fishery small trawl vessels that cannot safely go out into deep water. These vessels may currently earn all their revenues from one small area.

6.4 Likely Displacement Effects

If marine reserves are sited on active fishing grounds, displaced fishers will likely move their fishing operations to other fishing grounds.

Workshop Discussion:

It will be important to understand whether changes in resource use, such as changes in the quantity of fish harvested, will lead to changes in resource value, as expressed in ex-vessel price. What is the level of consumer willingness to pay for seafood caught in Oregon's Territorial Sea?

What are the regional impacts of changes in the quantity or location of fishery landings? For species managed with Total Allowable Catches (TACs), it is reasonable to assume that the same amount of fish may be caught after marine reserve implementation, although in somewhat different locations. For species not managed with TACs, such as Dungeness crab, the quantity of total landings could change.

6.5 Nonmarket Values

There could be appreciable nonmarket values associated with nearshore recreational fisheries, nearshore surfing, nearshore diving, and possible eco-tourism from visits to marine reserve sites.

Workshop Discussion:

Currently, we have no estimates of the willingness to pay or willingness to accept compensation for particular marine reserve sites, nor do we know the values placed by ocean users or the public on nearshore recreational fisheries, surfing, diving, or other recreational uses.

6.6 Reserve-related Effects

Planning for marine reserves will need to give due consideration to the incentives that will be needed for compliance with marine reserve restrictions and the cost of enforcement.

Workshop Discussion:

An important information need is how the size and shape of a marine reserve affects the cost of enforcing its boundaries and conditions. Also relevant is information on effective compliance incentives. For example, it is well known that the size of the fine for a violation affects compliance, so that to some extent a schedule of large fines can substitute for low levels of enforcement monitoring. However, although large fines have a deterrent effect, they can also be so large that courts will be reluctant to enforce them. Other positive enforcement incentives, such as the Bering Sea's "dirty-dozen" list of vessels in violation, are worth investigation.

6.7 New Data Collection

Workshop Discussion:

Logbooks are currently the only medium by which commercial fisheries in state waters are spatially documented. The groundfish, crab, and developmental fisheries provide logbook data; others (e.g., salmon and sport charter) do not.

Electronic methods of fishery data collection offer potential benefits for spatially explicit economic data that will support predictive modeling. However, developing these data-collection systems is a long-term effort that does not address the need for short-term analysis of proposed Oregon marine reserve sites. Electronic logbooks are uploaded automatically by equipment on a

vessel. Vessel monitoring systems (VMS) track fishing vessel location, although to date, vessels fishing solely within state waters are not required to carry VMS.

In the short term, the most likely means to collect spatially explicit economic data would be interviews, focus groups, and dockside surveys.

7.0 Existing Economic Data for Oregon Marine Reserves

The quantity of economic data to support analysis of Oregon marine reserves is limited.

The workshop heard five presentations regarding the fishery, economic, and GIS data that presently exist for the Oregon Territorial Sea. The first presentation, on spatial economics data, was given by David Colpo (Pacific States Marine Fisheries Commission). The second presentation, on state data, was given by David Fox (ODFW). The third presentation, on GIS data, was given by Arlene Merems (ODFW). The fourth presentation, on commercial fishery data, was given by Carla Sowell (ODFW). The fifth presentation, on recreational fishery data, was given by Linda ZumBrunnen (ODFW).

7.1 Spatial Economics Data

Spatial economics data are data that can be associated with a specific geographic place. There is presently no routine collection of economics data with a fine-scale spatial resolution. What are available are some port-specific data collected in the Pacific Coast Fishery Information Network (PacFIN) system, and non-spatial economics data held in the Economic Fisheries Information Network (EFIN) system. Both systems are managed by the Pacific States Marine Fisheries Commission.

The spatial data in PacFIN include fish ticket data (landings by trip) and trawl logbook data (landed catch by tow). Oregon law requires that all commercial fish landed in the state be sold to a wholesale fish dealer and reported on an Oregon Fish Receiving Ticket (Sampson et al. 1997). Fish ticket data include the weight and price by species purchased, as well as area of catch, port of landing, seller, and buyer. However, not all tickets report area of catch; even when the information is included, it will be misleading for trips that operated in multiple areas.

