SCIENTIFIC AND STATISTICAL COMMITTEE (SSC) REVIEW OF MARINE RESERVE ISSUES

Situation: The SSC Marine Reserves Subcommittee has been developing a white paper to facilitate Council consideration of marine reserve initiatives in relation to West Coast fishery management. The paper, titled "Marine Reserves: Objectives, Rationales, Management Implications and Regulatory Requirements," evaluates the implications of marine reserves for contemporary fishery management on the West Coast, taking into consideration reserve objectives and uncertainties associated with both reserves and traditional fishery management. A final draft of this report is now complete. At this meeting, Ms. Cindy Thomson of the SSC will summarize the contents of the report and provide the SSC's recommendations to the Council.

Council Action:

1. Consider Adopting SSC Recommendations.

Reference Materials:

1. Exhibit H.1.a, Attachment 1: SSC white paper titled "Marine Reserves: Objectives, Rationales, Management Implications and Regulatory Requirements."

Agenda Order:

a. Agendum Overview — Dan Waldeck
b. SSC Report — Cindy Thomson
c. Reports and Comments of Advisory Bodies
d. Public Comment
e. **Council Action**: Consider Adopting SSC Recommendations

PFMC
02/23/04

DRAFT REPORT FOR REVIEW

MARINE RESERVES: OBJECTIVES, RATIONALES, MANAGEMENT IMPLICATIONS AND REGULATORY REQUIREMENTS

February 2004

Marine Reserves Subcommittee
Scientific and Statistical Committee
Pacific Fishery Management Council

TABLE OF CONTENTS

ES. Executive Summary

ES.A. Introduction

The objectives of this white paper are: (1) to describe the rationale underlying a number of commonly cited marine reserve objectives and provide an SSC perspective on the plausibility of various claims regarding the benefits of marine reserves; (2) to discuss the implications of reserves for fishery management, taking into consideration the objective of the reserve; and (3) to describe SSC expectations regarding the technical content of marine reserve proposals submitted for Council consideration.

ES.B. Reserve Objectives and Rationales

Marine reserves are advocated for a variety of reasons: (1) as an insurance policy against uncertainty and error in fishery management, (2) as a source of fishery benefits, (3) as a source of ecosystem benefits, (4) as a source of societal benefits, and (5) as an opportunity to advance scientific knowledge. Based on existing rationales and evidence regarding reserve effects, the SSC offers the following perspective regarding the potential utility of reserves for addressing the above objectives.

- *Reserves as insurance policy* - Reserves are uniquely qualified to provide a complete age structure for target species and thereby enhance persistence, i.e., the ability of fish stocks to withstand adverse effects associated with management uncertainty and error. In this sense, reserves have significant potential as a tool for mitigating uncertainty in stock assessments and managing unassessed stocks. As illustrated by the Council's adoption of area closures as part of its annual specifications for the groundfish fishery, closures can also be used to reduce the risk of overfishing. With regard to whether the biomass in the reserve should be included or excluded in the calculation of optimum yield (OY), the SSC notes that this is ultimately a policy decision, with exclusion of the reserve biomass from the OY being a more risk averse strategy than including it.

- *Reserves as source of fishery benefits* - The reserves literature typically characterizes fishery benefits in terms of increased yield outside the reserve. Theoretical models that are used to demonstrate increases in yield are highly sensitive to underlying assumptions regarding the behavior of fish stocks, the extent of exploitation prior to the reserve and the extent of effort redistribution after the reserve is established. While such models provide insights into how particular circumstances and processes might affect yield, the practical question of how well model assumptions apply to particular fish stocks remains largely unanswered. For purposes of management, detailed life stage modeling is less relevant than whether an empirical relationship can be

established between reserves and yield outside the reserve. Existing empirical studies focus largely on increases in fish abundance and size inside reserves; the SSC notes that such effects do not necessarily imply increased recruitment to the fishery. The evidence for increased yield is not compelling - particularly in well-regulated fisheries. The SSC cautions against raising such expectations in Council-managed fisheries.

- *Reserves as source of ecosystem benefits* - In evaluating the ecosystem effects of reserves, it is important to consider effects both inside and outside the reserve. Depending on the nature and extent of fishing prior to reserve establishment, cessation of fishing may yield significant ecosystem changes within the reserve area. Reserves are a plausible tool for providing ecosystem benefits, provided that any significant effects of effort displacement on the ecosystem outside the reserve are also effectively managed.

- *Reserves as source of societal benefits* - Reserves are sometimes advocated for their own sake, i.e., for the "good for society". This objective differs in a fundamental way from objectives related to reducing management uncertainty or providing ecosystem or fishery benefits. While the choice of criteria to measure achievement of the latter objectives is constrained by technical considerations, the selection of criteria to measure achievement of "societal benefits" is ultimately a policy decision. Given the fundamentally un-scientific nature of this objective, the SSC has little to say regarding its plausibility.

- *Reserves as opportunities to advance scientific knowledge* - Proposals for research reserves should be evaluated on the same basis as other types of research proposals. Technical requirements for such proposals would include a well-defined hypothesis, a rationale for why the research is worth pursuing, and a description of experimental design (including controls and replicates) and sampling and analytical methods. Examples of reserve proposals that meet such standards are too limited for the SSC to make any general statements about the plausibility of this objective.

While reserves are a plausible tool for achieving a number of management objectives (most notably, reducing management uncertainty and providing ecosystem benefits), plausibility in itself is not sufficient reason to justify reserve implementation. The decision to implement must be based on data and analyses that are specific to the particular context in which reserves are being considered.

ES.C. Analytical Framework for Marine Reserve Proposals

A major focus of this white paper is on technical issues and analytical requirements that are specific (though not necessarily unique) to marine reserves. SSC interest in this topic is prompted by the limited extent to which reserves have

been evaluated in the context of Federal regulatory requirements and the likelihood of the Council's continued engagement in this topic. SSC treatment of this topic is intended to be consistent with all existing Federal requirements.

The management objective addressed by the proposal should be described in specific terms and in the context of existing mandates. Background information should be provided that enhances understanding of the problem that the proposal is intended to address. The proposal should describe the problem to be addressed, why the problem is significant and why the *status quo* is inadequate to address the problem. If reserves are deemed a unique solution to the problem, the proposal should explain what makes reserves unique.

The proposal should include a description of the *status quo*, i.e., current and future conditions that can reasonably be expected to prevail if the proposal is not implemented. The time frame used to define the *status quo* (as well as alternatives to the *status quo*) should reflect the time period over which effects of the proposed regulatory change are expected to be realized. This is particularly important if benefits and costs are expected to change over time or to be realized over different time frames. Current (baseline) conditions may be a useful proxy for the *status quo*, but only if current conditions are expected to continue into the future.

Reserve proposals should include a reasonable range of alternatives to the *status quo* and describe the rationale underlying each alternative. If the problem identified in the proposal can be addressed only by reserves, the alternatives should take the form of different reserve configurations. If the problem can also be addressed by non-reserve management measures or by combining reserves with other measures, the alternatives considered should reflect the broader range of feasible solutions. The proposal should include a description of the operational requirements (i.e., the specific combination of regulations) associated with each alternative. In designing alternatives, it is important to consider not only regulatory measures that promote achievement of the management objective but also measures that may be needed to address unintended consequences (e.g., adverse effects of effort displacement outside the reserve). Defining operational requirements is a critical step in the analysis, as it is only by defining such requirements that the biological, social, economic, environmental and enforcement implications of an action can be made evident.

Alternatives should be compared in terms of how well they achieve the management objective. Biological, social, economic and ecosystem effects should be documented, as well as monitoring and enforcement requirements. To the extent possible, the analysis should be based on studies specific to the fish stocks, ecosystems, fishery participants and fishing communities that will be affected by the proposal. Assumptions underlying the analysis should be plausible in terms of reflecting the characteristics and behavior of affected entities. All alternatives

(including the *status quo*) should be evaluated on a common spatial scale. Specifically, alternatives to the status quo should be analyzed in terms of what would occur both inside and outside the reserve area if reserves were established; the *status quo* is what would occur in the same two areas if no reserves were established. Regulatory analysis - whether it involves marine reserves or other types of management measures - is constrained by limited knowledge and data. It is important that reserve proposals be explicit about sources of risk and uncertainty in the analysis.

Reserve proposals should include a description of the process by which the need for reserves was identified and management alternatives were developed and analyzed. The extent of public involvement in the process and the nature of public comment should be documented.

ES.D. Conclusions and Recommendations

In considering reserves as a management measure, it is important not to lose sight of the fact that the appropriate starting point for discussion is the management objective. Management effectiveness is not achieved by focusing *a priori* on any particular regulatory measure but by determining which measure (or combinations of measures) would be most effective in addressing the objective. To accomplish this, it is important that the range of feasible solutions not be unduly restricted from the outset.

In preparing an EIS, sponsors of reserve proposals should be aware of the substantive role of the EIS in terms of providing a meaningful synthesis of the information relevant to the issue at hand, conveying that information to the public and policy makers, and moving the process forward in a systematic and well-documented way. Several iterations of an EIS may need to be drafted and made available for public comment to ensure that a reasonable range of alternatives is identified and adequately evaluated. The public cannot be expected to provide constructive input and policy makers cannot be expected to make well-informed decisions unless they have access to a technically sound EIS. EIS's are expected to be informative and balanced. Any policy preferences expressed in an EIS must reflect a careful weighing of alternatives and a recognition of positive and negative effects as well as uncertainties associated with all alternatives (including the recommended one).

Regardless of the management objective, the choice of a preferred management alternative is ultimately a policy decision. While science (meaning both natural and social sciences) may inform some aspects of reserve design and facilitate systematic consideration of reserve effects, all relevant factors must ultimately be weighed in ways that are beyond the scope of science. In order to ensure that management is informed by the best available science, it is important to distinguish

between issues that can be addressed by science and those that cannot. In terms of what constitutes "science", the SSC notes the importance of distinguishing between replicable results derived from technically rigorous analysis and personal opinions expressed by individual scientists (which may differ widely and are not amenable to scientific validation). While scientists (like everyone else) are entitled to personal opinions, it is important that sponsors of marine reserve proposals not rely on such personal opinions to advocate for reserves as a "scientific" solution to management problems. Such advocacy is misleading in terms of what science is and how it can contribute to policy, and ultimately undermines the credibility of science itself.

The EIS for the Council's 2003 groundfish management specifications highlighted the role of OY's, spatial closures, season closures, vessel landings limits and gear restrictions in protecting overfished groundfish stocks. This was an important objective for the Council. However, by reducing the operational flexibility of fishing operations, such measures may also accentuate (however unintentionally) the incentive for vessel operators to seek additional avenues of investment that allow them to remain competitive in the race for the fish. The SSC takes note of this latter effect not to discourage use of such measures (which are integral to addressing many of the Council's needs) but to point out that there is no panacea for fishery management problems. Reserves - like other types of management measures - are well suited for some purposes but not others, and can aggravate as well as address problems. The SSC encourages caution in making broad generalizations about reserve effects.

The SSC requests that the Council consider developing procedures for dealing with reserve proposals submitted to the Council by outside entities and clarifying the relative responsibilities of the Council and the proposal sponsor in terms of developing management alternatives and preparing the regulatory analysis. The SSC also requests that the Council consider assuming a broad, proactive role in reserve discussions, including working with other appropriate entities to develop a coordinated approach to marine reserves on the West coast. Such coordination would facilitate communication, avoid duplication of effort and increase the likelihood of a productive outcome for all parties. Proactive Council involvement in marine reserve planning processes would help ensure that such planning is grounded in the best available science and realistically reflects the complexities of management.

Given the Council's increasing reliance on area closures as a management tool and the interest in reserves being conveyed to the Council by other entities, the SSC sees a growing need for spatially explicit data and models. The SSC also notes that data collection is costly and model development is not guaranteed to improve the science needed for management. Increased spatial resolution will require more complex models and thus estimation of many more parameters. Model selection techniques will need to be applied to determine how differences in spatial resolution affect model performance and what approaches to data pooling might be

appropriate.

A potentially important issue for the Council in evaluating reserve proposals is whether fishery-independent surveys would be allowed in reserve areas and (if allowed) whether any constraints would be imposed on the conduct of such surveys. To the extent that reserves significantly interfere with the customary spatial coverage of surveys, the Council may be faced with loss of age structure information that is critical to estimating year class strengths in stock assessment models. Increased dependence on alternative non-lethal data collection methods - e.g., remotely operated vehicles, submersibles - may need to be considered in reserve areas to address management needs. In addition to issues regarding loss of data important for stock assessment, the use of such methods also raises issues of cost and calibration. Consideration will also need to be given to whether possible changes in fish dynamics associated with reserve establishment may require changes in stock assessment models.

I. Background

The Pacific Fishery Management Council has a long history of using area closures as a management tool. For instance, the Northern Anchovy Fishery Management Plan (FMP), as implemented by the Council in 1978, prohibited reduction fishing in nearshore waters to protect pre-recruits and reduce the possibility of social conflict between the live bait and reduction sectors of the fishery. The Groundfish FMP, as implemented in 1982, included area closures for foreign and joint venture operations. The Salmon FMP, implemented in 1984, closed designated areas around river mouths to fishing, and also specified the use of flexible time/area closures as a tool for setting annual specifications for the fishery. The Highly Migratory Species FMP, adopted in 2002, closed designated areas to pelagic longline and drift gillnet to reduce turtle bycatch.

Since adoption of these FMPs, the Council has periodically used area closures to address new management needs. The most notable examples in recent years have occurred in the groundfish fishery. In 2001, the Council closed designated areas south of Point Conception to groundfish fishing to prevent bycatch of overfished cowcod. During September-December 2002, the Council implemented depth-based closures on the continental shelf to prevent bycatch of darkblotched rockfish, and subsequently expanded those closures in 2003 to protect overfished bocaccio and canary rockfish as well as darkblotched rockfish.

In response to a court order, the Council is in the process of preparing a Programmatic Environmental Impact Statement (PEIS) for the groundfish fishery to address essential fish habitat (EFH) requirements of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA, Section 303(a)(7)). The PEIS includes consideration of area closures as a management tool. Unlike the rationales previously used by the Council to justify such closures, the EFH mandate requires a more systematic consideration of habitat requirements than previously undertaken by the Council and a change in focus from protecting habitat to benefit fish stocks and fisheries to protecting habitat from potentially adverse effects of fishing operations.

In recent years there has been growing attention to the use of area closures as a means of protecting and managing not only target species but marine resources in general. While closures initiated by the Council have been intended to improve management of particular fisheries, proposals are being made to close areas of the ocean to most, if not all, fishing activity. While the time frame for closures customarily used by the Council ranges from short-term (e.g., annual specifications for the salmon and groundfish fisheries) to long-term (e.g., closures of anchovy habitat), the new proposals focus more exclusively on permanent closures (i.e.,

reserves). It is these types of closures which are the focus of this document.[1]

Expanding interest in marine reserves is evident at both Federal and State levels. For instance, Executive Order 13158 (Marine Protected Areas) mandates that, "To the extent permitted by law and subject to the availability of appropriations, the Department of Commerce and the Department of the Interior ... shall develop a national system of MPAs" (EO 13158, Section 4). The five National Marine Sanctuaries on the West coast (four in California, one in Washington) are in varying stages of revising their own management plans, with marine reserves being one area of consideration. One of these sanctuaries (Channel Islands) has already implemented reserves in the State portion of Sanctuary waters and is in the process of extending these reserves into the Federal portion. California's Marine Life Protection Act (MLPA) requires the California Department of Fish and Game to develop a Master Plan that includes "recommended alternative networks of MPAs" (California Fish and Game Code, Section 2856) in State waters.[2] Oregon's Ocean Policy Advisory Council has recommended that "Oregon test and evaluate the effectiveness of marine reserves in meeting marine resource conservation objectives through a system of marine reserves ..." (Oregon Ocean Policy Advisory Council, 2002, p. 1).

II. Introduction

Marine reserves are advocated for a variety of reasons: (1) as an insurance policy against uncertainty and errors in fishery management, (2) as a source of fishery benefits, (3) as a source of ecosystem benefits, (4) as a source of societal benefits, and (5) as an opportunity to advance scientific knowledge. The scientific literature pertaining to marine reserves has proliferated in recent years. Much of the discussion in the literature has focused on the development of theoretical models and guiding principles. In addition, some (albeit limited) empirical research has been conducted on the effects of West coast reserves (e.g., Martell *et al.* 2000, Paddack and Estes 2000, Palsson and Pacunski 1995, Schroeter *et al.* 2001, Tuya *et al.* 2000). The literature provides useful insights into conditions and processes that are conducive to achieving reserve benefits, as well as suggestions for how to improve existing research in this area. However, if reserves are to achieve their true potential, real world management implications must also play a pivotal role in these discussions. The Council, given its management responsibilities, does not have the luxury of ignoring such considerations.

---

[1] The Council defines a "marine reserve" as "an area where some or all fishing is prohibited" (see http://www.pcouncil.org/reserves/reservesback.html). This document is similarly intended to apply to both limited-take and no-take areas.

[2] Implementation of the MLPA has been indefinitely delayed due to State budget constraints.

Marine reserves are generally not discussed in the literature in a currency that is useful for management. This lack of a common currency is partially reflected in the different perspectives taken by fishery biologists (who focus on fish stocks at the population level), ecologists (whose interests are less species-specific and more focused on the relationship between organisms and their environment) and social scientists (who focus on human behavior within particular cultural, economic and institutional contexts). While much can be learned from each perspective, the differences among the disciplines make it difficult to integrate the knowledge that each provides. This difference is exacerbated by differences in perspective between the worlds of academia and policy making - the former focused on the use of specialized expertise to develop and explore innovative ideas, the latter focused on considering each management problem in its real world context and in all its dimensions. While good science is essential for good management, managers must be selective in focusing on scientific results that are not only technically sound but also applicable to the issue at hand. Management requires that concepts and objectives be translated into operational requirements. It is in the course of defining such requirements that the biological, socioeconomic, environmental and enforcement implications of an action become apparent.

Council-managed fisheries are heavily regulated. As indicated by the Council's recent experience with groundfish closures, incorporating such closures into the existing mix of complex regulations requires careful forethought and consideration of a number of important questions. What contributions can spatial closures make to management that cannot be achieved (or achieved as well) by other types of management tools? What types of management measures must be implemented in conjunction with closures to ensure that management objectives are met and/or to mitigate potential adverse effects of effort displacement?

The objectives of this white paper are as follows:

- to describe the rationale underlying various marine reserve objectives and provide an SSC perspective on the plausibility of various claims regarding the benefits of marine reserves;

- to discuss the implications of reserves for fishery management, taking into consideration the objective of the reserve; and

- to describe SSC expectations regarding the technical content of marine reserve proposals submitted for Council consideration.

Section III further elaborates on the five reserve objectives previously mentioned in this paper. Section IV provides guidance on the preparation of regulatory analyses of reserve alternatives as they relate to each objective. Section V summarizes SSC recommendations to the Council, and Section VI identifies research

and data needs. Appendix A discusses implications for the Council if fishery-independent surveys are restricted inside reserves.

This white paper should be considered a living document which may be modified over time as additional issues become apparent to the SSC in the course of reviewing marine reserve proposals, or as significant new research becomes available on marine reserves.

III. Reserve Objectives and Rationales

The following five objectives are commonly included among the reasons to implement marine reserves: (1) to provide insurance against management uncertainty and error, (2) to provide fishery benefits, (3) to provide ecosystem benefits, (4) to provide societal benefits, (5) to provide opportunities to advance scientific knowledge. Each objective is discussed here in terms of its underlying rationale and general plausibility. Guidance is provided for reserve proposals in terms of the need for specificity in defining objectives, careful interpretation of the literature and appropriate conceptualization of reserve issues.

Evaluating the plausibility of particular reserve rationales requires careful consideration of what the reserves literature does and does not demonstrate with regard to reserve effects. The SSC offers the following caveats in interpreting that literature:

- Existing reserves (at least in the U.S.) have not been sited on the basis of statistical design considerations.[3] As a result, empirical studies of the effects of such reserves have been conducted primarily and by necessity under less than ideal conditions - e.g., lack of replicate reserves, non-random placement of reserves, lack of baseline information prior to reserve establishment. Lack of replicates makes it difficult to isolate reserve effects from other influences. Non-random placement of reserves makes it difficult to extrapolate results to other settings and complicates the placement and interpretation of control areas. Lack of baseline information limits the empirical analysis to comparisons of reserve and control areas after reserve establishment. In many of these empirical studies, technical difficulties are carefully discussed and appropriate caveats are placed on study results. Reserve proposals that rely on results of empirical studies to justify claims of potential benefits must be similarly cognizant of the limitations as well as strengths of such studies and scale their claims accordingly.

- An issue that merits further discussion in the literature is the possibility that

---

[3] See Section III.E. for further discussion of these considerations.

the reserve itself - due to the effects of effort displacement on fishery resources and habitat in the open area - contributes to the differences observed between reserve and open areas. In other words, the very establishment of the reserve modifies the context within which its effects are evaluated. While it is theoretically possible to control for this effect by including replicates that reflect varying degrees of effort displacement from the reserve, it is generally impractical to do this. Differences between reserve and open areas detected in empirical studies should not be interpreted as improvements that reserves would provide over the *status quo*. The open area does not represent the *status quo* but rather the *status quo* modified by effort displacement and other changes precipitated by the reserve. The effects of the reserve are more aptly reflected in what occurs both inside and outside the reserve after reserve establishment; the *status quo* is what would have occurred in the same two areas if no reserve had been established.

III.A. Reserves as "Insurance Policy"

Reserves are sometimes advocated as an "insurance policy", that is, as a means of protecting some fraction of a fish stock against errors and uncertainty in management. The SSC notes that uncertainty in fishery management arises from two general sources: getting the science wrong and getting the management wrong. Potential sources of scientific error include (1) biological process error (variability in demographic parameters), (2) observation error (survey, laboratory and database error), (3) model choice error (e.g., Ricker versus Beverton-Holt), and (4) error structure error (e.g., gamma vs. lognormal). Potential sources of management error include (5) judgment error (e.g., not paying adequate attention to the science) and (6) implementation error (e.g., implementing regulations that result in catches over or under the intended target). This characterization of management uncertainty pertains to stocks which are assessed. Many stocks are not assessed. For unassessed stocks, uncertainty is more fundamental, since the uncertainty itself is unknown without an assessment.

Reserve proposals intended to achieve an insurance objective should be specific regarding what the insurance is intended to achieve. For instance:

- If the objective is to reduce the risk of overfishing, the SSC notes that the concept of overfishing has a particular technical meaning in the context of Council-managed fisheries. Reserve proposals that are intended to "protect against overfishing" must similarly include a clear definition of what the proposal defines as overfishing and how reserves can protect against it. A certain amount of risk aversion is currently reflected in Council harvest policy

and regulations.[4] It is important that reserve proposals explicitly contrast their suggestions with existing policy and regulations in terms of reducing overfishing risks.

