

WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

REPORT ON THE 2007 ECOSYSTEM POLICY WORKSHOP



Prepared by

IMPACT ASSESSMENT, INC.
PACIFIC ISLANDS OFFICE
iai@hawaii.rr.com

September 2007

IMPACT ASSESSMENT, INC.
Pacific Islands Office
2950 C Pacific Heights Road
Honolulu, Hawai'i 96813
iai@hawaii.rr.com; iai@san.rr.com

September 10, 2007

Mr. Paul Dalzell, Senior Scientist
Western Pacific Regional Fishery Management Council
1164 Bishop Street, Suite 1400
Honolulu, Hawai'i 96813

Dear Mr. Dalzell:

We are pleased to submit the proceedings of the Council's Ecosystem Policy Workshop held in Honolulu during early January of 2007. The report has been prepared in accordance with the terms of Contract No. 06-WPC-036

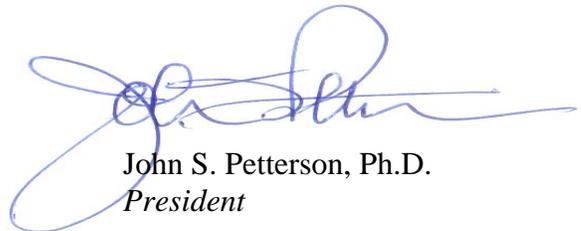
The objective of the enclosed report is to summarize the rationale and agenda for the final workshop in the Council's ecosystem series, and to disseminate the contributions, findings, and recommendations of the experts assembled to provide guidance to the Council as it moves forward with the planning and implementation phases of the ecosystem approach to management across the region. Additional context is provided to enhance the value of the report for the Council and interested readers.

We wish to express our deep appreciation of the efforts of you and your staff in the preparation and conduct of the workshop described herein, and our thanks for the opportunity to be involved in this important project.

Sincerely,



Edward W. Glazier, Ph.D.
Project Manager



John S. Petterson, Ph.D.
President

Table of Contents

1.0 Introduction	1
1.1 Background.....	1
1.2 An Ecosystem Approach for the Western Pacific.....	3
A Vast and Complex Region	3
Addressing Uncertainties with an Adaptive and Incremental Strategy	4
The Suitability of an Ecosystem Approach in the Western Pacific	5
Development of Fishery Ecosystem Plans.....	6
1.3 Summary Overview of the Ecosystem Science and Management Planning Workshop.....	6
Overview.....	7
Ecosystem Data.....	7
Ecosystem Modeling.....	8
Ecosystem Indicators	8
Concluding Summary and Recommendations of the Biophysical Workshop.....	9
1.4 Summary Overview of the Social Science Workshop.....	10
Overview.....	10
Island Variability and the Critical Importance of Seafood and Fisheries in the Region...	11
Traditional Ecological Knowledge and Stakeholder Involvement	11
Additional Points of Summary and Recommendation.....	12
1.5 Prelude to the Ecosystem Policy Workshop.....	13
1.6 Content and Organization of this Report	13
2.0 The Ecosystem Policy Workshop	15
2.1 Summary of Policy Workshop Day One	17
2.2 Summary of Policy Workshop Day Two.....	34
2.3 Summary of Policy Workshop Day Three.....	51
3.0 Summary Conclusions and Recommendations	56
3.1 Overview.....	57
3.2 Potential Benefits of the Ecosystem-based Approach	58
Regarding the Suitability of the Ecosystem Approach in the Region	58
A Shift in Mode of Governance.....	58
Addressing the Knowledge and Needs of Stakeholders across the Region.....	58
Ecosystem Research and Monitoring.....	58
3.3 Summary Recommendations for Maximizing the Benefits of the New Approach	59
Biophysical Workshop Recommendations Reiterated.....	59
Social Science Ecosystem Workshop Recommendations Reiterated.....	60
Policy Workshop Recommendations for Enhancing Participation.....	62
Policy Workshop Recommendations for Identifying Resources	63
Conclusions and Final Recommendations	64
References	67
Appendix A: Biographies and Contact Information for Consulting Participants	72

List of Figures

Figure 2-1 Total Ecology of U.S. Marine Fisheries.....19
Figure 2-2 Ecosystem Principles20
Figure 2-3 Institutional Linkages between Governing Elements under the New FEPs24
Figure 2-4 Conceptual Model for the Role of Ecosystem Science26
Figure 2-5 Timeline for Developing HARP27
Figure 2-6 Direct and Indirect Ecosystem Relationships29
Figure 2-7 Kū'ula, the Hawaiian God Rising from the Ocean38

List of Maps

Map 1-1 Western Pacific United States Exclusive Economic Zones4

List of Tables

Table 3-1 Council FEP Objectives and the Prospective Role of Social Science.....61

WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

Report on the 2007 Ecosystem Policy Workshop

1.0 Introduction

The Western Pacific Regional Fishery Management Council (WPRFMC; the Council) convened the last in its series of three fishery ecosystem planning workshops during the first week of 2007. The workshops were held to assist the Council as it transitions from conventional species-based fisheries management to ecosystem-based fisheries management in the Western Pacific. Local, regional, national, and international experts representing a variety of relevant disciplines were involved in each of the meetings.

The first workshop was held in April 2005 to examine biophysical data and modeling needs for implementing an ecosystem-based fishery management approach in the Western Pacific. The second was held in January 2006 to examine social, economic, and governance aspects of the approach in the region. Reports summarizing the first two workshops are available via the Council website at <http://www.wpcouncil.org/>.

The final workshop was held during January 2007 to synthesize the results of the first two meetings and to deliberate on policy options for the Council's fishery ecosystem planning process. This report summarizes the final workshop and provides essential context for understanding the unique nature of fisheries in the Western Pacific and the manner in which the Council has initiated an ecosystem-based approach to aid in their management.

1.1 Background

The biophysical and social processes addressed by fishery scientists and managers around the world are challengingly complex. Fish and other marine organisms are, of themselves, complex in genetic and behavioral terms, and the course of their evolution, their distribution around the world's oceans, and their population dynamics are by no means fully known. Living marine resources are also interactive elements in what are recognized as biological, chemical, oceanographic, and climatic systems, the dynamics of which have become important subjects of scientific inquiry. Humans are increasingly seen as important components of such systems in that we affect marine resources directly through fishing and other extractive activities, and indirectly through effects on the physical environment.

The underlying goal of fishery management as undertaken in the U.S. Exclusive Economic Zone (EEZ) is to develop and adjust policies that ensure the sustainable use of living marine resources over time. This requires ongoing assessment of marine resources and analytical control of associated environmental conditions. But the internally complex nature of the resources and their dynamic interactions with a wide range of biophysical factors and forces renders this a

challenging goal even in the absence of fishery interactions – the variable of particular interest in fisheries disciplines.

Fisheries science and management can indeed be fairly characterized as challenging endeavors, and the latter has involved mixed results. While one perspective holds that the world's fisheries are headed towards failure, others assert that many fisheries have, in fact, been managed successfully and that strategies for appropriate control of pressure on the resources will enable positive future scenarios. Some hold fast to the utility of the scientific method and well-informed management decisions. Because fisheries science and management unarguably address highly complex and dynamic processes, strategies for achieving sustainability inevitably require approaches that are adaptive to changing environmental conditions, to variable pressure on the resources, to new conceptual paradigms and advances in modeling, to new empirical data and analyses, and to ongoing uncertainties.

Management approaches ideally are also adaptive to the unique aspects of the region in question. Species and their dynamic interaction with the marine environment, types of nearshore and deep sea fisheries, regional marketing conditions, the social demography and needs of stakeholders, and local and regional systems of governance are but some of the factors that at once vary extensively by region and constitute important considerations for effective fisheries management. In some cases, a given region is characteristically complex, and a suite of management approaches are called for. In others, focus on a predominant fishery or species can enable highly effective management.

An example of the latter is reduction of fishing pressure through a sustainable yield-based limited entry program for commercial salmon fisheries in Bristol Bay, Alaska. The strategy has ultimately been successful in biological terms (Hilborn 2006) because it fits the unique nature of the species and fisheries in question. That is, yield potential is, in this case, readily addressed by on-site monitors who can quickly regulate highly focused fishing pressure in response to escapement and fishery performance data. The process is augmented through overall annual limits on the size of the commercial fleet and numbers of recreational and subsistence permits, with allocation issues resolved via a regional regulatory process that incorporates public input (Brady 2004). Of significance from a biological perspective, population bio-complexity appears to contribute to the sustainability of the fishery despite cyclically unfavorable oceanographic conditions in the adjacent North Pacific Ocean (Hilborn et al. 2003).

Despite the biological successes of management in this case, participants in the Bristol Bay commercial salmon fisheries have long been challenged by depressed salmon prices resulting in part from saturation of world markets with farmed salmon products. In this regard, while the single-species approach appears to have ensured an abundant resource, and allocation decisions are successfully brokered through a process enabling the meaningful input of stakeholders, it has largely failed to address the constraints of the macro-economic context in which the fishery is executed. The overall benefits of biologically successful management in this case are therefore

uncertain.¹ If sustainability is to assume real meaning for the most deeply involved stakeholders, then a more holistic strategy may be called for. It can be argued that such a strategy would necessarily prioritize human values, needs, and experiences, and address them as integral and pivotally important elements of marine ecosystems.

1.2 An Ecosystem Approach for the Western Pacific

Much knowledge of marine resources, fisheries, and stakeholders has been gained through the traditional species-based approach to management in the Western Pacific. But the Council has increasingly recognized the suitability of an approach that emphasizes relationships between those resources and the unique physical and human environmental contexts in which they are situated. The Council's past efforts have led to recognition that its region of jurisdiction is unique and well-suited to a science-based management approach that is responsive to the dynamics of large, open-ocean marine ecosystems and to social and economic connections between islands, islanders, adjacent marine ecosystems and jurisdictions, and associated marine resources.

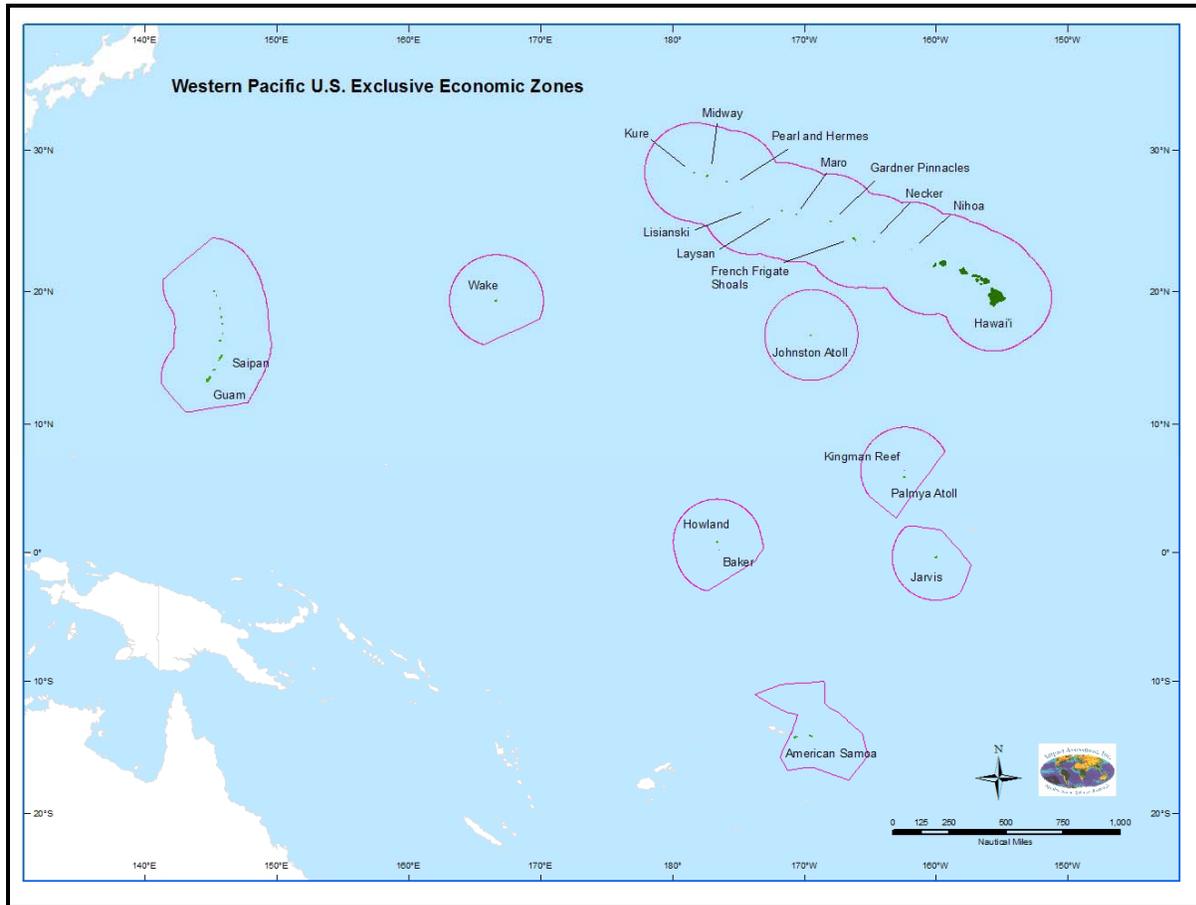
A Vast and Complex Region. The Western Pacific is indeed unique: the nearly 1.5 million square nautical mile area of Council jurisdiction comprises 48 percent of the nation's EEZ and, as such, it is by far the largest in the U.S. Numerous and varied nearshore and deep sea fisheries occur here, and unlike fisheries administered by other Councils in the U.S., fisheries in the Western Pacific are conducted from small islands located many thousands of miles from North America or any other continental land mass. Societies vary widely in terms of historical and contemporary economic, cultural, political, and linguistic attributes, and such variation can be notable both within and across island settings and associated fishing fleets.

Although great strides have been made in scientific understanding of diverse reef, demersal, neritic-pelagic, and pelagic species and fisheries in the vast Western Pacific, many unknowns and uncertainties remain. The scientific process is ongoing. Social scientific inquiry is also ongoing and similarly challenged by the size of the region and the diversity of conditions across the archipelagos and their respective islands. These include: the islands of the State of Hawai'i, the islands of the Territories of American Samoa and Guam, and the islands of the Commonwealth of the Northern Marianas (CNMI). There are also seven remote atolls or islands in the region: Johnston Atoll, Palmyra Atoll, Kingman Reef, Baker Island, Howland Island, Jarvis Island, and Midway Island.

It should be noted that some of these areas share offshore jurisdictional boundaries with other nations, thereby lending a level of complexity to governance that is unique among the fishery councils in the U.S. Areas of shared international boundaries in the region include: (1) Palmyra Atoll and Jarvis Island, which are adjacent to the Northern and Southern Line Islands governed by the Republic of Kiribati; (2) Howland and Baker Islands, which are adjacent to the Kiribati-

¹ Note that individual and collective capacity to fish for consumptive and cultural purposes in rural Alaska is today often based in part on income derived through jobs in the commercial fishing industry. There are therefore few distinct benefits to the subsistence sector in the absence of benefits to the commercial sector (Impact Assessment, Inc. 2007).

governed Phoenix Islands, (3) American Samoa, which is adjacent to independent Western Samoa and Tonga, and to the Cook Islands, Niue, and Tokelau; (4) Wake Island, which is adjacent to possessions of the Republic of the Marshall Islands, (5) Guam, which is adjacent to possessions of the Federated State of Micronesia, and (6) the Northern Marianas islands, which are adjacent to various islands of Japan.



Map 1-1 Western Pacific United States Exclusive Economic Zones

The Council is also responsible for managing migratory and highly migratory pelagic fishery resources across a vast portion of the Pacific. This is increasingly complicated in that numerous groups and conventions now address management of resources across international jurisdictional bounds, including those of the U.S. EEZ. These entities include the Inter-American Tropical Tuna Commission, the Interim Scientific Committee for Tunas and Tuna-like Species in the North Pacific, the Western and Central Pacific Fisheries Commission, the Secretariat of the Pacific Community, the Multilateral Treaty on Fisheries between the Government of Certain Pacific Island States and the Government of the United States, and others.

Addressing Uncertainties with an Adaptive and Incremental Strategy. The WPRFMC has adopted an approach to fisheries management that is novel in its attention to whole marine systems and to the physical and biological relationships among the components of those systems. While the ecosystem approach holds promise for addressing the aforementioned complexities of fisheries science and management, some envision uncertainty in how it might be applied and

what its benefits might be in the realm of management. The approach can therefore be seen as presenting a conundrum to some scientists and managers, wherein the intricacies of marine systems are widely recognized as important subjects of inquiry of direct relevance to understanding fishery dynamics, but the very complexity of those systems is seen as daunting, overly taxing of available resources, or too great (or too nominal) a departure from already productive areas of inquiry.

But it should be noted that the Council continues to seek information that is based on the foundation of empirical science, and although the ecosystem approach necessarily involves expansion of attention into a larger realm of scientific inquiry, this is to occur incrementally and adaptively rather than abruptly. In fact, the new approach may be seen as involving an initial period of gradual change wherein the species-based approach is converted to a place-based approach that reorganizes and complements rather than replaces ongoing scientific inquiry and management. This is in keeping with the approach as envisioned by NOAA's Ecosystem Principles Advisory Panel in 1998:

“Ecosystem-based management can be an important complement to existing fishery management approaches. When fishery managers understand the complex ecological and socioeconomic environments in which fish and fisheries exist, they may be able to anticipate the effects that fishery management will have on the ecosystem and the effects that ecosystem change will have on fisheries” (Ecosystem Principles Advisory Panel 1999)

The Suitability of an Ecosystem Approach in the Western Pacific. The ecosystem approach is seen as particularly amenable to the Pacific island context for many reasons. For instance, historic management strategies undertaken here effectively recognized human and biophysical relationships and interactions and therefore provide conceptual models for planning a new approach. Island settings foster common recognition of such relationships and interactions, and an ecosystem strategy organized by archipelago may improve investigation and monitoring of such relationships and interactions at local and archipelagic levels of analysis. This is likely to reduce administrative burdens associated with management of single species pursued by multiple fleets across distant islands and archipelagos.

As discussed in the proceedings from the Council's Social Science Ecosystem Workshop (IAI 2006), several attributes render islands in the Western Pacific particularly suitable for examining ecological processes and, by extension, for applying ecosystem principles to management of marine resources. First, they are small relative to continents and they tend to present distinct and isolated settings for certain forms of investigation. Further, marine life congregates at islands (Sibert and Hampton 2003), and as Vitousek (1995:11) asserts, islands afford the “opportunity to understand controls on ecosystem structure and function” and to develop models which “can be applied as the basis for understanding more complex continental systems.” Similarly, Kirch and Hunt (1997) assert that understanding long-term feedback effects of ecological change in such settings may yield much insight into similar processes in larger island and continental ecosystems around the world.

The sea and the bounds between land and sea and their respective biophysical systems are readily envisioned from islands (Berkes 1999:69), and marine resources are invariably important

in social and economic terms in island settings. But long-term residents of islands typically recognize that living marine resources are finite and sometimes challenging to acquire. Moreover, many goods and services are not available unless they are imported through trade or other economic transaction. Viewed in historical perspective, such limitations have required islanders to develop extensive knowledge of marine resources and the factors that constrain or enable their availability, abundance, and acquisition (see Poepoe et al. 2003). Local and traditional knowledge of marine ecosystems and relationships between their components can thus often be extensive in island settings in the Pacific.

Development of Fishery Ecosystem Plans. The WPRFMC actually developed the nation's first ecosystem-based fishery management plan in 2001—a plan for managing coral reef ecosystems in the region. The Council has since begun to replace existing Fishery Management Plans (FMPs) with Fishery Ecosystem Plans (FEPs) to address complex relationships between populations of organisms, habitats, oceanographic conditions, human communities and societies, and other dimensions of marine ecosystems. A Draft Programmatic Environmental Impact Statement for implementing the FEPs was completed in 2005 (National Marine Fisheries Service 2005a).