Oregon law also requires that logbooks be maintained for each vessel that harvests ocean food fish, which includes fish caught with groundfish trawls, pots, longlines, jigs, vertical longlines, and trolls, as well as shrimp trawls. Trawl logbook data include latitude and longitude of tows and estimated retained catch by tow. The response rate is about 95 percent. Most trawl tows off Oregon occur in deeper water, outside of the Oregon Territorial Sea.

Some economics survey data exist. The survey questionnaires focused on four types of information not provided by other sources (landings, registration, logbook, etc.): annual costs, annual earnings, vessel characteristics, and crew compensation. Survey data include limited-entry trawl vessels (1999; 2003–04), processors (1999), charter vessels (2001), fixed gear vessels (2003–04), open-access groundfish and salmon vessels (2005–06), and fuel costs (ongoing; 1999+). Response rates varied widely.

A number of other data sources are relevant to economic analysis. State and Coast Guard vessel registration data include vessel characteristics and ownership information. Federal limited-entry permit data include permits held by vessels. The processed-product survey reports the quantity and mix of product annually produced by plants or companies, although the data are of unknown quality and representativeness because it is a voluntary survey. Vessel monitoring system (VMS) data exist for vessels catching groundfish in federal waters. Community profiles of Oregon fishing ports include descriptive information on seafood buyers and processors, markets, landings, ex-vessel revenues, and demographics.

7.2 State of Oregon Data

Using a broad definition of economic data as any data that may apply to an economic analysis, a few state data sources apply. Landings data are collected for commercial and some recreational fisheries. The Oregon Parks and Recreation Department collects visitor data at state parks. The Oregon Tourism Commission collects tourism-related data.

Few Oregon data are represented in Geographic Information System (GIS) format. Commercial and recreational fishery data can be characterized according to four categories of GIS data-readiness: (1) electronic data at fine resolution (e.g., latitude-longitude or Loran coordinates or 1-minute blocks); (2) electronic data at coarse resolution (e.g., port/reef/management area); (3) hard copy data at fine resolution (e.g., latitude-longitude or 1-minute blocks), and (4) hard copy data at coarse resolution (e.g., port/reef/management area). Hard-copy data exist on paper and are not entered into any electronic database, and thus are further away from being incorporated into GIS.

Oregon commercial fishery data fall into all four categories. Data available as categories 1 or 2 are available to be used in GIS format.

- GIS-ready as category 1 (at least some data): logbooks for groundfish bottom trawl, nearshore groundfish (mostly drift jig), sardine, shrimp, spot prawn, urchin, and flat abalone fisheries.
- GIS-ready as category 2: fish tickets for species caught with bottom trawl, midwater trawl, shrimp trawl, fish and crab pots, hook and line, longlines, troll, shellfish hand gear, and non-foodfish bait. Logbook data for some years of the nearshore groundfish and urchin fisheries.

There is a data-entry backlog for categories 3 and 4, and there is no expectation that these data will be available in electronic form in the near future. Some entry of crab and spot prawn data is taking place. No funds are available to support entry of fixed-gear data. Nearshore logbook data have not been error-checked and are not considered usable for detailed analysis. Other data have quality issues, for example, uncertainty about entered fishing locations. Some data are confidential because they are revenue information for specific vessels. These data are available for research purposes according to specified protocols. More-detailed discussions of Oregon commercial fisheries data can be found in two reports of The Research Group (2005; 2007).

Information about the economic effects of Oregon coastal recreational fisheries is scattered among different sources. A 2006 study was undertaken to bring together existing economic information and provide estimates for fisheries where none existed, but the included fisheries are still selective (The Research Group 2006).

The Ocean Recreational Boat Survey (ORBS) conducted by the ODFW is an annual angler-intercept survey of ocean salmon and bottomfishing. It provides data on catch and effort In some years, the ODFW has also surveyed recreational fishing in the lower estuary areas through the Shore and Estuary Boat (SEB) survey. Due to budget restrictions, this survey has not been conducted since 2005. The Columbia River mainstem recreational fisheries are surveyed through the Columbia River Creel Program (CRCP). Estimates of recreational catch and effort derived from the ORBS, SEB, and CRCP surveys are compiled in the RecFIN database administered by the Pacific States Marine Fisheries Commission (PSMFC). The most recent ocean fisheries trip information is 2006 (The Research Group 2007).