- If the objective is to insure for persistence, reserves - because of their potential to change the age structure of target species in ways that cannot be accomplished with other fishery management tools - may be uniquely qualified to achieve this. Persistence implies that it is better to have a complete age structure in one area (i.e., the reserve) than an exploited age structure everywhere. With a full age structure, target species are more likely to weather environmental and human-induced adversity. In this sense, reserves may be suited as a tool for mitigating the uncertainty in stock assessments and managing unassessed stocks - irrespective of any judgment regarding whether they are over- or under-exploited but simply to ensure persistence.

The potential for reserves to serve as insurance for persistence varies among species. For sessile species with small dispersal distances (e.g., abalone), a network of reserves can be quite effective. For groundfishes, information regarding distribution and movement is limited, with available information indicating significant behavioral differences among species. Given these differences, it is unlikely that any single reserve can be tailored to achieve a complete age structure for more than a handful of groundfish species. It would be helpful if reserve proposals identified (to the extent possible) the species or species complexes likely to be affected by the reserve.

An important issue to consider is how fisheries outside the reserve would need to be managed in order to be consistent with the insurance objective. Specifically, should optimal yield (OY) be based on total biomass or just the portion of the biomass outside the reserve? If the intent of the reserve is strictly preservation, then it may make more sense to take the biomass in the reserve "off the table". If the intent is to manage for sustainable fisheries, then it may be more appropriate to include the fish in the reserve as part of the managed stock. Selecting one approach over the other has a number of implications:

- The SSC notes that basing OY on the portion of the biomass outside the reserve is easier said than done. For instance, distinguishing the biomass in the reserve

---

[4] Precautionary measures employed in the groundfish fishery include the 40-10 harvest rate policy for assessed stocks. For stocks for which data are not adequate to conduct assessments, the Council sets levels of allowable biological catch - i.e., 75% of average annual historical landings for rudimentarily assessed stocks and 50% for unassessed stocks - that are consistent with NMFS guidelines for data-poor situations (Restrepo *et al.* 1998).

by subtracting it from the total biomass does not necessarily mean that the subtracted fish are removed from the assessment, since q and selectivity can compensate for the subtracted biomass.

- The decision whether to include or exclude biomass inside the reserve in the calculation of OY is a policy decision. Excluding the biomass in the reserve from the OY is a more risk averse strategy than including it.

- Whether the two approaches (i.e., including versus excluding the biomass in the reserve in the calculation of OY) produce significantly different outcomes will depend on the portion of the biomass set aside in the reserve and how the difference in biomass between the two areas changes over time.

III.B. Reserves as Source of Fishery Benefits

The reserve literature includes a number of theoretical models that demonstrate benefits to fisheries associated with the export of adults and eggs/larvae from reserve areas. Fishery benefits are typically defined in such models as an increase in yield. Underlying these models are critical assumptions regarding species mobility, the extent of density dependence at different life-history stages, the amount of exploitation prior to creation of the reserve, and the extent of effort redistribution after the reserve is established.

The basic scenario is as follows: Fishery exploitation causes reductions in numbers, ages and sizes of target species. Conversely, increases in numbers, ages and sizes can be expected to occur when target species are protected in reserves. These structural changes in fish populations within the reserve cause yield to increase outside the reserve, via several possible mechanisms.

Adult export hypothesis - According to this hypothesis, increases in the biomass/density of fish within the reserve result in net emigration of adult fish from the reserve to the open area. This adult "spillover" is precipitated by density-dependent processes, i.e., fish leave the reserve as density and thus competition for resources increases within the reserve.

The degree to which fish move has a significant bearing on the extent of adult spillover from the reserve. If mobility is low relative to reserve size, substantial biomass may accumulate in the reserve but export will be low because fish will not migrate to the open area in appreciable numbers. Conversely, if mobility is high relative to reserve size, fish will not remain in the reserve long enough to avoid the impact of fishing. Mobility must therefore be in an "intermediate" range in order to achieve both the accumulation of biomass within the reserve and the level of spillover that may lead to enhanced yields.

Egg/larval export hypothesis - The change in age structure that occurs in the absence of fishing causes total egg production per recruit to increase in the reserve; this increase is largely due to the higher fecundity of older females. Older females may also tend to produce eggs that experience higher survival rates. In addition, the total number of fish in the reserve can be expected to increase due to the removal of all sources of fishing mortality, irrespective of any changes that may occur in the age structure. In concert, these two effects act to boost total egg production within the reserve. Dispersal of larvae from the reserve to the open area may then increase yield to the fishery, particularly if it is presently overexploited.

Due to density dependent processes (e.g., competition for resources), the per capita surplus production of fish populations tends to increase as biomass/density decreases. Thus total surplus production (i.e., the product of per capita production and population size) tends to be highest at intermediate levels of biomass and/or density. Consequently, adverse effects from density dependent interactions are expected to occur at the reserve level as fishing mortality decreases. The SSC notes that the manner in which density dependence manifests itself has a significant bearing on the egg/larval export argument for marine reserves. If density dependence occurs pre-dispersal, the per capita production of adult fishes in reserves will decrease as density increases, thus countering the potential increase in egg production per recruit associated with the presence of older females in the reserve. If density dependence occurs post-dispersal, the extent to which egg/larval production results in increased recruitment to the fishery will depend on factors such as dispersal distances, metapopulation structure and source-sink dynamics.

The SSC notes that conclusions drawn from theoretical models of adult or egg/larval export regarding the effect of reserves on fishery yield are highly sensitive to the assumptions underlying the model. The validity of model assumptions to particular fish stocks is generally known only in a qualitative sense. For purposes of management, detailed life stage modeling is less relevant than whether an empirical relationship can be established between reserves and yield outside the reserve. Moreover, the body of empirical studies on West coast reserves is limited and not definitive in terms of yield effects. Most empirical studies do not focus directly on fishery yield but rather on whether increases in fish abundance and size occur inside reserves. The SSC notes that increases in yield cannot be inferred solely on the basis of such changes.

Advocacy of reserves as a means of increasing fishery yield is typically based on comparisons of reserves with a vaguely defined *status quo* - typically a general statement regarding the failure of management or disparate examples intended to illustrate such failure. The SSC notes that the *status quo* in reserve proposals must

pertain to the specific fishery for which reserves are being considered, as the details of that fishery matter a great deal to the conclusions that can be drawn. For instance, if the *status quo* is an overexploited fishery, reserves may enhance fisheries yield. However, if the *status quo* is a fishery that is being managed for maximum sustainable yield (MSY), it is not clear that reserves can enhance yield, given existing theoretical studies that demonstrate a direct equivalence between the yield obtained through area-based and quota-based management schemes.

Fishery benefits are typically characterized in reserve models in terms of increased yield outside the reserve. Even in cases where potential yield increases outside the reserve, there is no guarantee that fishery benefits will increase. For fishery participants and fishing communities, economic and social effects (e.g., changes in producer and consumer surplus, income and employment impacts, community stability) often matter more than yield. Whether or not changes in yield imply such benefits depends on what happens outside the reserve with regard to displaced effort, harvesting costs, pressure on fishery resources, potential for social conflict and fishery regulation. Factors such as these will need to be considered in assertions of fishery benefits.

III.C. Reserves as Source of Ecosystem Benefits

Ecosystems can be characterized in a variety of ways. Reserve proposals based on claims of ecosystem benefits must be clear in what is meant by this objective. It is important that the objective not be expressed as a vague claim (e.g., "the objective of the reserve is to provide a fully functioning ecosystem"). Rather the objective should be expressed in terms that make apparent the relationship between the objective and measurable indicators that convey progress toward meeting the objective.

The literature on ecosystem benefits of reserves provides a number of theories and guiding principles regarding what happens to ecosystems in the absence of fishing and differences in ecosystem effects associated with larger versus smaller reserves. A number of empirical studies have also been conducted (largely outside the U.S.) that evaluate the nature and extent of ecosystem effects associated with reserves. Depending on the study, the comparison is typically based on one or more indicators (e.g., density, numbers, biomass, size, diversity of organisms) classified in some particular way (e.g., trophic level, family, genus, species, rare or keystone species, target versus non-target species, all species); habitat characteristics are occasionally also included in the comparison.

A number of reviews and meta-analyses have been conducted of ecosystem reserve studies conducted around the world (e.g., Cote *et al.* 2001, Halpern 2003, Mosquiera *et al.* 2000). Given the many ways in which ecosystem changes can be characterized, meta-analysis is necessarily constrained by the limited number of

studies which provide common indicators that can be used as a basis for comparison. Comparison is further hampered by lack of documentation in some studies of additional factors that may also account for some of the observed ecosystem changes (e.g., extent of exploitation and habitat condition prior to reserve establishment, effectiveness of enforcement of reserve boundaries). One consistent result noted in many studies is that overall abundance/density of organisms tends to increase inside reserves. When analyses focus on effects at the individual species level, results tend to be mixed - with a tendency for some species (e.g., larger fish, predators) to increase in abundance/size and for other species (e.g., smaller fish, prey) to do the opposite. The SSC notes that reserves that are intended to provide ecosystem benefits will not necessarily foster outcomes that are consistent with objectives of single species management. Trade-offs like this are inevitable, given the complexity of species interactions in the ecosystem. Similar trade-offs also occur at the single species level, e.g., when regulations that benefit one species adversely affect other species.

Ecosystem effects of reserves are typically characterized in the literature by contrasting what happens inside and outside the reserve area. Depending on the nature and extent of fishing prior to establishment of the reserve, cessation of fishing may bring about significant ecosystem changes within the reserve area. However, it is important to note that the ecosystem includes the area inside and outside the reserve; it does not end at the boundary of the reserve. Thus, reserve proposals intended to provide ecosystem benefits must focus not only on potential effects within the reserve but also potentially adverse effects of displaced effort on the ecosystem outside the reserve. Reserve size must be tempered by the trade-off between ecosystem effects inside and outside the reserve. Effort displacement - which is typically viewed as implying economic and social effects - also has direct implications for whether reserves can achieve ecosystem objectives; ecosystem effects cannot be determined independently of displacement effects.

III.D. Reserves as Source of Societal Benefits

The objective of a reserve may be to simply close areas to fishing as a matter of public policy, that is, for the "good of society". Reserves established on this basis may reflect motivations that run the gamut from "zoning" the ocean into varying types of use and non-use areas to eliminating fishing altogether. If closure *per se* is itself the objective of the reserve, this motivation should be stated as such and not be confounded with other objectives.

The specific rationale underlying this objective is important for determining "optimal" reserve size. For instance, if "zoning" is the motivation, the size of the reserve will depend on the "value" placed on fishing- versus no-fishing zones. However, if elimination of fishing is the motivation (essentially assigning zero societal value to fishing), then the larger the reserve, the better. Any number of

criteria can be used to define societal benefits. The choice of criterion is a matter of policy rather than scientific judgment. Decisions regarding reserve design and size reflect - implicitly if not explicitly - which criteria matter and whose interests count in terms of defining societal value. A logical implication of establishing reserves on this basis is that monitoring is not needed to measure progress toward meeting the objective, as the objective is met simply by the act of reserve creation.

III.E. Reserves as Opportunity to Advance Scientific Knowledge

In cases where the objective of the reserve is to advance scientific knowledge, then the reserve proposal will need to meet the expectations of a scientific research proposal. Hurlbert (1984) identifies the basic design features of ecological experiments as controls, replication, randomization and interspersion. These features, as they relate to evaluating the effects of marine reserves, are as follows:

Controls - Reserve effects cannot be evaluated by simply comparing changes that occur in a given area before and after a reserve is established in the area, or by comparing conditions in reserve and open areas after reserve establishment. Given the inherent temporal and spatial variability of ecosystems, it is important that controls be established that allow reserve effects to be distinguished from other types of influences. For instance, in order to account for the possibility that temporal changes observed in reserve areas may not be due to a reserve effect but rather to environmental and other influences that may be affecting areas outside as well as inside reserves, it is important that open areas be included as controls in the experiment. In order to account for the possibility that differences observed between reserve and control areas may not be due to the reserve but to location-specific differences that pre-date establishment of the reserve, it is important that reserve and control areas be compared prior to as well as after reserve establishment.

Replication - Multiple units (replicates) of both reserve and control areas must be included in the experiment. Replication is essential to control for the stochasticity inherent in the environment, that is, to ensure that reserve effects can be distinguished from the inevitable noise in the data due to environmental variability. Replication of this type is not achieved by taking subsamples in a single reserve and a single control area and comparing statistics generated from the subsamples for the two areas. While analysis of this type may provide a basis for comparing the two areas sampled, it does not provide an adequate basis for evaluating reserve effects.

Randomization - Replicates of reserve and control areas need to be randomly sited to ensure that results of the experiment are not subject to experimenter bias.

Interspersion - In situations where replication takes the form of spatial clustering of reserve and/or control areas, it is not possible to determine whether differences between reserves and controls are due to a reserve effect or to unknown location-specific factors associated with clustering of replicates. This situation may even arise when replicates are randomly sited. Thus Hurlbert (1984) recommends "restrictive randomization" to ensure spatial interspersion of replicate reserve and control areas.

It is important that reserve proposals be based on principles of sound experimental design. Replication is a critical feature of such design. The SSC notes that randomness and spatial interspersion in the placement of replicates may be complicated by difficulties associated with displacing current uses in candidate areas. Thus some flexibility may be needed with regard to placement of replicates, although it will be important that such flexibility not compromise the integrity of the experiment.

Just as scientific research proposals gain credibility by demonstrating specific knowledge of the nuances of the research, reserve proposals should also demonstrate an awareness of the complexities involved in conducting the proposed ecological experiment. For instance, it will not be enough to claim that reserves can provide more precise estimates of natural mortality simply because the confounding effect of fishing mortality has been removed from the reserve. The proposal will need to demonstrate an appreciation of the technical issues involved, e.g., how to account for emigration from the reserve (which may create an impression of mortality within the reserve) in the derivation of natural mortality estimates.

This is not to say that experimentation is not worthwhile. Carefully designed reserve experiments may provide valuable scientific information that could not be otherwise obtained. However, such experiments will likely require significant investment in time and money. Given the resource requirements and the effort displacement and regulatory adjustments that may need to occur to accommodate such experiments, it will be important that the design of the experiment provide reasonable assurance that it will yield conclusive results.

Reserve proposals intended to achieve scientific objectives will need to include a well-defined hypothesis, a rationale for why the hypothesis is worth exploring and a statistically valid experimental design (including a power analysis). The proposal should also include information on the timeline for completion of the experiment, the methods of data collection and analysis that will be used, and the budget (including any assurances that can be provided regarding the adequacy of funding for the duration of the experiment). In cases where some flexibility exists regarding the number/size/location of reserves to be used in the experiment, it would be helpful if the proposal included a comparison of experimental design alternatives in terms of the nature and conclusiveness of results that can be expected from each alternative,

as well as any other notable differences (e.g., budget) that may exist among alternatives. The SSC also notes that, while pressures may arise to initiate experiments by taking immediate action to establish reserves, a well-designed experiment may require that sampling be conducted for a number of years prior to reserve establishment.

III.F. SSC Perspective on Plausibility of Reserve Objectives

Reserves - like other types of management measures - must be considered in the context of the specific objective that they are intended to achieve. Based on existing rationales and evidence regarding reserve effects, the SSC offers the following recommendations regarding the plausibility of reserves as a tool for achieving the objectives discussed in Sections III.A. to III.E. SSC recommendations should not be construed to imply any judgment about the relative importance of the objectives themselves. Moreover, the plausibility of reserves relative to a particular objective is not intended to imply that the objective can necessarily be achieved by reserves alone (i.e., without other accompanying regulations) or that reserves are always essential to achieving the objective. Plausibility is intended to convey the extent to which reserves merit serious consideration as one method of achieving an objective.

- *Reserves as insurance policy* - Reserves are uniquely qualified to provide a complete age structure for target species and thereby enhance persistence, i.e., the ability of fish stocks to withstand adverse effects associated with management uncertainty and error. In this sense, reserves have significant potential as a tool for mitigating uncertainty in stock assessments and managing unassessed stocks. Other rationales may also exist for reserves. For instance, the Council's annual specifications for the groundfish fishery include reserves as a way to reduce the risk of overfishing. With regard to whether the biomass in the reserve should be included or excluded in the calculation of OY, the SSC notes that this is ultimately a policy decision. Excluding the biomass in the reserve from the OY is a more risk averse strategy than including it.

- *Reserves as source of fishery benefits* - The reserves literature typically characterizes fishery benefits in terms of increased yield outside the reserve. Theoretical models that are used to demonstrate increases in yield are highly sensitive to underlying assumptions regarding the behavior of fish stocks, the extent of exploitation prior to the reserve and the extent of effort redistribution after the reserve is established. While such models provide insights into how particular circumstances and processes might affect yield, the practical question of how well model assumptions apply to particular fish stocks remains largely unanswered. For purposes of management, detailed life stage modeling is less relevant than whether an empirical relationship can be established between reserves and yield outside the reserve. Existing empirical

studies focus largely on increases in fish abundance and size inside reserves; the SSC notes that such effects do not necessarily imply increased recruitment to the fishery. The evidence for increased yield is not compelling - particularly in well-regulated fisheries. The SSC cautions against raising such expectations in Council-managed fisheries.

- *Reserves as source of ecosystem benefits* - In evaluating the ecosystem effects of reserves, it is important to consider effects both inside and outside the reserve. Depending on the nature and extent of fishing prior to reserve establishment, cessation of fishing may yield significant ecosystem changes within the reserve area. Reserves are a plausible tool for providing ecosystem benefits, provided that significant effects of effort displacement on the ecosystem outside the reserve are also effectively managed.

- *Reserves as source of societal benefits* - Reserves are sometimes advocated for their own sake, i.e., for the "good for society". This objective differs in a fundamental way from objectives related to reducing management uncertainty or providing ecosystem or fishery benefits. While the choice of criteria to measure achievement of the latter objectives is constrained by technical considerations, the choice of criteria to measure achievement of societal benefits" is ultimately a policy decision. Thus the SSC has little to say regarding the plausibility of this objective.

- *Reserves as opportunities to advance scientific knowledge* - Proposals for research reserves should be evaluated on the same basis as other types of research proposals. It is not enough to argue that reserves provide generalized research opportunities. Proposals should include a well-defined hypothesis, as well as information regarding rationale, experimental design, budget, sampling and analytical methods, timeline and budget. Examples of reserve proposals that meet such standards are too limited for the SSC to make any general statements about the plausibility of this objective.

While reserves merit consideration as a potential tool for achieving a number of management objectives (most notably, reducing management uncertainty and providing ecosystem benefits), plausibility in itself is not sufficient reason to justify reserve implementation. The decision to implement must be based on data and analyses that are specific to the particular context in which reserves are being considered. Section IV provides a discussion of how such an analysis should be carried out.

IV. Analytical Framework for Marine Reserve Proposals

SSC expectations of all regulatory analyses are guided by Federal requirements as specified in the National Environmental Policy Act (NEPA), the Regulatory

Flexibility Act (RFA), Executive Order (EO) 12866 and other applicable law. This paper is not intended to serve as comprehensive guidance to such regulatory requirements. Such guidance exists elsewhere (e.g., CEQ 1993, CEQ 1997, NMFS 2000, NMFS 1997, NOAA 1999, NOAA 1998, SBA 2003). Nor is the intent to provide a "cookbook" approach to evaluating reserve alternatives, as reserve proposals can vary widely in terms of their objectives and the particular context in which they are considered. The intent is rather to make recommendations regarding how to address technical issues and analytical requirements that are specific (though not necessarily unique) to marine reserves. Addressing these requirements involves consideration of a number of factors - e.g., the appropriateness of the data used in the analysis, the statistical validity of the methods used to collect the data, the soundness of analytical methods, the extent to which the conclusions are supported by the analysis.

The guidance provided here pertains to topics that are customarily included in regulatory analysis: defining the objective, describing the management context and affected environment, identifying the problem, and defining and analyzing management alternatives. For illustrative purposes, discussion of each topic is accompanied with examples of how that topic was addressed in the Environmental Impact Statement (EIS) prepared by the Council for the 2003 groundfish specifications (PFMC 2003). The reason for using this particular EIS as an example is that area closures were an integral component of the management alternatives considered in the EIS. Moreover, as a recently completed analysis, the EIS reflects current Federal regulatory requirements under NEPA, RFA and EO 12866.

The Council's EIS may also differ in significant respects from an EIS that might be prepared for marine reserve proposals:

- The management objective addressed in the Council's EIS is to reduce the risk of overfishing. As indicated in Section III, other types of objectives are also possible.

- The area closures considered in the EIS are unprecedented in the Council's experience in terms of their size and the range of affected fishing operations. Reserve proposals will likely differ in scope and size.

- The Council's EIS pertains to setting annual specifications for the groundfish fishery. These specifications are subject to reconsideration according to the Council's biennial management cycle. Proposals involving reserves (i.e., permanent closures) will require a much lengthier temporal analysis than the EIS.

- The management objective addressed in the Council's EIS is to ensure that optimum yields (OY's) for individual species - expressed as specific numeric

values - are not exceeded. Marine reserve proposals may not be based on such strictly quantitative objectives.

Thus, the Council's EIS should not be viewed as a strict template for marine reserve EIS's but rather as suggestive of the types of issues that may arise in considering reserves and the types of data and analytical approaches that may be useful for considering the impacts of reserves.

IV.A. Specifying the Management Objective

The management objective addressed by the proposal should be described in specific terms and in the context of existing mandates. Some of the mandates that the Council is responsible for addressing (e.g., MSFCMA) may differ from mandates for reserve proposals initiated by outside entities (e.g., National Marine Sanctuaries Act).

Council Example - Jan 2003 EIS: The management objective addressed in the EIS was "to ensure that Pacific Coast groundfish subject to federal management are harvested at OY during 2003 and in a manner consistent with the ... Groundfish FMP and National Standards Guidelines [of the MSFCMA](50 CFR 600 Subpart D)" (PFMC 2003, p. 1-1).

IV.B. Describing the Management Context and Affected Environment

Background information should be provided that enhances understanding of the problem that the proposal is intended to address. Relevant areas of discussion include (1) the current management situation, (2) events leading up to the current situation, (3) ongoing or anticipated management issues or measures that may not be directly related to the proposal but may have a bearing on the larger context within which the proposal is considered, and (4) the environment (e.g., ecosystem, fish stocks, fishery participants, fishing communities) expected to be affected by the proposal.

Council Example - Jan 2003 EIS: The EIS placed the 2003 groundfish specifications in their historical context. Extensive information on the history and current status of groundfish stocks and management was provided. The EIS described the criteria used by the Council to determine whether assessed stocks are overfished, in precautionary status, or healthy (PFMC 2003, p. 3-6); current harvest rate policies (PFMC 2003, Figure 3.2-1 for assessed stocks and Section 3.5.1 for unassessed stocks); life history, status and management history of individual groundfish stocks (PFMC 2003, Section 3.2.1); and rebuilding parameters for currently overfished stocks (PFMC 2003, Tables 3.2-2 and 3.2-3).