Ecosystem plans are thus being developed for: (1) the Mariana Archipelago (Guam and the Northern Mariana Islands); (2) the Hawaiian Islands Archipelago (including Midway and Johnston Atolls); (3) the Samoa Islands (American Samoa and possible Western Samoa); and (4) the Pacific Remote Islands (Howland, Baker, Jarvis, Kingman Reef, Palmyra Atoll and Wake Island). The new FEPs subsume fishery management plans (FMPs) for bottomfish, seamount groundfish, coral reef ecosystems, crustaceans, and precious corals under a single plan for each sub-region. An FEP for pelagic resources and ecosystems is being developed separately.

As noted above, an incremental and adaptive approach is being used to develop and implement FEPs across the region. The approach also involves the input of science and policy experts and a range of stakeholders. One element of this collaborative approach is the series of three workshops being conducted by the Council to aid in the transition from FMPs to FEPs and to enhance application of ecosystem-based management principles over the long-term. As summarized below, the workshops have enabled informed discussion and expertise regarding the ecosystem approach and means for its effective application in the Western Pacific.

1.3 Summary Overview of the Ecosystem Science and Management Planning Workshop

The Ecosystem Science and Management Planning Workshop (the Biophysical Workshop) was held during April 18-22, 2005 as the first in a series of three workshops exploring requirements for implementing ecosystem-based fisheries management in the Western Pacific. Approximately 60 scientists and marine policy experts participated in the meeting. Presentations and discussions were organized around three central topics: (1) data needed to support ecosystem-based science and management, (2) ecosystem models and modeling, and (3) indicators of utility for gauging ecosystem processes and the effects of management and other factors. This

subsection summarizes the basic outcome of the meeting as per the aforementioned proceedings available on the Council website.²

Overview. The overarching goal of the Council's initial workshop was to identify science protocol and information needed to support an ecosystem-based approach to marine resource management in the Western Pacific. In order to achieve this goal, the workshop was designed to address six basic objectives, as follow: (1) review ecosystem models in terms of management utility and application; (2) identify management requirements in the Western Pacific region; (3) identify the best suite of quantitative ecosystem indicators and associated trade-offs to support ecosystem-based management in the region, (4) within the confines of existing mandates, identify the most effective short-term application of ecosystem-based approaches to management that can be implemented based on current data, and in this context address whether a precautionary approach has a role; (5) identify new data or models that would be required to advance ecosystem-based approaches to marine resource management in the Western Pacific, and (6) identify changes in policy or science that would be needed to effectively implement those approaches in the region.

Meeting participants regarded tasks (1) through (3) above as within the purview of scientists, and tasks (3) through (6) within the purview of marine policy experts. Participants determined that the role of scientists needs to be clearly differentiated from that of policy-makers, and that subjective decision-making about allocation of resources and related issues is the distinct purview of managers and policy-makers. Three breakout groups were established during the course of the workshop to enable informed and interactive discussion of ecosystem data, modeling, and indicators.

Ecosystem Data. Obviously, the function of data in fisheries management is to provide resource managers with valid information needed to make well-grounded decisions. With this in mind, workshop participants identified three imperatives for collection and use of relevant data: (1) it must be appropriate in terms of scale and suitable for purposes of modeling; (2) it must involve a triangulated focus on human, ecological, and environmental dimensions; and (3) it must be well-managed, archived, and accessible. Participants recognized that data needs will depend on modeling requirements that inevitably vary across time and space.

Other important workshop findings regarding data and data collection included the following: (1) high-quality data will facilitate development of quality indicators and models which will ultimately enhance management of the resources and fisheries, and local knowledge can enhance the quality of data; (2) new or different data will be needed to support ecosystem models and ecosystem-based management, especially as regards non-target species; (3) adaptive management experiments involving spatially-sensitive comparison of policy options are critical for improving understanding of the ecosystem effects of fishing; and (4) a data expert or clearinghouse will be essential for coordinating the appropriate collection, storage, distribution and analysis of ecosystem-relevant data.

² Workshop proceedings were developed by Jarad Makaiau, Paul Dalzell, Gerard DiNardo, Charly Alexander, Svein Fougner, and Dirk Zeller.

Participants also recommended formation of a Data Needs Working Group and identified a range of interim needs for new data that would support ecosystem-based management in the region. These included the following: (1) improved commercial, recreational, and subsistence landings and effort data; (2) information regarding by-catch and fishery interactions; (3) trophic interactions data; (4) information regarding habitat-species associations and habitat-fishery interactions; (5) data regarding spatial distribution of stocks; (6) data regarding the life history of relevant species; (7) data regarding marine environmental variability and consequences of and responses to climate change and oceanic regime shifts; (8) data regarding inherent ecosystem productivity and habitat alteration; (9) information regarding pertinent social and economic dimensions of marine ecosystems; (10) data supporting carrying capacity analysis and forage base interactions; and (11) information revealing ecosystem processes under differing use scenarios.

Ecosystem Modeling. Extensive discussion about ecosystem models and modeling occurred throughout the workshop. The transferability of models and associated data and indicators across the region and its archipelagos was of particular concern. While management issues and priorities will drive the development and application of specific models in each of the five sub-regions, the group identified four data layers that would be appropriate for modeling applications across the Western Pacific. These are: (1) hydrodynamics, (2) biological community dynamics, (3) habitats and species-habitat associations, and (4) the behavior of fishers. Regarding the last data layer, participants acknowledged that understanding fishing operations and full stakeholder involvement in the ecosystem-based management approach will be crucial to its success.

Participants also reached consensus regarding processual elements fundamental to successful ecosystem modeling efforts in the region. These include: (1) identification of salient resource and resource management issues; (2) identification of potentially viable management policies and options; (3) matching the model in question with appropriate management policies and options; (4) identification of data needs for the selected model(s); (5) inventory and collection of the requisite data; and (6) identification of any other biophysical processes that may be important in terms of analytical or experimental control. Participants agreed that the most important aspect of modeling is clear initial delineation of objectives. This includes determining whether predictive or evaluative models will be most useful for the application of interest. Participants recommended that adaptive management considerations should be incorporated into ecosystem modeling in the region.

The modeling discussion concluded with the group achieving consensus on the need to develop appropriate base models. It was agreed that these could be refined and adapted to predict or evaluate environmental or regulatory changes over the course of time.

Ecosystem Indicators. The role and utility of indicators in this context gave rise to vigorous discussion among workshop participants. Participants recognized that no single set of indicators would serve in a functionally holistic manner across the archipelagic sub-regions of the Western Pacific. Rather, indicators would need to be prioritized and adapted to fit specific places and situations. There was agreement that scientists: (a) should distinguish between emergent properties operating in a given ecosystem and measures used for theoretical or experimental control, (b) should distinguish between ecosystems properties that are intractable and those

which can be manipulated to create a desirable effect or mitigate an adverse effect, (c) should develop a mechanistic understanding of how indicators are derived, and (d) should exercise caution when using ecosystem indicators as performance measures.

While discussion of caveats and conditions for developing and applying ecosystem indicators was extensive, participants were able to identify a variety of indicators that could be used as to examine the status of ecosystems and various pressures on those systems. These included: habitat ‘quantity’ and ‘quality’; keystone/functional species; sentinel and protected species; assemblage structure; biodiversity; pathogens; harmful events; and fishery measures. There was clear consensus that the final choice of indicators should be clearly linked to management objectives.

The indicators working group generated the following recommendations and priorities for identifying and implementing ecosystem indicators in the Western Pacific. First, it will be necessary to develop and evaluate a list of valid candidate indicators. Second, each candidate indicator should be ranked in terms of applicability by experts in each of the five regions. Third, the performance of specific indicators should be determined by experts in each of the regions. Fourth, indicators should be selected for use in keeping with salient management needs and modeling requirements. Finally, approaches should be developed for linking ecosystem status and pressure indicators, and for evaluating the feedback effects of management actions.

Concluding Summary and Recommendations of the Biophysical Workshop. In sum, participants identified eight broadly conceived operational objectives for the region’s FEPs. These are: (1) conserving and managing the [target] species; (2) minimizing by-catch; (3) managing trade-offs; (4) accounting for feedback effects; (5) establishing appropriate ecosystem boundaries; (6) maintaining ecosystem productivity and balanced ecosystem structure; (7) accounting for climate variability; and (8) using adaptive approaches to management. It was agreed that consideration of ecosystem management must extend beyond the biophysical components of the region’s marine ecosystems. Participants in all three breakout sessions recognized the need for data, models, and indicators of utility for understanding and addressing human dimensions of marine ecosystems in the Western Pacific.

Six recommendations were developed as general policy advice for the Council as it moves forward with implementation of ecosystem-based management in the region (see WPRFMC 2006:143). First, it was recommended that the fishing industry and managers should “endeavor to be proactive in changing the burden of proof regarding the impacts of fishing.” This would in part be enabled by industry “taking an active participatory role in research and monitoring and resource conservation and sustainability.”

Second, it was recommended that a precautionary approach should be employed in implementing the ecosystem-based approach to management in the region. This would enable sufficient time for scientific understanding to meet the requirements of the new approach to management.

A third recommendation asserted the need for spatial or other latitude in development and implementation of ecosystem-related policy. The intent of this recommendation is to identify ways and means for scientists and managers to develop sufficient understanding of changing

environmental conditions as per the parameters of a truly adaptive approach to managing fisheries and fishery resources.

Fourth, it was recommended that lessons should be drawn from other regions, and an adaptive approach should be employed in the Western Pacific. This is in keeping with the assertions that fisheries management in the U.S. and elsewhere has involved successes and that lessons deriving from those successes may well augment current and future management strategies.

Fifth, it was recommended that proper incentives should be used to aid in the achievement of management goals. This reflects an understanding of the historic and potential future needs, interests, and tendencies of fishery participants vis-à-vis the management and regulatory processes.

Finally, it was recommended that the issues of fairness and equity should be duly considered in the ecosystem-based approach to management in the Western Pacific and elsewhere. This relates to concerns for appropriate and ethical balancing of social and economic benefits and liabilities potentially following from implementation of an ecosystem-based approach in the region.

1.4 Summary Overview of the Social Science Workshop

The Social Science Ecosystem Workshop was held during late January 2006. The overarching goal of the meeting was to facilitate informed discussion of social science requirements for implementing effective ecosystem-based fisheries management in the Council's region of jurisdiction. Nationally-recognized social scientists and regional experts were thus convened to examine a range of pertinent issues. These included: (1) marine fisheries, fisheries management, and related human and biophysical factors in the Western Pacific, (2) the need for and utility of social science in the context of ecosystem-based management in this region and elsewhere, (3) institutional constraints and opportunities for incorporating social science into ecosystem-based management, (4) relevant information needs, useful types of data, and data collection methods, (5) ecosystem-relevant human behavior and resource modeling, (6) indicators for assessing regulatory effects and the performance of management strategies, and (7) scope and scale of social science applications to ecosystem-based management in the Western Pacific.

Overview. Workshop discussions were organized around the major functional-analytical components of marine ecosystems. As asserted at the outset of the meeting, these are comprised of: (1) the biophysical ecology of marine ecosystems, and (2) the human ecology of marine ecosystems, which has two distinct components of relevance to social scientific inquiry: (a) the human ecology of the constituent groups - the people whose behavior affects, or is affected by, a defined biophysical ecology, or who are otherwise concerned with the state of that biophysical ecology; and (b) the human ecology of the governance institutions which have authority or responsibility for establishing and/or enforcing formal rules of human behavior with respect to the defined biophysical ecology. It was determined that these components together comprise the ecosystems to be addressed by fishery management agencies in the Western Pacific.

The workshop was organized so that relevant aspects of the Western Pacific region and its archipelagic sub-regions were discussed at the outset, thereby providing context for meaningful discussion of ecosystem-based fishery management. Presentations and related discussions were both general and specific in scope, and regional experts were on hand to provide their own perspectives and experiences regarding the realities of island life in the Pacific, and the various fishery management challenges and solutions that have been encountered and applied in the region.

Presenters made clear that each archipelago in the region is distinct in terms of its socio-cultural, socioeconomic, and demographic attributes. Mode and culture of governance, marine environmental conditions, and types and extent of fishing and other pursuits and uses of marine resources also vary extensively. It was determined that: (a) this variation may be effectively addressed for purposes of meeting FEP objectives through appropriate application of social science methods, including those that facilitate public participation in relevant decision-making processes, and (b) selection of social science methods and analytical techniques should be closely tailored to the particular environmental and social conditions and specific information needs and objectives that characterize each archipelago.

Concepts of the relationship of humans and society to and within marine ecosystems were repeatedly discussed during the course of the workshop. It was argued that scientists and managers must understand that humans are not merely exogenous entities affecting marine systems. Rather, we are integral and pivotally important components of those systems. As such, it was asserted that any institutional mandate promoting sustainability of marine resources will be effective only insofar as it can successfully manage human behavior.

Island Variability and the Critical Importance of Seafood and Fisheries in the Region.

Workshop discussions tended to underscore human and environmental variability within and across the island groups that comprise the vast Western Pacific. Participants recognized that social science research must address such variation and translate findings in a manner that is optimally useful for resource managers seeking to make fair and equitable decisions in an increasingly complex and contested socio-political environment. Regional variation notwithstanding, pursuit and consumption of seafood and related cultural processes were seen as constant and critically important aspects of life throughout the archipelagos. As such, it was agreed that there is vital need for monitoring the full range of factors that may impinge on these activities and processes, including the potential effects of conservation interests and ecosystem-based management.

Traditional Ecological Knowledge and Stakeholder Involvement. An important outcome of the social science workshop was recognition of the ongoing importance of indigenous fishery practices and traditional and local knowledge of marine resources and ecosystems. Indigenous Pacific islanders draw on lengthy histories and ever-evolving knowledge and traditions of interaction with ocean ecosystems and with each other to successfully draw sustenance from that environment. The Council's approach to ecosystem-based management involves, among other strategies, adaptive management, emphasis on indigenous forms of resource management, and opportunities for stakeholder involvement in the management process across the archipelagic

sub-regions. There was consensus among workshop participants that this is a valid approach and that it should continue to be emphasized by the Council as it moves forward with the FEPs.

Additional Points of Summary and Recommendation. An assortment of valuable insights, lessons, and pertinent background information about ecosystems, ecosystem social science, and the context of fisheries in the Western Pacific may be derived from the social science workshop and proceedings. Again, individuals and social institutions were clearly recognized as critically important elements of marine ecosystems, and given their place in the trophic hierarchy, human behaviors, beliefs, and values were envisioned as primary considerations in the implementation of ecosystem-based approaches to fishery management.

Workshop participants indicated that the nascent paradigm shift to ecosystem-based management may potentially lead to further institutional complexity in this unique region of multiple jurisdictions. Given its size, extensive diversity in socio-demographic and socio-political context, and increasing involvement of international entities in allocation decisions regarding migratory species, participants recommended that an incremental and adaptive strategy coupled with appropriate incentives may augment the success of ecosystem-based management in the Western Pacific.

Valid social and economic indicators were seen as particularly useful for assessing and monitoring direct and indirect human-environmental interactions, and as a basis for adjusting resource use policy under the new mode of management. Although specific variables were not identified, there was agreement that social indicators of utility for ecosystem-based management in the region should articulate with a wide range of climatic, macro-economic, socio-demographic, regulatory, and community-related factors. It was determined that such indicators will ideally be based on: (a) their potential utility for meeting Council objectives, (b) extant and readily obtainable data regarding the social and biophysical contexts in question, and (c) relevant elements of the social indicators literature and associated theory of social and economic change.

As indicated during the course of the workshop, a well-formulated social science approach to ecosystem-based management could enhance Council efforts to meet its FEP objectives and to administer the new form of management over the long term. The approach would ideally include a series of related elements, as follow: (1) a venue or venues for choosing high priority FEP objectives; (2) design of research to meet prioritized objectives and related information needs; (3) implementation of a research strategy to gather and analyze requisite information, (4) development of an indicators-based archipelagic monitoring system through which to gauge and analytically parse social change potentially associated with Council actions; and (5) implementation of a liaison and performance and evaluation program to ensure the validity and effectiveness of the social science approach to ecosystem-based management in the region.

The ecosystem approach calls for greater attention to relationships between components of marine ecosystems, including relationships between marine fisheries and the broader social communities of the islands. But participants noted that social science cannot be equated with community development *per se*. Rather, application of social science may further understanding of community context and the potential for stakeholder input, local receptivity to or need for fisheries-related development programs, and the potential or actual social and economic costs

and benefits of such processes and programs. Social science may therefore be used to help identify ways in which communities and individuals may participate in the abundance of positive ocean opportunities available throughout the Western Pacific region.

Given that a number of fisheries or fisheries-relevant social science research and monitoring programs have been undertaken in the United States and abroad in recent years, participants indicated a strong social science approach supporting the Council FEPs would ideally articulate with these, both drawing upon and contributing to the base of knowledge regarding human interaction with the marine environment and the many related aspects of human behavior discussed during the course of the workshop.

1.5 Prelude to the Ecosystem Policy Workshop

As the principal focus of this report, the Ecosystem Policy Workshop is reviewed in depth in the following pages. In brief, workshop participants reviewed the cross-jurisdictional and cross-cultural settings that are characteristic of the region, and they discussed options for enhancing the ecosystem approach in each island group. Participants once again defined marine ecosystems to include humans and their institutions, and they examined the needs and interests of indigenous fishing practitioners and other stakeholders in this context. Finally, the group discussed needs and opportunities for ecosystem research and long-term monitoring in the Western Pacific.

As reviewed in subsequent sections of these proceedings, participants generated a number of immediately practical results on the final day of the workshop. These included: (1) policy options for meeting the Council's goal of empowering communities and working with local governments to develop place-based fishery management plans, (2) viable means for establishing effective long-term consultation with communities through the Council's Regional Ecosystem Advisory Committee (REAC) process, (3) recommendations for documenting Traditional Ecological Knowledge (TEK) through effective and culturally-sensitive collaboration with indigenous practitioners, and (4) possible opportunities for acquiring funding and deploying human resources that would enable long-term ecosystem research and monitoring across the region.

The final workshop was moderated by Dr. Michael Orbach of Duke University's Nicholas School of the Environment, and facilitated by Dr. John Kirkpatrick of Belt Collins Hawai'i, Ltd. The Pacific Islands Office of Impact Assessment, Inc. in Honolulu organized the workshop and prepared these proceedings.

1.6 Content and Organization of this Report

Following this introductory discussion, Chapter Two summarizes the Ecosystem Policy Workshop per notes and transcripts recorded during the course of the event. The materials are organized and presented in chronological sequence.

A series of presentations were given during the morning of the first day of the Ecosystem Policy Workshop. These summarized the previous two workshops and provided the context needed to inform subsequent discussion of the region's fisheries and associated management challenges. Facilitated sessions were held during the late morning and afternoon hours to aid in developing an integrated science framework for meeting the Council's ecosystem information needs and management objectives.

During the morning hours of Day Two of the event, regional experts discussed the various challenges confronting fishery scientists and managers across the region, and approaches that may assist the Council as it develops and implements the new FEPs. Specific policy issues were addressed through facilitated interaction during the afternoon hours. Topics included: (a) challenges associated with introducing a new system of management in a region of many agencies and jurisdictions, (b) involving indigenous practitioners and other stakeholders in the management process, and (c) implementing the ecosystem approach through valid long-term research and monitoring.

Discussions during Day Three of the workshop were focused on review and synthesis of findings and recommendations generated during the previous days of the event. A discussion of how to assist the Council in its Regional Ecosystem Advisory Committee process was held during the morning hours. This was followed by facilitated discussion and concluding prioritization of information and policy recommendations for developing and implementing an integrated approach to long-term ecosystem-based management in the Western Pacific.