At the federal level, NMFS has conducted the nationwide Marine Recreational Fisheries Statistics Survey (MRFSS) since 1979. The MRFSS is a two-stage survey: a random-digit-dialing telephone survey of coastal residential households and an access-point intercept survey of anglers. The survey provides estimates of marine recreational angler fishing effort, participation, and catches of finfish, and distinguishes among three different modes of fishing: bank, charter boat, and private boat at two locations in the ocean (within and outside territorial seas and inland saltwater (estuary) areas. The West Coast MRFSS was discontinued in 2002, and state survey programs (ORBS in Oregon) have substituted for acquiring recreational fishing data collection (Schindler et al. 2003, cited in The Research Group 2007).

Oregon recreational data are classified as categories 1 and 2, although none are GIS-ready. Survey data exist for the ocean shore finfish, ocean boat finfish, and charter boat fisheries for various time periods. Economic data elements in these surveys include trip costs, other expenditures, county of expenditure, boat ownership, income, distance traveled, and charter revenues.

The ODFW is now working on an economic survey of fish and wildlife recreation. The survey comprises four separate sub-surveys: hunting, angling, shellfish harvesting, and wildlife viewing. The first three sub-surveys use a stratified random sample of the recreational license database. The primary focus of the survey is trip costs and their association to the county-level (or wider) economic contribution of recreational shellfish harvesting, hunting, and fishing. The fishing survey breaks out marine species as an aggregate rather than individual species. The fourth survey, on wildlife viewing, is a phone survey of the general population, with a focus similar to the hunting and fishing surveys. The surveys will have spatial data represented by the nearest city or county to where trips were taken. A final report on the surveys will be available in early 2009 (Fox 2009).

8.0 Economic Data Gaps for Oregon Marine Reserves

Proposed sites for Oregon marine reserves received an initial qualitative evaluation based on eight coarse review criteria. One criterion was the minimization of significant adverse impacts to

ocean users/coastal communities. The qualitative evaluation addressed which fisheries exist in the affected area and described general impacts on those fleets. The intent is that in the next phase of review, the proposed sites will be analyzed for economic impacts on ocean users and coastal communities.

The workshop discussion identified a number of gaps in the economics data that will need to be addressed if economic impacts are analyzed.

Baseline data: The absence of ongoing collection of economic data for Oregon fisheries and other ocean uses means that there is no spatially explicit economic baseline representing conditions before planning for new action on reserves began. A limited baseline is provided by the identification of port of landing or trip end. However, there is no documentation of the spatial uses of the Territorial Sea, the value they produce, or their economic contribution to coastal communities. The absence of a pre-reserve baseline severely restricts the ability to quantify post-reserve impacts. Most of the existing fishery data are limited by the lack of a spatial component.

Spatially explicit data: Spatially explicit economic data are limited to logbooks and fish tickets for some commercial fisheries. They are limited in the extent to which they can be used to document fishery uses of proposed marine reserve sites and fishery revenues produced in those sites. Other marine uses such as surfing, boating, or ecotourism are not represented by spatial data.

Recreational fishery data: There is a marine sampling program for Oregon's marine recreational fisheries, with some components being sampled more completely than others. Recreational fisheries data collection is targeted on key fisheries from a management perspective and needs to be assessed with regard to their use in the economic analysis of reserve proposals or evaluations.

Valuation of marine reserves: No research exists on the economic values placed on marine reserves by the Oregon public. Such research would estimate the values of the ecosystem services produced by a marine reserve, for example, insurance values.

Valuation of the Territorial Sea: There has been limited assessment of the economic values placed on the Territorial Sea's portfolio of marine economic activities by the Oregon public. New methods of analysis that derive empirical social preferences for different ecosystem services offer potential to supplement traditional methods based on estimated monetary values (cf. Fisher et al. 2009; Whitmarsh and Palmieri in press).

Coastal community economics: Research in this area needs updating. The most recent version of FEAM is based on 2006 data, with recreational fishing represented only through 2002. There is a critical need for data on shoreside infrastructure, for example, jetties, seafood processing, and ice production.

9.0 Workshop Findings and Recommendations

Workshop participants worked sequentially through a series of topics related to the economic analysis of Oregon marine reserves: OPAC objectives for marine reserves, economic elements of

marine reserves, economic analytical methods, examples of models and software, economic data needs, existing economic data, and gaps in these data. A number of findings and recommendations emerged from these discussions.