The OY's for overfished stocks associated with each management alternative were based largely on results of rebuilding analyses conducted as part of the Council's

stock assessment and review process. The EIS placed these rebuilding analyses in their broader temporal context: "The management framework and rebuilding analyses for overfished species are based on long-term stock rebuilding targets; current year OY's are based both on estimates of how past fishing mortality has affected the population and an assumption that the current harvest will be used over the course of the rebuilding period. In this sense a rebuilding analysis is a cumulative effects analysis of 'past, present, and reasonable foreseeable future actions'" (PFMC 2003, p. 4-14).

The EIS identified a number of pending Groundfish FMP amendments that were relevant to the setting of annual specifications. These included amendments related to establishment of a biennial management cycle (PFMC 2003, p. 4-61) and a vessel monitoring system (VMS) for the limited entry (LE) trawl and fixed gear fleets (PFMC 2003, pp. 3-62, 4-60 and 4-61).

Because the 2003 management specifications were expected to affect fisheries coastwide that target groundfish or harvest groundfish as bycatch, the affected environment described in the EIS broadly encompassed all such fisheries. Thus the EIS described historical trends in coastwide commercial and recreational fisheries (PFMC 2003, Tables 3.3-1a to 3.3-1d, Tables 3.3-2a to 3.3-4c, Tables 3.3-5a to 3.3-5b, Tables 3.3-6a to 3.3-6b, Table 3.3-20) and provided detailed baseline descriptions of commercial harvesting activity (PFMC 2003, Tables 3-3.23a to 3.3-25, Table 3.3-7), commercial processing activity (PFMC 2003, Tables 3.3-26 to 3.3-33), recreational fishing (PFMC 2003, Tables 3.3-34 to 3.3-38) and fishing communities (PFMC 2003, Tables 3.3-39 to 3.3-47, Tables 3.3-49 to 3.3-50). Given the emphasis of the 2003 specifications on protecting overfished species, the EIS described landings and discard of overfished species in the recreational fishery (PFMC 2003, Table 3.4-3) and landings of overfished species in the commercial fishery (PFMC 2003, Table 3.4-2), and provided detailed documentation (as available) of bycatch in selected sectors of the commercial fishery (PFMC 2003, Tables 3.3-8 to 3.3-15, Tables 3.4-4 to 3.4-9, Table 3.4-11, Tables 3.4-13 to 3.4-14).

IV.C. Identifying the Problem and Role of Reserves in Addressing the Problem

The proposal should describe the problem to be addressed, why the problem is significant and why the *status quo* is inadequate to address the problem. If reserves are deemed a unique solution to the problem, the proposal should explain what makes reserves unique. As indicated in Section III, the role of reserves should be explained in specific terms. For instance, if reserves are intended to address an ecosystem objective, rather than stating that reserves will "provide a fully functioning ecosystem", the proposal should describe what aspects of ecosystem well-being are expected to be enhanced by reserves. If reserves are intended to reduce management uncertainty or provide fishery benefits, the proposal should specify the type of uncertainty that will be reduced or the type of benefits that will be provided.

Council Example - Jan 2003 EIS: The EIS characterized the management problem as follows: "... groundfish fisheries are now largely managed for certain key constraining overfished species. The harvest limits placed on these species prevents the fisheries from approaching OY's for other overfished and healthy stocks" (PFMC 2003, p. 4-14).

With regard to the role of area closures in reducing the risk of overfishing, the EIS stated: "The centerpiece of the Council-preferred Alternative and for all considered alternatives other than the No Action Alternative and Allocation Committee Alternative (without depth restrictions) is depth-based restrictions that seasonally move fisheries that catch overfished stocks out of the depth zones they inhabit. This management strategy was considered critical for managing fisheries to stay within the OY's of the most constraining overfished groundfish stocks given the current uncertainty in monitoring total catch for most fishery sectors. Depth-based fishery restriction zones are therefore prescribed to reduce the risk of overfishing these stocks" (PFMC 2003, p. 2-1).

With regard to the role of area closures in providing continued opportunities to fish healthy stocks, the EIS noted that "While bycatch reduction is the primary goal of depth-based management, it also provides some economic benefits for some sectors of the fishery, especially those sectors operating in areas deeper than the outer bounds of Conservation Areas. In those circumstances, there is an ability to allow larger trip and cumulative landings limits that are not constrained by the need to limit harvest of otherwise co-occurring overfished species" (PFMC 2003, p. 2-1).

According to the EIS, fishing activities that did not contribute to the problem would be allowed in the closed area: "... fisheries without a significant bycatch of overfished groundfish species or those with mitigative gear modifications may be allowed to occur" (PFMC 2003, p. 2-1). The particular fisheries and gears that would be prohibited in the reserve varied among management alternatives, depending on the OY's associated with the alternative, and also by area, depending on which overfished species were present in the area and how susceptible those species were to particular gear types. For instance:

- With regard to the Council Preferred Alternative, the EIS noted: "All gears with a demonstrated significant bycatch of bocaccio, cowcod, and other constraining overfished groundfish species are excluded from the 20-150 fm [fathom] depth zone south of Cape Mendocino, California where these species reside" (PFMC 2003, p. 2-1).

- For the Low OY Alternative, which prohibited all bocaccio harvest, "it was assumed that any nongroundfish fishery with reasonably measurable amounts of bocaccio would be closed in order to achieve the zero OY". To justify the choice of fishery closures, the EIS documented the extent of bocaccio bycatch in a number of fisheries - including pink shrimp, ridgeback prawn, salmon troll,

sea cucumber and spot prawn (PFMC 2003, Table 3.4-5). For other non-groundfish fisheries for which bocaccio bycatch data were not available (e.g., Dungeness crab, gillnet complex, Pacific halibut, coastal pelagics, highly migratory species), the likelihood of bocaccio bycatch was surmised on the basis of groundfish bycatch and whether the fishery occurred in areas where bocaccio were likely to be encountered (PFMC 2003, pp. 3-56 to 3-57, pp. 3-58 to 3-59). "Based on discussions of the Ad Hoc Allocation Committee and Council" (PFMC 2003, p. 4-26), the EIS identified the non-groundfish fisheries that would be closed under the Low OY Alternative to include California halibut, gillnet complex, shrimp and prawn trawl and coastal pelagics.

IV.D. Defining the *Status Quo*

The proposal should include a description of the *status quo*, i.e., current and future conditions that can reasonably be expected to prevail if the proposal is not implemented. The time frame used to define the *status quo* (as well as alternatives to the *status quo*) should reflect the time period over which effects of the proposed regulatory change are expected to be realized. This is particularly important if benefits and costs are expected to change over time or to be realized over different time frames. Also, as discussed in Section III, all alternatives (including the *status quo*) should be evaluated on a common spatial scale, i.e., including areas both inside and outside the proposed reserve. Current (baseline) conditions may be a useful proxy for the *status quo*, but only if current conditions are expected to continue into the future.

Council Example - Jan 2003 EIS: Because the EIS pertained to setting management specifications for a single year (2003), the time frame for the analysis was also one year. It should be noted that this time frame is shorter than would be required for marine reserve proposals. The *status quo* (as well as alternatives to the *status quo*) was defined to include conditions both inside and outside the proposed reserve area.

For purposes of the EIS, the regulatory *status quo* consisted of the management measures implemented in 2002 (PFMC 2003, Table Tables 2.1-6 to 2.1-8). However, defining the fishery *status quo* was more complicated. Because Council deliberations on the 2003 management specifications began in 2002, the most recent year for which complete annual fishery information was available was 2001. The EIS, however, deemed November 2000-October 2001 to be a more plausible baseline period for the commercial fishery than calendar year 2001 on the basis that "in November and December of 2001 the fishery was under severe limits that are not typical of the usual fishing cycle" (PFMC 2003, pp. 4-23 to 4-24). A *status quo* estimate of the ex-vessel value of landings was then derived from the baseline by assuming (1) a 10% reduction in groundfish landings and revenues from the baseline, to account for more restrictive regulations in 2002, and (2) no change in non-groundfish landings and revenues relative to the baseline period (PFMC 2003, pp. 4-24 to 4-25). Thus the EIS provided

an example of a situation in which adjustments to baseline had to be made to obtain a reasonable representation of the *status quo*.

IV.E. Defining Alternatives to the *Status Quo*

Reserve proposals should include a reasonable range of alternatives to the *status quo* and describe the rationale underlying them. If the problem identified in the proposal can be addressed only by reserves, the alternatives should take the form of different reserve configurations. The relevance of particular reserve features (e.g., location, size, configuration) should be discussed in relation to the management objective and other relevant considerations. Documentation of the data and assumptions underlying reserve design (e.g., habitat maps, species distributions, larval dispersal patterns, spatial distribution of fishing activity) should be provided, as well as any models or algorithms[5] that contributed to reserve design.

The marine reserves literature provides some insights into general principles for the design, size and location of reserves (e.g., larger reserves provide greater ecosystem benefits within their borders than smaller reserves; networks of reserves are needed to provide insurance against uncertainty). Specific recommendations in the literature regarding reserve size are based largely on theoretical models that focus on fishery benefits of reserves. As indicated in Section III.B., the results of such models are highly sensitive to underlying assumptions and have been subject to limited validation. Reserves are not "one size fits all". If reserve proposals intend to rely on size recommendations from the literature, it is important that such recommendations be consistent with model assumptions that are reasonably realistic in the context of the proposal.

The proposal should include a description of the operational requirements (i.e., the specific combination of regulations) associated with each alternative. If reserves are not a unique solution to the problem - that is, if the problem can also be addressed by non-reserve management measures or by combining reserves with other measures - the alternatives considered should reflect the broader range of feasible solutions. For instance, achieving an ecosystem objective may involve consideration of gear restrictions or effort reduction - either separately or in conjunction with

---

[5] If a reserve siting algorithm is used to evaluate impacts of alternative siting schemes, it is important that use of the algorithm not be limited to a single reserve size. The algorithm should be rerun over a range of sizes to gain a better understanding of how achievement of the objective specified in the algorithm is affected by alternative sizes. It is also important to recognize that such algorithms are analytical tools and that not all considerations relevant to policy decisions can be quantified in a single algorithm.

reserves. Achieving an insurance objective may involve considering more precautionary adjustments to existing harvest rate policies - either as a separate alternative or in conjunction with reserves. In designing management alternatives, it is important to consider not only regulatory features that promote achievement of the management objective but also features that may be needed to address unintended consequences (e.g., adverse effects associated with effort displacement outside the reserve).

Council Example - Jan 2003 EIS: The EIS included five alternatives to the *status quo* (PFMC 2003, pp. 4-14 - 4-15). A regulatory package was specified for each alternative that included OY's, depth-based closures, seasonal closures, cumulative landings limits, and gear restrictions for individual commercial fishery sectors (including LE groundfish, directed OA groundfish, tribal groundfish and non-groundfish sectors), and bag/size/gear/depth/season restrictions for the recreational fishery (PFMC 2003, Table 2.1-3).

The OY's specified under each alternative for key constraining overfished stocks (PFMC 2003, Table 4.2-1) reflected varying degrees of risk with regard to the probability of rebuilding these stocks to B_{MSY}. The EIS provided a rationale for the range of OY's as follows:

- The *Low OY Alternative* was consistent with bocaccio fishing mortality of 0 metric tons (mt) and rebuilding probabilities of 80%-100% for other overfished stocks. According to the EIS, this alternative "projects the lowest bycatch of all the overfished species and is the only alternative to meet the zero fishing mortality standard for bocaccio" (PFMC 2003, p. 4-41).

- The *High OY Alternative* was deemed "risk neutral" in the EIS in that it is "based on rebuilding trajectories with an estimated 50% probability of rebuilding by T_{MAX}. This is the longest rebuilding duration and the highest harvest allowed for overfished groundfish species under the National Standards Guidelines" (PFMC 2003, p. 2-3).

- With regard to the remaining three alternatives, the EIS noted that "The OY's represent a mix of the harvest levels and management measures within the range specified under the Low OY Alternative and the High OY Alternative" (PFMC 2003, p. 2-3). The two *Allocation Committee Alternatives* (one with, the other without reserves) were consistent with rebuilding probabilities of 60%-70%. The *Council Preferred Alternative* was more conservative than the Allocation Committee Alternatives in terms of depth and gear restrictions but less conservative than the High OY Alternative in terms of OY levels.

The EIS elaborated on each alternative by describing the role of each management measure - OY's, depth-based closures, season closures, trip/cumulative landings limits, gear restrictions - in ensuring precautionary management of

overfished stocks while providing (to the extent possible) continued fishing opportunities. For instance:

- The EIS highlighted the role of area closures as a key feature of the alternatives: "The Council and its advisors recommend a depth-based management strategy that prohibits some fisheries and fishing gears in the depth zones these [overfished] species inhabit. This is considered a significant precautionary strategy and, in effect, establishes (if ultimately adopted) the largest marine reserve in U.S. territorial waters" (PFMC 2003, p. 4-39). The boundaries of the closure were based on the depth affinity of the harvestable component of key constraining overfished stocks - most notably bocaccio in areas south of 40°10' N. lat., and canary and yelloweye in areas north of 40°10' N. lat. To meet the needs of these species, reserve boundaries differed north and south of 40°10' N. lat., and also varied depending on the OY's and the other regulatory measures associated with each management alternative. Reserve boundaries specified in the EIS design were also influenced by enforcement considerations. "Upon the advice of the Council's Enforcement Consultants, these lines are specified to be as straight as possible for ease of enforcement" (PFMC 2003, p. 2-1).

- With regard to the effect of the OY's on the size of the spatial closures and duration of seasonal closures, the EIS noted: "The area and time fisheries are restricted varies among alternatives relative to the amount of harvest allowed under each alternative. More liberal harvest alternatives allow more fishing opportunities in those depth zones during a greater portion of the year in order to better access healthy co-occurring groundfish and non-groundfish stocks" (PFMC 2003, p. 2-1).

- The relationship of depth and time closures to landings limits was described as follows: "While bycatch reduction is the primary goal of depth-based management, it also provides some economic benefits for some sectors of the fishery, especially those sectors operating in areas deeper than the outer bounds of Conservation areas. In those circumstances, there is an ability to allow larger trip and cumulative landings limits that are not constrained by the need to limit harvest of otherwise co-occurring overfished species" (PFMC 2003, p. 2-1).

- Gear restrictions were also imposed that would provide continued fishing opportunities in the sanddab fishery by reducing the likelihood of groundfish bycatch in that fishery: "The Council OY exception of allowing commercial line gear with no more than five hooks (number 2 or smaller) and up to five lbs of eight if the gear is closely attended is designed to allow some risk-averse target opportunities to catch Pacific sanddabs. The smaller hooks and the horizontal groundlines used in the fishery significantly reduce bocaccio impacts" (PFMC 2003, p. 4-44).

In addition to protecting fish stocks within the reserve, the EIS also focused on the need to prevent bycatch of overfished species outside the reserve from exceeding the OY levels specified in the management alternatives. Bycatch reduction regulations were customized to suit particular fisheries. For instance:

- "Yelloweye rockfish catch is a particular concern given their high market value, sedentary life style, and vulnerability to baited longlines. The GMT [Groundfish Management Team] recommended prohibiting retention of yelloweye rockfish in 2003 fixed gear fisheries and restricting most of these fisheries to outside the 100 fm management line....The recommendation to prohibit fixed gears in waters shallower than 100 fm...was based on the results of the IPHC [International Pacific Halibut Commission] Halibut longline survey where 99.1% of the yelloweye rockfish was caught inside 100 fm (Table 4.2-3)" (PFMC 2003, p. 4-43).

- With regard to the need to protect nearshore fish stocks from the effects of displaced effort, the EIS noted: "One of the consequences of limiting shelf fishing opportunities south of Cape Mendocino in 2003 is a significant commercial and recreational effort shift to nearshore areas. The southern nearshore fishery therefore needs to be restructured in 2003 in order to prevent over-harvesting of 14 nearshore rockfish species (including California scorpionfish) that are found primarily inside 20 fm" (PFMC 2003, p. 4-49).

  One method of restructuring nearshore fisheries involved strategic use of season closures that took into consideration the migratory patterns of key species. For instance, "...it was determined necessary to concentrate fishing opportunities during summer and autumn months, when the deeper nearshore stocks typically undergo an inshore migration....This approach matches fishing opportunities with the depth distribution of the resource, avoids over harvest of other deeper nearshore (i.e., non-permit) species that have a more shallow depth distribution (such as olive rockfish and treefish), and addresses concerns the proposed 20 fm restriction could increase the potential for localized depletion of those species with a preference for shallow habitat. These specifications form the basis for the Council-preferred Alternative harvest levels for the 2003 southern nearshore fishery" (PFMC 2003, p. 4-50).

- Gear restrictions were also used to reduce bycatch: "Gillnets were a gear with a demonstrated bycatch of groundfish. The gillnet complex fishery primarily occurs in waters off California where bocaccio bycatch is a major concern. One of the specifications of the Council-preferred Alternative was to prohibit set gill and trammel nets with mesh sizes less than six inches within the CRCA [California Rockfish Conservation Area]" (PFMC 2003, p. 4-40).

- The EIS utilized information on the participation of LE groundfish trawl, hook-

and-line and pot vessels in non-groundfish fisheries during 1994-1998 (PFMC 2003, Figures 3.3-2a to 3.3-2c) to predict which non-groundfish fisheries would most likely be impacted by the transfer of groundfish effort from the reserve. The EIS noted that "It is clear...there is some degree of gear loyalty for groundfish vessels participating in groundfish fisheries. For example, a notable proportion of the nongroundfish fishery participation by groundfish trawl vessels occurs in the shrimp and prawn trawl fisheries" (PFMC 2003, p. 3-40). Based on this result, several State regulatory actions were included in the management alternatives (PFMC 2003, Table 2.1-5) to reduce the effect of displaced effort on groundfish bycatch in the shrimp and trawl fisheries. Specifically:

> (1) "Vessels targeting pink shrimp also land groundfish species.... Efforts are underway to reduce the incidence of groundfish bycatch, by requiring bycatch reduction devices (BRDs a.k.a. finfish excluders) and no-fishing buffer zones above the seafloor" (PFMC 2003, p. 3-56).
>
> (2) "Trap and trawl gears that target spot prawn exhibit differential bycatch rates; trawls are much more prone to catch overfished groundfish species (PFMC 2003, Table 3.4-9)....California revealed plans to either eliminate spot prawn trawls, convert the gear endorsements to trap only, or restrict spot prawn trawls to waters deeper than 150 fm. Despite the fact that spot prawn trawls are rare north of Cape Mendocino, Oregon plans to eliminate spot prawn trawls soon and Washington has already done so" (PFMC 2003, p. 4-46).

- Given the assumption that non-groundfish fisheries would absorb the extra costs associated with bycatch avoidance requirements and continue to operate unless otherwise constrained (PFMC 2003, p. 4-26), particularly severe action was expected to be required to implement the Low OY alternative. Specifically, "it was assumed that any nongroundfish fishery with reasonably measurable amounts of bocaccio would be closed in order to achieve the zero OY" (PFMC 2003, p. 4-26).

The EIS also documented features of the management alternatives that were intended to mitigate adverse ecosystem effects associated with effort shift to the open area. These included gear restrictions and reserve boundary features that encouraged movement of effort toward habitats where it would be less likely to have adverse effects on the ecosystem. Specifically:

- "Footrope restrictions, already implemented but extended to all areas shoreward of the closed areas under the Council-preferred Alternative, also reduce habitat impacts" (PFMC 2003, p. 4-3).

- The Council-preferred OY alternative specified an offshore reserve boundary of

250 fm (compared with the 150-250 fm boundary specified in the Allocation Committee alternative), while also allowing some trawling with small footropes in the nearshore CRCA. As noted in the EIS, "Assuming that trawl impacts in mud and sand areas are moderate, these exemptions may counterbalance the deeper outer boundary of the closed area, when comparing these two alternatives" (PFMC 2003, p. 4-4).

The alternatives were crafted in ways that highlighted the significance of particular management measures. For instance:

- Two versions of the Allocation Committee Alternative (with and without reserves) were devised to illustrate what would happen if reserves were not included in the regulatory package. Specifically, the EIS notes that "The Allocation Committee Alternative with no depth restrictions has lower trip limits and would result in the lowest projected catch of target species, although it would result in the highest bycatch of overfished species" (PFMC 2003, p. 4-4).

- Two versions of the Council-preferred alternative were evaluated to illustrate the importance of the nearshore caps. "For the nearshore fisheries it was assumed that effort and harvest would increase during open periods, and any nearshore caps established to control harvest would be fully harvested.... In order to better depict the economic effects of the cap, the recommended Council-preferred Alternative was modeled with and without the nearshore caps" (PFMC 2003, p. 4-25).

The EIS also documented alternatives that were considered and rejected. For instance, alternatives that would allow the bocaccio OY to exceed 20 mt were rejected on the basis that "More liberal bocaccio harvest level alternatives could risk stock extinction or an Endangered Species Act (ESA) listing" (PFMC 2003, p. 2-6). Complete year-round closure of the commercial fishery was rejected on the basis that it "would have significant socioeconomic consequences" (PFMC 2003, p. 2-7). Complete closure at certain times of the year was rejected on the basis that it "could force some segments of the fishery into times of the year when bycatch rates for a particular overfished species are highest....there is not one optimal time when all mixed stock fisheries could be closed and achieve the lowest bycatch rates" (PFMC 2003, p. 2-7). Documentation of this type is advisable in situations where management alternatives that may have been of particular interest to a stakeholder group did not make the "final cut" in the regulatory analysis.

IV.F. Analyzing Management Alternatives

In addition to specifying an objective (Section IV.A.) and the specific problem impeding achievement of the objective (Section IV.C.), the proposal should provide measurable, verifiable indicators of progress toward achieving the objective and

thresholds for determining when the objective has been achieved. Alternatives should be compared in terms of success in meeting the objective. Since the point of the analysis is to determine whether a change from the *status quo* is warranted, each alternative should be evaluated relative to the *status quo*.

Effects that may not be directly relevant to the objective should also be evaluated. For instance, if the objective of the reserve proposal is biological, management alternatives should also be analyzed in terms of socioeconomic and ecosystem effects - both positive and negative.

One effect common to all reserve proposals is effort displacement. The SSC is aware of the limited information and high degree of uncertainty inherent in addressing the effects of displacement. However, given the need for managers to consider whether closer monitoring and/or additional regulation are needed to address such effects, this issue cannot be ignored. The size of the closures considered in the Council's 2003 groundfish specifications warranted extensive consideration of this issue, including more restrictive regulation outside the closed area. Reserve proposals are likely to be more modest in scope and will not necessarily warrant changes in monitoring or regulation outside the reserve; however, this cannot be determined without some demonstration of the extent of displacement.