Chapter Three of this report revisits the outcome of the ecosystem policy workshop in the context of the two previous events, and it reiterates and contextualizes policy options and recommendations generated during each event. References and appendices follow. An appendix reviewing relevant portions of literature on cooperative and indigenous management of natural resources is provided to assist the Council as it more fully involves its stakeholders in the management process under the expanded parameters of the ecosystem-based approach.

2.0 The Ecosystem Policy Workshop

The final event in the Council's ecosystem workshop series was held during early January 2007. Local, regional, and national policy and topical experts were convened for three days to assist in synthesizing output from the preceding workshops and to develop viable ecosystem policy options for use in the Council's fishery ecosystem planning process. A critical objective of the event was to discuss the challenges of implementing new marine resource management policies in the diverse social and biophysical settings that are characteristic of the region. The workshop involved deliberation on three basic issues of relevance to planning and implementing an ecosystem-based approach in the Western Pacific.

Participants discussed the concept of institutional ecology and related governance issues with the intent of identifying policy options for maximizing the potential benefits of ecosystem-based management in the cross-jurisdictional and cross-cultural settings that are characteristic of the region. A range of challenges were addressed in this regard, including: issues of scale, institutional inertia, inter-agency coordination and sustained allocation of fiscal resources in support of a new system of management, and pursuit of equity and fairness in resource decision-making processes.

The group also examined policy options for addressing the needs and interests of indigenous fishing practitioners and other resource user groups and stakeholders across the region. Special attention was given to the Hawaiian system of managing resources in and adjacent to ahupua'a or political land divisions within which available resources from mountain to sea were and are produced, managed, and utilized, including resources from the deep sea (see Kirch 1985 and Minerbi 1999). This system provides an example of the potential value of local monitoring and management of marine resources, and regional representation of the needs and interests of the human constituents of marine ecosystems.

Finally, participants discussed options for enhancing the benefits of fishery ecosystem research and monitoring in the region. This discussion was particularly important in that it was intended to assist the Council as it and its constituents increasingly address connections within and between biophysical and social components of the region's marine ecosystems.

During the course of the workshop, participants examined many of the institutional challenges associated with integrating ecosystem principles into fisheries management, and they ultimately developed various priority recommendations for implementing the approach in the region. First, although change in the marine environment is associated with many factors and processes, it was recognized that fishery managers are best equipped to influence humans and the effects of their activities. Thus, the ideal focus of management agencies was seen to be upon humans and their position in and relationship to marine ecosystems, a situation which clearly warrants additional attention to social science applications to fishery management.

Workshop participants agreed that policy-makers and managers need to define essential ecosystem terminology to maximize understanding across the biophysical and social sciences and to reduce uncertainty in the definition of management objectives. Similarly, it was determined that ecosystem-based resource management will be enhanced when the conceptual

and physical bounds of marine ecosystems are clearly delineated. Participants also agreed that efforts to increase rapport between scientists, stakeholders, and managers will serve to minimize conflicts and thereby enhance the new form of management.

Organizers of the workshop sought the participation of those who could effectively provide expertise on a variety of topics of particular relevance to fishery ecosystem planning in the Western Pacific. Some participants had been involved in the previous events and were asked to inform further deliberations on ecosystem concepts and marine policy based on their generalized expertise. Others were asked to attend based on specific geographic or topical expertise. As such, a combination of generalized and regional expertise was brought to bear on the issues at hand.

Consulting Participants

Fini Aitaoto, American Samoa Department of Marine and Wildlife Resources
Stewart Allen, NOAA Fisheries, Pacific Islands Fisheries Science Center
Judith Amesbury, Micronesian Archaeological Research Services
Lee Anderson, University of Delaware, Graduate College of Marine Studies
Paul Bartram, Akala Products, Inc.
Jim Burchfield, University of Montana, School of College of Forestry and Conservation
Athline Clark, State of Hawai'i, Department of Land and Natural Resources
Leimana DaMate, Hawaiian Civic Clubs
Leanne Fernandes, Great Barrier Reef Marine Park Authority, Australia
David Fluharty, University of Washington, School of Marine Affairs
Svein Fougner, Fisheries Consultant
Ed Glazier, Impact Assessment, Inc., Pacific Islands Office
John Gourley, Micronesian Environmental Services
Mike Hamnett, Research Corporation of the University of Hawai'i
Susan Hanna, Oregon State University, Coastal Oregon Marine Experiment Station
Colin Kippen, Native Hawaiian Education Council
David Kirby, Secretariat of the Pacific Community
John Kirkpatrick, Belt Collins Hawai'i, Ltd.
Arielle Levine, University of Hawai'i, Joint Institute for Marine & Atmospheric Research
Marc Miller, University of Washington, School of Marine Affairs
Michael Orbach, Duke University, Nicholas School of the Environment
Minling Pan, NOAA Fisheries, Pacific Islands Fisheries Science Center
Frank Parrish, NOAA Fisheries, Pacific Islands Fisheries Science Center
John Petterson, Impact Assessment, Inc., La Jolla Office
John Sibert, University of Hawai'i, Pelagic Fisheries Research Program
Jeff Polovina, NOAA Fisheries, Pacific Islands Fisheries Science Center
Samuel Pooley, NOAA Fisheries, Pacific Islands Fisheries Science Center
Craig Severance, University of Hawai'i at Hilo, Department of Anthropology
Janna Shackeroff, Duke University, Nicholas School of the Environment
Herman Tuiolosega, State of Hawai'i, DOH, Environmental Planning

2.1 Summary of Policy Workshop Day One: Wednesday, January 3, 2007

Following a brief round of introductions, the Ecosystem Policy Workshop was initiated in earnest. This and subsequent sections of the report summarize the event and provide context through which to better understand the potential benefits and challenges of the ecosystem-based approach in the Western Pacific. This section of the report summarizes presentations and facilitated discussion from the first day of the event. Graphics provided in this section were developed by the presenters for purposes of discussion and dissemination.

Kitty Simonds, Executive Director of the WPRFMC

Kitty Simonds, Executive Director of the Council welcomed all workshop participants and provided an historical overview and discussion of the unique nature of the Western Pacific and its respective islands and archipelagos. The discussion emphasized the suitability of a place-based approach to ecosystem management across the region.

Ms. Simonds also emphasized that the ecosystem-based approach will require close relationships with existing government agencies and non-governmental entities. Moreover, it will be a particularly appropriate means for empowering communities and for ensuring that long-accumulated traditional and local knowledge of marine ecosystems and resources is available for purposes of effective management.

It was also made clear that considerations regarding community involvement are now codified in the recently reauthorized Magnuson-Stevens Fishery Conservation and Management Act (MSFMCA), and that a series of Puwalu or conferences were being held in Hawai'i to more fully incorporate Native Hawaiian perspectives into the fishery management process in the region. Ms. Simonds noted the potential for bureaucratic challenges in implementing an ecosystem-based approach to management in the Western Pacific and called for workshop participants to muster their expertise to assist the Council in its efforts.

**Dr. Samuel Pooley, Director, NOAA Fisheries
Pacific Islands Fisheries Science Center**

Dr. Sam Pooley, Director of the Pacific Island Fisheries Science Center, initiated the deliberations with a practical and evocative discussion of challenges associated with integrating ecosystem principles into fisheries management in a large and complex region such as the Western Pacific. As a fisheries economist and agency administrator with decades of experience in the Western Pacific, Dr. Pooley is well-suited for stimulating thought on issues of overarching importance to implementation of the ecosystem-based approach to management in the region.

Dr. Pooley noted that ecosystem science, while novel in some ways, actually develops directly from the kinds of research that have been undertaken in the region over the past decades. Moreover, it will involve many, if not all, of the same challenging issues as have been addressed by the existing mandates.

Among the most notable issues discussed by Dr. Pooley were challenges associated with: (a) effectively inspiring institutions already deeply engaged in research and management of complex natural resource issues to engage a new paradigm which is not without uncertainties, (b) the costs of administering new programs given ongoing fiscal demands, and (c) coordination of efforts to implement a new system of management in a large and complex multi-jurisdictional region.

<p style="text-align: center;">Dr. Michael Orbach, Professor, Duke University Nicholas School of the Environment</p>
--

Dr. Orbach of Duke University's Nicholas School of the Environment stressed the importance of establishing the perspective that the social sciences have as much or more to contribute to ecosystem science and ecosystem-based management as do the biophysical sciences. This requires development and use of parallel language and concepts. For instance, the term and concept of *connectivity* that is increasingly used to describe relationships between physical components of marine systems is also useful for describing the way people interact with the ocean and its resources, with each other while pursuing those resources, and with the institutions that govern those activities. Similarly, the concept and term *resilience* used to describe biophysical responses to sources and vectors of change can be used to describe social responses to sources and vectors of change, including those associated with marine ecosystems.

Dr. Orbach notes that while defining marine ecosystems in terms of integrated biophysical, human, and institutional components requires attention to a larger and more complex field of inquiry, it can and must be accomplished. The attributes of biophysical systems, populations of user groups, and government institutions can be defined and mapped, and the symbiotic relationships between them can be deciphered and analyzed (Figure 2-1). Significantly, Dr. Orbach asserts that regulatory institutions cannot directly affect the biophysical environment. Rather, the biophysical environment is indirectly affected through mediation of human behavior. He reminded the audience that "we don't manage fish, we manage fishermen."

Dr. Orbach posed two basic questions for workshop participants to consider as the meetings moved forward. First, he asked how ecosystem-based management would differ from single species management. This question derived from discussions with Dr. Pooley originating at the Ecosystem Social Science Workshop. Second, he asked about the timing of implementing the new approach. That is, at what point in the existing regime should implementation of new principles and approaches begin? Regarding the latter, he suggested starting with a place-based island or archipelago-centric approach as the Council has done. This would ideally emphasize the human and institutional ecology of the sub-regions, and connections between people and resources in those areas. Dr. Orbach asserted that this principle is at the heart of ecosystem-based fishery management and is conceptually opposite from concepts underlying single-species management approaches, since these generally emphasize the biophysical resources and factors and work toward the people, often almost incidentally.

Dr. Orbach also pointed out that while all should be sensitive to the fact that NOAA and the Councils have well-specified authorities and responsibilities, there is latitude for re-structuring the system. This could involve development of partnerships with stakeholders, constituents, and agencies not generally or heretofore addressed in the existing approach to fishery science and management.

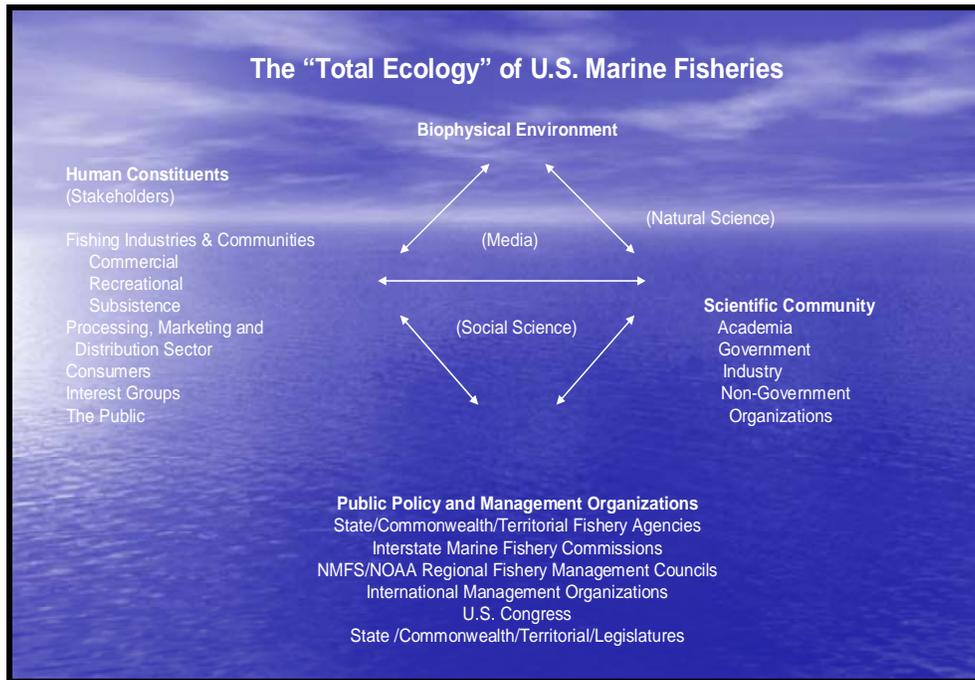


Figure 2-1 Total Ecology of U.S. Marine Fisheries

In conclusion, Dr. Orbach reiterated main points deriving from the previous two workshops and the need to bridge differences between the natural and social sciences in moving toward an effective new approach to fishery management in this and other regions. Finally, he asked participants to keep considering ways in which the outputs from the natural and social science workshops were complementary and ways in which they differed, and how the sciences might best be integrated to enable a more holistic approach to ecosystem management across the unique and diverse archipelagic sub-regions that comprise the Western Pacific.

**Dr. David Fluharty, Professor
University of Washington School of Marine Affairs**

Dr. Dave Fluharty of the University of Washington School of Marine Policy discussed the history and background of ecosystem-based fishery management in the U.S., focusing especially on federal-level management institutions in the U.S. He noted that as of the late 1980s, the term “ecosystem management” was not yet widely used in scientific literature. Today, however, articles on ecosystem management and its implications abound in a variety of journals and reports. This change began in the late 1980s when a federal report was written to describe the inability of fishery managers to resolve certain issues under the then-current fishery management

plans. These related to the need to control for a variety of environmental factors impinging on assessment of fishery resources. Although the authors described the potential merits of an ecosystem-based approach to solving the issues, administrators did not act on the findings.

Dr. Fluharty noted that in 1996, NMFS appointed a 20-person panel to study the potential applications of ecosystem principles in U.S. fisheries management. The panel agreed that more effective control of marine fisheries was in order, and that this could be accomplished through better enforcement of regulations, monitoring target and by-catch harvests more carefully, and through calculated control of harvest capacity. It was also deemed that a number of prerequisites would need to be satisfied if the ecosystem approach were to reach a point at which it could respond to some of the problems being encountered in the management of marine fisheries in the U.S. The panel defined a mission and developed seven principles that could guide the future of ecosystem-based fishery management (Figure 2-2).

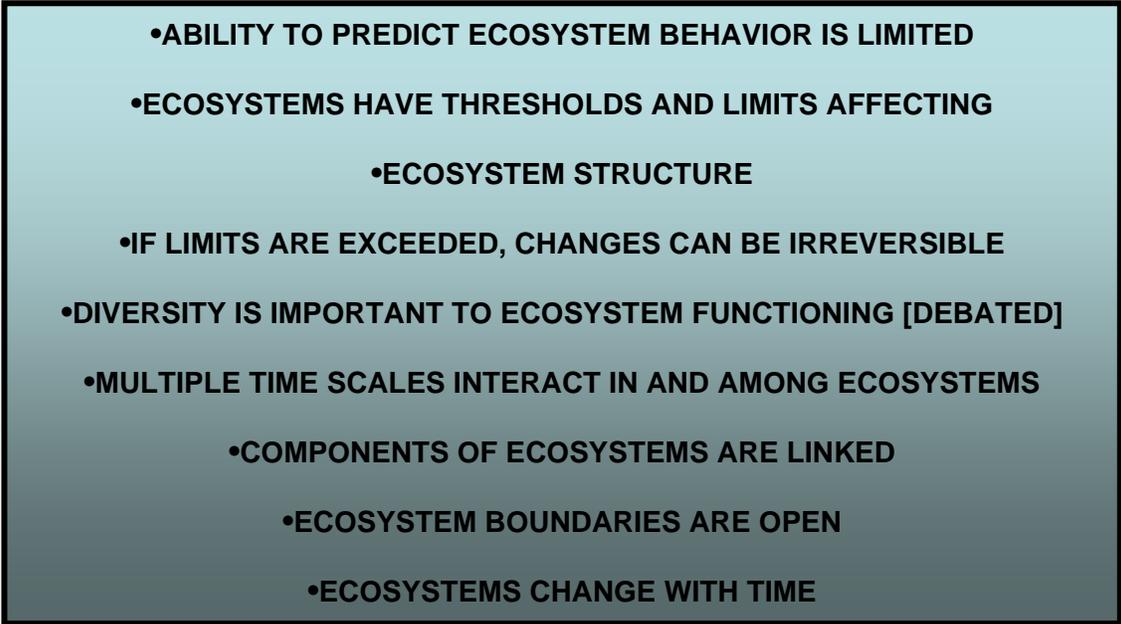
- 
- **ABILITY TO PREDICT ECOSYSTEM BEHAVIOR IS LIMITED**
 - **ECOSYSTEMS HAVE THRESHOLDS AND LIMITS AFFECTING**
 - **ECOSYSTEM STRUCTURE**
 - **IF LIMITS ARE EXCEEDED, CHANGES CAN BE IRREVERSIBLE**
 - **DIVERSITY IS IMPORTANT TO ECOSYSTEM FUNCTIONING [DEBATED]**
 - **MULTIPLE TIME SCALES INTERACT IN AND AMONG ECOSYSTEMS**
 - **COMPONENTS OF ECOSYSTEMS ARE LINKED**
 - **ECOSYSTEM BOUNDARIES ARE OPEN**
 - **ECOSYSTEMS CHANGE WITH TIME**

Figure 2-2 Ecosystem Principles

The panel struggled with key questions associated with ecosystem-based management. These included: (a) how to deal with different scales of activities, (b) how to deal with open boundaries, and (c) what kind or level of change is acceptable? The panelists concluded that any policy advice generated through their efforts should be unbiased, particularly as regarded evaluation of the effectiveness of a particular change in management. Panelists recommended that NMFS apply a precautionary principle in implementing ecosystem management, and that the agency should seek to learn from experience and consider incentives for establishing real change in the way fishing fleets operate. Regarding the latter, panelists agreed on the importance of understanding what motivates people to comply with regulations. It was determined that any changes in the management process must enable equity and fairness—outcomes that are not typically concerns in a top-down form of resource management.

The Panel developed a Fisheries Ecosystem Plan to provide ideas for coordinating the efforts of regional fisheries managers to move beyond the status quo. Although it was well-received by Congress, the Plan was effectively shelved due to budgetary and administrative constraints.

Dr. Fluharty noted that since 2003 however, there has been a proliferation of ecosystem management initiatives around the nation, including: the North Pacific Council's Aleutian Islands Fisheries Ecosystem Plan; NOAA's approval of the Chesapeake Bay FEP; funding of the West Coast, Gulf, and New England Councils to begin an FEP process; the Pacific Fishery Management Council's decision to start the FEP process; and, more broadly, NOAA's own interest in ecosystems approaches to management. The NOAA initiative to address the Gulf Hypoxic Zone was mentioned as another example of integrated ecosystem assessment.

Dr. Fluharty also mentioned the U.S. Ocean Policy Report, which includes recommendations for moving away from single species management. It also recommends doubling the amount of funding for NOAA, creating regional ocean ecosystem councils, and refining fishery management to use an ecosystem approach. The Ocean Policy Council (OPC) was established as a result of those recommendations. Most recently, Vice-Admiral Conrad Lautenbacher announced a new Regional Collaboration strategy. Although it is not yet fully funded, the plan calls for integrated ecosystem assessment, resilient coastal hazards management, and integrated weather and climate approaches.

Dr. Fluharty asserts that while some scientists argue that an ecosystem-based approach is too difficult to effectively define and implement, it is his contention that it is readily attainable when the focus is on managing human behavior rather than managing the entire ecosystem. In conclusion, he predicts that the recent emphasis on ecosystem-based management will bring about the following changes:

- Marine fisheries will be managed for abundance, not scarcity;
- Fishing capacity and employment will likely diminish;
- Marine fisheries will involve higher levels of income and use of more sophisticated technology;
- Fishing practices leading to extensive impact on habitat will be replaced by alternative techniques;
- There will be greater use of spatially-explicit management measures; and
- Fisheries restrictions and regulations will serve to meet corollary goals, such as conservation of biodiversity.