General Findings

Finding 1: OPAC's marine reserves objectives require the assessment of economic impacts on ocean users and coastal communities.

Finding 2: The assessment of economic impacts (both positive and negative) of marine reserves has several dimensions: documenting existing ocean uses and their economic contribution to people and communities, predicting human behavioral responses, and identifying benefits and costs. Marine reserves may be complementary to fishery regulations already in effect in Oregon's Territorial Sea.

Finding 3: Executive Order 07-08 lists ocean users and coastal communities as the focus of impact assessment for marine reserves; however, depending on their scale and placement, marine reserves may also have impacts beyond coastal areas.

Finding 4: Several methods and models are appropriate for analyzing economic impacts of marine reserves.

Specific Findings and Recommendations

Finding 5: Existing economic data are limited in their geographic specificity and are therefore inadequate to analyze the impacts (both positive and negative) of Oregon marine reserves on ocean users and coastal communities. There are fundamental gaps in baseline data, spatially explicit data, recreational fishery data, coastal community economics, public valuation of marine reserves, and public valuation of other marine activities in the Territorial Sea.

Finding 6: There is no coherent, comprehensive documentation of the spatial uses of the Territorial Sea, the value they produce, or their economic contribution to coastal communities. The absence of a pre-reserve baseline severely restricts the ability to quantify post-reserve implementation effects. Most of the existing data are on fishery uses, but these data have limited information about exact harvesting locations, ports where the catch is delivered, or residency of fishing industry workers. Spatially explicit economic data are needed for effective marine reserve implementation and for management to ameliorate adverse effects.

> ***Recommendation 6.1*:** OPAC should highlight the inadequacy of economics data needed to support its marine reserve objective for avoiding significant adverse economic impacts on ocean users and coastal communities and for estimating the potential of positive, long-term economic impacts.
>
> ***Recommendation 6.2*:** In the short term, OPAC should recommend the collection of spatially explicit economic data for specific marine reserve sites through expert opinion methods that involve ocean users and managers. The collected data should be

crosschecked with available data and judged verifiable before being incorporated into the decision-making process.

***Recommendation 6.3*:** In the short term, OPAC should recommend the collection of information about likely user group and community response to spatial exclusion through surveys of affected groups. The collected data should be crosschecked with available data and judged verifiable before being incorporated into the decision-making process.

***Recommendation 6.4*:** As the lead agency for marine reserves, ODFW should create a Web space to host the economic information they fund, with links to other pertinent marine economic information, to enhance its circulation and application.

Finding 7: State-level marine economics data are collected. However, the process of data collection is *ad hoc*, incomplete, and uncoordinated.

***Recommendation 7.1*.** For the long-term economic assessment of marine reserves and other uses of the Territorial Sea, OPAC should recommend the formation of an Oregon Marine Economics Data Work Group charged with defining an ongoing core economic data-collection program.

***Recommendation 7.2*.** The Oregon Marine Economics Data Work Group should consider methods to involve ocean users and coastal communities in data collection, including incentive-based programs.

***Recommendation 7.3*.** OPAC should recommend state funding of the core data program developed by the Oregon Marine Economics Data Work Group.

Finding 8: Economic impacts are one element of marine reserve performance. There are opportunities to learn about economic impacts of marine reserves by investing in economic data and research.

***Recommendation 8.1*:** OPAC should ensure that economic performance indicators are a component of the monitoring and periodic performance review of marine reserves. Economic and ecological monitoring should be coordinated and complementary.

***Recommendation 8.2*:** OPAC should recommend that cooperative research be funded to learn from existing and ongoing studies of marine reserves on the U.S. West Coast and elsewhere, and to enhance the ability to understand and interpret economic impacts of reserve creation and operation.

Finding 9: Economic data are also needed for the planning and analysis of other uses of Oregon's Territorial Sea, such as wave and wind energy.

***Recommendation 9.1*:** OPAC should recommend that the economic data collection program to be designed by the Oregon Marine Economics Data Work Group include the full range of uses of the Oregon Territorial Sea.