Reserves involve trade-offs between benefits that may accrue to fish stocks and ecosystems inside the reserve and potentially adverse biological, socioeconomic and ecosystem effects associated with effort displacement. In considering the effects of displacement, it is important to distinguish between effort foregone (effort that disappears from the fishery altogether) and effort that shifts to the open area. From an economic perspective, effort foregone implies economic losses, while effort shifted to the open area provides at least some opportunity to mitigate the short-term economic losses associated with the reserve. Effort shift may have implications not only for displaced vessels but also for vessels with whom they interact outside the reserve in terms of increased competition, congestion, harvesting costs and social conflict.

Whereas effort shift implies some ability to mitigate the short term economic losses associated with the reserve, from a biological or environmental perspective, the less effort that moves to the open area the better. Determining the nature of such effects is not always straightforward. For instance, biological effects are not necessarily limited to stocks previously harvested in the reserve. Effort transferred to the open area may focus on different species than were targeted in the reserve. Bycatch patterns may also differ from what previously occurred in the reserve. Ecosystem effects may vary, depending on whether the transferred effort is associated with gear types or fishing strategies that are more or less likely to adversely affect habitat, and whether effort is transferred to habitats that are more or less vulnerable to gear effects.

To the extent possible, the analysis should be based on data and studies specific to the fish stocks, ecosystems, fishery participants and fishing communities that will be affected by the proposal. Assumptions underlying the analysis should be plausible in terms of reflecting the characteristics and behavior of the affected entities. To the extent that the analysis relies on data or results for other stocks, ecosystems, participants and communities, the appropriateness of relying on such outside information should be apparent in the analysis.

Regulatory analysis - whether it involves marine reserves or other types of management measures - is constrained by limited knowledge and data regarding the environment, fish stocks, and the social and economic behavior of fishery participants. A number of analytical approaches (e.g., risk assessment, sensitivity analysis) can be used to convey the extent of risk and uncertainty in an analysis. Careful interpretation and qualification of results are also useful for conveying the extent of uncertainty. In cases where effects cannot be quantified, a qualitative analysis may be useful for portraying the direction of change or relative differences among alternatives. A careful qualitative evaluation is preferable to a quantitative evaluation that conveys more certainty than is warranted. If an effect is unknown, it should be characterized as unknown.

Council Example - Jan 2003 EIS: The analysis in the EIS relied on landings receipt, port sampling, logbook and survey data that were specific to the fisheries and species potentially affected by the management alternatives. The EIS also relied on relevant results from previous studies. For instance, descriptions of the distribution, life history and status of individual groundfish stocks contained in the EIS (PFMC 2003, pp. 3-6 to 3-24, Table 3.2-1) included numerous references to previous research specific to these particular stocks. The stock assessment and rebuilding analyses that served as the basis for the OY's specified in the management alternatives - as well as the development and analysis of alternatives - were based on information directly relevant to the species and fisheries under consideration.

All alternatives were evaluated on a comparable spatial scale, i.e., including areas both inside and outside proposed closed areas. Alternatives were evaluated on a common temporal basis, i.e., single year effects. Given that the EIS pertained to annual fishery regulations, this time frame was appropriate for this particular analysis.

Table 4.3-1 of the EIS compared the management alternatives relative to the *status quo*. However, in other tables (PFMC 2003, Tables 4.3-2a to 4.3-11), the comparison was made relative to the baseline rather the *status quo*. The reason for this inconsistency is not clear. However, it appeared to make little difference to the conclusions of the EIS, as the relative differences in ex-vessel revenue among alternatives tended to be similar, regardless of whether the basis for comparison was the baseline or the *status quo* (PFMC 2003, Table 4.3-1).

Sections IV.F.1. to IV.F.3. describe some of the approaches used in the EIS to analyze biological, social, economic and ecosystem effects. Section IV.F.4. addresses monitoring and enforcement requirements.

IV.F.1. Biological (Species-Specific) Effects

If the management objective pertains to protection or enhancement of particular species, analysis of biological benefits should focus on those species. Effects on species that are not directly relevant to the objective may also be of interest, particularly if such effects have implications for management of those species. While anticipating effects of reserves at the species level can be difficult, even information on the identity of affected species or species complexes and the direction of the effect may be helpful in identifying biological effects.

As discussed in Appendix A, the exclusion of fishery-independent surveys from reserve areas may complicate the Council's efforts to conduct the types of assessments needed to fulfill its management responsibilities. Reserve proposals should be clear regarding whether conventional research surveys, based for example on trawling, would be allowed in the reserve area and (if allowed) whether any constraints would be imposed on the conduct of such surveys.

Council Example - Jan 2003 EIS: The EIS provided a verifiable and measurable way to evaluate each alternative in terms of achieving the biological objective. Specifically, "The alternatives are compared in terms of their efficacy in constraining total fishing mortality on overfished stocks and the probability of rebuilding stocks" (PFMC 2003, p. 4-14). Alternatives were compared relative to the objective as follows: "Table 4.4-1 presents estimates of bycatch of overfished species across all fisheries....These values can be compared to the OY's in Table 2.1-1, which shows that the projected total mortality is at or below the OY's for all of these species, in some cases by a substantial amount (e.g., widow rockfish) due to the need to manage for constraining overfished species such as bocaccio, canary rockfish and darkblotched rockfish" (PFMC 2003, p. 4-15).

In evaluating the accuracy of the bycatch projections (Table 2.1-1), the EIS noted that harvests above OY "will have significant biological impacts," while harvests below OY will result in "socioeconomic impacts because of foregone income and fishing opportunities....Harvests above OY are unlikely because management measures can be changed throughout the year in order to slow harvest rates. However, harvests below OY for a given species have occurred in past years because of difficulty in managing multi-species fisheries" (PFMC 2003, p. 4-14).

As indicated in Section IV.E., the OY's specified under each alternative for key constraining overfished stocks (PFMC 2003, Table 4.2-1) reflected varying degrees of risk with regard to the probability of rebuilding those stocks to B_{MSY}. These

probabilities were based on the results of formal risk assessments. The EIS offered the following caveat regarding the uncertainty in the assessment results: "The accuracy and reliability of various data used in assessments - and the scientific assumptions on which they are based - need to be further evaluated to improve the quality of forecasts. Uncertainty associated with fishery logbook data, calibration of surveys, and accuracy of aging techniques also need more evaluation when considering survey reliability. Finally, a better understanding of ecosystem change and its influence on groundfish abundance will also improve stock assessments" (PFMC 2003, p. 3-60).

The bycatch estimates for overfished species provided in the EIS were based on an analysis of the separate effects of each management alternative on each key overfished species and each fishery sector. Some examples of the methods used in the EIS (and associated caveats regarding outcomes) are as follows:

- The EIS relied on a formal quantitative bycatch model developed by the GMT (PFMC 2003, pp. 4-40 to 4-43) to project harvest of key overfished species in the limited entry (LE) non-whiting trawl fishery under each management alternative. The model used PacFIN and trawl logbook data to estimate historical participation patterns specific to each vessel, target fishery, two-month cumulative landing period, area and depth. Using historical fishing patterns as a baseline, the model predicted the amount of effort displaced from the reserve under each alternative and the percentage of displaced effort expected to move to the open area. Observer data were used to estimate bycatch rates of individual overfished species in the various target fisheries (PFMC 2003, Tables 4.2-3a to 4.2-3b).

- The EIS offered the following caveats regarding bycatch estimates for non-trawl fisheries: "Without a comparably informative bycatch model for the fixed gear fisheries (including both the limited entry and open access sectors), there is much greater uncertainty estimating bycatch in these fisheries" (PFMC 2003, p. 4-43). Also, "The distribution of groundfish catch and bycatch in incidental open access fisheries is far less certain than in the other sectors (Table 3.4-5)" (PFMC 2003, p. 3-56).

- The EIS relied on behavioral inferences drawn from historical data and results of prior empirical studies to project the effect of the recreational fishery on key overfished groundfish stocks. Specifically, "The potential impact of nearshore fishing on these species [bocaccio, canary, yelloweye] may be estimated by (1) examining catch by depth from the recent recreational fishery, (2) estimating potential effort shift based on the recent performance of the recreational rockfish fishery during those periods when only 0 to 20 fm fishing was allowed; and (3) applying hooking mortality estimates to the bycatch of overfished species that will be inadvertently caught and released in the 0 to 20 fm fishery" (PFMC 2003, p. 4-51).

- Another example of an inference drawn from prior studies was use of a study by Lawson (1990) to predict the extent of groundfish bycatch in the salmon troll fishery: "With four spreads (the current configuration in Oregon south of Cape Falcon), catch rate reductions associated with alternatives that require a 4 fm distance between the cannonball and the lower most spread would be: 95% for canary rockfish, 0% for yelloweye rockfish (only two were caught), and 89% for lingcod (Figure 4.2-4)" (PFMC 2003, p. 4-45).

- To deal with uncertainties regarding how the Council might choose to allocate OY's of nearshore species between commercial and recreational fisheries and the effects of effort displacement in the recreational fishery on overfished stocks, the EIS described the implications of alternative feasible commercial/recreational allocations (PFMC 2003, Table 4.5-1) and also included a sensitivity analysis that explored the implications of different recreational effort shift and hooking mortality assumptions (PFMC 2003, Tables 4.5-2 and 4.5-4).

Given the importance of not underestimating bycatch of overfished species, the EIS preferred to err on the side of caution in making such estimates. For instance:

- "Since the [GMT bycatch] model did not incorporate more recent logbook data than 1999, the effect of the small foot rope restrictions on bottom trawling on the shelf are not represented. Use of the model in 2003 may tend to overestimate the bycatch of overfished shelf rockfish species and, in effect, provides a conservative buffer against overfishing" (PFMC 2003, p. 4-40).

- "For the nearshore fisheries, it was assumed that effort and harvest would increase during open periods, and any nearshore caps established to control catch would be fully harvested" (PFMC 2003, p. 4-25).

- "For the whiting and sablefish fisheries, it was assumed OYs would be fully harvested" (PFMC 2003, p. 4-26).

The EIS described various types of surveys (trawl, hook-and-line and SCUBA) that provide data in support of groundfish management. The EIS noted the usefulness of these surveys in providing "fishery-independent data which - because it is gathered in a uniform, consistent manner - provide 'benchmarks' used to track natural and anthropogenic changes in fish abundance" (PFMC 2003, p. 3-61). The management alternatives considered in the EIS allowed for continued collection of research survey data and an explicit accounting of mortality of overfished species in NMFS trawl and shelf surveys in the 2003 management specifications (PFMC 2003, Table 4.4-1).

IV.F.2. Social and Economic Effects

Approaches for evaluating economic effects include economic impact analysis and benefit-cost analysis. Economic impact analysis focuses on income and employment impacts in local economies, while benefit-cost analysis focuses on societal-wide effects, as estimated using standard concepts of economic value (producer and consumer surplus, opportunity cost). Available data and models are rarely adequate for conducting a comprehensive benefit-cost analysis that covers all affected entities (e.g., businesses, consumptive and non-consumptive resource users, seafood consumers). A partial cost-benefit analysis (e.g., covering some affected entities) may be useful, although any such analysis should also be accompanied by appropriate caveats regarding the types of effects that could not be addressed.

In cases where limitations in existing information preclude estimation of economic impacts or economic value, it may be necessary to rely on other monetary or non-monetary indicators of economic and social well-being. For instance, effects on fishery participants may be evaluated in terms of numbers of affected entities (e.g., boats, processors, other businesses, fishermen); amount of commercial and recreational effort displaced; changes in landings, revenues, costs, profits; extent of dependence on fisheries within the reserve area.

Socioeconomic effects expressed in a common monetary unit can have different meanings. Monetary effects that have disparate meanings should not be directly compared or added. For instance, measures of economic impact and economic value are not comparable. Even in cases where the same monetary variable is used to characterize effects on different entities, its meaning may depend on the context in which it is used. For instance, the ex-vessel value of landings is a source of revenue when applied to fishing vessels but a cost when applied to processors. While this particular component of processor cost may be correlated with processor revenue or differ from revenues only by a markup factor, it nevertheless has a different meaning to vessels and processors.

Reserve proposals should also include a discussion of the allocational implications of each management alternative, i.e., who reaps the benefits and who bears the costs. For instance, effects may be categorized by fishery, gear type, geographic area (e.g., ports, counties, states, management areas), vessel size class. The types of categorization relevant to evaluating distributional effects will depend on the specifics of individual reserve proposals.

Council Example - Jan 2003 EIS: The EIS described the management alternatives in terms of how they would affect economic opportunities in specific fisheries. For instance:

- "The Low OY alternative would effectively end the recreational groundfish fishery in the south since the harvest rate on bocaccio would be set to zero. While other recreational fishing activities may be supportable in southern

waters, these may be limited by the fact that bocaccio are not exclusively caught on the bottom or over hard substrate" (PFMC 2003, p. 4-46).

- "The High OY, Allocation Committee (with depth restrictions) and Council-preferred alternatives all specify no fixed gear opportunities in the 27-100 fm zone north of Cape Mendocino in California and Oregon and restricts the fishery to outside of 100 fm in waters off Washington to minimize canary rockfish and yelloweye rockfish bycatch....Without the depth restrictions, as modeled in the Allocation Committee Alternative, the fishery would be restricted to the nearshore 0 fm to 27 fm zone in northern California and Oregon. Fixed gear fisheries would be eliminated in Washington without depth restrictions since Washington does not allow commercial groundfish fisheries in their coastal marine waters" (PFMC 2003, p. 4-44).

The monetary and non-monetary indicators used in the EIS to describe socioeconomic effects were driven largely by data availability. In using available data, no attempt was made to "over-interpret" the data or construe the analysis as a benefit-cost analysis. Thus, for instance, because effects of the alternatives could not be measured in a consistent way among fishery sectors, comparison of alternatives was done on a sector-by-sector basis. The EIS also demonstrated a clear understanding of the distinction between economic impacts and economic value and took care to provide an accurate interpretation of income impacts: "These effects [income impacts] should be thought of as those 'associated with' the fishery rather than 'generated by' the fishery, because in the absence of the fishing opportunity some of the income would still be generated in the community or elsewhere in the economy" (PFMC 2003, p. 3-44).

Efforts of the management alternatives on fishery participants and fishing communities were characterized in a variety of ways. For instance, fishery effects were expressed in terms of ex-vessel value for commercial harvesters (PFMC 2003, Tables 4.3-1 to 4.3-9, Table 4.3-13) and buyers/processors (PFMC 2003, Tables 4.3-10 to 4.3-11), and in terms of fishing effort and personal income impacts for the recreational fishery (PFMC 2003, Table 4.3-12).

In considering the distributional implications of each alternative, the EIS went to great lengths to compare effects not only among fishing communities and among commercial, recreational and tribal fisheries but also within fisheries. For instance, effects on the commercial fishery were evaluated separately for LE trawl, LE entry fixed gear, targeted OA, incidental OA and non-groundfish vessels. Additional analysis was done to demonstrate how effects within each of these categories varied, depending on vessel dependence on groundfish (measured as percent of revenue attributable to groundfish), vessel involvement in fishing (measured by total fishing revenue) and vessel length (PFMC 2003, pp. 4-30 to 4-31, Tables 4.3-2a to 4.3-3b, Tables 4.3-5a to 4.3-6b). Effects on buyers/processors were evaluated in terms of their fishery participation (measured by the ex-vessel value of their landings receipts)

(PFMC 2003, Table 4.3-10). Effects on the recreational fishery were evaluated by area and fishing mode (PFMC 2003, Table 4.3-12). Tribal effects were evaluated by gear type (PFMC 2003, Table 4.3-13). Community effects were evaluated by categorizing coastal ports into 17 fishing communities (PFMC 2003, Table 4.3-14), and expressing effects in each community in terms of the ex-vessel value of landings and income and employment impacts (PFMC 2003, Tables 4.3-14 to 4.3-18).

In addition to providing quantitative measures of socioeconomic effects, the EIS also provided qualitative insights into the economic and behavioral implications of the alternatives. For instance:

- "To the degree that vessels might possibly target the species covered in the preceding list [species for which fishing would be potentially affected by depth restrictions south of Cape Mendocino] by moving their effort in areas that remain open, it is likely that costs would be higher and/or CPUEs lower than in normal fishing areas, raising cost per unit of catch" (PFMC 2003, p. 4-28).

- "Recreational charter vessels are probably more dependent on their home port than commercial vessels, though recreational charter vessels are known to exhibit some mobility between ports....Charter vessel operators and crew which do attempt to move operations to a port in an open area will face obstacles in recruiting clientele or developing new relationships with booking agents. The operator and crew may experience social effects associated with distance from family and social networks" (PFMC 2003, p. 4-32).

- "Those [recreational groundfish anglers] that live in an area may respond to a time/area closure by (1) not going groundfish fishing at all and spending their time and money in the same community on an alternative activity; (2) going groundfish fishing at a different, less optimal time; or (3) traveling to a different area to go fishing or take part in an alternative recreational activity. All cases reflect a loss of value to the individual associated with a shift to second choice activities" (PFMC 2003, p. 4-32).

IV.F.3. Ecosystem Effects

As indicated in Section IV.F., reserve proposals should provide some measurable, verifiable indicator of progress toward achieving the objective. In cases where the objective is ecosystem-related, identifying such an indicator is complicated by the many ways in which ecosystem effects can be portrayed. Given the limited information regarding density/numbers/biomass/size/diversity of organisms, it may be more feasible to characterize alternatives in terms of the extent to which they protect relevant habitat types. Reserve size should be tempered by the trade-off between beneficial ecosystem effects inside the reserve and potentially adverse effects of effort shifted to the ecosystem outside the reserve. Given the difficulty of directly evaluating such adverse effects, it may be necessary to rely on indirect

indicators - e.g., the amounts and types of effort shifted to the open area, the size of the area over which this effort is likely to be dispersed, the habitat types like to be occupied by this effort.

Council Example - January 2003 EIS: While the Council's management objective was largely biological (to protect overfished stocks), the management action was of sufficient magnitude to warrant careful consideration of potential (albeit unintended) effects of displaced effort on the ecosystem outside the reserve.

Citing several west coast studies on the effects of trawl gear on habitat (Freese *et al.* 1999, Friedlander *et al.* 1999), the EIS concluded that "Bottom trawling is known to modify seafloor habitats by altering benthic habitat complexity and by removing or damaging infauna and sessile organisms" (PFMC 2003, p. 4-1). With regard to other gear types, the EIS noted that "Limited qualitative observations of fish traps, longlines, and gillnets dragged across the seafloor during set and retrieval showed results similar to mobile gear, such that some types of organisms living on the seabed were dislodged. Quantitative studies of acute and chronic effects of fixed gear on habitat have not been conducted" (pp. 4-1 to 4-2). Given the limitations in existing knowledge regarding gear effects, the EIS concluded that "... there is insufficient information to quantitatively predict the effects of the Pacific Coast groundfish fishery on ecosystems and habitats because indirect and cumulative effects are poorly understood" (PFMC 2003, p. 4-3). The evaluation of ecosystem effects provided in the EIS was thus largely qualitative.

The EIS noted the beneficial effect of area closures on the ecosystem inside the reserve: "Depth-based restrictions, if used, would eliminate bottom trawl impacts to habitat in large areas of the continental shelf (depending on the alternative)" (PFMC 2003, p. 4-3). In addition, the EIS evaluated potentially adverse effects on the ecosystem outside the closed area in terms of the specific regulatory measures associated with each alternative. For instance, the EIS noted that alternatives associated with smaller closures and/or lower OY's for overfished species would necessarily be accompanied by lower trip limits on target species to ensure that total bycatch of overfished species remained within the bounds set by the OY's; because lower trip limits would discourage targeting of healthy stocks, they would also imply lower levels of fishing effort and thus lesser effects on the ecosystem outside the closed area. The EIS described existing gear restrictions intended to protect habitat against adverse effects of fishing gear: "Bottom trawl footrope restrictions implemented by the Council make it difficult for fishers to access rock piles and other areas of complex topography (due to the risk of gear damage)" (PFMC 2003, p. 4-1). As indicated in Section IV.E., the EIS also discussed specific features of the management alternatives - i.e., spatial expansion of footrope restrictions, boundary features of the closed area that encouraged movement of effort toward habitats where such effort would be less likely to adversely effect the ecosystem - to mitigate the effects of displaced effort on the ecosystem outside the closed area.

The EIS utilized fishing effort as a surrogate for evaluating relative ecosystem effects among alternatives. Effort displacement, however, could only be modeled for the LE trawl fleet. As noted in the EIS, "...in the absence of a comprehensive assessment that will enhance the ability to quantify the effects of different types and amounts of fishing, the relative effects [derived from the trawl effort model] are presumed to correlate with total fishing effort and its distribution among the alternatives, which must also be evaluated qualitatively since currently we do not model fishing effort across all fisheries. This makes it difficult to meaningfully distinguish between the alternatives with respect to effects on the ecosystem because, although we know that the alternatives would have differential effects on ecosystem and habitat, we cannot specify the nature or magnitude of those effects with any precision" (PFMC 2003, p. 4-3).

The EIS described each management alternative in terms of closed area boundaries and trip limits (PFMC 2003, Tables 2.1-9 to 2.1-12). Footrope restrictions were described in Table 2.1-2 for the LE trawl fishery and in Table 2.1-5 for non-groundfish trawl fisheries (California halibut, sea cucumber, ridgeback prawn). By comparing the alternatives in terms of presence or absence of these ecosystem-relevant features, the EIS was able to provide some qualitative insights into the ecosystem effects of particular alternatives. For instance:

- "The Low OY Alternative will have the least impact on ecosystem and habitat because it has the lowest projected catch and most extensive closed areas" (PFMC 2003, p. 4-3).

- "Trip limits under the High OY Alternative are generally higher and depth-based restrictions are not as extensive as under the Low OY and Council-preferred alternatives. Thus this alternative is likely to have the greatest relative effect on ecosystem and habitat because it would allow the highest level of fishing effort. It would, however, implement depth-based restrictions but not the depth-based footrope requirement" (PFMC 2003, p. 4-4).

Conclusions in the EIS regarding ecosystem effects were tailored to what could be surmised from available information: "All of the action alternatives will result in reduced fishing effort in comparison to baseline conditions because of lower trip limits. Depth-based restrictions, if used, will eliminate bottom trawl impacts to habitat in large areas of the continental shelf (depending on the alternative). Footrope restrictions, already implemented but extended to all areas shoreward of the closed areas under the Council-preferred Alternative, also reduce habitat impacts. Thus, although the alternatives will have some effect on ecosystems and habitat (including EFH), these effects will be reduced from historical levels" (PFMC 2003, p. 4-3).

It is important to note that the management objective specified in the EIS was to protect overfished species, not provide ecosystem benefits. Thus for purposes of

the EIS, it was deemed sufficient merely to demonstrate that management action would not make the ecosystem worse off relative to the *status quo*. Reserve proposals for which ecosystem benefits are the objective will require more concerted efforts to rank alternatives in terms of ecosystem effects than demonstrated in the EIS.