Mr. Paul Dalzell, Senior Scientist
Western Pacific Regional Fishery Management Council

Mr. Paul Dalzell is Council Senior Scientist and Pelagics Coordinator. He is highly-respected for his scientific expertise and extensive background in fishery management experience across the Western and South Pacific. Mr. Dalzell presented an evocative and practical discussion titled “Ecosystem-based Fishery Management in the Western Pacific - an Example of Joined-up Ocean Governance or a Ball of Confusion.”

Mr. Dalzell discussed a range of factors and concerns suggestive of the need to implement an ecosystem-based management approach in the Western Pacific. These included the following: (1) sufficient understanding of the population dynamics of protected species, such as monk seals and green turtles, requires attention to a wide range of physical and human environmental factors; (2) evaluation of the effectiveness of Marine Protected Areas needs to be undertaken, thus requiring a range of valid data; (3) changes in fishing mortality, such as that associated with jack species in Hawai‘i, requires greater attention to ecosystemic factors; (4) the population dynamics of exotic invasive species, such as the explosive growth of ta‘ape, which has a limited local market need to be better understood in more holistic context; and (5) the changing human demography of the Western Pacific and associated changes in fishing and reef collecting practices requires attention to a broad array of factors and variables.

Mr. Dalzell subsequently provided an overview of Council actions toward implementation of an ecosystem-based approach in the region. He noted that the Council is currently in the process of reorganizing extant management measures and regulations, and its overall institutional framework as it shifts from a species-based approach to a place-based archipelagic approach to management. As noted elsewhere in this report, FEPs are being developed for each of the archipelagoes and for the region’s pelagic fisheries. The latter will focus on basin-scale and Pan-Pacific stock issues, thereby involving the least amount of change to the existing system of management.

Mr. Dalzell described ten objectives formulated to guide implementation of ecosystem-based fisheries management policy in the region. These are as follow:

- 1) to maintain biologically diverse and productive marine ecosystems and to foster the long-term sustainable use of marine resources in an ecologically and culturally sensitive manner through the use of a science-based ecosystem approach to resource management;
- 2) to provide flexible and adaptive management systems that can rapidly address new scientific information and changes in environmental conditions or human use patterns;
- 3) to improve public and government awareness and understanding of the marine environment in order to reduce unsustainable human impacts and foster support for responsible stewardship;

- 4) to encourage and provide for the sustained and substantive participation of local communities in the exploration, development, conservation, and management of marine resources;
- 5) to minimize fishery by-catch and waste to the extent practicable;
- 6) to manage and co-manage protected species, protected habitats, and protected areas;
- 7) to promote safety of human life at sea;
- 8) to encourage and support compliance and enforcement with all applicable local and federal fishery regulations;
- 9) to increase collaboration with domestic and foreign regional fishery management and other governmental and non-governmental organizations, communities and the public at-large to successfully manage marine ecosystems; and
- 10) to improve the quantity and quality of available information to support marine ecosystem management.

Actions the Council will need to undertake as it moves forward with its ecosystem planning process and with implementation of an ecosystem approach over the course of time were also identified. These included the following:

- 1) develop appropriate indicators of ecosystem conditions, including socio-economic indicators;
- 2) develop place-based conceptual food web and population models with various dynamic forcing mechanisms;
- 3) implement new data collection and analysis programs to better understand ecosystems;
- 4) continue adaptive management, using best available scientific information;
- 5) incorporate traditional knowledge into management;
- 6) continue and increase participation in international management forums;
- 7) participate in meetings and workshops with neighboring nations; and
- 8) increase community participation in the Council process.

Mr. Dalzell noted that the Council has created several new advisory committees, panels, and teams to meet the above objectives. These include advisory panels comprised of fishery participants and other stakeholders in each archipelago; planning teams for reviewing the FEPs and plan administration; standing committees composed of Council members; a Community

Demonstration Projects Advisory Panel; and a Community Development Advisory Panel. Finally, a Regional Ecosystem Advisory Committee (REAC) is being established for each archipelago. These will be composed of persons from various branches of government, non-governmental organizations, and others involved or interested in the ecosystem approach to fishery management in the region.

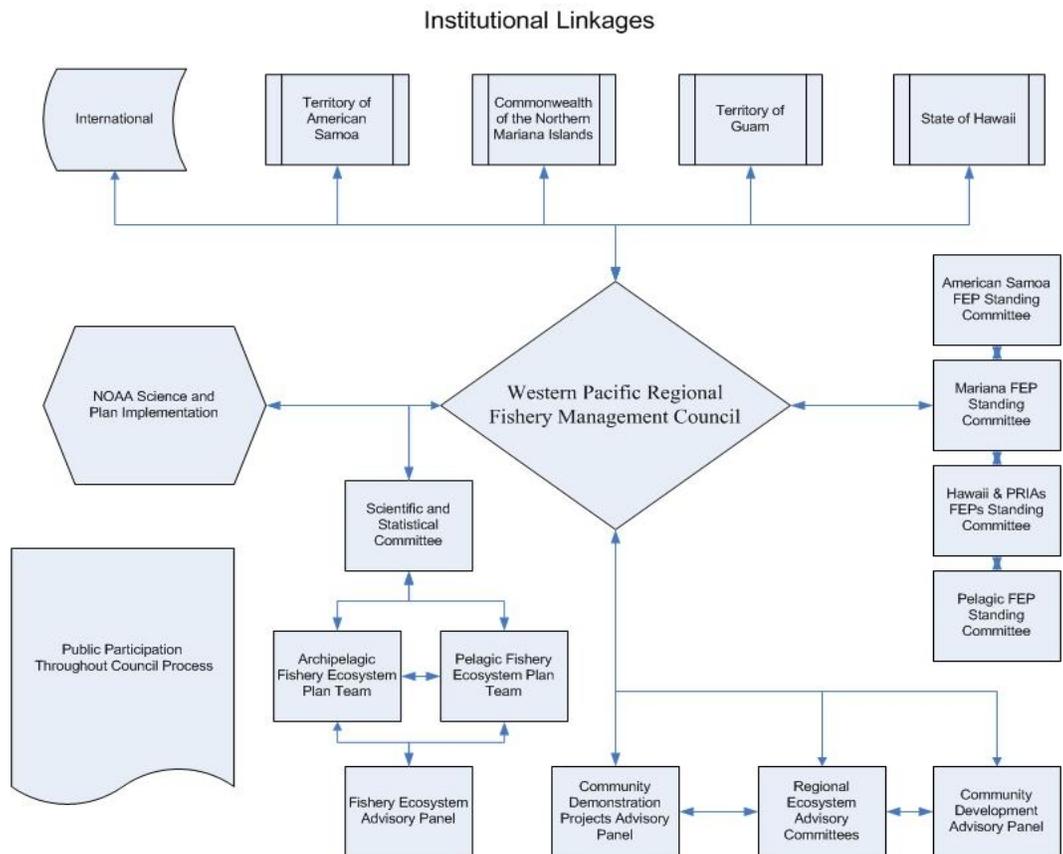


Figure 2-3 Institutional Linkages between Governing Elements under the New FEPS

Given the many layers of involvement in the management process under the new FEPS, Mr. Dalzell warns of the potential for “bureaucratic paralysis.” He related that the number of governing elements involved in the effort and sometimes conflicting agendas may make for a challenging arena for effective management, and that solutions for this potential problem will need to be addressed in the planning process and as the effort moves forward. Discussion of challenges associated with the prospective institutional complexities of ecosystem-based management was noted as an important objective of the current workshop.

**Dr. David Kirby, Senior Scientist
Secretariat of the Pacific Community**

Dr. David Kirby is Senior Fisheries Scientist in the Oceanic Fisheries Programme of the Secretariat of the Pacific Community. He presented a summary review of the first ecosystem workshop in the Council's series of three. Because the biophysical workshop is summarized in the previous chapter of this report, we present only those aspects of Dr. Kirby's talk that provide new information to the readers.

Dr. Kirby identified several important shared understandings during the course of workshop discussions concerning the role of ecosystem modeling. These were: (1) ecosystems are complex systems and the quantitative integration of available knowledge will inevitably lead to complex models; (2) details that are difficult to model can nevertheless have potentially significant effects on outcome; (3) some models appear to be capable of addressing great complexity but can yield spurious results and/or questionable precision; (4) complex models may be used to explore strategic trade-offs and risks even if their results are not precise; (5) humans tend to make decisions based on what they understand, and thus there is a need for models that are relatively straightforward; moreover, communication at the interface between science and management and between science and policy must be clear and precise; and (6) language regarding the structural assumptions and limitations of data, indicators, and models must be made patently clear.

Dr. Kirby also revisited workshop discussions concerning the role of scientists and how scientists and managers may best interact to successfully undertake and implement ecosystem-based management. The majority of those present at the biophysical workshop agreed that: (1) scientists need to know what policy options or potential outcomes should be modeled, and then they determine what data should be obtained, what indicators should be monitored, and what approaches should be undertaken to support analysis of such options; (2) managers should be able to use such data and accompanying analyses to think through potential policy outcomes and effects on stakeholders; (3) hard trade-offs and decisions are inevitably made by managers; scientists ideally will work to reduce the uncertainties of their data, models, and indicators.

Several operational objectives for the Council's FEPs were reviewed. These were previously presented by Dr. Steve Murawski of NOAA Fisheries, and include the following: (1) conserving and managing the [target] species; (2) minimizing by-catch; (3) managing trade-offs; (4) accounting for feedback effects; (5) establishing appropriate ecosystem boundaries; (6) maintaining ecosystem productivity and balance to ecosystem structure; (7) accounting for climate variability; and (8) using adaptive approaches to management.

Figure 2-4 below illustrates the role of ecosystem science under an ecosystem approach to fisheries as envisioned by participants at the biophysical workshop. Under the parameters of this model, the externally-derived management objectives are supported by the data, models, and indicators of relevance to the needs of the Council.

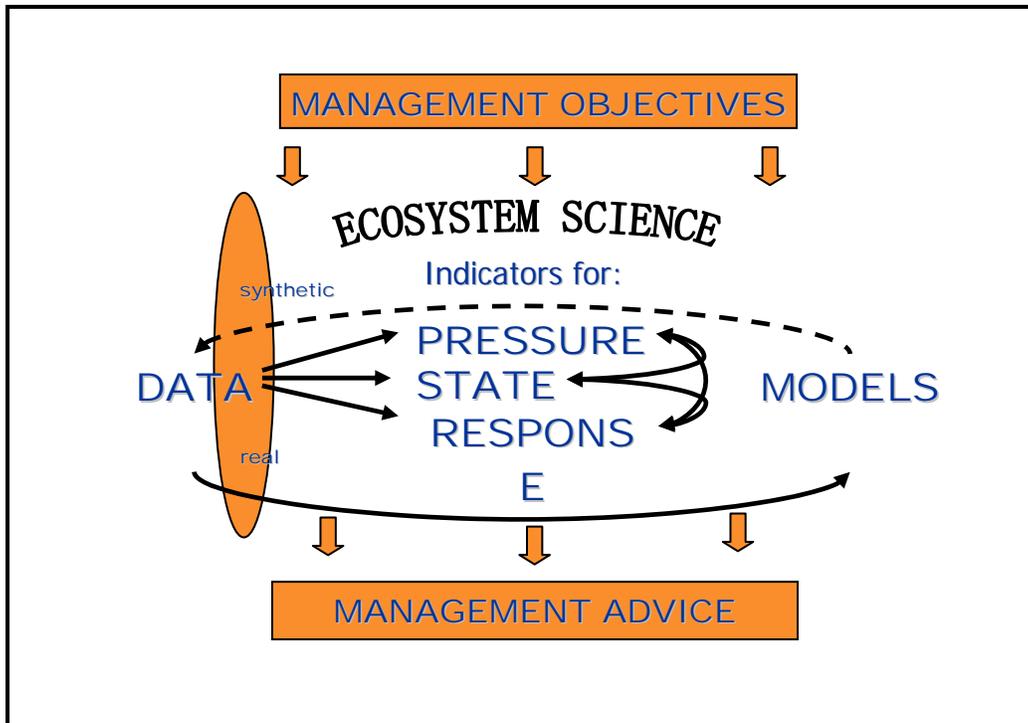


Figure 2-4 Conceptual Model for the Role of Ecosystem Science in Support of Fisheries Management

Dr. Kirby concluded his summary of the biophysical workshop by identifying several weaknesses of the meeting. In his opinion, the meeting itself had no specific policy questions to consider, without which discussion of specific data, indicators, and modeling approaches were necessarily abstract. Moreover, he felt that the synthesis of the meeting as described in the proceedings was not so much of a summary of what had been previously discussed as an overview of policy-making in the context of ecosystem-based management. He also expressed concern that ecosystem science could potentially be progressively ignored over the course of time.

On a more positive note, it was felt that workshop participants demonstrated the scientific basis for an effective ecosystem approach to fisheries management. Provided that management goals are made clear and funding is duly allocated, Dr. Kirby concludes that there is no reason why natural science should not continue to contribute significantly to the management of marine resource across the Western Pacific.

**Dr. Frank Parrish, NOAA Fisheries
Pacific Islands Fisheries Science Center**

Dr. Frank Parrish described the goals, objectives, and challenges of establishing ecosystem science and management in the Main Hawaiian Islands via the Hawai'i Archipelagic Ecosystem Research Plan (HARP). HARP is a long-term multi-agency research plan designed to address ecosystem-relevant information needs in and across the Hawaiian Archipelago. HARP was initiated following the Northwestern Hawaiian Islands Symposium, with the goal of defining

new and emerging research priorities and advancing scientific inquiry in support of ecosystem-based resource management. The organization is guided by an Executive Management Team, a Steering Committee, and a Drafting Team. The HARP mission is as follows:

“Sustainable conservation and management . . . through improved understanding of the unique physical and biological attributes of the Hawaiian archipelagic marine ecosystems, their interconnected dynamics, and their interactions with human beings.”

Among the initial tasks undertaken by the HARP Drafting Team was provision of a plan of action and timeline for developing an ecosystem research plan (see Figure 2-5). During this process, the following research principles were identified:

- 1) select testable hypotheses consistent with vision statement;
- 2) understand physical, biological, and social processes at an archipelagic scale;
- 3) employ comparisons between the MHI and NWHI;
- 4) acknowledge understanding of the human component as essential to long-term ecosystem management; and
- 5) conduct research at a scale and intensity that will advance ecosystem modeling and forecasting.

The HARP Drafting Team currently anticipates a ten-year time frame for HARP, though a starting point has yet to be determined. Requisites for any proposed action include establishment of a panel of international experts that would provide independent review of the plan, suggest revisions, and request modifications to complement existing national and international resource management priorities.

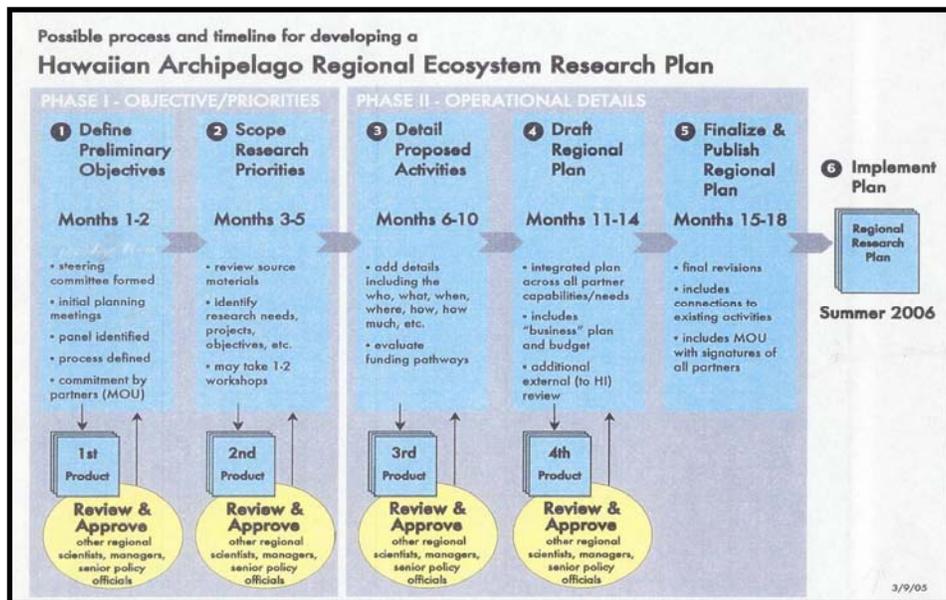


Figure 2-5 Timeline for Developing HARP

Dr. Parrish also noted that the HARP Drafting Team examined, compared, and analyzed several ecosystem research plans from other regions. In so doing, the team identified six notable process-oriented priorities and themes. These are as follow:

- 1) ecosystem indicators and metrics, which include physical, chemical, biotic, and remote sensing indices;
- 2) native biodiversity (endemic and vanishing) and invasive species;
- 3) connectivity, which includes hydrodynamics of the archipelago, movement studies on adult taxa, transport modeling, and population genetic structure;
- 4) monitoring of human interactions and anticipation of human impacts to the marine ecosystem;
- 5) sustainability, resilience, and recovery, which focus on pathways of and modifiers to resilience; and
- 6) modeling and forecasting, which includes identifying the variables, resolution, and relevant scale for ecological models; reviewing existing models and conduct of gap analysis; evaluating parameter research and model validation; and developing a capacity for ecosystem forecasting.

Dr. Parrish reported that the Drafting Team also conducted a series of focus group interviews with local experts to obtain structured input regarding each of the themes listed above. It is notable that biological, physical, and social considerations are integrated into each.

<p style="text-align: center;">Susan Hanna, Professor of Marine Economics Oregon State University Coastal Oregon Marine Experiment Station</p>

Susan Hanna of Oregon State University reviewed and summarized the Council's Ecosystem Social Science Workshop, the purpose of which was to discuss social science requirements for ecosystem-based management in the Western Pacific. Dr. Hanna defined ecosystems holistically at the outset - humans were defined as integral to rather than merely exogenous factors exerting effects on marine systems. Because the workshop is summarized in previous sections of this report, we provide only those portions of Dr. Hanna's presentation that offer new information to the readers.

Dr. Hanna noted that workshop participants represented a wide variety of disciplines, agencies, and institutions. This enabled a diversity of perspectives and experience relevant to the task of discussing the human dimensions of fishery management in a large and complex region. Although a single unifying theme was lacking at the outset, the participants clearly united across disciplines through agreement on three basic themes: (1) management is about managing people,

not fish; (2) incentives are paramount to implementing effective fisheries management; and (3) context is everything.

Dr. Hanna then discussed a variety of points and themes emerging from the workshop, as synthesized by Dr. Glazier in the Council Ecosystem Social Science Report. The first recognizes the importance of context in that long-standing fishing practices and management concepts may be usefully integrated into existing management efforts. Dr. Hanna reminded the audience that traditions and experiential knowledge are at once varied and extensive in the Western Pacific, and that these may contribute to adaptive and integrative approaches to management across the region.

Second, Dr. Hanna noted that management objectives ideally will direct the course of social science research and analysis. In other words, social scientists should not impose their own research interests in this area unless they are relevant to the needs of decision-makers. For example, scientists could design culturally-appropriate protocols for defining sustainability within a particular context and then again for helping to understand the potential for behavior that would promote such sustainability. Social scientists could be stationed so as to monitor the behavior of resource users and thus enhance the potential for adaptive management. There is also potential for social scientists to assess the need and ideal means for stakeholder input, and for addressing the feasibility of cooperative management of marine resources. Dr. Hanna reminded the audience that community-based management is as institutionally complex and challenging as any other form of management.

A third theme recognizes that social scientists must monitor human interactions within ecosystems in terms of the direct flow of goods and services (Figure 2-6). In order to do that, social scientists will need to develop valid social and economic indicators (the fourth theme emerging from the workshop). Dr. Hanna asserted that indicators should relate clearly to management objectives, involve distinct measures, build on existing practices, utilize the benefits of local ecological knowledge, and assume some measure of commonality across fisheries.