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Appendix A. Workshop Participants

Christine Broniak	Oregon Department of Fish and Wildlife
Chris Carter	Oregon Department of Fish and Wildlife, Ret.
Dave Colpo	Pacific States Marine Fisheries Commission
Shannon Davis	The Research Group
Jeff Feldner	Oregon Sea Grant
Dave Fox	Oregon Department of Fish and Wildlife
Susan Hanna	Oregon State University
Michael Harte	Oregon State University
Dan Huppert	University of Washington
Sarah Kruse	Ecotrust
Arlene Merems	Oregon Department of Fish and Wildlife
Hans Radtke	Economics consultant
Jay Rasmussen	Oregon Sea Grant
David Sampson	Oregon State University
Carla Sowell	Oregon Department of Fish and Wildlife
Charles Steinback	Ecotrust
Gil Sylvia	Oregon State University
Linda ZumBrunnen	Oregon Department of Fish and Wildlife

Notetakers:

Chris Cusak	Oregon State University
Juna Hickner	Oregon Sea Grant

Appendix B. Public Observers

Laura Anderson	Local Ocean Seafoods
Walter Chuck	Sport fishing representative, Newport, OR
Flaxen Conway	Oregon State University
Carl Finley	Corvallis, OR
Onno Husing	Oregon Coastal Zone Management Association
Andy Lanier	Salem, OR
Jim O'Higgins	Newport, OR
Ron Mason	Sport fisherman, Newport, OR
George Mpitsos	Newport, OR
John Sherman	Coastal resident
Chuck Weller	Coast Range Association

Appendix C. Public Comments

Tuesday, October 21, AM

- Chuck Willer, Coast Range Association:
  - This process must be interdisciplinary.
  - Re: the social discount rate and uncertainty: a negative discount rate is what should probably be assumed.
  - Scale issues are important – relevant to biodiversity over time.
  - Extensive literature in conservation biology

- Ron Mason, sport fisherman:
  - Experience value: need to take into account sport fishing. Biggest part of experience is just being out on the ocean. Won't go out just to look at the area, but being able to go out is very important.
  - Economic impact: spends money in places other than just coast.
  - Fisheries management sustainability: OPAC said reserves aren't for this, but clear that it is. Many places where MRs went in had poor management, and Oregon has some of the best management in the world.
  - Can't tell how MRs will improve experience for beachwalkers, surfers, etc.

- Walter Chuck, sportfisher representative:
  - Asks that discussions consider economic impact to existing businesses. If current businesses went away, what would the cost be in five years to re-enter business?
  - Need to focus also on wave energy, gas/oil exploration, aquaculture, etc.
  - Each port along the coast has different tipping points: losing 10 percent in one port could be devastating, while not a huge impact on other areas.
  - Long-term funding considerations. Outside money not well received.

- Onno Husing, Oregon Coastal Zone Management Association:
  - Urges workshop participants to spend very little time trying to figure out what's on OPAC's mind and instead focus on the Territorial Sea Plan.
  - Thinks that at OPAC, two pilot projects will go forward and the rest will be asked to go back to the community level. So economists have time to go forward with somewhat of a blank slate.
  - SOORC: Group from Depoe Bay will start working with Ecotrust.

- George Mpitsos
  - Problem: it is a complex, multidimensional system in ocean and on land. We know very little about the environment, and environment has to restore itself. Answer won't come in numbers, but in terms of values: where we wish to place our resources.

Tuesday, October 21, PM

- Laura Anderson, Local Ocean Seafood:
    - From the industry perspective, it's important to ensure a steady supply of sustainable seafood. Also from the industry perspective, reserves are only one issue on the horizon.
    - Burden of proof falls on industry to provide information useful to decision makers. Some industry groups are moving forward (SOORC); others should be because it's in their best interest to defend their boundaries.
    - A two-year time frame is enough to start conversations and work on getting industry on board.
    - Notion of adaptive management is beyond the scope of immediate data needs, but pertinent to trying to predict where fishermen will move. Tools can help us understand what has happened – can show why a certain fishery went downhill so it doesn't get blamed on incorrect factor.

- Chuck Willer, Coast Range Association:
    - OPAC is an advisory committee; the governor and legislature then make decisions. So the work done here can inform more than just OPAC.
    - Analytic tools: we're talking about relatively small reserves, and many tools are scaled toward larger areas.
    - Re: Santa Barbara group doing some modeling: has a paper he will bring in. Reserves will benefit fishers; it's just a matter of how far in the future.
    - Economics is static, extremely hard to do dynamic analysis. Impact to individual fishers must be weighed against future benefits to others.