IV.F.4. Monitoring and Enforcement

Reserve proposals should include a description of monitoring plans. These plans should be relevant to the objective of the proposal and the quantitative indicators identified in the proposal that measure progress toward meeting the objective. For instance, if a proposal is intended to achieve objectives such as reducing management uncertainty or providing ecosystem or fishery benefits, monitoring would provide the feedback needed to evaluate the effectiveness of the action taken and make adjustments as necessary to that action. If the objective is to advance scientific knowledge (see Section III.E.), monitoring would need to be consistent with the requirements of the experiment. Reserve proposals should include a description of the types of data that will be collected, the regularity with which they will be collected, data collection methods and costs, and whether there is any long-term commitment of resources for data collection.

The SSC appreciates the difficulties associated with designing and implementing monitoring programs. For instance, pilot studies may need to be conducted in order to address statistical design requirements of the program. Unanticipated issues may arise after the program is initiated that require reconsideration of data needs or sampling methods. It is important that data analysis and review of monitoring procedures be conducted periodically so that such issues can be revealed and resolved in a timely manner. If results of the monitoring program are intended to be relevant to future management decisions, it is important that the relevant data and analyses be available at appropriate points in the management cycle.

The proposal should indicate the extent to which existing data collection programs are expected to contribute to the monitoring effort. Monitoring costs (like other aspects of the management alternatives) should be evaluated relative to the *status quo*. If relevant monitoring efforts are already underway (and these efforts can be reasonably expected to continue into the future), then only the incremental cost over and above existing monitoring efforts should be considered in evaluating alternatives.

Reserve proposals should also specify enforcement requirements associated with each management alternative. Enforcement costs (like monitoring costs) should be evaluated relative to the *status quo*. If the management alternatives themselves include any features that are intended to facilitate monitoring or enforcement, these features should be identified.

Council Example - Jan 2003 EIS: The EIS described the *status quo* in terms of existing monitoring and enforcement activities. These included vessel reporting requirements (e.g., fish tickets, logbooks, declaration programs[6]), as well as agency activities such as dockside sampling and shoreside and at-sea surveillance (PFMC 2003, p. 3-62). Achieving the objective specified in the EIS (i.e., ensuring that harvests do not exceed OY's) has been a long-standing Council responsibility: "In accordance with the Groundfish FMP, since 1990 the Council has annually set Pacific Coast groundfish harvest specifications (acceptable and sustainable harvest amounts) and management measures designed to achieve those harvest specifications" (PFMC 2003, p. 1-2). As indicated in the EIS, existing methods of harvest monitoring and making in-season regulatory adjustments would continue to be used. For instance, "The commercial fishery HGs [harvest guidelines] will be tracked inseason through the PacFIN 'Quota System Management' (QSM) system next season, and adjustments to the trip limits will be employed to align the cumulative landings with the available tonnage for the commercial sector" (PFMC 2003, p. 4-54).

The EIS described several ways in which monitoring and enforcement considerations shaped the management alternatives. For instance, with regard to alternatives that included area closures, the EIS noted that "Upon the advice of the Council's Enforcement Consultants, these lines [closed area boundaries] are specified to be as straight as possible for ease of enforcement" (PFMC 2003, p. 2-1). As another example, the EIS identified a provision of the High OY, Allocation Committee and Council-preferred alternatives that was intended to encourage full accounting of canary bycatch in the recreational fishery: "...a sublimit of one canary rockfish in the daily bag limit would be allowed in the north. This accommodates unavoidable bycatch and reduces the number of canary rockfish that are discarded dead. In the Council's judgment, this would not promote targeting of the species" (PFMC 2003, p. 4-47).

The EIS distinguished between management alternatives that included area closures and those that did not in terms of enforcement requirements: "Depth-based closed areas are proposed in four of the action alternatives as a way to reduce bycatch by keeping vessels out of areas where species of concern - overfished species - occur. However, this change in the management regime introduces a new set of enforcement issues because compliance must occur at sea, requiring different monitoring and enforcement requirements" (PFMC 2003, p. 4-48).

The EIS described the Council's plans to address enforcement requirements

---

[6] According to the EIS, "Under declaration programs, legal incursions into closed areas must be reported to state enforcement authorities prior to fishing. This requirement is generally reserved for vessels that would otherwise appear to be fishing illegally when viewed from an at-sea patrol craft" (PFMC 2003, p. 3-62).

associated with the management action: "The existing methods of patrolling sea areas either by airplane or ship (carried out primarily by the Coast Guard, although state agencies have some capacity in this regard), and using fishery observers to monitor vessel position can be used to monitor and enforce closed areas. In fact, until VMS is implemented these will be the available methods. However, VMS is a superior enforcement technology because the position of vessels with transmitting units can be tracked at all times. Because violations can be relatively easily determined, VMS would also serve as an effective deterrent for participating vessels" (PFMC 2003, p. 4-49).

The EIS documented the cost of using VMS for enforcement: "The Council has recommended that VMS units be installed on the limited entry trawl and limited entry fixed gear fleets (over 400 vessels).... Currently, the estimated costs of a VMS transmitting unit ranges from $1,800 to $5,800 with transmission costs of $1.00 to $5.00 per day. In the absence of federal funding the costs may be bourne entirely by the vessel owners" (PFMC 2003, pp. 3-62 to 3-63). The EIS also noted the potential for VMS to enhance enforcement capabilities: "As a new monitoring tool for West Coast groundfish fisheries, VMS will dramatically enhance rather than replace traditional techniques" (PFMC 2003, p. 3-62).

IV.G. Documenting Public Process

Reserve proposals should include a description of the process by which the need for reserves was identified and management alternatives were developed and analyzed. The extent of public involvement in the process and the nature of public comment should be documented.

Council Example - Jan 2003 EIS: The EIS included a description of the annual specifications process - including scoping and public review processes. It also includes comments by the Ad Hoc Allocation Committee and a summary of written, email and oral comments provided by the public at Council meetings, State-sponsored public hearings and other public fora (PFMC 2003, pp. 1-5 to 1-13, Tables 1.5-1 to 1.5-2).

V. SSC Conclusions and Recommendations to the Council

V.A. Marine Reserves in the Larger Management Context

Marine reserves are advocated as a means of achieving management objectives such as reducing uncertainty in management and providing fishery and ecosystem benefits. In considering reserves as a management measure, it is important not to lose sight of the fact that the appropriate starting point for discussion is the management objective. Management effectiveness is not achieved by focusing *a priori* on any particular regulatory measure but by determining which measure (or combinations of measures) would be most effective in addressing the objective. To accomplish this, it is important that the range of feasible solutions not be unduly restricted from the outset. The Council's EIS on the 2003 groundfish management

specifications provides a good illustration of this point. While area closures were integral to achieving the Council's objective, the objective could not have been achieved without combining those closures with other types of management measures.

The SSC is keenly aware of deficiencies and gaps in existing data and scientific knowledge and the high degree of uncertainty that this situation brings to the management process. Just as uncertainty is an important and explicit topic of discussion in assessment models and regulatory analyses produced by the Council, marine reserve proposals are also expected to convey the extent of uncertainty in data, methods and results. The SSC supports the Council's commitment to fostering a management process in which technical issues can be aired openly and frankly; such dialogue is essential for improving data, methods and the scientific basis of management decisions. Similar transparency is expected in discussions of marine reserve proposals.

An EIS is much more than a paperwork requirement. In preparing an EIS, sponsors of reserve proposals should be aware of the substantive role of the EIS in terms of providing a meaningful synthesis of the information relevant to the issue at hand, conveying that information to the public and policy makers, and moving the process forward in a systematic and well-documented way. To serve the public process, several iterations of an EIS may need to be drafted and made available for public comment to ensure that a reasonable range of alternatives is identified and adequately evaluated. The public cannot be expected to provide constructive input and policy makers cannot be expected to make well-informed decisions unless they have access to a technically sound EIS. Given the SSC's responsibility to foster use of the best available science, an EIS is expected to provide an informative and balanced evaluation of the management issue and the alternatives being considered to address the issue. Any policy preferences expressed in an EIS must be based on a rationale that reflects a careful weighing of alternatives and a recognition of positive and negative effects as well as uncertainties associated with all alternatives (including the recommended one).

Regardless of the management objective, the choice of a preferred management alternative is ultimately a policy decision. While science (meaning both natural and social sciences) may inform some aspects of reserve design and facilitate systematic consideration of reserve effects, all relevant factors must ultimately be weighed in ways that are beyond the scope of science. The uncertainty and imprecision that are inherent in fishery data and assessment methods are also inherent in existing knowledge of marine reserves. Policy makers must weigh the risks and uncertainties associated with reserve and non-reserve management outcomes. Potential beneficial effects within the reserve must be weighed against potentially adverse effects of effort displacement outside the reserve. Intertemporal effects must be weighed in terms of short- versus long-term effects. The distribution of effects among stakeholders must be weighed in terms of defining an equitable

outcome. Policy decisions are further complicated if the reserve is intended to achieve multiple objectives, as the same reserve outcome is not necessarily suited to all objectives and the importance of each objective will need to be weighed in making the decision. In order to ensure that management is informed by the best available science, it is important to distinguish between issues that can be addressed by science and those that cannot. In terms of what constitutes "science", the SSC notes the importance of distinguishing between replicable results derived from technically rigorous analysis and personal opinions expressed by individual scientists (which may differ widely and are not amenable to scientific validation). While scientists (like everyone else) are entitled to personal opinions, it is important that sponsors of marine reserve proposals not rely on such personal opinions to advocate for reserves as a "scientific" solution to management problems. Such advocacy is misleading in terms of what science is and how it can contribute to policy, and ultimately undermines the credibility of science itself.

The EIS for the Council's 2003 groundfish management specifications highlighted the role of OY's, depth-based closures, season closures, vessel landings limits and gear restrictions in protecting overfished groundfish stocks. This was an important objective for the Council. However, by reducing the operational flexibility of fishing operations, such measures may also accentuate (however unintentionally) the incentive for vessel operators to seek additional avenues of investment that allow them to remain competitive in the race for the fish.[7] [8] The SSC takes note of this latter effect not to discourage use of such measures (which are integral to achieving

---

[7] The "race for the fish" - which is endemic in most West coast fisheries - creates an incentive for fishery participants to invest in boats and equipment in ways that increase their competitive advantage. Because all vessels share this incentive, the initial advantage gained from such investment eventually dissipates as more vessels engage in this strategy. The collective result is to encourage additional rounds of investment to stay competitive and more intensive fishing to pay off the debt burden associated with this wasteful type of investment. The economic pressures resulting from excess investment encourage the industry to take a short- rather than long-term view of resource stewardship, require increasingly restrictive measures that contribute to the continuing cycle of overinvestment, and place untenable demands on fishery managers. This is the fundamental problem of fisheries management

[8] The EIS made several allusions to this issue as follows: "Proposed gear restrictions [finfish excluders, small footrope requirements] are likely to reduce gear efficiency, increasing cost per unit of harvest" (PFMC 2003, p. 4-29). Also, "As fishery revenue declines, absent new innovations that increase efficiency, and given the tendency of regulators to impose inefficiency as a means of fishery management, it is likely the fishery's ability to service debt declines" (PFMC 2003, p. 4-29). In an effort to change the incentive to race for the fish, the Council and the industry are now considering the use of individual transferable quotas in the groundfish trawl fishery.

many of the Council's objectives) but to point out that there is no panacea for fishery management problems. Reserves - like other types of management measures - are well suited for some purposes but not others. Reserves - like other measures - can aggravate as well as address problems, depending on the context in which they are applied and the manner in which they are used. The SSC encourages caution in making broad generalizations about reserve effects.

V.B. Process for Considering Marine Reserves

The Channel Islands National Marine Sanctuary has established reserves in State waters and intends to extend these reserves into Federal waters. Given the interest in marine reserves expressed by some States and other National Marine Sanctuaries, similar additional proposals will likely be forthcoming. The SSC requests that the Council consider developing procedures for dealing with such proposals. Council guidance could extend to a number of areas - e.g., procedures for keeping the Council informed and getting on the Council agenda; time constraints and deadlines for participating in the Council process (e.g., Council meeting schedules, briefing book deadlines, meeting notice requirements); types of information regarding the proposal that are needed at various stages of the process (initial discussion, development of alternatives, regulatory analysis, Council deliberation); advisory committees that need to be consulted at each stage; relative responsibilities of the Council and the proposal sponsor in terms of developing management alternatives and preparing the regulatory analysis.

Proposal sponsors would logically have prime responsibility for justifying their own proposals and preparing the analyses needed to evaluate the effects of what is proposed. However, in cases where the objective of a reserve proposal could also be achieved by changes in existing fishery regulations (or by some combination of reserves and non-reserve management measures), the SSC expects the proposal to include alternatives that reflect such possibilities. Not all sponsors are likely to know enough about Council regulations to adequately address this expectation on their own, and may desire Council input in shaping or suggesting alternatives as they relate to fishery regulation. This may be desirable from the Council's perspective as well, to ensure that reserve proposals do not compromise the Council's ability to fulfill its own management responsibilities.

The SSC also requests that the Council consider assuming a broad, proactive role in reserve discussions by developing an explicit policy with regard to marine reserves and working with other appropriate entities to develop a coordinated approach to marine reserves on the West coast. Such coordination would facilitate communication, avoid duplication of effort and increase the likelihood of a productive outcome for all parties. Limited resources are clearly an issue. However, the SSC notes that some commitment of resources will be required, regardless of whether the Council chooses to involve itself by reacting to individual reserve proposals on a case-by-case basis or by being more strategic in its involvement. The SSC is concerned that the currently

fragmented focus on marine reserves as a management strategy may result in outcomes that unduly complicate the Council's ability to carry out its management responsibilities. Given the stock assessment and fisheries expertise available within the Council family and the Council's experience with regulatory process and requirements, proactive Council involvement in marine reserve planning processes would help ensure that such planning is grounded in the best available science and realistically reflects the complexities of management.

VI. Research and Data Needs

The data and models currently used by the Council provide limited consideration of the spatial distribution of habitat, fish and fishing activities. Recent developments (e.g., groundfish closures, EFH considerations) indicate a growing need for spatially explicit data and models. Such needs are directly relevant to Council management concerns and are not unique to marine reserves. Because reserves can affect a broad range of fisheries (depending on the types of fishing activity eliminated from the reserve and the alternative fisheries pursued by displaced vessels in the open area), spatial data are needed for a broad range of fisheries in terms of the distribution of fishing effort and social and economic characteristics of fishing activity. More and better information is needed on habitat and fish distributions. Research is needed on stock assessment models that include a spatial as well as temporal dimension, models that predict spatial shifts in fishing effort, and models that integrate stock and fleet dynamics in a spatially explicit way. Development of appropriate constrained optimization models based on explicit management objectives would be helpful for designing spatial management alternatives and evaluating the degree to which they meet the stated objective.

While more attention to spatial data and models is needed, the SSC notes that data collection is costly and model development is not guaranteed to improve the science needed for management. Increased spatial resolution will require more complex models and thus estimation of many more parameters. Model selection techniques will need to be applied to determine how differences in spatial resolution affect model performance and what approaches to data pooling might be appropriate. To the extent that data pooling occurs in non-spatial dimensions, the possibility exists that models will become less informative with regard to non-spatial dimensions of fish and fishery behavior.

Spatial closures are one of several methods that can be used in fishery management to reduce bycatch. The Council's groundfish closures are an example of this, albeit an extraordinary one due to the size of the closures. The groundfish closures provide a unique opportunity to analyze the effects of effort displacement on fishery participants, fishing communities and fish stocks in the open area. An important aspect of such research will be to distinguish the effects of effort displacement from other factors that may be going on concurrently with the displacement (e.g., regulatory changes).

If fishery-independent surveys are prohibited in reserve areas, the possibility of alternative data collection methods in the reserve may need to be considered to ensure the continuity of time series data used in stock assessments. This will require evaluating alternative non-lethal sampling methods in terms of feasibility, cost and whether they would provide the types of data needed for stock assessment. If non-lethal methods are deemed suitable, sampling procedures for reserve areas will need to be developed, as well as methods of calibrating results of such surveys with those from more traditional survey techniques used in the past. Consideration will also need to be given to whether possible changes in fish dynamics associated with reserve establishment may require changes in stock assessment models.

VII. List of Acronyms

CEQ - Council on Environmental Quality
CPUE - catch per unit effort
EFH - Essential fish habitat
EIS - Environmental Impact Statement
EO - Executive Order
ESA - Endangered Species Act
fm - fathom
FMP - Fishery Management Plan
GMT - Groundfish Management Team
HG - harvest guideline
IPHC - International Pacific Halibut Commission
LE - limited entry
MSFCMA - Magnuson-Stevens Fishery Conservation and Management Act
mt - metric tons
NEPA - National Environmental Policy Act
NMFS - National Marine Fisheries Service
OA - open access
OY - optimum yield
RFA - Regulatory Flexibility Act
SBA - Small Business Administration
VMS - vessel monitoring system

VIII. References

Cote, I.M., I. Mosqueira and J.D. Reynolds. 2001. Effects of marine reserve characteristics on the protection of fish populations: a meta-analysis. *Journal of Fish Biology*. 59 (Supplement A): 178-189.

Council on Environmental Quality. January 1993. *CEQ Guidance Regarding Biodiversity*. Council on Environmental Quality, Washington DC.

Council on Environmental Quality. January 1997. *CEQ Guidance Regarding Cumulative Effects*. Council on Environmental Quality, Washington DC.

Freese, L., P.J. Auster, J. Heifetz, and B.L. Wing. 1999. Effects of trawling on seafloor habitat and associated invertebrate taxa in the Gulf of Alaska. *Mar. Ecol. Prog. Ser.* 182:119-126.

Friedlander, A.M., G.W. Boehlert, M.E. Field, J.E.Mason, J.V. Gardner, and P. Dartnell. 1999. Sidescan-sonar mapping of benthic trawl marks on the shelf and slope off Eureka, California. *Fish. Bull.* 97:786-801.

Halpern, B.S. 2003. The impact of marine reserves: do reserves work and does reserve size matter? *Ecological Applications*. 13(1) Supplement: S117-S137.

Hurlbert, S.H. 1984. Pseudoreplication and the design of ecological field experiments. *Ecological Monographs*. 54(2): 187-211.

Lawson, P.W. 1990. *Differential Selectivity of Three Gear Arrays Used in Commercial Trolling for Coho and Chinook Salmon*. Oregon Department of Fish and Wildlife, Ocean Salmon Management Program, Newport, Oregon.

Martell, S.J.D., C.J. Walters and S.S. Wallace. 2000. The use of marine protected areas for conservation of lingcod (*Ophiodon elongatus*). *Bulletin of Marine Science*, 66(3): 729-743.

Mosqueira, I. *et al.* 2000. Conservation benefits of marine reserves for fish populations. *Animal Conservation*. 4: 321-332.

National Marine Fisheries Service, Office of Sustainable Fisheries. Revised August 16, 2000. *Guidelines for Economic Analysis of Fishery Management Actions*.

National Marine Fisheries Service. Revised May 1, 1997. *Operational Guidelines - Fishery Management Plan Process*. Silver Spring, Maryland.

National Oceanic and Atmospheric Administration. 1999. *Environmental Review Procedures for Implementing the National Environmental Policy Act*. NOAA

Administrative Order 216-6.

National Oceanic and Atmospheric Administration. 1998. *Magnuson-Stevens Act Provisions; National Standard Guidelines; Final Rule* (50 CFR Part 600).

Oregon Ocean Policy Advisory Council. 2002. *Recommendation to the Governor - Oregon and Marine Reserves.* Revised Working Group Draft for Discussion August 16, 2002.

Pacific Fishery Management Council. January 2003. *Final Environmental Impact Statement for the Proposed Groundfish Acceptable Biological Catch and Optimum Yield Specifications and Management Measures - 2003 Pacific Coast Groundfish Fishery.*

Paddack, M.J. and J.A. Estes. 2000. Kelp forest fish populations in marine reserves and adjacent exploited areas of central California. *Ecological Applications.* 10(3): 855-870.

Palsson, W.A. and R.E. Pacunski. 1995. The response of rocky reef fishes to harvest refugia in Puget Sound. In: *Puget Sound Research Proceedings '95,* Vol 1, pp. 224-234, Puget Sound Water Quality Authority, Olympia, WA.

Restrepo, V.R. *et al.* 1998. *Technical Guidance on the Use of Precautionary Approaches to Implementing National Standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act.* NOAA Technical Memorandum NMFS-F/SPO. 54 pp.

Schroeter, S.C. *et al.* 2001. The use of marine reserves in evaluating the dive fishery for the warty sea cucumber (*Parastichopus parvimensis*) in California, U.S.A. *Can. J. Fish. Aquat. Sci.* 58: 1773-1781.

Small Business Administration, Office of Advocacy. May 2003. *How to Comply with the Regulatory Flexibility Act - A Guide for Government Agencies.*

Tuya, F.C., M.L. Soboil and J. Kido. 2000. An assessment of the effectiveness of Marine Protected Areas in the San Juan Islands, Washington, USA. *ICES Journal of Marine Science.* 57: 1218-1226.

Appendix A. Implications of Restricting Fishery-Independent Surveys Inside Reserves

An important issue to consider in evaluating reserve proposals is whether or not fishery-independent surveys currently used for stock assessment would be prohibited (along with other types of fishing activity) inside the reserve. To the extent that the size and location of reserves do not significantly interfere with the customary spatial coverage of fishery-independent surveys, this will not be a problem. However, to the extent that such interference does occur, alternative non-lethal data collection methods - e.g., remotely operated vehicles (ROVs), submersibles (subs) - may need to be considered in reserve areas.

Dead fish sampled in fishery-independent surveys provide valuable data on length, age, sex, stomach contents and stock structure, as well as an index of abundance. Non-lethal survey methods can provide data on observable characteristics of fish that are useful for stock assessment (length, index of abundance, also sex for species where this is visually obvious). In same cases, it may also be possible to collect genetic material without killing the animals. However, data on age and stomach contents cannot be obtained from non-lethal surveys (Table A-1). The loss of age structure information - which is critical to estimating year class strengths - is particularly significant in terms of limiting what can be done with stock assessment models.

In addition to issues regarding loss of data important for stock assessment, the use of non-lethal sampling methods also raises issues of cost and calibration. Non-lethal sampling is costly. Because sampling of this type provides an index of abundance for a limited time period, it must be repeated frequently to be useful for stock assessment. By contrast, a single trawl survey can provide a whole demographic sample from which inferences can be drawn regarding year class strengths.