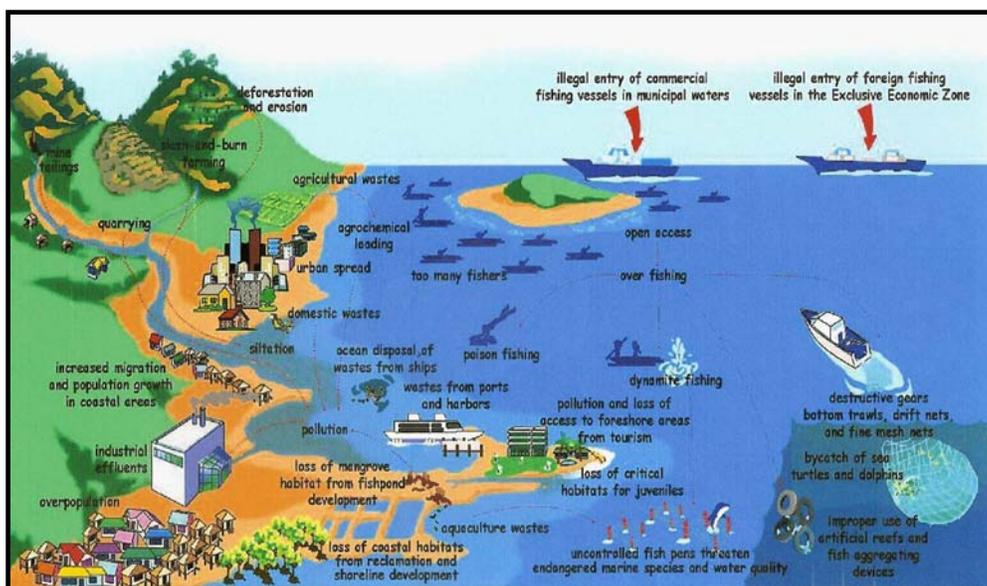


Figure 2-6 Direct and Indirect Ecosystem Relationships (Christie 2007)

The fifth point or theme discussed by Dr. Hanna involved indirect ecosystem relationships, such as tourism. She asserted that these are as important to monitor as are direct relationships such as those between fishers and fish. Indirect linkages or factors warrant consideration as they bear great potential for affecting biophysical systems or changing the social or economic context within which marine fisheries are undertaken.

The adaptive approach to fisheries management was also reviewed by Dr. Hanna. She noted that there can be tension between advocates of flexible and responsive management and persons charged with making sure established mandates and regulatory processes are closely followed. In other words, while an adaptive or flexible approach is logical and useful in some cases, it can interfere with management requirements (such as sufficient time and due notice for public comment).

Finally, Dr. Hanna discussed the need for building social science knowledge into management. It was asserted that this should occur directly and systematically and that it can be accomplished by meeting the following objectives: (a) clearly identifying needs for social science research and related data and modeling, (a) setting priorities for incorporating social science data and analyses into existing plans and programs, (c) adaptively responding to emerging challenges via social science research and data, and (d) monitoring and evaluating the outcomes of such work in terms of the degree to which it enhanced efforts to better manage the fishery in question.

<p style="text-align: center;">Stewart Allen, NOAA Fisheries Pacific Islands Fisheries Science Center</p>

Dr. Stewart Allen presented a discussion titled “Report from the Western Pacific Ecosystem Social Indicators Working Group.” Dr. Allen is social scientist for the Fisheries Monitoring and Socioeconomics Division of the Pacific Islands Fisheries Science Center and was involved in the organization and reporting of a social indicators workshop that generated indicators of utility for ecosystem-based fisheries management in the Western Pacific.

Dr. Allen described the rationale for and outcomes of the Social Indicators workshop held in Honolulu during autumn 2006. The two-day workshop began with a series of pre-planning meetings and discussions that followed the Ecosystem Social Science Workshop held in January 2006. The initial discussions were intended to lay the groundwork for an effective meeting later in the year.

The first day of the actual workshop focused on review of the vast literature on social and economic indicators. Participants explored the Global Socioeconomic Monitoring Initiative for Coastal Management (SocMon), the document titled *How’s Your MPA Doing?*, and a number of important texts and journal articles reviewing the utility of indicators developed to gauge social change resulting through and from a variety of vectors and sources. The premise of the exercise was that review of indicators literature would likely yield a deeper understanding of the rationale for and suitable use of specific indicators in the context of natural resource management.

Participants developed several scenarios to enable grounded discussion of the utility, applicability, and predictive capability of specific social and economic indicators. A template was developed to describe the name, function, and relationship of various indicators. This facilitated discussion of the indicators vis-à-vis Council management actions, issues of measurement, and data collection and analysis. Dr. Allen stressed that the process of conceptualizing the indicators in this systematic way was highly useful.

Dr. Allen discussed several ways in which social indicators can contribute to fisheries management in this and other regions. For instance, he noted that they could be used to monitor impacts predicted to occur in an Environmental Impact Statement, and to identify populations and resource use trends and conditions relevant to Council actions over the long term.

Working through the template, participants focused on the FEP objectives and measurements capable of gauging progress toward achieving Council objectives. To help simplify the task, participants separated the broad FEP objectives into parts. For example, by looking at just one part of the following phrase, “maintain biologically diverse and productive marine ecosystems and foster long-term sustainable use marine resources in an ecologically and culturally sensitive manner,” the group was able to produce nearly 40 potentially useful social and economic indicators, including the extent of use of traditional ecological knowledge in decision-making.

Finally, Dr. Allen reported the list of ten principles or guidelines that were determined by workshop participants to facilitate an effective approach to development and use of valid indicators. These included the following:

- 1) Indicators need to be developed and in some cases measured with involvement of a broader community of stakeholders to ensure that the indicators of interest are meaningful, comprehensible, and useful for other purposes (such as building social capital);
- 2) Indicators constitute an important component of a comprehensive social science research plan for implementing and monitoring the Council’s FEPs; indicators and indicator-related research findings should also be part of the social science information made available to decision makers and the public;
- 3) A principal method for developing and measuring several of the social science indicators should be a broad household survey; this would be conducted in addition to research directed toward specific sectors (as is currently the norm);
- 4) A valid science of ecosystems must view human beings as pivotally important in marine systems and as important elements of trophic systems; humans are *not* exogenous elements of otherwise “natural” systems;
- 5) Just as each indicator will have characteristics that render it useful for analysts and managers, the full set of social science indicators eventually adopted should be matched to a balanced set of methods, scales, and types of information requirements (both primary and secondary);

- 6) Social and economic indicators should be developed and considered in the context of biophysical indicators;
- 7) Ecosystem management and ecosystem indicators should provide avenues for bringing constituencies and jurisdictions together, particularly since co-management and community management approaches are likely to be necessary for effective ecosystem management;
- 8) Indicators can be “value-free” or “value-laden” depending on what they are measuring and how they are phrased; both scientists and managers need to be sensitive to this issue;
- 9) Causality can be difficult to determine through use of indicators; if important, the level of accuracy needed should be made explicit;
- 10) It is critical to pilot test the indicators and emplace a data management system through which to care for and readily analyze the data (a time-consuming but necessary undertaking).

Follow-up Discussion

A variety of issues were reviewed as follow-up to the presentations. A recurrent discussion addressed the appropriate scope of ecosystem fisheries policy. A number of participants asked whether the mission of scientists and managers in this case was to undertake (a) ecosystem management or (b) ecosystem-based fishery management. Although there was general agreement that the mission is ecosystem-based fishery management, there was extensive discussion about terrestrial linkages to marine systems, especially in the context of islands, and whether such linkages fell within the realm of responsibility of fishery managers. The group reached some consensus on this issue, as it was determined that relevant processes on land (such as pollution in upland and estuarine areas) were indeed important considerations within a holistic or ecosystemic approach to management of marine fisheries.

A similar discussion addressed the issue of public trust and the scope of public interest in the management of marine resources in the Western Pacific. Again, it was determined that the scope of interest exceeded those who use the resources directly. The general public has a stake in the future course of management as well, and certain user groups not involved in fishing have the potential to affect marine resources and fisheries. It was felt that expanding the scope of management considerations to include the general public and specific interest groups is in keeping with the ecosystem approach which, once again, addresses a larger set of relationships than has heretofore been addressed in the recent history of fishery management. The Council Regional Ecosystem Advisory Committee (REAC) process was discussed as a means for increasing the scope of stakeholder input in the management of marine resources.

**Facilitated Discussion:
Interactions between Scientists and Policy-makers**

Following the presentations and associated interaction between participants during the morning and early afternoon hours, Dr. John Kirkpatrick of Belt Collins Hawai'i, Ltd. facilitated group discussion regarding the interface of science and policy in the context of ecosystem-based fishery management. The discussion ultimately focused on the appropriate role of scientists in the process of resource management and policy-making.

Some points of common ground were identified between biophysical and social scientists present at the workshop. For instance, both groups accepted that science involves a reasonable level of adherence to the principles of objectivity, replication, and refutability. Both regarded sufficient data and valid indicators as essential for good science. Finally, while both groups respected the difficulties that resource managers must make, there was agreement that any form of science should be distinguished in some manner or to some extent from the subjective process of resource-related decision-making. There was not hard and fast agreement on this issue, however, and in the end some degree of consensus was reached that the management process would be enhanced through ongoing dialog between scientists and manager. This was effectively stated by Dr. Hanna as follows:

“What you are hearing me say is that there are different roles in the process that different people play at different times, and when you are designated as one of the policy-makers or as one of the science advisors, you fulfill one role or the other. However, it is very helpful for both policy-makers and scientists to be versed in the language of the other, to engage in the kind of dialogue that allows each to be informed by the other. But that is very different from a science advisory body taking on the responsibilities of making policy decisions, or decision bodies taking on the responsibility of muddling through management.”

Participants were asked to consider what means could be used to bridge biophysical science, social science, and traditional knowledge as the ecosystem-based management process moves forward. There was initial consensus that integration and effective use of what is at times disparate and at times complementary information is one of the important roles of the Council as it implements the ecosystem approach across the region. But the actual mechanics of this process were seen as likely to be somewhat variable and to some extent uncertain. It was stated that at times integration of scientific data falls under the purview of Council plan teams, and at others it occurs during development of Environmental Impact Statements or similar large-scale documentation and assessment efforts. It was also asserted that a reserve of data and knowledge is available at the regional science center and via Council staff.

Extensive attention was applied to the potential role of Geographic Information Systems (GIS) as a potentially highly effective means for integrating ecosystem-relevant data from each of the sciences. Some participants asserted that much of the data necessary for implementing an ecosystem-based approach to fisheries management already exists, but that an effective tool is

needed to integrate such information so that it can be widely and readily used. It was asserted that geography is the discipline best-equipped for integrating highly variable data and applying it in a place-based management regime such as that being developed by the Council, and GIS was advanced as the ideal tool for so doing. The potential value of GIS in this context was asserted by a number of persons, including Dr. John Petterson, who stated the position as follows:

“If we're starting to map landings, effort, CPUE, and other variables in terms of geography, then we're moving toward an integrated data system. We are now able to depict whether the fishery is being conducted in the inshore waters or offshore zone, three miles, thirty-two miles, benthic or pelagic, et cetera. Once we start mapping these sorts of variables against the many factors and processes being address by the biologists and the ecologists - that is the nexus of interest. That is the link between the world of the biophysical sciences and the world of the social sciences. That is the point of integration. We need to look at the variety of data points and how they link up in the ecosystem . . . the data are linking us together.”

Finally, there was discussion about the nature and roles of traditional knowledge and stakeholder input, and appropriate ways in which such information may be integrated into the process of management. It was made clear at the outset that while such information is often invaluable and an excellent complement to data generated by formal scientific research, it cannot and is not intended to replace data generated through such research. Examples of programs enhancing opportunities for use of local and traditional knowledge, stakeholder input, and public involvement in formalized research were discussed at some length. These include programs undertaken by the State of Hawai'i, programs in New Zealand, and programs elsewhere in the Pacific. Dr. Craig Severance framed relevant points of the discussion in relation to the Council's own nascent REAC process, as follows:

“ . . . I would like to think that all scientists, including indigenous scientists, would be curious enough to want to learn how other people think and how people from other scientific disciplines think, because if we're going to work together on this, we have to understand where everyone is coming from. If the Council is going to take this process out following from what I view as a pretty successful exercise with the local Hawaiian community, and they're going to take it to the Samoan Council and to the Chamorro community and to the Carolinian community, and to the other communities in other parts of the region that are multi-ethnic, they're going to have to do it in a way that's legitimate. Which means that they're going to have to come out with respect for local knowledge . . .with respect for traditional ecological knowledge, and with some kind of model for how to integrate the information . . .”

2.2 Summary of Policy Workshop Day Two: Thursday, January 4, 2007

Overview. Day Two of the Ecosystem Policy Workshop involved extensive examination of challenges associated with effectively addressing the needs and interests of indigenous fishing practitioners and other stakeholders in the various archipelagic sub-regions of the Western Pacific. A series of presentations were interspersed with interactive discussions during the morning hours, and group discussions were facilitated later in the day.

Presenters discussed a variety of challenges associated with management of marine resource challenges in the Commonwealth of the Northern Marianas Islands (CNMI) and Guam. These reportedly include: (a) depletion of nearshore fisheries, (b) lack of enforcement, (c) commercial and residential over-development, (d) diminishing fishing grounds, and (e) regional economic emphasis on tourism with concomitant deleterious effects on marine fisheries. Management problems in American Samoa reportedly include management inertia and contested maritime boundaries and fishing areas, among others. A variety of historical and contemporary challenges were described in relation to marine fisheries in the Hawaiian Islands.

Workshop participants anticipated that asking local agencies across the Western Pacific to work together on implementation of the Council FEPs will not be an easy task. For instance, it was thought that competing interests and agendas were likely to present various challenges. Workshop participants recognized the need to understand cultural aspects of management in the regions of interest, and it was suggested that incentives may be designed to enhance the efforts of the Council.

Participants made several additional recommendations for enabling a streamlined approach to ecosystem-based management across the archipelagos. For instance, it was felt that management problems on Guam and CNMI might best be approached by appointing a liaison to help initiate dialogue between these somewhat cultural distinct island areas. Other recommendations include efforts to: (a) improve enforcement of nearshore fishing regulations on the populated islands, (b) integrate local knowledge with formal science-based approaches to management, and (c) increase local involvement of stakeholder in the management process.

The issue of empowering stakeholders was discussed at length during the second day of the workshop. It was recognized that there is much local and traditional knowledge from which to better understand resources, ecosystems, and human use thereof. There was also discussion of the desirability of enabling meaningful local and regional participation in management of marine resources rather than imposing rules and regulations from the outside.

Finally, a range of issues associated with interagency cooperation were discussed at some length. Participants agreed that successful implementation of the FEPs will require the support of local agencies and institutions, and that attaining such support in a context of multiple interests and agendas may be challenging. It was felt that there may be a role for social scientists in developing a better understanding of the socio-cultural context of fishery management in the archipelagos, and that this could help streamline data gathering and incorporation of regional needs and interests via the Council's REAC system and other forms of local involvement in the management process.

Dr. David Kirby, Senior Scientist
Secretariat of the Pacific Community

Dr. Kirby presented a discussion titled “Ecological Risk Assessment for Species Caught in WCPO Tuna Fisheries: Inherent Risk as Determined by Productivity-Susceptibility Analysis.” The discussion was intended to provide workshop participants with a more complete understanding of some of the pertinent aspects of ecosystem process modeling in the Western and Central Pacific.

Dr. Kirby discussed ecological risk assessment research and modeling work recently undertaken for the Scientific Committee of the Western and Central Pacific Fisheries Commission. The effort attended to a need for information regarding fisheries-related interactions between target, at-risk, and incidental species typical of the pelagic fisheries in the region.

The productivity-susceptibility model employed by Dr. Kirby uses data regarding biological characteristics of the species of interest to estimate the degree to which they are interacting with a given fishery in the absence of precise catch or mortality estimates. In his presentation, Dr. Kirby demonstrated that effects on a target species bear differential implications for other parts of the ecosystem, such as non-target species. The model thus illustrates certain connectivity dimensions of pelagic fishery ecosystems. The work is particularly germane to ecosystem-based fishery management given recent legislation intended to address incidental catch of certain species in various parts of the region.

Dr. Kirby used observer data to identify the species landed in pelagic fisheries across the region. He then assessed biological characteristics and indicators of productivity for each. Indicators included age-based metrics, maximum length, length at maturity, and reproductive strategy. Data regarding the condition of the fish when captured and whether it was kept or released were also used. Data were aggregated across the region for the period 2001 through 2005. Based on these factors, Dr. Kirby derived composite indices of risk and susceptibility for a range of open ocean species.

Dr. Kirby noted that bird-fishery interactions usually result in avian mortality. Effective management measures would therefore ideally focus on preventing such encounters. Turtle encounters are not usually fatal and, as such, effective management measures would most effectively include post-encounter treatment, including hook extraction and rest and recovery before release. Finally, encounters with sharks are not usually fatal. Dr. Kirby asserted that if sharks landed alive were promptly released, fishing-related shark mortality could decrease by some 30 percent.

While it was made clear that this modeling effort involved some subjective determination in terms of weighting the indices, Dr. Kirby concluded that the model does enable an objective means for ranking extent of susceptibility of a range of species to fishery interactions. He noted that the analysis can be applied to non-fin species as well, providing the existence of the requisite data.

Mr. John Gourley
Micronesian Environmental Services

Mr. John Gourley presented a discussion titled “Management and Policy Challenges in CNMI.” The presentation was intended to provide the audience with an overview understanding of fisheries-related environmental issues currently salient in the region.

Mr. Gourley describes the physical constraints and characteristics of the Commonwealth of the Northern Marianas Islands (CNMI). The Northern Marianas are comprised of 14 islands: nine of which are volcanic in nature and five of which are comprised of raised limestone. The three inhabited islands—Saipan, Tinian and Rota—are located in the southernmost part of the archipelago. The population is comprised of several large multi-ethnic communities. Indigenous residents are outnumbered by workers who have arrived from other regions; slightly less than half of the total population is indigenous Chamorro or Carolinian. About 90 percent of the total population of the region resides in Saipan. Mr. Gourley asserts that there are numerous cultural differences between the people of the Northern Marianas and Guam, even though the indigenous populations share the same ethnic background (Chamorro). Challenging economic conditions, a diversity of habitats and reef ecosystems, and the vast size of the archipelago reportedly lend to a range of natural resource management challenges.

Mr. Gourley described the depletion of nearshore fish as one of the most pressing fisheries issues of the day. In order to address this and other resource management concerns, policy-makers in the CNMI region recently set forth several objectives. These include efforts to: (a) improve enforcement of nearshore regulations for the populated islands, (b) increase public and stakeholder involvement in the process of management, and (c) use public input to help coordinate science-based approaches in the balanced development of resource management programs.

While regulatory processes have an effect on the manner in which fisheries in the region are conducted, a variety of additional factors indirectly influence them. For instance, the Farallon de Medinilla region is an important fishing ground for residents, but weather conditions limit access to that area for about six months of the year. Cost factors also present various constraints. For example, lack of available capital has thus far deterred local fishermen from purchasing large ice-makers which Mr. Gourley believes would have a dramatic affect on the capacity of local fleets to meet demands for fresh seafood. Fishermen currently must carry ice to the grounds at Farallon de Medinilla, or go without.

There are two marine protected areas in the CNMI: the Managaha Marine Conservation Area (MMCA) and a protected area in Saipan. Mr. Gourley described the implementation process for the MMCA as one that was “done right.” He reports that the Department of Fish and Wildlife collaborated with local researchers to set up public outreach and education forums, to determine effective boundaries, and to conduct post-implementation monitoring surveys.