Wednesday, October 22, AM

- Chuck Willer, Coast Range Association:
    - Data issue: needs to be understood in terms of public interest. Data is becoming much more transparent.
    - Data needs: look at full suite of ecosystem services. Remember what it is that a reserve does that nothing else can do: re-establish functioning ecological conditions in a space.
    - Gaps: we don't have an understanding of historic range of variability, which is important.
    - "Outsiders driving process": not necessarily true. His organization has many coastal residents who support reserves.
    - Most economists in the room are probably conventional economists. Key problem: failure to interface or deal with ontological reality of what we're talking about. Wondering about data gaps from an institutional perspective. There are other economic schools out there with different data and perspectives.

- Onno Husing, Oregon Coastal Zone Management Association:
    - Confidentiality: diagram on flipchart of fishing area intensity. It is possible to collect information from fishermen on more than just fishing grounds.
    - Budget: Onno has been working to get grant funding to get outside dollars; hoping to move forward by 2009–10. Would hope to get spatially explicit mapping done. Has application in to Meyer Memorial Trust.
    - Response to Chuck's comments about "outsiders" and "community": hoping to have a process where people from coast, outside of coast, and industry take time to talk to each other about process.

- Laura Anderson, speaking as marine resource consultant:
    - Port Orford (PO) is a model of a community addressing economic questions.
    - Lots of work done already in PO. Ecotrust has been working in PO, also have other good baseline information.
    - Community members would likely want the same questions asked as have been talked about in the workshop: will catch levels go up or down, will revenue go down, will there be attrition in a fishery because of reserves?
    - If PO is adopted as a pilot site, there must be some level of funding. Minimum $25–50K/year to follow up on baseline of what's already there.

- John Sherman:
    - Lives on coast, frequently visits the beach (esp. from South Beach to Boiler Bay). Developed Devil's Punchbowl to Whale Cove proposal.
    - Asking group not to fret over perfect data – it will never be perfect. Do best you can with what you have.
    - In OPAC, there is a strong emphasis on commercial fisheries. But there are also people who have a strong interest in the marine environment and value it very much. Loves storm watching and walking along beach – how do you put a value on that? Hopes noncommercial values will be taken into consideration and the values/concerns/interests of those not fortunate enough to live on the coast.
    - Please try to reach out beyond commercial interests and coastal interests. Sooner or later the proposals will have to go to the legislature for funding, and will need support from broad constituent base.

Appendix D. Workshop Agenda
Ocean Policy Advisory Council Scientific and Technical Advisory Committee
Technical Workshop on Economic Data and Analysis of Marine Reserves
October 21–22, 2008
Library Seminar Room
Hatfield Marine Science Center, Newport, OR

Workshop Objective: To assess the status of economic data and analysis with regard to siting and management of marine reserves in Oregon waters and to reach a series of findings and conclusions regarding the availability and adequacy of data.

This is a technical workshop focused on economic data and analytical methods useful to inform decision makers. The workshop will explore tools for evaluating decision outcomes but will not include advocacy for particular policy outcomes.

Reporting Objective: To produce a report for STAC adoption and subsequent submission to OPAC. The report will identify economic questions relevant to the size, siting, and management of marine reserves; describe appropriate economic methodology; assess the existence and adequacy of economic data; and identify economic data gaps.

Workshop Format: Workshop will be open to the public, but discussions will be limited to invited participants. Public comment periods will be held at the end of each morning and afternoon session. Written submissions are also welcome.

Tuesday, October 21

9:00 – 9:10	Welcome: STAC Chair Jay Rasmussen
9:10 – 9:30	Workshop Chair Susan Hanna • Introductions • Review of workshop format and ground rules • Review and approval of agenda
9:30 – 10:00	Oregon OPAC Objectives for Marine Reserve Presentation: OPAC objectives (10 minutes)
	Discussion
10:00 – 11:00	What are the economic questions relevant to Oregon's marine reserve objectives?
	Discussion
11:00 – 11:15	Break
11:15 –12:15	What are the economic analytical methods relevant to marine reserves?