This is not to say that trawl surveys are well suited for all purposes. For instance, trawls have limited access to rocky areas. Trawls are also incapable of providing observations of fish behavior (e.g., fish-habitat associations, fish-fish associations) in the context of the environment in which they occur. On the other hand, non-lethal methods also have their limitations. For instance, the ability of small ROVs to run transects in heavy currents is limited. Large ROVs and subs are costly to operate. Use of subs is limited by weather conditions. Video techniques used on ROVs and subs are not suitable for observing pelagic rockfish. No single data collection method is suitable for all ocean conditions or purposes.

Fishery-independent trawl survey data provide critical information for stock assessment. A lengthy time series has been constructed with such data. Combining trawl survey data collected outside the reserve with data from live sampling inside the reserve will require intercalibration of surveys. Achieving such calibration will likely require that both survey methods be used outside reserves for a number of years.

If at some point the Council is faced with the prospect of utilizing non-lethal survey methods in reserve areas for its own assessments, it will be important that the Council evaluate the desirability of relying on sponsors of reserve proposals to provide such data from their own monitoring programs. One issue that may arise is whether the proposal sponsor is willing to provide the Council not only with summaries of monitoring results but also the raw data collected in the monitoring program. This may be problematic, for instance, If the data are collected by individual researchers who may claim the data as intellectual property. Additional issues in this regard pertain to whether the Council can count on the data collection being sustained over the long term and whether the data will be made available to the Council in a sufficiently timely manner to allow the Council to meet its assessment schedules. Continuity and timeliness of data are issues that the Council already faces with the data that it routinely uses. These issues are potentially more difficult if the Council must rely on data being collected by entities who do not have an ongoing stake in Council decisions.

The SSC notes that the development of alternative survey methods is an issue that the Council may need to address in the future, for reasons of its own. As indicated in the Council's Environmental Impact Statement on the 2003 groundfish management specifications, "For overfished stocks with low OY values, the research take can represent a significant proportion of the harvest specification. At the same time, the reduction in fishery catches means less data are available from this source, making it even more difficult to determine abundance, measure stock recovery, and estimate potential yields....Because catches of overfished species has become a critical concern, survey methods that do not involve capture need to be developed" (PFMC 2003, p. 3-61).

Table A-1. Types of biological data that can be obtained using non-lethal and lethal sampling methods.

Data Type	Non-Lethal Sampling Methods (e.g., subs, ROVs)	Lethal Sampling Methods (e.g., trawling)
Index of abundance	Yes	Yes
Length	Yes	Yes
Age	No	Yes
Sex	Maybe	Yes
Stomach contents	No	Yes
Genetics	Maybe	Yes
Fish-habitat association	Yes	No
Fish-fish association	Yes	No

Exhibit H.1.b
Supplemental SSC Report
March 2004

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON SCIENTIFIC AND STATISTICAL COMMITTEE REVIEW OF MARINE RESERVES ISSUES

The Scientific and Statistical Committee (SSC) discussed the draft report on marine reserve proposals being prepared by the SSC's Marine Reserves Subcommittee. This meeting was the first opportunity for the entire SSC to review the report, and the SSC does not have a final report for the Council to consider at this time. The draft report is comprehensive, and the SSC commends the Marine Reserves Subcommittee for its work thus far. The SSC received helpful comments from the public during its discussion. The SSC discussion and public comments motivated a set of revisions to the current draft, and the SSC anticipates that a final version of the report will be ready for the Council in June 2004.

The SSC would like to clarify that an intended audience for the report includes agencies and entities that request Council consideration of proposals to establish marine reserves in federal waters on the West Coast. Revisions to the draft report will make this intention explicit. The SSC emphasizes that material in the report should be interpreted as guidelines for future proposals. The report is intended ultimately to be used as a reference, and provide aid for navigating federal policies (e.g., National Environmental Policy Act) that must be followed by the Council to implement fishing regulations.

The SSC is aware that the terminology used to define spatial closures varies from one entity to another (e.g., California's Marine Life Protection Act, National Research Council). The SSC report distinguishes between closures for a specific period of time until some condition is met (e.g., rockfish conservation areas), and indefinite closures. In particular, the report currently refers to marine reserves as permanent closures to some or all forms of fishing. The SSC intends for language in the report to be consistent with terminology in other Council documents.

The report emphasizes the importance of defining objectives, setting performance standards, and establishing criteria to measure progress towards meeting objectives. In general, science can be useful for establishing criteria and methods for measurement. On the other hand, identifying objectives and setting standards for marine reserves will require policy decisions.

The report describes five types of objectives for marine reserves, (1) provide insurance against errors in fishery science or management, (2) provide fishery benefits, (3) provide ecosystem benefits, (4) provide nonfishing social benefits, and (5) provide opportunity to advance scientific knowledge.

Revisions to the draft report will further elaborate on the objectives related to providing social benefits (Section III.D.) and advancing scientific knowledge (Section III.E.). Specifically, Section III.D. will be expanded to include a discussion of trade-offs among consumptive, non-consumptive and non-use values of the ocean and the potential use of non-market valuation techniques (e.g., travel cost, hedonic pricing, contingent valuation) in revealing such trade-offs. Section III.E. will be expanded to focus on study plans for scientific research proposals. In addition, the discussion of EIS examples in Section IV of the current draft is extensive, and much of this material will be moved to an appendix.

PFMC
03/11/04

GROUNDFISH ADVISORY SUBPANEL STATEMENT ON SCIENTIFIC AND STATISTICAL COMMITTEE REVIEW OF MARINE RESERVES ISSUES

The Groundfish Advisory Subpanel (GAP) reviewed the report prepared by the Scientific and Statistical Committee's (SSC) Marine Reserves Subcommittee.

In general, the GAP agrees with the SSC report. As it has stated previously, the GAP believes that marine reserves are one tool in the management toolbox that should be available for use where appropriate. Marine reserves are not a general panacea to solve all problems related to groundfish conservation and management, but they could be useful in certain circumstances. The key point is that the problem should dictate which tool is to be used; we should not arbitrarily decide that we are going to have marine reserves and then look to see whether they have actually addressed a problem. If marine reserves are established, they should encompass well-defined scientific objectives and monitoring programs.

In this context, the GAP cautions that we should not consider marine reserves separately and distinctly from other conservation and management efforts. They have to be considered holistically along with such things as conservation of essential fish habitat, time and area closures, gear-specific closures to achieve allocation or other social and economic goals, and ecosystem-based management. In some cases, a marine reserve could encompass many of these management objectives, thereby reducing the amount of area put off limits to fishing.

PFMC
03/11/04

Exhibit H.1.c
Supplemental HC Report
March 2004

HABITAT COMMITTEE COMMENTS ON SCIENTIFIC AND STATISTICAL COMMITTEE REVIEW OF MARINE RESERVES ISSUES

The Habitat Committee (HC) reviewed and discussed the SSC White Paper on Marine Reserves. Our committee appreciates the substantial effort put forward to articulate the issues associated with the Council's consideration of marine reserves. We applaud the call for rigor and a consistent approach in the Council's consideration of all management tools, including marine reserves. This paper will lead to progress in implementing the marine reserve aspects of the Council's Groundfish Strategic Plan.

All of the Council's management and conservation decisions take place in a context of substantial scientific uncertainty. It is important to remember that marine reserves will represent another experiment in fishery management and conservation with comparable uncertainty.

Marine reserves have points in common with other management tools available to the Council, such as areas closures. They could also be a tool in protecting any designated habitat areas of particular concern (HAPCs) (those that contain rare, sensitive, vulnerable or important ecological functions). The SSC may want to address this role specifically in the White Paper.

Marine reserves have the potential to address multiple Council objectives concurrently, notably population size and age structure, bycatch, stock rebuilding, sustainable ecosystems, and habitat conservation. To ensure marine reserve proposals address these multiple objectives, the HC supports the SSC's recommendation that the Council consider developing a mechanism to ensure others understand Council expectations regarding marine reserve proposals.

The Habitat Committee suggests that the consideration of marine reserves as a management and conservation tool continue with as much rigor as possible, but without unrealistic *a priori* information requirements or expectations.

PFMC
03/11/04

UPDATE ON OTHER MARINE PROTECTED AREA ACTIVITIES

Situation: This update on ongoing marine protected areas (MPAs) activities covers the following areas:

1. Monterey Bay National Marine Sanctuary (MBNMS) MPA Planning.
2. Channel Islands National Marine Sanctuary (CINMS) Marine Reserves Process.
3. NOAA Meeting on Integration of MPA Science with Fisheries Management.
4. MPA Workshop to be Held in Seattle on March 27.

1. The **Monterey Bay National Marine Sanctuary** has developed a set of proposed action plans as part of the central California Sanctuaries' Joint Management Plan Review process. The plans relate to MPAs, bottom trawling effects on benthic habitats, krill harvesting, fishing-related research and education, and protection of Davidson Seamount. Staff from the MBNMS will provide a brief overview of MPA planning efforts in the Sanctuary. The Sanctuary's MPA Action Plan is included (Exhibit H.2.b, MBNMS Report.) The Council also received public comment related to MBNMS (Exhibit H.2.e, Public Comment).

2. CINMS Marine Reserves Process. The CINMS is in the process of preparing a Draft Environmental Impact Statement (DEIS) on marine reserves in the federal waters of CINMS. It is likely that a draft of the portion of the EIS describing the range of alternatives will be ready for review by the Ad Hoc Channel Islands Marine Reserve Committee before the June 2004 Council meeting. A review of the process and schedule for this effort may be available at the April 2004 Council meeting.

3. NOAA Meeting on Integration of MPA Science with Fisheries Management. NOAA held a meeting in Santa Cruz on February 26-27, 2004 to develop terms of reference for a series of workshops to integrate the science of MPAs and fishery management. The meeting was attended by representatives of NMFS Northwest and Southwest Regions, National Ocean Service, Council, Sanctuaries, and Oregon State University. Council staff will provide a brief summary of the meeting. A review of the process and schedule for this effort may be available at the April Council meeting.

4. The **National Marine Protected Areas Center's Training and Technical Assistance Institute** has developed a one-day workshop for the general public entitled "Understanding Marine Protected Areas." A workshop will be held on Saturday, March 27, 2004, at the Seattle Aquarium. The target audience for the workshop is the general public, and the workshop has been designed to be politically neutral. Council staff will be happy to provide more details about the workshop if requested.

Council Task:

1. Council Discussion.

Reference Materials:

1. Exhibit H.2.b, MBNMS Report: MBNMS's Special Marine Protected Areas Action Plan.
2. Exhibit H.2.e, Public Comment.

Agenda Order:

a. Agendum Overview	Dan Waldeck
b. Report of the Monterey Bay National Marine Sanctuary	Huff McGonigal
c. Report on NOAA Workshop	Dan Waldeck
d. Reports and Comments of Advisory Bodies	
e. Public Comment	
f. Council Discussion	

PFMC
02/24/04

SUPPLEMENTAL UPDATE ON OTHER MARINE PROTECTED AREA ACTIVITIES

Monterey Bay National Marine Sanctuary (MBNMS)

MBNMS is currently developing action plans for a suite of marine protected area (MPA) related initiatives within MBNMS, these include special MPAs, inclusion of Davidson Seamount within the sanctuary boundary, and a ban on krill fishing within the sanctuary.

Davidson Seamount and krill ban initiatives are scheduled for completion during 2004. Development of special MPAs is on a longer-term schedule and could be completed during the next few years.

Most of these MPA-related initiatives will require coordination with the Pacific Fishery Management Council (Council). For example, within the next six months, it is anticipated MBNMS will request Council input for both the krill harvesting ban and Davidson Seamount issues. This will likely include a request for the Council to determine its role in both endeavors.

To provide the Council more information on these activities, Dr. Holly Price (MBNMS) will brief the Council at the March 2004 meeting.

Channel Islands National Marine Sanctuary (CINMS)

CINMS is developing an Environmental Impact Statement (EIS) for alternatives to create MPAs within federal waters of CINMS.

CINMS staff intend to provide materials for the April 2004 Council meeting briefing book. At the April Council meeting, CINMS is tentatively scheduled to present information to the Scientific and Statistical Committee (SSC) and other Council advisory bodies. CINMS is seeking specific input from the SSC on technical aspects of draft management alternatives and analytical approaches.

It is anticipated CINMS will present information to the Council at the June 2004 meeting and request formal Council action in response to their draft EIS, specifically fishery-management related components of CINMS alternatives for MPAs in federal waters. To facilitate Council consideration of CINMS proposed alternatives, it is anticipated the Council's Ad Hoc Channel Islands Marine Reserve Committee will need to meet prior to the June 2004 Council meeting.

MPA Center

National Oceanographic and Atmospheric Administration's (NOAA) MPA Center in Santa Cruz, California is coordinating an initiative to address science and technical issues related to integration of MPAs with fishery management. This will involve establishment of a working group to address the science and technical issues and a two-year schedule for completion of the project.

An oversight group, including representatives from NMFS (Sustainable Fisheries, Protected Resources, Habitat), National Ocean Service, the Council, and Oregon State University, met February 26-27, 2004 in Santa Cruz, California. The group initiated development of a list of issue areas and specific issues that would form the basis of the working group's statement of work. The oversight group also discussed potential working group participants in terms of the types of expertise that would be required; for example, fishery scientists and managers, marine ecologists, fishery economists, and user groups (including commercial and recreational fisheries, and conservation groups). The oversight group is developing terms of reference and a statement of work for the working group.

The MPA Center is tentatively scheduled to present an informational update to the Council at the April 2004 meeting in Sacramento, California.

National Fisheries Conservation Center (NFCC) Marine Reserves Science Conference

A consensus conference related to the science of marine reserves is being coordinated by NFCC. Information about this conference was presented to the Council in 2003. Objectives of the conference included developing information about the "state of the science" related to the integration of marine reserves into fishery management. The conference has apparently been scheduled for June 2004 in Long Beach California. However, it is unclear if NFCC has secured the necessary funds for the conference. The Council has not received updated information from NFCC.

PFMC
03/11/04

Special Marine Protected Areas Action Plan

Goal Statement

To determine the role, if any, of additional Marine Protected Areas in maintaining the integrity of biological communities in the Monterey Bay National Marine Sanctuary, and to protect, and where appropriate, restore and enhance natural habitats, populations and ecological processes. If additional MPAs are to be created, provide for the design of MPAs that are compatible with the continuation of long-term sustainable fishing in the Sanctuary, as fishing is a key cultural and economic component of the region.

The action plan will outline the framework for coordinating with and providing input to appropriate state and federal agencies on the need for, purpose, design and implementation of MPAs within the MBNMS region, whether initiated or coordinated by the Sanctuary or other agencies. A multi-stakeholder workgroup will work together to implement the components of the action plan.

MBNMS Staff Contact

Holly Price	Resource Protection Coordinator

MBNMS Staff

Huff McGonigal	Environmental Policy Specialist
Erica Burton	MBNMS Research Assistant
Liz Love	Education Specialist

Working Group Members

Tom Canale	Commercial Fishing/SAC
Mike Ricketts	Commercial Fishing/Alliance Chair
Don Dodson	Commercial Fishing
David Crabbe	Commercial Fishing
Howard Egan	Recreational Fishing
David Ebert	Coastal Business and Ecotourism
Steve Scheiblauer	Fishing Related Businesses
Peter Grenell	Harbors/SAC
Jim Seger	PFMC
Lisa Wooninck	NMFS, SWR Science Center
Paul Reilly	CDFG/SAC
Chris Harrold	Research/SAC
Mark Carr	UCSC/PISCO
Bill Sydeman	Research, PRBO
Vicki Nichols	Conservation/SAC
Mike Osmond	Conservation

Kaitilin Gaffney	Conservation
Frank Degnan	Diving/SAC
Pat Clark-Gray	Education/SAC
Astrid Scholz	Socioeconomics
Mark Helvey	NMFS, SWR Regulatory
Rick Starr	Sea Grant

INTRODUCTION

Marine Protected Areas (MPAs) are a management tool that may include a range of strategies from fully restricting harvesting of marine life within a designated geographic area, allowing take of selected species or restricting other types of human activities. Scientific research has indicated that carefully crafted MPAs can be effective tools for conservation of biodiversity and habitats. MPAs may be used as a means to restore degraded areas and as a precautionary tool to conserve a range of representative habitats and biodiversity. Well-designed MPAs generally contain higher species diversity, more abundant species, and larger fish within their boundaries relative to impacted areas of similar habitat outside the reserve. These larger fish produce many more young than do smaller fish. MPAs are one of many useful tools that can be used to prevent, slow, or reverse negative habitat and ecosystem changes within the Sanctuary. MPAs may also cause unintended positive or negative ecological, social or economic consequences. As the science of MPAs is evolving, care must be given to actively evaluate emerging MPA studies, whether they show positive or negative impacts of MPAs. The MBNMS will also consider other management tools that may enable the Program to meet its conservation goals.

The MBNMS received many comments during the scoping period of the Joint Management Plan Review (JMPR) requesting increased protection of the ecosystem by taking the lead in implementing a network of MPAs in State and Federal waters. Scoping period comments also asked that regulatory authority on fishing and MPAs remain with existing State and Federal agencies, and that any consideration by the MBNMS of MPAs should be based on consensus with the fishing industry. The MBNMS believes that any consideration of MPAs should and will be a joint effort with the participation of many diverse stakeholders, including strong participation of the fishing community to tap into their extensive knowledge and to consider socioeconomic impacts of alternative MPA designs, as well as participation from other agencies, scientists, environmental organizations and the public.

Strong interagency collaboration with the National Marine Fisheries Service, Pacific Fisheries Management Council, and the California Department of Fish and Game will be an essential component during the evaluation of the need for MPAs and in their design. The Sanctuary will facilitate continuation of a multi-stakeholder workgroup representing agencies, the fishing community, environmental organizations, scientists and other stakeholders to carry out the evaluations outlined in the plan below. If the workgroup

ultimately recommends the establishment and locations of specific MPAs, they could be implemented in future years via a variety of mechanisms and agencies. Depending on the final design of MPAs, their implementation could draw on authorities of various state and federal agencies under the Magnuson-Stevens Act, the National Marine Sanctuaries Act, the state's Marine Life Protection Act and/or the Marine Managed Areas Improvement Act.

Workgroup Planning

To address the issue of the role, if any, of MPAs in protecting Sanctuary resources the MBNMS developed a Workgroup of the Sanctuary Advisory Council to provide guidance on several aspects of MPAs. Since the MBNMS is a "marine protected area" itself, this Action Plan is using the term Special Marine Protected Areas to distinguish these smaller, more focused MPAs that might limit harvest from the MBNMS itself.

The Workgroup was asked to outline the framework for the need for, purpose, design and implementation of MPAs within the MBNMS region. The framework describes the process, goals and criteria for effective special MPAs and provides recommendations for future steps to evaluate the issue. Although the revised management plan itself will not specify exact locations for special MPAs, the Sanctuary will continue the planning effort in the future with the Workgroup to conduct additional evaluations using the framework document as a guide. Much detailed work remains to conduct a thorough evaluation of the issue, including a more detailed assessment of the need for MPAs, identification of specific habitats and ecological processes that could benefit from protection, identification of potential and existing threats, development of site-specific goals, consideration of design criteria which incorporate biological and socioeconomic issues, integration with other management efforts, and articulation of monitoring, education and enforcement needs.

The Workgroup refined a draft list of future work topics that address these and other issues in the special MPA plan. This list, shown below, will provide the basis for a longer-term work program for implementation, with continued involvement by the Workgroup. The Workgroup identified the strategies below as necessary steps to achieving the objectives laid out in the goal statement. Strategy one addresses the need to form working partnerships with stakeholders and other agencies that will facilitate the implementation of the plan. Strategy two focuses on the evaluation of the need for MPAs and identification of the resources to be protected. Strategies three through six focus on effective design of MPAs, considering biological issues, patterns of use, socioeconomics and potential for integration with other management measures. Strategies seven through nine focus on considering education, enforcement and research programs during both MPA design and implementation phases. Strategies ten and eleven focus on implementation issues related to phasing of MPAs and to coordination of interagency designation processes, assuming a decision is reached in future years regarding the need for MPAs and on their locations.

Strategy MPA-1: Develop Partnerships

Activity 1.1: Develop Partners During Evaluation, Goal Setting, and Design Phases

A. Continue multi-stakeholder workgroup for evaluation and design, and allow for continued involvement of local communities
B. Ensure constituent involvement and adequate notification for public involvement
C. Outline roles and steps for involvement of Sanctuary, NMFS, PFMC, and CDFG and identify common goals
D. Develop partnerships with CDFG, NMFS, PFMC and consider joint staffing during evaluation and design phases
E. Evaluate linking to and coordination with potential PFMC evaluation of MPAs
F. Ensure coordination with any processes in state waters

Status: Phase 1
Potential Partners: NMFS, CDFG, PFMC, local research institutions, fishermen, MPA working group members

Strategy MPA-2: Conservation Goals and Objectives and Habitats and Resources to be Protected

Strategy Description
This strategy outlines activities the working group must address in defining more specific conservation objectives for special MPAs, considering the range of habitats and ecological interactions which may warrant protection, and the threats to those resources.

Activity 2.1: Develop Specific Conservation Goals and Objectives for Special MPA Program, Building on General Goal Statement Above as Part of Ongoing Multi-stakeholder Process

Status: Phase 1
Potential Partners: MPA Group Members, NMFS, CDFG, fishermen, scientists

Activity 2.2: Consider Range of Representative Habitat Type- e.g. Hard Bottom, Soft Bottom, Kelp Forest, Pelagic, Rocky Intertidal, Estuarine, etc.

Status: Phase 1
Potential Partners: NMFS, CDFG, Fishermen, MPA Group Members

Activity 2.3: Identify Key Ecological Interactions, Including Predator-Prey Relationships, Migratory Patterns, Life History Stages, and the Role of Biogenic Habitat (e.g. kelp)

Status: Phase 1
Potential Partners: NMFS, CDFG, fishermen, MPA group members

Activity 2.4: Identify Emerging or Existing Threats to These Habitats, Resources or Interactions

Status: Phase 1
Potential Partners: NMFS, PFMC, CDFG, fishermen, MPA group members

Activity 2.5: Identify Resource or Habitat-specific Objectives for Special MPAs and/or Network/Collection of Special MPAs

Status: Phase 1
Potential Partners: MPA group members

Activity 2.6: Include Mix of Degrees of Habitat Health Ranging from Areas that are Minimally Disturbed and Set Aside for Protection, to Historically Productive, Currently Underused Habitats Set Aside to Allow Recovery

Status: Phase 1
Potential Partners: NMFS, CDFG, fishermen, MPA group members

Strategy MPA-3: General Design Criteria

Strategy Description
This strategy outlines the various criteria the working group must describe and evaluate in designing special MPAs, including biological issues, human use patterns, questions of scale and size, and practical implementation issues.

Activity 3.1: Consider Biological and Physical Factors

A. Consider biological factors identified above in Strategy MPA-2.
B. Consider proximity to ecological "hotspots."
C. Evaluate physical oceanographic factors such as currents, upwelling, etc.
D. Consider biological relationships between State and Federal waters for a network/collection of special MPAs.