Mr. Gourley reports his perspectives on the recent proclamation of the Micronesian Challenge³ which “challenges” governing bodies across Micronesia to commit to the preservation of at least 30 percent of nearshore marine areas and 20 percent of forested areas in each of the countries and territories across the archipelagos. While Mr. Gourley perceives that these percentages are arbitrary rather than based on the tenets of science, many in the CNMI are taking the Micronesian Challenge very seriously and see it as a vehicle for advancing the rationale for establishment of marine reserves. Thus far, officials from Guam, CMNI, the Republic of the Marshall Islands (RMI), the Republic of Palau (ROP), and the Federated States of Micronesia (FSM) have signed on to the commitment.

Mr. Gourley asserted that government officials of the CNMI are also discussing options for establishing marine reserves around the western seamounts. These are under Council jurisdiction. This suggests to Mr. Gourley that there is a need for improved understanding of jurisdictional responsibilities and the potential socioeconomic effects of establishing reserves in the EEZ surrounding the CNMI. There appears to be significant momentum behind the Micronesian Challenge, and Mr. Gourley notes that various non-governmental groups are supporting the effort.

In order to best approach the various resource management challenges that are unique to CNMI and Guam, Mr. Gourley suggests that workshop participants contemplate a way to bring together the stakeholders of Guam and CNMI so that ecosystem-based management can be streamlined through an archipelagic approach rather than via separate political entities. He suggests that the Council should designate some key person to mediate between the two sub-regions and facilitate the necessary dialogue to bring the stakeholders together to a common ground public forum.

Mr. Gourley warns, however, that it is often the case that expatriate professionals make comments at public hearings while local stakeholders do not. He asserts that this is not a matter of indifference, but rather a cultural difference. Many local residents are not comfortable offering comments at public hearings. This means that comments often reflect the opinions and agendas of only a small percentage of stakeholders, and that a more encompassing approach may be warranted.

Ms. Judith Amesbury
Micronesian Archaeological Research Services

Ms. Judy Amesbury of Micronesian Archaeological Research Service presented a discussion titled “Management and Policy Challenges in Guam.” The talk provided context for group deliberation on a variety of issues of pertinence to management of marine resources in this part of the Western Pacific.

Before moving on to the central theme of her presentation, Dr. Amesbury described longstanding differences between Chamorro residents living on Guam and Chamorro residents in the CNMI. This was said to be a political artifact of World War II, when Chamorros in the CNMI were forced by Japanese infiltrators to act as spies and translators against interests on Guam. Efforts

³ The proclamation was made on November 5, 2005 by Palau President Tommy E. Remengesau, Jr.

undertaken in the 1970s to unite the two regions into a single political entity ultimately failed, in part due to historical animosity. Ms. Amesbury asserted that it may be difficult to effectively address these differences in the event the two sub-regions are to be treated as a single entity for purposes of eliciting stakeholder input.

The U.S. military first arrived on Guam in 1944. Today, military interests are said to be pervasive and likely to increase dramatically over the next six years as approximately 8,000 military personnel relocate to the island with family members and various other persons needed to support an increase of this size. It is anticipated that the influx will lead to a 15 percent increase in population, with implications for the capacity of existing physical and service infrastructure and potential environmental effects associated with expansion of roads, construction of new sewage facilities, pressure on sources of potable water, and so forth.

Dr. Amesbury reported that the general nature of relations between the people of Guam and the U.S. military has been alternately welcoming and negative. In the 1990s, some residents initiated a movement to remove the military and acquire lands deemed to be taken by the federal government. But the downturn in the Asian economy reportedly led to a rethinking of this process on the part of some, in that military activities are central to the regional economy.

Relations between the government and local fishermen are also said to be periodically problematic. Dr. Amesbury asserted that establishment of several marine preserves around Guam were not welcomed by some, and some fishermen refute that the Division of Aquatic and Wildlife Resources enabled fair representation in its public comment process. She noted that some fishermen may have not become aware of the hearings. As such, she believes the protocol for disseminating public hearing notices may need to be re-examined.

Local fishermen are also said to be expressing claims of inequity since some areas are closed to extractive uses but allow other activities to continue. Some resident fishers are said to object to disturbances caused by recreational jet skiers. Although there is a ban on jet skiing in East Agana Bay during certain fish runs, some contend there is inadequate enforcement. Some assert a resultant need to fish in distant or unfamiliar waters, and that safety and the availability of fish in such areas are issues of increasing concern.

Another concern related by Dr. Amesbury involves apparent redundancy in coastal resource planning. She asserts that jurisdictional uncertainties sometimes lead to situations in which pressing or latent problems do not get addressed. Moreover, because tourism is a critically important industry in the region, there has been a tendency toward over-development, and hotel properties reportedly are tending to limit the access of fishermen to historically important fishing grounds.

But the speaker also noted that the region is not without beneficial policies and situations; some benefit commercial and conservation interests alike. For example, the region's small boat commercial fishing cooperative has established several policies that ultimately conserve marlin. One is that cooperative buyers pay more per pound for small male fish than for larger females, thus enhancing spawning potential. Buyers also limit how many pounds of certain reef fish species may be purchased during a given period of time.

In conclusion, Dr. Amesbury stressed the potential benefits of empowering stakeholders in the region. She contends that some sort of shared management process is needed to enhance the possibility that the needs, interest, values, and conservation measures currently enjoined by residents are not overlooked in the years to come.

<p style="text-align: center;">Mr. Fini Aitaoto Council On-Site Coordinator for American Samoa</p>
--

Mr. Fini Aitaoto presented a discussion titled “Management and Policy Challenges in American Samoa.” The discussion informed the audience of participants of some of the important fishery issues, governance factors, and cultural attributes of relevance to implementation of the ecosystem approach to fishery management in American Samoa.

Mr. Aitaoto reviewed some of the challenges that may arise in association with the proposed shift to an ecosystem-based approach in American Samoa. In sum, these include the following: (1) there may be some level of administrative and jurisdictional inertia and/or confusion regarding a new approach to management in the region; (2) maritime boundaries and fishing areas between American Samoa and independent Western Samoa are to some extent contested and this may complicate any management efforts; (3) the large amount of fresh seafood imported from Western Samoa is indicative of diminishing production in American Samoa; this suggests a need for deeper understanding of current trends and conditions in American Samoa fisheries; and (4) there is ongoing contestation between the U.S. Department of Fish and Wildlife and Territorial government agencies regarding refuge policies at Rose Atoll; this may complicate collection and/or analysis of data regarding fisheries and related issues specific to the area.

The traditional matai system of governance was discussed in some depth, and it was asserted that this may present some challenges should the new system of resource management require significant changes to existing policies. He noted that conflicts of authority can occur on occasion, and that some measure of cultural sensitivity is warranted. For example, Territorial government officials have on occasion attempted to restrict land use in areas where tenure or ownership is claimed by persons with ascribed status under the cultural and political parameters of traditional village life. In some cases this can lead to an attempted overriding of previously exercised authority, with a range of problematic long-term implications.

Mr. Aitaoto notes that the traditional mode of governance present clear benefits in that chiefly authority can serve to put a swift and absolute stop to detrimental activities or behaviors associated with use of natural resources. Meanwhile, government agencies can merely issue a restriction, which may or may not yield the desired results. Mr. Aitaoto recommends that American Samoans and their established mechanisms of social control must be approached with respect and diplomacy if the matai system is to yield effects that are complementary to the objectives of fishery managers with responsibilities in the region.

Mr. Aitaoto also recommends that the FEP include formalized and culturally sensitive protocols and procedures. He also recommends that formal guidelines be formulated to aid in implementing the new approach to fishery management in the region. This would serve to help scientists collect fisheries data more efficiently, minimize duplication of effort, and provide a timeline for delivery of data and reports.

<p style="text-align: center;">Ms. Leimana DaMate Association of Hawaiian Civic Clubs</p>

Ms. Leimana DaMate of the Association of Hawaiian Civic Clubs presented a discussion titled “A Report on Puwalu Series.” The discussion provided workshop participants with background for informed deliberation on the potential for incorporating traditional ecological knowledge and resource management practices into the nascent ecosystem-based approach to marine resource management in Hawai‘i.

Ms. DaMate discussed the series of three Puwalu (conferences) held in Hawai‘i during 2006. The overarching intent of the meetings was to convene Native Hawaiian cultural practitioners from each district on each island, and other interested individuals and groups, to address issues of relevance to contemporary management of marine resources in the Main Hawaiian Islands.

The first meeting in the series emphasized the gathering of cultural experts and practitioners and the need for resolution to move forward with incorporating indigenous values and knowledge into the management process. The second meeting emphasized the input of educators, and the need to revitalize and validate traditional systems of knowledge in formal and informal educational settings around the state. The third meeting was focused on development of working policies needed to advocate for the perpetuation of Native Hawaiian values, practices, and interests.

The theme of the series— “truth”— is symbolized in the illustration of Kū‘ula, the Hawaiian god rising from the ocean holding a wana (sea urchin) in his hand (Figure 2-7). Each meeting built on the knowledge, resolutions, and directives of the one before it. Ms. DaMate asserted that one objective of the meetings was to protect and restore ecosystem integrity by promoting the restoration of traditional resource use and management practices implemented in the ahupua‘a.

Prior to the first meeting in October 2006, conference organizers identified the principal groups with interests in the management of marine fisheries in the islands, and they identified persons who would likely be able to represent the respective groups. The stakeholder groups included: (a) fishing communities, including Native Hawaiian communities, (b) commercial, recreational, and subsistence fishers, (c) federal, state, and county government agencies, and (d) non-governmental organizations with an interest in marine fisheries and related issues.

Representatives from a range of public and private sector agencies and organizations subsequently participated at some point in the event. Participating entities included: the

Association of Hawaiian Civic Clubs; the Department of Land and Natural Resources; the Office of Hawaiian Affairs; the Hawai'i Tourism Authority; the Office of Planning - Coastal Zone Management; the Department of Business, Economic Development and Tourism; Kamehameha Schools; and the Office of Hawaiian Affairs, among others.

The Puwalu organizers convened traditional lawai'a (fishing) and mahi'ai (agricultural) practitioners from each of the 37 mokus or traditional land districts in the islands. Ms. DaMate asserts that the meetings were successful because participants chose their own representatives from each moku.

The first meeting was characterized as the most challenging as it required organizers to establish trust among a wide range of participants. Participants were united by their shared concern for protecting and sustaining their natural resources. A resolution was passed that would "unite Native Hawaiians to move forward, to live, to grow, to gather together, to stand firm and to restore and perpetuate the Hawaiian way of life."

The second Puwalu involved the participation of educators from each of the private, public, immersion, and charter schools in the State of Hawai'i. The educators learned that natural resources, seasons of harvest, and types of fishing and gathering practices vary by island. Participants also realized that a protocol would need to be adopted for asking kūpuna to share traditional knowledge, as the sacred nature of that knowledge can limit discussion of traditions with outsiders. Ms. DaMate reported that plans are underway to integrate knowledge derived through traditional place-based Hawaiian science into educational programs throughout the state.

Ms. DaMate reported that the participants in the third workshop have worked to develop legislation incorporating the concepts and objectives of 'aha moku, which are regional councils representing the interests of Native Hawaiian stakeholders from around the island. The intent is to formally enable a community consultation process for each island, with council representatives selected by participants in each district.

* * *

[Author's note: House Bill 1948 H.D.2 S.D.1 was passed by the 24th Legislature of the State of Hawai'i in spring of 2007. The bill specifies its purpose, in part, as enabling:

"A system of best practices that is based upon the indigenous resource management practices of moku (regional) boundaries, the contours of the land, the specific resources located within those areas, and the methodology necessary to sustain resources and the community. The 'aha moku council system will foster understanding and practical use of knowledge, including Native Hawaiian methodology and expertise, to assure responsible stewardship and awareness of the interconnectedness of the clouds, forests, valleys, lands, streams, fishponds, and sea. This council system will include the use of community expertise and establish programs and projects to improve communication, education, and provide training on stewardship issues throughout the region."

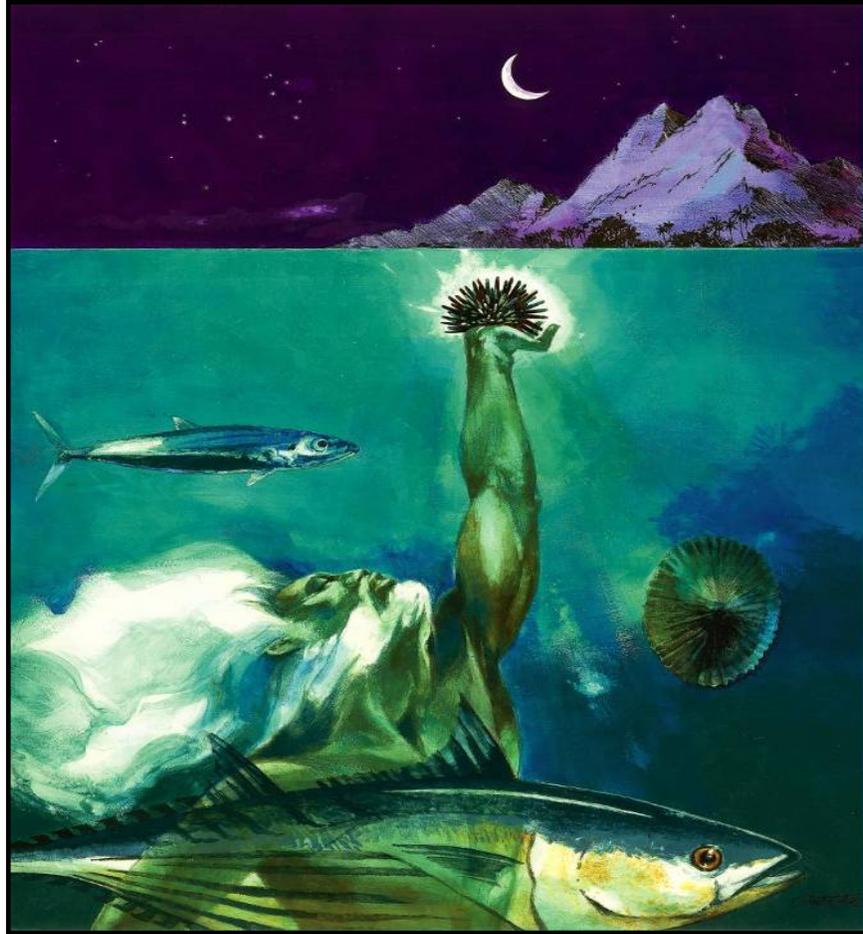


Figure 2-7 Kū'ula Rising from the Ocean

**Mr. Colin Kippen, Executive Director
Native Hawaiian Education Council**

Mr. Colin Kippen is Executive Director of the Native Hawaiian Education Council, the local entity responsible for assessing, evaluating, and coordinating activities under the Native Hawaiian Education Act. Mr. Kippen presented a discussion titled “Bridging Practice and Policy in Indigenous Science.” The presentation built upon that of Ms. DaMate and was focused on the educational dimension of the ‘aha moku system, and on the general importance of communicating traditional ecological knowledge across generations of Native Hawaiians.

Mr. Kippen began his presentation by asking workshop participants to consider what would be needed to build a figurative bridge between traditional practitioners who depend upon marine resources and decision-makers who typically do not. He asserted that such a linkage will be an essential requirement for successful implementation of ecosystem-based fisheries management in a region such as the Western Pacific.

Mr. Kippen regards the strategy of enhancing communication between practitioners and policymakers, as is being undertaken by the organizers of the Puwalu meetings, as fully

appropriate to the issues at hand. Government officials tend to be once-removed from the natural environment with which practitioners are so familiar. It was thus argued that bringing the concerns of those practitioners and their descendants to a forum such as the Puwalu series is critically important to the future of Native Hawaiian and other indigenous societies in the Western Pacific. He compared the process to an inverted Christmas tree, whereby the people closest to the resources are brought into the system, and unlike the “traditional Christmas tree where the person at the top of the tree represents all of the branches below and one person speaks for all, it is actually an inverted model which breaks down all expectations.”

Mr. Kippen asserted that the Puwalu series was successful in facilitating communication in that all interested parties were provided with information needed to make the best possible decisions. He asserts that the strength of the ‘aha moku system is its capacity to encourage effective communication between members of island communities that are often quite different in nature in both historic and contemporary terms. Although this can involve much time and effort during initial periods of consultation, the process can move very quickly once participants reach consensus on a given issue. While agreement with a given decision will not always be universal, Mr. Kippen believes that there is widespread respect among participants for the process through which decisions are being made.

The speaker also observed that the ‘aha moku process was capable of supporting the cross-generational interests of cultural practitioners. The process is envisioned as a long-term venue for ensuring that the concerns of the kūpuna or revered elders are heard and addressed. These include concerns about the future, and the importance of passing knowledge of the environment and traditional practices to future generations of Hawaiians. Education, he asserted, is the foundation of the bridge between the past and future, and the culturally appropriate consultation structure of the Puwalu process has helped the kūpuna understand the need for a proactive attitude in transmitting their knowledge to others. He believes that the system will enable practices and knowledge developed over thousands of years of Hawaiian history to be effectively communicated to future generations.

<p style="text-align: center;">Mr. Paul Dalzell, Senior Scientist Western Pacific Regional Fishery Management Council</p>

Mr. Paul Dalzell presented a discussion of salient fisheries issues in the region titled “Pan-Pacific Issues and Challenges.” The presentation was made on behalf of Dr. Tim Adams, Director of the Marine Resources Division of the Secretariat of the Pacific Community. Dr. Adams was unable to attend the meeting due to an illness.

The presentation was broadly focused on issues associated with management of pelagic species, and especially tunas, in the Pacific Basin. Approximately two-thirds of global tuna production derives from this vast region, with roughly half of the tonnage landed by fleets active in the Western and Central Pacific.

Several agencies regulate and manage tuna fisheries in the Pacific. These include the Western and Central Pacific Fishery Commission (WCPFC), the Inter-American Tropical Tuna

Commission (ITTTC), and the Forum Fisheries Agency (FFA), which is based in the Solomon Islands. The independent nations of the Pacific comprise the FFA.

Palau, the Federated States of Micronesia, the Marshall Islands, Kiribati, the Solomons, Papua New Guinea and Nauru comprise an important sub-grouping within the FFA. These are collectively titled the Parties to the Nauru Agreement (PNA). The PNA receives the largest share of revenues from a treaty between the U.S. and the independent Pacific island nations that enables access to the region by the U.S. purse seine fleet. The PNA derives the majority of its revenue from the aku or skipjack fishery as the resource. By way of contrast, the Central South Pacific does not have a centralized skipjack resource and its fleets are more deeply involved in longline fisheries.

The Secretariat of the Pacific Community (SPC) is an apolitical organization with departments that provide scientific and technical advice on marine fisheries issues to member nations and territories. The SPC Oceanic Fisheries Program has been responsible for conducting most of the stock assessments and monitoring programs in the region for the past quarter-century. Although the Program primarily addresses stocks and fleets in the Western, Central, and South Pacific, it also monitors longline activities in the Eastern Pacific.

Mr. Dalzell listed a range of issues and concerns relevant to the context surrounding pelagic fisheries management in the Pacific. These include the following: (a) highly productive longline fishing, (b) generalized overfishing of certain resources, (c) live reef fish fishery enterprises in the Pacific, mostly China-based, (d) the “China Syndrome,” in which many marine resources are exported to China - particularly beche demer, trochus, green snail, pearl oysters, and reef fish, (e) rapid population growth in many island nations, with between two and five percent annual growth not uncommon, and (f) loss of skilled labor to industrialized nations around the Pacific Rim.

Mr. Dalzell reported that longline fishing has increased dramatically over the course of time in the Western and Central Pacific Ocean. The fleet has increased in size from about 2,000 vessels to around 4,500 vessels in the last few years. This mode of harvest has become increasingly popular in recent years in American Samoa, Samoa, Fiji, Tonga, and Papua New Guinea. Meanwhile, the size of the purse seine fleet in the Eastern Pacific and other regions, which had begun to decline, has recently increased in size.