	Setup summary presentation: Types of economic analyses of marine reserves (10 minutes)
	Discussion
12.15 – 12:30	Public comment
12:30 – 1:30	Lunch provided
1:30 – 2:30	Presentations: models and software
	1:30 – 2:00 FEAM I-O Model Hans Radtke
	2:00 – 2:45 OCEAN Tools software Charles Steinback Sarah Kruse
2:45 – 3:30	What are the economic analytical methods relevant to marine reserves in Oregon?
	Discussion
3:30 – 3:45	Break
3:45 – 4:45	What data are needed to support economic analyses of Oregon marine reserves?
	Discussion • Market goods and services • Nonmarket goods and services
4:45 – 5:00	Public comment
5:00	Adjourn for the day: Dinner on your own

Wednesday, October 22

8:30 – 9:00	Discussion: review of Day 1 and modification of Day 2 agenda
9:00 – 10:30	Inventory of existing economic data
	Spatial economics data: Dave Colpo, PSMFC (15 minutes) State data: Dave Fox, ODFW (15 minutes)

	GIS data: Arlene Merems, ODFW (15 minutes)
	Discussion
10:30 – 10:45	Break
10:45 – 11:30	What are the data gaps for Oregon marine reserves?
	Discussion • Identification of data gaps • Cost of bridging the gaps
11:30 – 1:00	Workshop findings and recommendations
	Discussion
1:00 – 1:30	Public comment
1:30	Adjourn Lunch provided

Appendix E. Outline of Economic Data for Measuring Marine Reserve Impacts

1. Community Baseline Conditions
    - Degree of fishery dependence
        - History and tradition of fishing
        - Proportion of total economic activity represented by the fishing industry
        - Dependence on activities within reserve areas
    - Existing ocean users
        - Commercial fishing
            - number and sizes of vessels
            - gear types
            - value of landed catch
        - Charter fishing
            - number and sizes of vessels
            - numbers of anglers and fishing trips
            - value per fishing trip
        - Recreational non-charter fishing
            - numbers of anglers and fishing trips
            - value per fishing trip
        - Diving
            - numbers of divers and dive trips
            - value per dive trip
        - Surface recreation (kayaking, whale watching, etc.)
            - number of trips
            - value per trip
        - Shipping
            - traffic
            - gross tonnage
    - Existing shoreside economic activities
        - Seafood processors
        - Marine suppliers: gear, fuel, ice, bait, etc.
        - Dock support and maintenance
        - Tourism-related businesses
        - Marine-related festivals and events
    - Ocean access infrastructure
        - Jetties
        - Dredging
        - Maintenance

2. Trends in Existing Uses in Proposed Reserve Area
    - Fishery participation
        - Commercial fleet home-ported
            - vessel numbers by gear type
            - vessel size by gear type

        - employment
        - federal permits
        - state permits
    - Charter fleet home-ported
        - vessel numbers by gear type
        - vessel size by gear type
        - employment
    - Recreational non-charter
        - numbers
    - Seafood buyers and processors
        - number
        - size
    - Other fishery infrastructure
        - marine suppliers: gear, fuel, ice, bait, etc.
        - other marine–related businesses
- Fishery revenues
    - Ex-vessel commercial
    - Charter
    - Processing
- Fishery costs
    - fixed
    - variable
- Other revenues
    - Guided diving
    - Whalewatching, etc.
    - Tourism-related businesses
- Threshold effects
    - Interactions among businesses
    - Minimum scales for continued operation
    - Recent infrastructure developments or losses

3. Trends Outside the Reserve Area

- Other spatial set-asides (e.g., Rockfish Conservation Areas)
- Other fishery management actions
- Other fishing opportunities
- New ocean uses

4. Likely Displacement Effects

- Fishing effort
    - Commercial
    - Charter
    - Non-charter recreational

- Substitute areas
    - Spillover effects
- Avoidance costs
    - Travel time
    - Fuel
- Safety
    - Vessel suitability for new areas
- Landings change (volume, composition, and location)
    - Commercial
    - Charter
    - Non-charter recreational
- Revenue change
    - Commercial
    - Charter
    - Non-charter recreational
    - Processor
    - Ecotourism
- Marine Reserve Research
    - Monitoring costs
    - Evaluation costs

5. Nonmarket values
    - Nearshore recreational fisheries
    - Nearshore surfing
    - Nearshore diving
    - Marine reserves

6. Reserve-related Effects
    - Compliance incentives
    - Enforcement costs

7. New Data Collection