Status: Phase 1
Potential Partners: NMFS, PFMC, Fishermen, MPA Group Members, Local Research Institutions

Activity 3.2: Consider Human Use Patterns

A. Evaluate distribution of human activities on the water. (Phase 1)
B. Evaluate how locations and distances may impact different user groups and local communities. (Phase 1)
C. Consider distances from port and safety issues. (Phase 1)
D. Evaluate potential impacts of displacement of fishing effort to other areas. (Phase 2)
E. Consider access by other target users, such as divers, kayakers, shore fishermen, researchers. (Phase 2)
F. Map location of existing small reserves, areas closed to certain types of fishing, and other types of MPAs. (Phase 1)
G. Consider locations of other types of human threats—e.g. water quality, landslides, vessel traffic, MPWC. (Phase 1)

Potential Partners: Fishermen, USCG, Harbormasters, CDBW, CDFG, Fishing Clubs, NOAA Rec. Survey, Dive Shops, Whale Watchers, Kayak Companies, Yacht Associations, MPA Center, NMFS, Divers, Researchers

Activity 3.3: Address Considerations of MPA Size and Scale

A. Ensure that special MPAs are sized appropriately to meet objectives, considering biological and socioeconomic factors.
B. Consider distances between special MPAs and between types of special MPAs.
C. Evaluate the need for a network of special MPAs as opposed to individually sited special MPAs.

D. Determine appropriate scale of a network/collection.
E. Incorporate variability in special MPA design to improve effectiveness evaluations.

Status: Phase 2
Potential Partners: Fishermen, USCG, Harbormasters, CDBW, CDFG, Fishing Clubs, NOAA Rec. Survey, Dive Shops, Whale Watchers, Kayak Companies, Yacht Associations, MPA Center, NMFS, Divers, Researchers

Activity 3.4: Consider Design Issues Specific to Federal Waters

A. Define conditions where it is beneficial to extend state MPAs to federal waters, and when separate special MPAs may be more appropriate
B. Evaluate type and orientation of extension that may be appropriate across state and federal waters, and consider the benefits and disadvantages of doing so
C. Evaluate potential for separate offshore special MPAs focused on biological hotspots correlated with persistent physical and oceanographic features
D. Evaluate the persistence of pelagic hotspots over time
E. Consider practical feasibility of pelagic restrictions, including possibility for temporary closures

Status: Phase 1
Potential Partners: NMFS, CDFG, PFMC, local research institutions, fishermen, MPA working group members

Activity 3.5: Consider Practical Implementation Issues

A. Consider proximity and ability to enforce.
B. Consider ability to monitor for effectiveness evaluation.

Status: Phase 2
Potential Partners: USCG, CDFG, MPA Center, NMFS, local research institutions

Strategy MPA-4: Types of Use

Strategy Description
Special MPAs may vary from full no-take reserves which allow no harvest to areas which allow some levels of harvest, and areas which allow varying types of non-extractive uses. This strategy outlines the need for the working group to evaluate options for varying types of use
in designing special MPAs

Activity 4.1: Consider mix of options that may restrict certain human activities at selected sites in a special MPA or special MPA network/collection

Status: Phase 2
Potential Partners: Fishermen, CDFG, MPA working group members, NMFS, local research institutions, PFMC, divers

Activity 4.2: Consider relationship between state MPA classifications and Sanctuary designations

Status: Phase 2
Potential Partners: CDFG, MPA working group members, NMFS, local research institutions

Strategy MPA–5: Integrated Management

Strategy Description
This strategy outlines issues the working group must consider in coordinating the development of special MPAs with other types of management measures.

Activity 5.1: Identify and Evaluate Other Existing or Planned Ecosystem, Fishery, or Land-based Management Tools, as Feasible Within Staff Limitations

Status: Phase 1
Potential Partners: CDFG, MPA Center, NMFS, local research institutions, PFMC, fishermen

Activity 5.2: Identify and Evaluate Gaps, Limits and Constraints of Existing Tools, as Feasible Within Staff Limitations

Status: Phase 1
Potential Partners: CDFG, MPA Center, NMFS, local research institutions, PFMC, fishermen

Activity 5.3: Evaluate Means to Effectively Integrate and Coordinate Special MPAs With These Tools to Leverage and Strengthen Efforts and Avoid Duplication

Status: Phase 2
Potential Partners: CDFG, MPA Center, NMFS, local research institutions, PFMC, fishermen

Activity 5.4: Use Special MPAs to Help Leverage Agency Resources to Address Multiple Threats to Key Sites, Including Land-based Activities

Status: Phase 2
Potential Partners: CDFG, MPA Center, NMFS, local research institutions, Cal-Trans

Activity 5.5: Identify and Consider Possible Synergies Between Land-based Protected Areas (e.g. state parks) and Adjacent Special MPAs For Staffing, Education, Enforcement, Research, or Reduction of Land-based Threats

Status: Phase 2
Potential Partners: State Parks, CDFG, MPA Center

Strategy MPA-6: Socioeconomic Impact Analysis and Mitigation

Strategy Description
This strategy outlines activities to assess potential negative and positive socioeconomic impacts of MPAs during the design and post-design stages, and steps to mitigate potential negative effects.

Activity 6.1: Identify Types of Socioeconomic Analyses to Assist in the Design and Evaluation of Biologically Effective Special MPAs That Will Allow Continuation of Sustainable Fishing Practices and Sustainable Communities

A. Evaluate how the community is affected, including cultural and economic sustainability of both consumptive and nonconsumptive factors and values.
B. Evaluate user groups and ports affected, short and long-term effects, and potential for buffering or reducing negative effects
C. Consider economic uses that may be improved by designation of special MPAs
D. Consider social values of a wide variety of different people in evaluating special MPAs

Status: Phase 1 for background studies to assist in design, Phase 2 for later studies to evaluate design
Potential Partners: CDFG, MPA Center, NMFS, local research institutions, PFMC, fishermen, socioeconomists, user groups

Activity 6.2: Prioritize Studies Needed and Ensure Their Implementation, Including Those Required by NEPA

Status: Phase 1
Potential Partners: CDFG, MPA Center, NMFS, local research institutions, PFMC, fisher, Socio-economists, user groups

Activity 6.3: Work with NOAA and Department of Commerce to Expand/Develop Economic Mitigation Programs for Users That May be Impacted

Status: Phase 2
Potential Partners: CDFG, NMFS, local research institutions, PFMC, fisher, Socio-economists

Strategy MPA-7: Enforcement and Compliance Program

Strategy Description
This strategy outlines activities needed to design an effective enforcement program.

Activity 7.1: Identify Components of an Effective Enforcement Program and Implementation Mechanisms to Provide Adequate Surveillance on the Water and in the Air

Status: Phase 2
Potential Partners: CDFG, USCG, State Parks

Activity 7.2: Develop Partnerships and Cooperative Interagency Enforcement Plans

Status: Phase 2
Potential Partners: CDFG, USCG, State Parks, MPA working group members

Activity 7.3: Ensure Adequate Training of Enforcement Officers in MPA Management and Regulations

Status: Phase 2
Potential Partners: CDFG, USCG, State Parks, NOAA OLE

Activity 7.4: Work to Facilitate Compliance via Tools such as GPS Systems

Status: Phase 2
Potential Partners: CDFG, USCG, State Parks, PFMC

Activity 7.5: Enlist Community Participation in Special MPA Management and Enforcement to Maximize Cost-effectiveness of Enforcement Program and Enhance Compliance

Status: Phase 2
Potential Partners: CDFG, USCG, State Parks, community groups

Strategy MPA-8: Education and Outreach Program

Strategy Description
This strategy outlines outreach and education needs during both the design and post-design phases.

Activity 8.1: Identify Target Audiences and Develop Components of an Effective Education and Outreach Program

Status: Phase 2
Potential Partners: SEP, NMFS, CDFG, PFMC

Activity 8.2: Conduct Regional Workshops to Share Information and Gather Input From Fishing Leaders and the Community After Special MPA Design Criteria are Determined by Multi-stakeholder Groups

Status: Phase 2
Potential Partners: SEP, NMFS, CDFG, PFMC, fishermen, MPA working group members

Activity 8.3: Consider ongoing education potential of individual reserve locations

Status: Phase 2
Potential Partners: SEP, NMFS, CDFG, PFMC, local research institutions

Activity 8.4: Link Efforts to General Education Strategies on Fisheries (a separate working group) and to MBNMS Regional Education and Outreach Plans

Status: Phase 2
Potential Partners: SEP, NMFS, CDFG, PFMC, fishing interest organizations, FIRE Working Group

Activity 8.5: Integrate Education with Enforcement and Research

Status: Phase 2
Potential Partners: SEP, NMFS, CDFG, PFMC, USCG, State Parks

Strategy MPA-9: Research and Monitoring Program

Strategy Description
This strategy outlines activities needed to develop a research and monitoring program which will assess and distribute information on the biological effectiveness of the special MPAs and their impacts on patterns of human use.

Activity 9.1: Design and Conduct Biological Effectiveness Evaluations Linked to Specific Goals of Special MPAs

A. Evaluate biological changes within and outside of special MPAs
B. Include comparisons to adequate control sites
C. Distinguish between natural and anthropogenic changes
D. Evaluate potential spillover effect to local populations

Activity 9.2: Evaluate Human Activities and Changes Relative to Specific Goals of Special MPAs

A. Assess consumptive and non-consumptive use patterns inside and outside special MPAs
B. Determine effects of scientific monitoring
C. Include observer program on research and fishing vessels
D. Monitor socioeconomic changes in user groups after special MPAs are established

Activity 9.3: Coordinate Monitoring and Data Distribution

A. Coordinate special MPA monitoring with other biological monitoring in the region and link to MBNMS/SIMoN
B. Involve fishermen and divers in monitoring activities
C. Coordinate with other sanctuaries conducting special MPA monitoring
D. Package and distribute readily understood monitoring information and effectiveness evaluations to decision-makers, fishermen and public

Status: Phase 2
Potential Partners: NMFS, CDFG, PFMC, local research institutions, fishermen, other stakeholders

Strategy MPA-10: Timing Strategies and Phasing / Effectiveness Evaluations

Strategy Description
This strategy outlines activities for evaluating the potential for phasing in the implementation of special MPAs over time, as well as development of a defined process for adaptive management.

Activity 10.1: Evaluate Potential Benefits and Disadvantages of Phasing

Activity 10.2: If Phasing is Considered Appropriate, Develop Criteria for Establishing a Reasonable First Phase

Activity 10.3: Determine Criteria for Frequency of Effectiveness Evaluation of Special MPAs, Linking Criteria to Site-specific Goals

Activity 10.4: Establish Criteria for When Evaluations Should Lead to Adaptive Management or Changes in MPAs Based on Improved Knowledge

Status: Phase 2
Potential Partners: NMFS, CDFG, PFMC, local research institutions, fishermen, other stakeholders, MPA working group members

Strategy MPA-11: Interagency Coordination and Implementation in Federal and State Waters

Strategy Description
This strategy outlines the procedures and coordination for special MPA implementation and for ensuring interagency coordination in the process.

Activity 11.1: After Identification of Special MPA Needs, Feasibility, Site-specific Goals and Designs as Outlined Above, Identify and Recommend the Most Appropriate Process and Agency to Implement

Note: Options for implementing MPAs as of 2003 are included below as background material. The working group did not try to reach consensus on these options and did not recommend which of these options or others may be appropriate once strategies 1-10 are completed. The group also recommends further legal review of the current and future options.

A. For Federal waters, options and considerations as of 2003 include:

- PFMC could adopt special MPAs under its own statutory authorities under Magnuson Stevens, provided the species covered are addressed by a Fishery Management Plan (FMP) and state landing laws could be used to restrict landings of non-FMP species; or

- PFMC could be given the opportunity to draft regulations drawing on authorities of the National Marine Sanctuaries Act, as outlined in subsection 304 (a)(5) of the Act, allowing it to address species not covered by a FMP

- If PFMC declines to draft regulations under either the Magnuson Stevens Act or the National Marine Sanctuaries Act, NOAA could prepare the draft regulations drawing on authorities in NMSA.

- Promulgation of regulations under the NMSA would require amendment of the 1992 MBNMS designation document since regulation of fishing activities is not identified as falling within the scope of current or future regulations. As outlined in the 1992 designation document, any future amendment of the designation document to regulate fishing activity could only occur in consultation with fishery management agencies, the fishing community, and the public, and would be subject to formal public hearings, EIS preparation, and Congressional notification requirements. A revision of the designation document could be constrained to focus only on MPA designation and not on fishery regulations in general.

B. For State waters, options and considerations as of 2003 include:

- The State of California (through the Fish and Game Commission and/or the Park and Recreation Commission) could adopt special MPAs pursuant to its authorities under the Marine Managed Areas Improvement Act and these MPAs could potentially be ultimately incorporated into a statewide MLPA plan.

- NOAA could prepare draft regulations drawing on authorities in the NMSA. The same process described above regarding amending the designation document would apply, with the additional condition that the approval of the governor would also be required.

Status: Phase 2
Potential Partners: NMFS, CDFG, DPR, PFMC, NOAA General Counsel

Activity 11.2: Ensure Coordination between State and Federal Implementation Measures and Timelines

Since state and federal implementation may occur via different agencies, ensure adequate coordination of implementation outcomes related to design and phasing.

Status: Phase 2
Potential Partners: NMFS, CDFG, DPR, PFMC, NOAA General Counsel, MPA workgroup members

Exhibit H.2.e
Public Comment
March 2004

Alliance of Communities for Sustainable Fisheries

P O Box 1309, Carmel Valley, CA 93924 (831) 659-2838

October 22, 2003

San Luis Obispo County Board of Supervisors
Room 370 County Government Center
San Luis Obispo, CA 93408

RE: Recommendation to not support expansion of the Monterey Bay National Marine Sanctuary into San Luis Obispo County at this time

Dear Chairman Mike Ryan and Board Members:

The Alliance of Communities for Sustainable Fisheries (Alliance), has been following the question as to whether the Monterey Bay National Marine Sanctuary will expand its boundaries southward. Our organization represents primarily the men and women of recreational and commercial fishing who use the ocean waters from Port San Luis to San Francisco. We are unique in that we bridge the fishing community with the greater community that supports them, and particularly emphasize the culture, heritage, and economic contribution of fishing in our region. Further, as our name implies, we are committed to the sustainable use of ocean resources. To that end, we have worked very hard to improve the science used in resource management, utilizing the knowledge that fishermen have.

Since our organization has worked closely with the staff and Sanctuary Advisory Council for the MBNMS on a variety of issues, we feel that we have a valid perspective to share on the good works and problems we have seen in this organization.

There is no doubt that the Federal Government can bring additional resources to the study and management of offshore waters. The Sanctuary Program is at its best when it works cooperatively with agencies and industries to educate and coordinate towards mutual goals. Accomplishments such as the extension of the oil tanker traffic lanes farther offshore, the water quality protection program, and the four county agricultural plan are examples of this cooperative effort. Perhaps the biggest benefit in the public's mind lies in the regulation that prevents oil and gas development. We would, at this time, venture to say that the situation with potential oil development is not clear as to whether Sanctuary status will actually prevent future development in new areas, or that such development cannot be prevented through other local means. The other regulations of the MBNMS, we must point out, could be, or are, equally accomplished by local authorities. The fact is, California's offshore waters are among the most heavily managed and regulated of any in the world even without Sanctuary status.

With that being said, we believe that this Program has no business expanding until it can solve some basic governance issues and can better manage the resources in the 5300 square miles it already has. Indeed, we in the fishing community have strongly sought to work cooperatively with the Sanctuary Program to develop far better fish stock abundance assessments than are presently utilized by either the Department of Fish & Game or by NOAA Fisheries. We also point out that critical work areas named in the MBNMS Management Plan, such as developing real-life oil spill contingency plans which will utilize the resources of the fishing community, have not even begun after eleven years. Moreover, there are significant governance problems inherent in Sanctuary status:

- The National Marine Sanctuary Act is overly broad and vague on key concepts, and does not provide proper guidance to staff for administration. One conflict of National Policy is that the "protection" (an undefined term) of sanctuary resources, such as fish stocks, takes precedence over the sustainable management of an important food source for the nation. Congress needs to step in and provide guidance to sort this out.

- The role of the Sanctuary Advisory Council (SAC), which was intended originally to provide a strong, local voice to give local perspective to the federal agency on resource matters, is not working as intended. In fact, the Association of Monterey Bay Area Governments (AMBAG), representing Santa Cruz, San Benito, and Monterey Counties recently voted to formally study and make recommendations about the governance issues in the SAC after hearing continuing complaints about how the SAC is managed and limited by NOAA. AMBAG is represented by all elected officials. Their fact-finding report will be presented in a few months.

- Experience has shown that despite promises made to a variety of local communities about how things would be under Sanctuary Management, it appears the Sanctuary Program has little ability to keep its promises. There was clearly the promise made to the fishing community that the Sanctuary would not represent another bureaucracy that fishermen would have to deal with. This has not proven to be the case. Fishermen do have to worry about the Sanctuary bureaucracy and its assertions of regulatory power, even over the Department of Fish & Game and the Pacific Fishery Management Council. As mentioned above, community members believed that they would have a vehicle in the SAC for strong local representation. This, however, has not proven to be the case thus far. Lastly, our harbor members tell us that promises were made that the Sanctuary would not be in a regulatory role over dredging operations. However, the Sanctuary has asserted this authority, with the result being added time and cost delays in dredging permitting with no added value. Numerous federal, state and local agencies already weigh in on dredge material disposal.

It is therefore our recommendation to the San Luis Obispo County Board of Supervisors that the MBNMS is not ready to expand. Many of our concerns apply to the National Marine Sanctuary Program as a whole. If citizens want to work toward a superior ocean

resources management agency, they would be best served by focusing on the problems in the Program as they exist today, and solving those problems. Or, alternatively, support the fledgling Marine Interests Group as a non-regulatory, coordinating body to improve resource management. We deeply hope that the Sanctuary Program will outgrow its difficulties and be the partner with the fishing community that we had originally envisioned. Until that time, our organization cannot support Sanctuary expansion and we urge the San Luis Obispo County Board of Supervisors to establish the same position.

Thank you for considering these thoughts.

Sincerely,

Mike Ricketts
Co-Chair, ACSF

Kathy Fosmark
Co-Chair, ACSF

Supporting Associations & Organizations

Pacific Coast Federation of Fishermen's Association
Port San Luis Commercial Fishermen's Association
Morro Bay Commercial Fishermen's Association
Monterey Commercial Fishermen's Association
Fishermen's Association of Moss Landing
Santa Cruz Commercial Fishermen's Marketing Association
Half Moon Bay Fishermen's Marketing Association
Fishermen's Alliance
Western Fishboat Owners Association
Ventura County Commercial Fishermen's Association
Federation of Independent Seafood Harvesters
Golden Gate Fishermen's Association

C: The Honorable Sam Farr
The Honorable Anna Eshoo
The Honorable Lois Capps
The Honorable Elton Gallegly
The Honorable Richard Pombo
The Honorable Bruce McPherson
Admiral Conrad Lautenbacher, USN (ret.)
Dr. William Hogarth, National Marine Fisheries Service
Don Hanson, Chair, PFMC
Dan Basta, Director, Office of National Marine Sanctuaries
Bill Douros, Superintendent, Monterey Bay National Marine Sanctuary
SAC for Monterey Bay National Marine Sanctuary
SAC for Channel Islands National Marine Sanctuary
SAC for Gulf of the Farallones National Marine Sanctuary

Alliance of Communities for Sustainable Fisheries
P O Box 1309, Carmel Valley, CA 93924 (831) 659-2838

October 13, 2003

Dan Basta, Director
Office of National Marine Sanctuaries
1305 East-West Highway, Room 11523
Silver Spring, Maryland 20910

Bill Douros, Superintendent
Monterey Bay National Marine Sanctuary
299 Foam Street
Monterey, CA 93940

Dear Director Basta and Superintendent Douros:

We are writing to advise you that the fishing community does not support the inclusion of the Davidson Seamount into the boundaries of the Monterey Bay National Marine Sanctuary, or any other sanctuary.

We continue to believe that there are mechanisms available through the Pacific Fishery Management Council to assure that any destructive extractive practices on the bottom of the seamount may be prevented. We are convinced that the Program has no ability to provide the guarantees that we need into the future that sanctuary status will not be used as a justification to lead to ever-increasing restrictions on fishing, including fishing at or near the surface. We further observe that the problems which we have experienced in the management of the Monterey Bay National Marine Sanctuary, which really stem from a lack of clarity in the Management Plan and the National Marine Sanctuary Act, must be substantially addressed before the Sanctuary Program could credibly entertain the idea of expanding its territory. Lastly, at some 5300 square miles, the Monterey Bay National Marine Sanctuary is already too large by many measures for thorough management.

If the Sanctuary Program is looking for more to do, may we respectfully suggest that there is significant work to be done on resource abundance assessments, which we hope the Monterey Bay National Marine Sanctuary will do in partnership with the fishing industry. This information could be provided to the fishery management agencies, providing a basis for improved decision-making - a goal we all share.

In addition to the Alliance of Communities for Sustainable Fisheries, we want to point out the list of supporting members of our organization. In addition to this general support, this letter has been specifically endorsed by:

- Western Fishboat Owners Association
- Ventura County Commercial Fishermen's Association
- Santa Barbara Commercial Fishermen's Association, Inc.
- Port San Luis Commercial Fishermen's Association
- Morro Bay Commercial Fishermen's Association
- Monterey Commercial Fishermen's Association
- Fishermen's Association of Moss Landing
- Santa Cruz Commercial Fishermen's Marketing Association
- Half Moon Bay Fishermen's Marketing Association

- Federation of Independent Seafood Harvesters
- The Fishermen's Alliance
- Coastside Fishing Club (recreational)
- Recreational Fishing Alliance
- Pacific Coast Federation of Fishermen's Associations (PCFFA)
- United Anglers of California, Inc.

Please be very clear that recreational and commercial fishermen do not support the inclusion of the Davidson Seamount into the Monterey Bay National Marine Sanctuary.