Extensive fishing pressure on yellowfin and bigeye tuna stocks in the Pacific is a particularly acute challenge for managers. Pressure stems in large part from the activities of the purse seine fishery, and from use of various gear around fish aggregating devices (FADs). FAD fishing and generalized use of purse seine gear are tending to affect juvenile components of bigeye and yellowfin stocks, and bigeye populations are particularly stressed by longlining. Substantial changes in allowable take were therefore recommended by the Science Committee at the third meeting of the WCPFC.

In light of this information and the stated interest of many Pacific island nations in development programs that include expansion of marine fisheries, Mr. Dalzell presents the audience with the challenges of how it will be possible to at once develop fisheries and conserve tunas. He also

noted that one unintended consequence of fisheries expansion in the region is that failure to meet quotas may under certain conditions lead some Pacific island nations to lease unused quota to distant water fleets of nations outside the region.

Mr. Dalzell notes that the WCPFC is attempting to reduce pressure on tuna populations by instituting a changeover from limiting the number of purse seine vessels to limiting the number of overall vessel days that can be fished by the various fleets and nations. The conservation effects of the new regulatory changes in the region are not yet known.

Follow-up Discussion

The group engaged in some initial discussion of the risk-susceptibility model presented by Dr. Kirby. Dr. John Sibert of the Pelagic Fishery Research Program at the University of Hawai'i noted that the model is somewhat inconsistent with what is known about certain species such as skipjack tuna, which appears to be proliferating despite extensive fishing pressure. He noted that there are uncertainties in the rationale underlying the model in that "rather than adding to the list of species that are in trouble, we should be looking for processes that are counterintuitive, processes that indicate something meaningful about the ecosystem." Dr. Lee Anderson of the University of Delaware School of Marine Affairs, addressed the model in terms of its potential for indicating specific trade-offs; that is, areas and issues that managers will need to address in terms of the effects of fishery interactions on non-target species under the expanded parameters of ecosystem-based management.

The Micronesian Challenge was also a topic of discussion. Dr. Marc Miller of the University of Washington School Of Marine Affairs spoke to the multiple objectives of marine protected areas. He noted that while the areas can be established to enhance fish stocks, they are also established for reasons that have little to do with marine fisheries or which, in fact, preclude fishing entirely. Dr. Miller raised a range of issues associated with the way in which marine reserves are portrayed to the public, and the suitability of the strategy for some areas but not others.

Dr. Sam Pooley, Director of the NOAA Fisheries Pacific Islands Fishery Science Center, discussed the governance dimension of ecosystem-based fishery management in this regard, noting the difficulties in arriving at a governance structure that can address the plurality of localized value systems on one hand and globalizing processes and pressures on the other. He asserted that clarity and transparency of objectives, such as those underlying the Micronesian Challenge, are requisites for effectively addressing the local implications of changing management strategies.

Extensive discussion was also applied to resource use conflicts associated with the recent increase in ethnic diversity in the CNMI. It was argued that fishing and gathering practices unique to newly-arriving populations of residents are exerting new pressures on marine resources in the region, and that social research may effectively improve understanding of the nature and scope of that pressure and related issues of concern.

Dr. Susan Hanna lauded the virtues of the planning process underlying the Puwalu initiative. She noted that unlike many community-based management approaches, the effort in this case was undertaken systematically and that it bears potential lessons for similar work undertaken elsewhere around the world. There was also extended discussion of the unique nature of representation under the 'aha moku mode of governance.

Dr. Pooley compared the system to a “community of governors” through which competing jurisdictions could represent their respective interests without losing individual autonomy. Strong assertions were made by a number of participants regarding the overall benefits of maintaining the integrity of traditional ecological knowledge and other elements of indigenous culture through mechanisms of governance such as those discussed during the course of this portion of the workshop.

Finally, a range of issues were discussed in relation to Mr. Dalzell’s presentation on management issues related to pelagic species across the Pacific. The fisheries are particularly important since some 85 percent of total catch in the Western Pacific region derives landings of pelagic species. Noteworthy discussion included review of factors that render an ecosystem approach useful for understanding and managing the fisheries. These included: (a) the political and managerial need to address by-catch and incidental take of protected species, (b) the significance of fishery-resource interactions at seamounts and other ocean features, (c) a range of macro-level environmental factors such as El Nino Southern Oscillation and its effects on patterns of tuna movement and migration, (d) population dynamics of tunas vis-à-vis fishery interactions, and (e) the many political factors associated with management of migratory or highly mobile species in an area of multiple jurisdiction and a complexity of management arrangements.

<p style="text-align: center;">Facilitated Discussion: Management Scenarios, Challenges, and Solutions</p>

Dr. John Kirkpatrick facilitated discussion on a range of ecosystem policy issues during the afternoon hours of the second day of the workshop. The original purpose of the session was to elicit the deliberative thought of participants on the following policy-related issues:

Policy Issue One: Institutional Ecology

Can participating agencies be expected to incorporate a new decision-making framework into their respective management agendas? How might this be enabled in a way that would minimize human impediments to potentially beneficial results? That is, what intra-agency and interagency challenges might be expected and how might these be overcome?

How might socio-cultural and institutional variability complicate development and implementation of ecosystem-based management policy in the diverse archipelagic sub-regions that comprise the Western Pacific?

Policy Issue Two: Indigenous Practitioners and other Stakeholders

How might indigenous and traditional interests, approaches to ecosystems, and management of marine resources be incorporated into the contemporary ecosystem-based fishery management process across the region?

What are the implications of an ecosystem-based management approach for the full range of resource users, and how might such persons respond to attendant policies and regulations? How might the challenges be equitably addressed?

Policy Issue Three: Facilitating Ecosystem Policy Process with Valid Research & Monitoring

What scientific research and monitoring efforts need to be undertaken to enable effective ecosystem-based policy and management in a region as diverse as the Western Pacific? What challenges might be expected in this regard and how might these be met?

To what extent can such efforts be coordinated to yield integrated biophysical and social science research products and monitoring programs of utility for managers and policymakers here? How can such integration be maximized?

Are existing human and fiscal resources sufficient to enable effective ecosystem research and monitoring work in the region? If not, what is needed and what new resources might be identified?

In order to focus discussion on these issues, participants were asked to select an area in which the ecosystem-based approach to fishery management will actually be applied through the Council FEP process. Given its diversity of cultures, environmental conditions, and fishery issues and factors, the CNMI was chosen for focused heuristic discussion.

Participants were subsequently asked to identify: (1) the major ecological zones of the region, (2) the most significant marine resources, and (3) user groups of significance to ecosystem-based management efforts in the region. The group collectively identified the major ecological zones as including: seamounts, pelagic zones, deep slopes for the deep-water bottomfish complex, fringing reef areas, barrier reefs, lagoons, and sea grass beds. Resources identified from the lagoon outward included: reef fish, invertebrates, algae, mollusk, coral, sea grass, the water column, pelagic fish, bottomfish, substrates, crustaceans, turtles, sharks, cetaceans, and birds. User groups included: commercial, recreational, and consumptive-oriented fishers; Chamorros, Carolinians, and other Micronesians; immigrants; snorkelers; seafood consumers; persons using the resources for visual, spiritual, emotional, or other non-consumptive purposes; cruise ship owners and operators; military vessels; scientists, researchers, educators, and students; and children and future generations.

In terms of governance, several agencies were identified as sharing responsibility for management, rule-making, and enforcement of the region's marine ecosystems and associated resources. These agencies (from lagoon to deep slope waters) include: the Division of Environmental Quality (DEQ), Coastal Resources Management (CRM), the U.S. Environmental Protection Agency (EPA), the Army Corps of Engineers (ACOE), the U.S. Coast Guard

(USCG), WPRFMC, NMFS, U.S. Fish and Wildlife Service (FWS), the Department of Public Works (DPW), National Park Service (NPS), and the Department of Interior (DOI).

Participants in the exercise were then asked to envision a process through which all of the agencies involved in governance of deep slope activities around the CNMI would be convened to deliberate on ecosystem-based management of resources in that ecological zone. The participants identified the following particularly salient concerns and challenges deemed likely to be encountered during the process.

- 1) Appropriate delineation and application of jurisdiction was seen as particularly important given: (a) limited resources available to conduct ecosystem research and monitoring, and (b) interest in avoiding duplicative management and enforcement efforts. Issues of scale and application of understanding at a scale appropriate for addressing interaction between ecosystem components and processes was seen as particularly important. As one participant noted: “everybody has jurisdiction, but few exercise it on an ecosystemic scale.”
- 2) The legal capacity and reach of authority under existing systems of governance vis-à-vis the extent of application of governance powers in reality was raised as important issue in this exercise. In other words, it was asserted there is a fundamental disconnect between what governing authorities can do and actions that are actually undertaken. For instance, a marine ecosystem may be heavily impacted by siltation of reefs caused by shoreside development. Agencies may have the power to act in a way that would ultimately regulate such activities and satisfy resource management mandates, but typically they do not. In short, agency involvement is often both overly narrowly defined and practiced.
- 3) Because agency representatives involved in management of marine resources in the CNMI were thought likely to be pursuing a variety of mandates and agendas (similar to personnel in resource agencies elsewhere in the U.S.), participants felt that full support from the Governor of the CNMI would streamline the gathering of support from the cognizant agencies. It was felt that a leader with full authority in support of the principles of ecosystem-based management could offer integrating support in his region of responsibility.
- 4) Concern was expressed about the tendency for biologists to determine policy when policy-makers or agency directors do not have the background needed to determine effective means to desirable outcomes. Thus, it was felt that certain social or economic factors or incentives may not be addressed in the information gathering, analytical, or decision-making processes associated with implementing an ecosystem-based approach to management of marine resources in the region. These concerns were not perceived as specific to the CNMI but were rather emblematic of the situation in settings around the U.S.

Participants also identified the zones and resources over which NMFS and the Council exert management authority. These zones included: (a) barrier reefs and seamounts that are more than three miles from shore, (b) the deep slope, and (c) the open ocean and associated pelagic species, sharks, turtles, and cetaceans. Significantly, the application of ecosystem principles and attention to connectivity between the biophysical and human components of marine ecosystems expands attention of federal agencies to a larger field of ecological zones, species, and human constituents. As such, the level of interaction between NOAA Fisheries and the Council on one hand and local agencies and institutions on the other is likely to increase.⁴

Participants in this exercise anticipated that several challenges result from increased interaction with local agencies during the implementation phase of the FEP process. Again, it was asserted that the competing interests and agendas of local and regional agencies may render streamlined interaction problematic in some cases. It was asserted that effort should be applied to understanding the incentives that drive the actions of agencies and their representatives, and how these relate to interagency dynamics. It was determined that sustained cooperation may require formalized agreement and appropriate incentives such as reciprocal sharing of data.

It was also asserted that in order for the FEP in CNMI (and elsewhere) to be successful, it will also need to be supported by the local polity. Some degree of involvement in the management process by local constituencies will also enhance the chances for success. There was discussion of this issue in terms of the reauthorized Magnuson-Stevens Act, which mandates extensive public involvement and use of traditional ecological knowledge in the process of managing resources in the Western Pacific. As such, it was recommended that the Council consider marine ecosystems in the CNMI through the eyes of village leaders and resource users. This would require equitable opportunity for input from Chamorro, Carolinian, and other cultural practitioners throughout the region.

Dr. Kirkpatrick presented workshop participants with an emergency scenario in which the Island of Hawai'i was isolated by an earthquake. Participants were divided into three groups to discuss a logical course of action needed to sustain the region's fisheries for sake of survival. The point of this heuristic exercise was to encourage participants to consider the ways in which people are linked to marine ecosystems in the Western Pacific, and appropriate and logical governance strategies for responding to disruptions to such systems.

All three groups developed creative means for responding to the variety of problems that would inevitably result from sudden isolation and dependence on finite natural resources. Significantly, each group employed scientific principles to arrive at solutions for sustaining important terrestrial and marine resources over the course of time. Of particular note in this regard, each group's plan relied extensively upon the knowledge systems of indigenous cultural practitioners and others familiar with marine ecosystems in the region. The issue of regulation of human behavior was also important as it was recognized that a system of governance and allocation of resources would be particularly necessary during times of scarcity.

⁴ Of note, the Council likely may also become increasingly involved with administrative review processes for a greater range of federal permit processes, such as those associated with seabed mining.

While the scenario minimized the external complexities of modernity and globalization, it was generally felt that the exercise was useful in that it inspired participants to reflect on decision-making processes associated with the most basic challenges of effective fishery management.

These include challenges associated with: (a) maximizing the utility of a finite base of natural resources for the collective good of the polity, (b) arriving at and maintaining system of governance that enables sustainability of natural resources, and (c) allocation of limited resources in a manner that is fair and equitable.

2.3 Summary of Policy Workshop Day Three: January 5, 2007

Overview. During the third and final day of the Policy Workshop, participants discussed a variety of options for maximizing opportunities for and benefits of fishery ecosystem research and monitoring, and stakeholder involvement in the management process. As summarized in subsequent sections of this and the concluding chapter of this report, the discursive input and recommendations generated by workshop participants will guide the Council as it moves forward with the ecosystem approach across its region of jurisdiction.

In reiteration, the Council is expanding its consultation process to enable additional opportunities for public input in the management process. This involves outreach to the full range of stakeholders via the Regional Ecosystem Advisory Committee (REAC) process, and ongoing implementation of the Council Community Development Program (CDP) and Community Demonstration Project Program (CDPP). The latter continue to be administered with the intent of providing technical and fiscal resources to indigenous communities around the region.

Workshop participants reviewed several challenges likely to be encountered as the Council engages ecosystem-based management. Means for interacting with the variety of agencies and stakeholders in the region were discussed once again. It was determined that the Council would ideally identify ways to provide leadership while enabling the sharing of knowledge and responsibility for the stewardship of natural resources. There was also deliberation on how best to evaluate how the strategy for ecosystem-based management actually performing. It was stated that without clear performance objectives, progress cannot be readily measured.

As described in the final sections of this report, several high priority recommendations for the Council FEP process were generated during the final day of the workshop. These are associated with what were widely perceived as critical needs for: (a) clearly defined roles, rules, responsibilities, and terms of reference for ecosystem based management in the various archipelagic sub-regions, (b) mapping and monitoring of physical and human environmental impacts following from or in some manner addressed by the new management approach, (c) developing partnerships for research and monitoring with stakeholders, (d) building capacity among stakeholders, and (e) developing trust and empowering communities around the region.

Group Discussion: How to Proceed?

The final morning of the workshop began with group discussion on what had been accomplished to that point in the meeting, which issues should be addressed during the final hours of the meeting, and what the best format for discussion would be. Extensive discussion was applied to the overarching issue of whether implementation of the Council's place-based ecosystem plans should be incremental in nature, or whether this should proceed via a wholesale changeover from the existing process of managing single species across the region.

There was also extensive deliberation on the nature of the ecosystem planning process and how the ecosystem mode of management would in reality differ from the existing mode of managing the region's fisheries. It was eventually determined that the Council will indeed proceed incrementally and adaptively and that this strategy would likely preclude a range of challenges potentially resulting from an overly rapid shift to the new paradigm and approach.

A useful summary of the unique elements of the ecosystem planning process and the nascent ecosystem-based approach to management in the region was offered by Dr. Stewart Allen of NOAA Fisheries Pacific Islands Fishery Science Center. Dr. Allen stated the Council's new approach and its unique attributes as follows:

“The Council is adopting an archipelagic approach which involves reliance on a new institutional mechanism, the Regional Ecosystem Advisory Committees, which is a kind of expansion of kuleana (realm of responsibility). It involves greater emphasis on community co-management and on the applications of Hawaiian science. It involves greater reliance on biophysical ecosystem models and concepts. It involves greater reliance on biophysical and social indicators. [In terms of governance], it's about collaboratively extending – it doesn't consider existing authorities as some sacred boundary beyond which we will not cross. So to me, what we've been moving toward is a willingness to go beyond NMFS and Council traditional authorities and responsibilities, where appropriate, and to recognize other influences on the ecosystems that we manage a portion of through our fisheries management processes, and do that through increased collaboration with other jurisdictions and entities. To me, we've already identified the suite of ways in which the Council wants to move beyond our existing processes.”

Overview Discussion: Mr. Paul Dalzell, Council Senior Scientist

Mr. Dalzell initiated deliberations on the final day of the workshop with a presentation regarding the then upcoming Regional Ecosystem Advisory Committee (REAC) meetings. The intent of the talk was to present participants with information about the REAC program and it is intended to fit within the Fishery Ecosystem Planning process.

Regional Ecosystem Advisory Committees (REACs) have been established for each of the archipelago. The advisory bodies are comprised of invited Council members with expertise in

marine fisheries and related issues, and representatives from federal, state, and local government agencies, businesses, and non-governmental organizations with responsibilities or interests in land-based and non-fishing activities potentially affecting the marine environment.

Mr. Dalzell asserted that the REACs will provide a mechanism for the Council and member agencies to share information about relevant programs and activities, and to coordinate management efforts to better address factors impinging on the status of marine ecosystems within and beyond the jurisdiction of the Council. The Committees are also intended as a resource for local communities with which they can interact to given and gather information about area-specific issues.

A newly-established Marine Education Program will also be part of the new approach. This program will promote the integration of traditional knowledge and marine science into educational programs around the region.

The Council is visiting the archipelagos during 2007 to discuss the ecosystem-based management approach with stakeholders. Mr. Dalzell noted that the Council is shifting incrementally toward the ecosystem approach and implementation of the FEPs.

* * *

[Author's note: Initial REAC meetings were held in the CNMI and on Guam during February 2007 and in American Samoa and Hawai'i during April 2007. Each of the REACs expressed overarching concerns about loss of traditional ecological knowledge and deterioration of cultural practices directly and indirectly related to marine resources and ecosystems. A principal issue of concern on Guam was loss of access to shoreline areas associated with beachfront development and marine reserves. Concerns regarding loss of traditional Chamorro life ways were expressed by REAC representatives in the CNMI. Such concerns were also expressed by representatives in Hawai'i, though there was favorable discussion regarding perpetuation of traditional fishing practices and related patterns of culture in certain areas around the islands. Additional concerns around the region include enforcement problems, pollution, and detrimental aspects of tourism (see Western Pacific Fishery Management Council 2007).]

<p style="text-align: center;">Overview Discussion: Mr. Jarad Makaiau, Council Habitat Coordinator</p>
--

Mr. Jarad Makaiau, Council Habitat Coordinator, presented additional information regarding the nature and intent of the Regional Ecosystem Advisory Committees. Mr. Makaiau has played a key role in the ecosystem planning process and he is highly knowledgeable of the variable biophysical and social conditions in which the FEPs are being developed and implemented around the region.

Mr. Makaiau noted that, with their mandated focus on management and regulatory processes, governing bodies sometimes disregard the fact that it is local residents who are most closely involved with marine resources. Stakeholders care for and depend upon those resources for

income, sustenance, and a range of social and cultural purposes and outcomes. He noted too, that management and regulatory processes function to condition the behavior of persons who on occasion may not attend to traditional or normative behavior regarding proper use of marine resources.

The Council's goal in implementing the FEPs is to assist and empower individuals and communities dependent on healthy and productive marine ecosystems. Because not every individual and group can be immediately assisted, however, efforts are necessarily focused on addressing the most salient issues and challenges. That is, resources are first applied to persons and groups with the most pressing and feasible goals. Mr. Makaiau described a process wherein communities will bring their issues to the REAC, which will then ask the Council if it is an appropriate and feasibly-addressed issue. If so, the Council will apply resources to the issue with the intent of enabling the community in question to assume some measure of collaborative responsibility for effectively meeting the challenge.

Mr. Makaiau noted that the Council's Community Development Program (CDP) can serve to provide communities with technical support to address problems such as pollution or habitat degradation. The Community Demonstration Project Program (CDPP) can also help solve such problems. As noted by Mr. Dalzell, the newly authorized Marine Education and Training Program authorizes the Western Pacific and North Pacific Councils to provide funding and technical expertise to promote the incorporation of traditional knowledge into the management process. In short, the non-regulatory component of the FEPs provides for application of various resources to meet a range of fishery-related concerns and challenges in communities throughout the region.