Sincerely,

Mike Ricketts
Co-Chair, ACSF

Kathy Fosmark
Co-Chair, ACSF

Supporting Associations & Organizations

Pacific Coast Federation of Fishermen's Association
Port San Luis Commercial Fishermen's Association
Morro Bay Commercial Fishermen's Association
Monterey Commercial Fishermen's Association
Fishermen's Association of Moss Landing
Santa Cruz Commercial Fishermen's Marketing Association
Half Moon Bay Fishermen's Marketing Association
Fishermen's Alliance
Western Fishboat Owners Association
Ventura County Commercial Fishermen's Association
Federation of Independent Seafood Harvesters
Golden Gate Fishermen's Association
Port San Luis Harbor District
City of Morro Bay Harbor
City of Monterey Harbor
Moss Landing Harbor District
Santa Cruz Port District
Pillar Pt. Harbor, San Mateo County Harbor District

C: The Honorable Sam Farr
The Honorable Anna Eshoo
The Honorable Lois Capps
The Honorable Elton Gallegly
The Honorable Richard Pombo
The Honorable Bruce McPherson
Admiral Conrad Lautenbacher, USN (ret.)
Dr. William Hogarth, National Marine Fisheries Service
Don Hanson, Chair, PFMC
SAC for Monterey Bay National Marine Sanctuary
SAC for Channel Islands National Marine Sanctuary
SAC for Gulf of the Farallones National Marine Sanctuary

Exhibit H.2. e.
Public Comment
March 2004

Alliance of Communities for Sustainable Fisheries

P O Box 1309, Carmel Valley, CA 93924 (831) 659-2838

December 1, 2003

Stephanie Harlan, Chair, Sanctuary Advisory Council
Bill Douros, Superintendent
Monterey Bay National Marine Sanctuary Advisory Council
299 Foam Street
Monterey, CA 93940

Dear Chair Harlan and Superintendent Douros,

We are writing to express our qualified support for the Special MPA workplan that will be considered by the Sanctuary Advisory Council on December 5, 2003. We also want to provide some background information which we greatly hope the members of the Sanctuary Advisory Council will read thoroughly.

A total of seven Alliance members participated in the SMPA workgroup to develop this draft plan. The workgroup effort began with what appeared to be an assumption that there would be additional MPAs supported by and placed within the Sanctuary, and the workgroup process is one in which the location and size would be identified. Through a large effort by all involved, the workgroup effort shifted to address a concern that it be more of a fair scientific inquiry as to the need, if any, for additional MPAs within the Sanctuary, and fairly evaluate both potential benefits and potential harms that might occur from these MPAs. You should be aware that there are still elements of the plan which make us nervous, such as the goal statement which seems overly broad, and the lack of identification of the role and authority of the Sanctuary Program. However, it was in the desire to constructively move forward that the Alliance members voiced their consensus, but importantly, at the lowest level of comfort for the final workgroup plan.

In addition to the contribution of individual Alliance members, the Alliance does formally also give its guarded endorsement for this workplan. We request that our level of endorsement be passed on at every stage of decision-making as this draft plan moves through the Sanctuary Program and NOAA towards adoption. We do not want to have our consensus statement characterized as fishermen being "wildly supportive" of MPAs or this process.

You should also be aware that the fundamental basis for our support of this plan is to provide the Sanctuary Program a sound method of commenting to the appropriate state and federal agencies on the MPA issue. Any comments would, of course, come from the perspective of the goals of the Sanctuary Program, and after consulting with our industry, but they would be just that – comments. It has never been intended by the Alliance or its members that the Sanctuary Program take a leadership role in the MPA question. Further, in the scenario that the Sanctuary would ever want to use its own authority to create a fishing regulation, then a change in the Designation Document of the Sanctuary would be required. For fishermen to support such a change in the Designation Document, there would need to be ample evidence that the change would be good for them, and that the change would not lead to unintended consequences. Short of that, the fishing community

is likely to actively resist any effort to change the Designation Document, as we believe it contains the inherent promise made to us that the Sanctuary would not regulate fishing or be in fishery management.

It was understood from the beginning of the SMPA workgroup process that the effort would be focused mostly on establishing MPAs for conservation, biodiversity, and science study goals. However, a point that was raised numerous times was that even if established for such goals, MPAs will have inherent and significant fishery management implications. In fact, the most current science available now shows what fishermen have intuited for awhile, that because MPAs essentially just shift fishing effort from one area to another, overfishing the outside areas, which includes damage to spawning and recruitment cycles, is a distinct possibility. The irony of this is huge, as it could be that permanent MPAs, unless carefully sized and placed, could actually have a net overall negative consequence on the environment. More critical thinking within the science community needs to occur before the MPA experiment is conducted to any great degree. We predict that there will continue to be a place for MPAs in the toolbags of both the fishery manager and the conservationist. However, the actual application of this tool will be very specific and limited if it is to stay in the positive environmental realm.

As background to these concerns, and for the SAC's knowledge of current MPA thinking, we have attached three short articles that recently appeared in the publication of the Ecological Society of America. These articles generally address the question "Marine Reserves: the best option for our oceans?" Also attached is a letter dated March 8, 2002, responding to a number of Alliance members participation in a forum on MPAs held in Portland, Oregon. This letter still serves as a good summary of fishermen's questions and concerns about the use of MPAs from a biological, social, economic, and even ethical perspective. We hope that SAC members will give all of these attached documents a careful review.

Sincerely,

Mike Ricketts
Co-Chair, ACSF

Kathy Fosmark
Co-Chair, ACSF

Supporting Associations & Organizations

- Pacific Coast Federation of Fishermen's Association
- Port San Luis Commercial Fishermen's Association
- Morro Bay Commercial Fishermen's Association
- Monterey Commercial Fishermen's Association
- Fishermen's Association of Moss Landing
- Santa Cruz Commercial Fishermen's Marketing Association
- Half Moon Bay Fishermen's Marketing Association
- Fishermen's Alliance
- Western Fishboat Owners Association
- Ventura County Commercial Fishermen's Association
- Federation of Independent Seafood Harvesters
- Golden Gate Fishermen's Association
- Port San Luis Harbor District
- City of Morro Bay Harbor
- City of Monterey Harbor
- Moss Landing Harbor District
- Santa Cruz Port District
- Pillar Pt. Harbor, San Mateo County Harbor District

Churchill B Grimes and Stephen Ralston
National Marine Fisheries Service, Santa Cruz, CA, USA

In his opening statement Norse writes, "Ideas and epidemics have intriguing similarities." So too, we believe, do epidemics and the sudden advocacy of (MPAs) as a panacea for the ocean's ills. Epidemic is exactly how we would describe the onslaught of information supporting the use of MPAs to save the imperiled seas from, among other things, the adverse effects of fishing (NRC 2001; Lubchenco *et al.* 2003). While we don't quibble with the assertion that, globally, the oceans are in dire need of increased protection, we would argue that some of the touted benefits of MPAs are controversial and have not been conclusively demonstrated.

Unfortunately, the debate concerning the use of MPAs to achieve sustainable fisheries has become polarized, and is rife with scientific advocacy and oversimplification (Lubchenco *et al.* 2003; Shipp 2003). Most egregious to us is the naiveté of some people regarding the accomplishments of fishery science. For example, Norse states that prior to 1997, "fisheries biology...had generally treated the sea as being uniform". Such a statement, at best, ignores the rich and long-standing contributions of fisheries science to our understanding of ocean ecosystems (Hjort, Cushing, Harden-Jones, and Sinclair) and, at worst, subliminally casts blame on fisheries science for bringing us to our current state of affairs. In fact, 50 years ago two pre-eminent fisheries biologists, Ray Beverton and Sidney Holt, modeled the impact of spatial closures on fishery yields (Guénette *et al.* 1998). As to the quality of government fishery science, several National Research Council studies (eg NRC 2002) concluded that US National Marine Fisheries Service (NMFS) stock assessment techniques are second to none among government fishery management agencies worldwide.

The justification that is most often cited for establishing domestic MPAs is that traditional fisheries management in the US is a failure. However, this is ill-informed. The present low levels of many fish stocks reflect poor management decisions made many years ago. A closer look at current exploitation rates reveals that current management is doing far better. Although many fisheries (eg cod in the northwest Atlantic and certain rockfish stocks along the west coast of the US) are in severe decline, many others, such as king mackerel in the Gulf of Mexico, summer and yellowtail flounder, Atlantic mackerel, and sea scallop along the US Atlantic coast, are at sustainable levels. In fact, of the 283 (25%) of 905 fish stocks managed by NMFS for which the status is known, only 15% are overfished and 39% are fished at or near their long-term potential yield (NRC 2002). Moreover, many US fisheries are already managed under severe spatial management regimes; for example, virtually the entire continental shelf of the west coast is presently closed to groundfishing.

While we are aware of evidence of the conservation benefits of biodiversity enhancement, population growth, attenuated size/age composition, and habitat recovery inside reserve boundaries, as well as adult spillover outside reserve boundaries, there are other critical scientific issues that are poorly understood. One simplistic generalization being touted by MPA advocates is that, at a minimum, 20% of a species' habitat needs to be protected to realize the benefits of an MPA (Agardy 2003). This figure is apparently based upon theoretical results showing that when fishing mortality is excessive, overall fishery yields could be enhanced by substantial area closures. However, many studies also show that traditional fishery management controls on fishing effort correspond directly to area controls, and that it is possible to manage fisheries optimally just using effort controls (Mangel 1998; Hastings and Botsford 1999), which has been the general paradigm practiced within the US. Moreover, the claim has been frequently made that MPAs will promote sustainable fisheries and enhance fishery yields (Nowlis and Roberts 1998), but density-dependent theory tells us that per-capita production is lowest at carrying capacity (ie in the absence of fishing), and that compensation at lower population levels produces a surplus that can be sustainably harvested. How will overall stock dynamics (eg potential yield, spawning stock-recruitment relations, spawning biomass targets and rebuilding trajectories) be affected by declining compensation within reserve boundaries, and how will the time-delayed impact of MPAs affect ecological and stock dynamics both inside and outside the reserve? Equally important, how will fishing effort displaced by MPAs affect catch rates, yields, and habitats outside reserve boundaries?

We are certainly not opposed to the use of MPAs to attain the conservation benefits pointed out above to provide insurance against errors in traditional fishery management, and as natural research and reference areas. However, we believe there are important unresolved issues that need to be answered before claims that MPAs will improve fishery management can be fully accepted. In addition, managing fisheries with MPAs needs to be placed in the context of existing management controls, which requires a case-by-case consideration of all available options.

References

Agardy T, Bridgewater P, Crosby MP, *et al.* 2003. Dangerous targets? Unresolved issues and ideological clashes around marine protected areas. *Aquatic Conserv* 13: 353–67.

Guénette S, Lauck T, and Clark C. 1998. Marine reserves: from Beverton and Holt to the present. *Rev Fish Bio Fisher* 8: 251–72.

Hastings A and Botsford LW. 1999. Equivalence in yield from marine reserves and traditional fisheries management. *Science* 284: 1537–38.

Lubchenco J, Palumbi SR, Gaines SD, and Andleman S. 2003. Plugging a hole in the ocean: the emerging science of marine reserves. *Ecol Appl* 13 (Suppl): S3–S7.

Mangel M. 1998. No-take areas for sustainability of harvested species and a conservation invariant for marine reserves. *Ecol Lett* 1: 87–90.

National Research Council (NRC). 2002. Science and its role in the National Marine Fisheries Service. Washington, DC: National Academy Press.

Nowlis JS and Roberts CM. 1998. Fisheries benefits and optimal design of marine reserves. *US Fish Bull* 97: 604–16.

Ray Hilborn
School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA, USA

Amidst the concerted rush of ecologists to push for the establishment of networks of MPAs, we need to brush off a little old-fashioned scientific skepticism and look carefully at the potential benefits and costs of MPA networks. As a conservation tool, MPAs move fishing effort out of some areas and shift it to others. It is not too surprising that abundance increases where fewer fish are removed, but the displaced fishing effort goes elsewhere. We need to ask whether the biodiversity benefits inside the protected area are more valuable than the biodiversity costs of additional fishing pressure outside. Once we realize that MPAs are effort-shifting programs, we recognize that the comparison of abundance inside and outside protected areas is flawed; the benefits estimated by comparing abundance inside and outside reserves, or before and after reserves are established (Halpern and Warner 2002) will be exaggerated.

Most MPA literature begins with a litany of the failures of fisheries management and MPA advocates have often used the fisheries management benefits of MPAs as a major selling point. MPAs can only benefit the yield of managed species if the species is overfished and if the movement rate of the spawning population is low enough relative to the size of the MPAs that spawning populations can build up inside them. Shipp (2002) points out that these two circumstances are rather unusual. Only 30% of the major fisheries in the US are classified as overfished, and for most of those species the movement of adults is great enough that only large MPAs would have much effect. Since current yield of US fisheries is over 80% of its potential yield (Hilborn *et al.* in press), there is little room for MPAs to increase fish yields.

For MPAs to be effective in increasing sustainable yield for a species, the sizes of the protected areas must be carefully matched to the movement of that species. If the MPAs are very large relative to movement, then yield is reduced because the fish are locked up. If the MPAs are too small, then there is insignificant buildup inside the reserves. No pattern of MPAs will be optimal, or even suitable, for all species; having different areas closed for different species would provide better yield and conservation benefits than blanket MPAs. Such areas are steps forward in the management of fisheries because they recognize the need for spatial management, but they are very blunt tools and we can do much better than one-size-fits-all networks if our objective is to maximize sustainable yield. Rather than broadly improving fisheries yields, a network of MPAs might improve yield in a few instances.

MPAs must be integrated into the fisheries management system. It is easily demonstrated that adding an MPA to a fishery regulated by catch quotas will generally require that the quota be reduced. While advocates argue that MPAs will increase fish yields (PISCO 2002), they rarely, if ever, do the quantitative work necessary to determine how regulations will need to change when an MPA is put in place.

Despite my skepticism, I believe that the establishment of MPAs is indeed a good idea, and when done with very specific objectives can benefit specific fisheries. I have no doubt that the abundance of many species will be higher in protected areas, and would like to see more marine areas protected in the same way that I wish more of the terrestrial habitat had been protected in parks.

I do see MPAs having an important role in fisheries management. First, in some places it may be possible to enforce protected areas where other forms of fisheries regulation are not practical. Second, in the US and other intensively managed countries, the vast majority of species are not regulated. Several hundred species are caught in the west coast trawl fishery, yet fewer than 20 are assessed (Hilborn *et al.* in press.). The vast majority of species are generally not of major commercial interest, but conservation concern for all species is currently driving management regulations; the west coast fishery is largely closed at present to protect several species classified as overfished. I see that MPA networks can be established to protect the biodiversity of marine communities, so that exploitation of the commercially important and healthy species can take place outside reserves. Essentially, the reserves would guarantee the protection of overfished or unassessed species. This will probably mean less (not more) yield of the healthy species compared to their potential yield, but it would allow commercial exploitation to continue in some places while providing for protection of a broad range of species.

Dave Fraser
Captain, FV Muir Milach
Adak, AK, USA

Elliot Norse would have managers unleash a virtual epidemic of MPAs, but not just any strain. His prescription calls for a particularly virulent genus: "marine reserves", also known as "no take zones" (NTZs). As Tundi Agardy (2003) wrote, "The enthusiastic prescription of simplistic solutions to marine conservation problems risks polarization of interests and ultimately threatens bona fide progress in marine conservation. The blanket assignment and advocacy of empirically unsubstantiated rules of thumb in marine protection creates potentially dangerous targets for conservation science."

No one benefits from sound fisheries management more than those dependent upon commercial, subsistence, and sport fishing. Good management requires finding the right tool for the job. What is missing from the current MPA/NTZ campaign is the critical need to carefully define the problem before reaching for a tool.

If overfishing is the problem, then as Andrew Rosenberg (2003) said in this journal, "The only way to end overfishing is to fish less." In Alaska, as the Chairman of the Pew Commission acknowledged, we've seen the wisdom in that all along (Panetta 2002), which is perhaps why we have no overfished groundfish stocks.

Time and gear closures of huge tracts of ocean have long been facts of life in the North Pacific. In the Bering Sea, year-round bottom trawl closures encompass about 30 000 square nautical miles, an area larger than Indiana. Trawl closures in the Gulf of Alaska encompass 60 000 square nautical miles. Large expanses of the North Pacific are closed seasonally for bycatch reduction or to protect marine mammal habitat and feeding areas. Together, these closures comprise some 25% of the continental shelf. More importantly, catch and bycatch are limited and closely monitored through an observer program – without a network of permanent NTZs. In Alaska, in short, fisheries management already proceeds from the assumption that the entire ocean should be a marine protected area.

Despite our experience in Alaska, Norse concludes, "the case for reserves is so strong that it seems imprudent to wait until implacable opponents of marine conservation are convinced by the evidence". As an implacable supporter of marine conservation – though a skeptic on the value of NTZs as tools for fisheries management – I prefer policy based on evidence.

So what is the evidence? Norse dismisses a study by Shipp (2002) because it was funded by sport fishers. If funding is an appropriate criterion for assessing validity of scientific research, Norse's conclusions as a Pew-funded author, citing a Pew commission report that cites Pew-funded scholars, including himself, are also suspect. In any case, let's review their evidence. The Pew Commission's report on marine reserves (Palumbi 2003) cites a variety of studies indicating that:

- proof of augmented reproductive capacity via larval transport is rare, except with extremely over-exploited species
- there are few US studies of NTZs (except for "boutique-size" closures)
- most studies are mathematical models
- effort control can achieve the same purposes
- reserve networks are poorly studied
- studies of reserves show beneficial results in specific circumstances, where there are heavily exploited species, that the benefits are stronger within reserve borders, and that the effect is clearer for sedentary species.

The evidence that NTZs offer substantial incremental benefit to well-managed fisheries outside the NTZ is less than compelling. In advocating NTZs, supporters should clearly differentiate between NTZs as a fisheries management tool and NTZs as parks. Where NTZs can be demonstrated to increase yields at a lower cost to fishers than other management tools, fishers will accept the price of lost fishing grounds. However, were the public to decide that it wanted to create a new national park in the grasslands of Iowa, we wouldn't simply evict the farmers. Society as a whole would shoulder the cost.

Scientifically-based closures, carefully designed to accomplish specific goals, are part of a broader set of management tools that together provide sustainable fish populations and sustainable fisheries with the economically important jobs they provide. But habitat protection measures are not simple; there are endless gradations between totally open and completely closed. From the perspective of the fishing community, any measure should meet four critical tests. MPAs must be scientifically justified, have clearly articulated goals, incorporate provisions for continued monitoring to ensure that those goals are being achieved, and their creation must take into account existing closures.

The Northwest Indian Fisheries Commission (Franks 2003) and Pacific Coast Federation of Fishermen's Associations (PCFFA 2002) have thoughtful online policy statements on MPAs, NTZs, and sustainable fisheries, which articulate the concerns of the broader fishing community. Due to space restrictions, I have posted links to their sites and further discussion of the fishing community's perspective on MPAs and NTZs at www.olympus.net/personal/dfraser/mpalinks.htm.

"For every complex problem", wrote HL Mencken, "there is an answer that is clear, simple, and wrong". Properly considered, researched, and implemented, various types of MPAs adapted to specific circumstances may prove useful. Applied broadly without meaningful participation by stakeholders in the fishing community and other interest groups, they will engender conflict and resistance. Let's get it right before we unleash an epidemic of NTZs.

References

Agardy T, Bridgewater P, Crosby MP, *et al*. 2003. Dangerous targets? Unresolved issues and ideological clashes around marine protected areas. *Aquatic Conserv* 13: 353–67.

Franks B. 2003. Northwest Indian Fisheries Commission tribal policy statement on marine protected areas, marine reserves, marine sanctuaries, and fishery conservation zones. www.nwifc.org/newsinfo/MPAs%20.pdf. Viewed Oct 8 2003.

Palumbi SR. 2003. Marine reserves: a tool for ecosystem management and conservation. Chapters III and IV. Arlington, VA: Pew Oceans Commission.

Panetta LE. 2002. Panetta's new passion reviving ocean fishing. NPR Morning Edition. Dec 12.

PCFFA (Pacific Coast Federation of Fishermen's Associations). 2002. Principles of the Pacific Coast Federation of Fishermen's Associations regarding marine protected areas. www.pcffa.org/mpa3.htm. Viewed Oct 8 2003.

Rosenberg AA. 2003. Overexploitation of fisheries. *Front Ecol Environ* 1: 102–07.

-------- Original Message --------
Subject: Understanding MPAs Workshop in Seattle
Date: Wed, 18 Feb 2004 16:15:48 -0500
From: Greg Moretti <Greg.Moretti@noaa.gov>
Organization:DOC/NOAA/NOS/CSC/MPA TTAI (PSGS)
To: Donald McIsaac <Donald.McIsaac@noaa.gov>

Don,

The National Marine Protected Areas Center's Training and Technical Assistance Institute (Charleston, SC) has developed a one day workshop for the general public entitled "Understanding Marine Protected Areas." As a courtesy to the coastal and marine management community, we wanted to give you and others in the Seattle area a "heads-up" that we will be holding the workshop on Saturday, March 27, 2004 at the Seattle Aquarium. The target audience of this interactive workshop is the general public - people who may not be familiar with the complexities and issues surrounding MPAs, but who may have heard about MPAs through mass media or other sources.

The workshop is not designed for managers, nor any particular subset of MPA stakeholders. This workshop has been designed to be politically neutral; the workshop is not intended to foster support for MPAs, but rather to provide a neutral and comprehensive source of information on what MPAs are, how they function, and how people can get involved.

If you would like to provide any materials from your organization to distribute at the workshop, we can arrange to have those materials made available. A detailed description of the course (UMPAs_Overview.doc) is attached to this message.

Feel free to contact me if you have any questions about the workshop or to arrange to have materials made available.

Thank you,

Greg Moretti

(Don, please feel free to pass this message on to your colleagues and members of the Pacific Fishery Management Council.)

cc:
Leigh Espy (Leigh.Espy@wadnr.gov)
Yvonne deReynier (Yvonne.deReynier@noaa.gov)
Steve Copps (Steve.Copps@noaa.gov)
Daniel Waldeck (Daniel.Waldeck@noaa.gov)
George Galasso (George.Galasso@noaa.gov)
Robert Steelquist (Robert.Steelquist@noaa.gov)

Bill Laitner (Bill_Laitner@nps.gov)
Betsy Carlson (Betsy_Carlson@nps.gov)
Peter Dederich (Peter_Dederich@nps.gov)
Bill Gleason (Bill_Gleason@nps.gov)
Rob Harbour (Rob_Harbour@partner.nps.gov)
Ginger Hinchcliff (ginger.hinchcliff@noaa.gov)

--
<>< <>< <>< <>< <>< <>< <>< <>< <>< <>< <><
Greg Moretti
Coastal Management Specialist
Perot Systems Government Services Contractor

National Marine Protected Areas Center
Training and Technical Assistance Institute
NOAA Coastal Services Center
2234 S. Hobson Ave.
Charleston, SC 29405-2413

http://www.csc.noaa.gov/cms/cls/mpa_training.html
http://www.mpa.gov

Office: (843) 740-1251
Fax: (843) 740-1313
Cell: (252) 259-2426

"Providing information, tools, and strategies for the design and effective management of marine protected areas."

--
Donald O. McIsaac, Ph. D.
Executive Director
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 200
Portland, Oregon 97220-1384
Phone: (503) 820-2280
Fax: (503) 820-2299
Web: http://www.pcouncil.org

--

Pacific Fishery Management Council
Portland, Oregon
Toll free 866.806.7204 | www.pcouncil.org