The speaker also related that the CDPP could also be used to fund collaborative research between NOAA Fisheries scientists and participants in the region's fisheries. Program funding is provided on a year-to-year basis.

A team will be appointed to address Council-approved REAC recommendations. The Committees will ideally meet at least three times a year in their home locations. Regarding pelagic fisheries conducted in the region's EEZ, Mr. Makaiau reported that the Council may work through the REAC to assist the community in addressing a suitable strategy for addressing management issues in a given offshore area. Formalized scientific information and/or traditional ecological knowledge needed to inform the prospective management strategies will be determined on a case-by-case basis. Mr. Makaiau described the voluntary fisheries data collection initiative intended to gain basic understanding of small boat fisheries around the offshore banks near Guam. Finally, he reiterated that the Council's overarching goal is to empower communities and provide them with some of the tools needed to collaboratively assist in the management of their fishery resources and marine ecosystems.

Follow-up Discussion

A number of issues discussed by Mr. Dalzell and Mr. Makaiiau were reviewed by participants during the morning hours of the final day of the workshop. It was recognized that the Council will gradually and incrementally implement management measures to further operationalize the FEPs. But some participants asserted that even under an incremental approach a long-term vision and related management objectives will be needed to maintain continuity of the ecosystem approach across the region. Moreover, it was asserted that: (a) without clear objectives relating to that vision, it will be difficult to evaluate the overall effectiveness of the new approach, and (b) the regulatory component of the ecosystem-based approach will ideally involve a regular review process to identify lessons learned during its incremental implementation; thus, the approach can be revised as necessary for more effective implementation across the archipelagos.

Council staff members related that the WPRFMC has collectively arrived at a vision for the future of the ecosystem approach and that objectives have been developed to satisfy that vision. These relate primarily to the process for deepening relationships with stakeholders and their communities over the course of time, and to immediate and practical plans for initiating that process. That is, efforts are currently being undertaken to successfully initiate the REACs, which are intended to improve the Council's understanding of the biophysical and human dimensions of the region's marine ecosystems and thereby introduce a more effective and empowering management regime.

It was agreed that the REAC process could and would allow the Council to consider and address issues extending beyond those it has traditionally considered, such as terrestrially-generated pollution and other factors affecting comprehensively-envisioned marine ecosystems. It was determined that: (a) this will occur largely through enhanced and expanded advisory roles vis-à-vis other governing bodies in the region, (b) direct regulatory changes could only be effected in the EEZ, and (c) it may be useful to interact with local agency representatives during the early phases of the effort to explain the intent and nature of the advisory role of the Council in this regard.

Significantly, Council staff reported that increased attention will also be given to the well-being of communities of islanders who are to some extent involved in and/or dependent on marine ecosystems in the region. Understanding of community and stakeholder problems and needs will be communicated through the REACs, and with Council support, certain issues could be addressed through the actions of the Community Demonstration Projects Advisory Panel and Community Development Advisory Panel. Thus, by increasing opportunities for communication and administration of programs designed to assist communities in solving salient problems, the new approach could, for example, heighten the potential for commercial fishery participants to more successfully market their seafood products via a cooperative, or to inform agency representatives cognizant of a pressing shoreline access issue and potential options for addressing the problem. One workshop participant noted the potential value of social indicators for assessing the level of success of the approach in the communities. Finally, staff also noted that Community Development Program may enable the Council to assist in addressing non-

fishery issues as well, provided the involved stakeholders and agencies recognize a given issue as a priority.

One workshop participant repeatedly asserted the potential utility of GIS applications under the ecosystem approach to management. He noted that the spatial purview of the involved agencies and organizations can be mapped, as can spatial aspects of their respective mandates and regulations. Various physical and human ecological factors of relevance to marine fisheries and fishery management can also be mapped. Using such layers in conjunction, it will be possible to depict the interface of jurisdictions, mandates, ocean and climate factors and processes, spatial dimensions of populations of marine organisms and habitats, resource use patterns, and other factors - with great potential for integrating new and existing data and analyses for purposes of biophysical and social assessment and long-term monitoring under the new ecosystem approach to management. In short, total ecological relationships, conditions, and trends may be depicted. It was asserted that a GIS used in this manner has great potential for effectively monitoring fishery interactions and controlling for environmental factors over time, and for assessing changes related to the highly adaptive nature of commercial fishing fleets.

Some attention was applied to issues regarding participation and representation in the REAC process. It was asserted that social science research may be useful for generating in-depth understanding of social and cultural conditions and factors in the communities, thereby potentially optimizing the participation of knowledgeable persons not likely to become involved given various social or cultural constraints. Social science research methods may also be useful for gaining an understanding of inter-agency dynamics, potential challenges to effective interaction, and potential solutions for working collaboratively to solve pressing issues.

A number of participants discussed the need for a Council ecosystem science plan for both the biophysical and social sciences. It was recommended that this include an interdisciplinary approach to ecosystem-based management in the region.

Finally, the group discussed the topic of co-management. It was made clear that the intent of community empowerment process, by no means, involves replacement of the existing approach, wherein scientific information and advice is provided to help guide managers in making equitable decisions. Rather, increased involvement of stakeholders is intended to complement the existing process in a variety of ways. It was noted, for instance, that by involving a more comprehensive set of stakeholders, management objectives can better reflect the needs and interests of persons who are most directly involved in use of marine resources and/or those who are most informed of factors affecting or influencing the status of the region's marine ecosystems broadly conceived.

Problematic aspects of achieving such a system and ensuring favorable outcomes given the complexities of multiple jurisdictions, agencies, and stakeholder interests in the vast Western Pacific became a topic of focused discussion that carried the participants through the remaining hours of the final day of the workshop. We review that discussion in some depth by way of concluding summary and recommendations in the following chapter.

3.0 Summary Conclusions and Recommendations

The workshop described in this report provided a forum through which participants contributed their knowledge and expertise to ecosystem-based fishery management in the Western Pacific. The meeting was not about formulating ecosystem policy *per se*. Rather, it was intended to enable deliberation on important ecosystem management issues and provide insight and lessons from persons working in marine fisheries or relevant fields in other parts of the region, nation, and world. This chapter of the report reviews key elements of that insight, revisits some of those lessons, and generates summary conclusions and recommendations intended to assist the Council as it incrementally and adaptively moves forward with ecosystem principles in the years to come.

3.1 Overview

It should be kept in mind that the term *policy* derives the Greek *politeia* or *politēs*, meaning citizen. Policies regard principles or procedures for guiding *people*. The emergent workshop emphasizes on stakeholder involvement, political aspects of cross-jurisdictional management of marine resources, and expansion of management considerations into the realm of human ecology, were thus logically appropriate for a venue addressing matters of policy.

This in no way diminishes the critical importance of the biophysical sciences, the information generated through such investigation, or the dire need for understanding of the physical properties and processes of marine ecosystems. Rather, matters of marine policy force recognition that all means of acquiring knowledge of marine systems, and that knowledge itself, ultimately relate to human objectives. In the case of fishery management under existing federal mandates, objectives involve optimized sustainable human use of the ocean's living resources.

The Council has determined that ecosystem principles will likely optimize management of marine resources across its region of jurisdiction. In moving toward implementation of those principles, the Council has drafted Fishery Ecosystem Plans, established Regional Ecosystem Advisory Committees and related processes and entities, and convened national and region experts to deliberate on biophysical, social, and policy dimensions of an ecosystem-based approach. NOAA Fisheries has concomitantly undertaken an Environmental Impact Assessment process to examine the potential biophysical and social effects and implications of the approach.

The workshop reviewed in this report examined a wide range of issues relevant to ecosystem-based management. Participants discussed governance issues and policy options that would ideally maximize the benefits of the approach in the cross-jurisdictional and cross-cultural settings that characterize the region. The group also examined options for addressing the needs and interests of indigenous fishing practitioners and other resource user groups and stakeholders across the region. Finally, workshop participants discussed options and opportunities for fishery ecosystem research and monitoring in the Western Pacific. The following material reviews select elements of the discussions, framed in terms of the potential benefits of the new strategy.

3.2 Potential Benefits of the Ecosystem-based Approach

Regarding the Suitability of the Ecosystem Approach in the Region. The potential for an ecosystem-based approach to heighten scientific attention to connections between biophysical and human components of marine ecosystems was an important underlying theme of the workshop. As noted at the outset of this report, islands are in various ways amenable to scientific inquiry using ecosystem principles, and the approach is useful in concept and practice for controlling environmental factors affecting fish stocks and marine fisheries.

From a managerial perspective, the shift from a single-species approach to a place-based approach is seen as beneficial in that it will reduce the administrative complexities of studying and managing species and fisheries across rather than within areas that are highly varied in terms of their environmental and political attributes. That is, the FEPs consolidate and reorganize management provisions so that each archipelago and its marine resources are addressed as a distinct management unit. As previously noted, given tendencies of movement and migration, and related international jurisdictional factors, pelagic species are being managed separately.

A Shift in Mode of Governance. The ecosystem approach is being advanced for its potential to enhance understanding of relationships between the marine environment and users groups, and to provide the latter with expanded opportunities for contributing to the management process. This involves increased attention to issues of social and sociopolitical connectivity and necessitates expanded relationships between the Council, stakeholders, and governing entities across the region. Of note, the new process has some potential for blurring distinctions between jurisdictional boundaries historically imposed on biophysical systems whose components and processes often extend well beyond those bounds. This potential outcome will, of course, require successful interface between stakeholders and adjacent agencies in the REAC process.

Addressing the Knowledge and Needs of Stakeholders across the Region. In enabling expanded connections with stakeholders, the new approach will enable scientists and managers to benefit from traditional and local knowledge of marine resources, marine ecosystems, and long-standing fishing and shoreline food-collecting practices. This is potentially highly significant in a culturally-diverse region such as the Western Pacific. Each archipelago is home to indigenous peoples who have, to greater and lesser degrees, accumulated and transmitted centuries of knowledge regarding marine and terrestrial components of island ecosystems.

The approach is also significant in terms of its potential for identifying and potentially mitigating overuse of marine resources or potentially deleterious fishing or food-collecting practices undertaken by long-term residents or newly-arriving immigrant groups. Enhancing or expanding connections with stakeholders may serve to identify and mitigate non-fishing related factors impinging on the health of marine ecosystems. Finally, the approach may provide mechanisms for community development initiatives both related and unrelated to marine fisheries.

Ecosystem Research and Monitoring. It was widely agreed that the ecosystem-based approach to fishery management will involve expansion of scientific attention to a larger field of physical-environmental, social, and political processes, factors, and issues. A wholesale shift in existing stock assessments, attention to biomass issues, and species-based scientific inquiry is by no

means indicated. Rather, the intent is to incrementally and adaptively shift to an approach that more fully attends to ecosystemic processes such as those associated with food webs, predator/prey relationships, endangered species interactions, and so forth. While such expansion will require increasing levels of funding, policy workshop participants identified a number of venues potentially supporting ecosystem-based biophysical and social research and monitoring, as described further along in this concluding section.

It should be noted that the sustainability and productivity goals of revamped ecosystem research and monitoring are in keeping with the missions of the Fishery Councils and NOAA Fisheries. Moreover, potential opportunities for participation of stakeholders in ecosystem research and monitoring programs around the region are in line with the Council's stated interest in empowering communities. It was determined that such opportunities could be facilitated through the Council's Community Demonstration Project Program and other programs.

3.3 Summary Recommendations for Maximizing the Benefits of the New Approach

The ecosystem policy workshop was the third in the series of meetings convened to garner insight into the best course of action for implementing ecosystem-based management in the Western Pacific. This section draws on the findings and recommendations of the biophysical and social science ecosystem workshops, and the final ecosystem policy workshop, to present a series of options and recommendations to the Council as it moves forward with its FEPs and related processes for better understanding and addressing the context, information needs, and potential benefits and liabilities of the new mode of management.

Clearly, as is described in previous sections of this report and proceedings from the biophysical and social science workshops, participants expressed many doubts, concerns, caveats, and conditions regarding the future course of planning for an implementing the ecosystem approach in this and other regions. Participants identified and elucidated a variety of factors likely to challenge successful implementation of the new strategy. These included, among others: (a) institutional inertia, (b) uncertainty in terms of the capacity of science and existing data to sufficiently address highly complex ecosystem processes, (c) limited funding available for expanding physical and social scientific inquiry in support of the new approach, (d) lack of well-defined ecosystem-specific management objectives, (e) increased bureaucratic complexity, and (f) lack of well-defined incentives for agencies to collaborate in implementing a new strategy. But participants also worked diligently to arrive at solutions to these and additional challenges. Following is workshop-generated guidance for meeting such challenges if and as they arise in future planning and implementation phases of the new management regime.

Biophysical Workshop Recommendations Reiterated. As discussed in the introductory chapter of this report and in the proceedings of the biophysical workshop (WPRFMC 2006), participants in the first Council ecosystem workshop generated six basic points of policy advice for the Council to consider as it continues with its ecosystem planning process. These are as follow:

- As a default, a precautionary approach should be employed in implementing the ecosystem-based approach to management in the region;
- The fishing industry and managers should endeavor to be proactive in changing the burden of proof regarding the impacts of fishing, with industry taking an active participatory role in research, monitoring, resource conservation, and sustainability;
- “Insurance,” or spatial and other latitude will be useful in adaptive development and implementation of ecosystem-related policy;
- Lessons should be drawn from other regions and used adaptively in the Western Pacific;
- Proper incentives should be used to aid in the achievement of management goals;
- Fairness and equity should be duly considered in the ecosystem-based approach to management in the region.

Additional policy-relevant recommendations provided in WPRFMC (2006) include the following: (1) clearly define and articulate management/policy issues and questions along lines of urgency and identified needs, (2) assign a centralized resource entity with sufficient seniority and appropriate financial and human resources to establish and maintain a centralized data reference and contact point (the “who, what, where, and how” of data); (3) review and evaluate all currently available data and data collection schemes (biological, social, economic, etc.) and initiate and maintain data ‘mining’ and recovery activities; (4) undertake initial assessments and analyses of available data, based on key management/policy issues identified by management and stakeholders, this is primarily aimed at identify strengths and weaknesses of current data and data collection programs, and pointing out obvious data gaps; (5) identify and initiate adaptive management experiments at an ecosystem scale; (6) ensure data collection and models/analyses for ecosystem-based management are coordinated with and driven by clearly identified management needs and issues; (7) encourage keeping all models/analyses at the most ‘simple’ level, i.e., avoid the temptation to build large, exceedingly complex models; (8) ensure adequate support and resources for clearly identified ecosystem-scale research, monitoring, and analysis; and (9) evaluate a suite of indicators (both fishery-based, as well as new and emerging ecosystem-based) in an evolving and adaptive process.

Social Science Ecosystem Workshop Recommendations Reiterated. A number of recommendations and policy advice also emerged from the Council’s Ecosystem Social Science Workshop. Of overarching importance was the necessity for envisioning both the biophysical ecology of marine ecosystems and the human ecology of those systems, wherein the latter involves: (a) the human ecology of constituent groups, and (b) the ecology of governing institutions.

Options and recommendations for incorporating social science into ecosystem management in the region included the following: (1) establish venues for identifying priority issues and objectives to address with social research and monitoring, (2) design social research to meet prioritized objectives and related information needs, (3) implement a social, economic, and

socio-demographic research strategy for the archipelagos, (4) develop and implement liaison and ecosystem social science performance evaluation programs, (5) employ an incremental/adaptive strategy coupled with appropriate incentives, (6) identify valid social and economic indicators to assess and monitor direct and indirect human-environmental interactions and to adjust resource use policies, (6) apply social science to assess the potential for stakeholder input and development programs, and (7) effectively relate new research programs to ongoing programs.

Table 3-1 Council FEP Objectives and the Prospective Role of Social Science

Objective	Prospective Role of Social Science
(1) Maintain biologically diverse and productive marine ecosystems and foster the long-term sustainable use of marine resources in an ecologically and culturally sensitive manner through the use of a science based ecosystem approach to resource management	Determine culturally appropriate protocols for undertaking ecosystem-based management under variable social, cultural, and economic conditions and scenarios in each archipelago
(2) Provide flexible and adaptive management systems that can rapidly address new scientific information and changes in environmental conditions or human use patterns	Determine and document human use patterns and associated socioeconomic factors for each fishery in each archipelago; monitor changes in such patterns and conditions and assess associations with biophysical changes
(3) Improve public and government awareness and understanding of the marine environment in order to reduce unsustainable human impacts and foster support for responsible stewardship	Assess public and government awareness of environmental understanding within and across groups and institutions; identify means for improving venues for communication; identify, characterize, report, and monitor problematic forms of individual and collective interaction with or indirect influence on marine and associated terrestrial ecosystems
(4) Encourage and provide for the sustained and substantive participation of local communities in the exploration, development, conservation, and management of marine resources	Identify potential opportunities for and constraints on sustained community-level participation in these dimensions of marine fisheries; account for inter- and intra-cultural variability in receptivity to involvement
(5) Minimize fishery by-catch/waste to the extent practicable	Identify fisheries in which by-catch is significant and problematic fishing methods; determine whether individual or broad cultural processes or economic incentives are involved; identify alternative methods
(6) Manage and co-manage protected species, protected habitats, and protected areas	Identify practical, culturally appropriate means for shared management of such species, habitats, and areas; assess the potential for reintroducing historic forms of management
(7) Promote safety of human life at sea	Identify and assess behavioral factors that contribute to at-sea hazards and identify affordable, amenable, and practical means for reducing these for the various fleets
(8) Encourage and support appropriate compliance and enforcement with all applicable local and federal fishery regulations	Assess economic and socio-cultural factors associated with regulatory violations and identify ways in which regulations and/or user group behavior might be modified to improve compliance. Identify social and cultural settings in which extant customs/sanctions obviate regulations and enforcement and advance these or elements thereof as possible models
(9) Increase collaboration with domestic and foreign regional fishery management and other governmental and non-governmental organizations, communities, and the public at large to successfully manage marine ecosystems	Use economic, sociological, anthropological, and other social science theory and methods to assess the potential for effective collaboration; use such approaches to identify means for improving the effectiveness of such collaboration
(10) Improve the quantity and quality of available information to support marine ecosystem management	Identify information needs and perceived shortcomings of extant data from the perspective of managers and decision-makers working in the region; examine TEK and its potential for improving management of ecosystems

Policy Workshop Recommendations for Enhancing Agency and Stakeholder Participation.

Among the most essential points of advice generated during the final workshop were those relating to the process of engaging stakeholders and agencies in the Council's Regional Ecosystem Advisory Committee (REAC) process. It was perceived that the effort could involve a variety of challenges, but that these were by no means insurmountable. A range of options were reviewed for their potential to ensure programmatic success.

For instance, it was recommended that the Council should clearly determine its terms of reference and engagement prior to initiating formal relationships with agencies and individual stakeholders via the REAC process. This would involve determination of the rationale for involving/inviting stakeholder groups and identification of the expectations for each. These factors and the overall objectives and intent of the process would then be clearly communicated to REAC participants, thereby generating a context of transparency and trust.

Workshop participants felt strongly that Council representatives should clearly communicate to REAC participants that the intent of the effort is not to expand its jurisdiction, but rather to enhance opportunities for empowering communities and solving fishery-specific and other challenges. It was agreed that building trust will take time, but that it is essential to the long-term success of the program. It was suggested that the Council could enhance and streamline participation by identifying a problem of clear interest to multiple agencies and stakeholders, and to which available human and fiscal resources would be readily applied. That is, it was felt that a common threat or need is an effective incentive for galvanizing cooperation and encouraging the collective interest to transcend competitive interests. Conversely, it was recommended that potentially contentious issues, such as allocation of marine resources, be avoided.

One participant discussed the engaging effects of data sharing. This was advanced as a relatively easy and cost-effective means for gaining trust, building community capacity, and furthering the goals of ecosystem-relevant science and monitoring. Discussion focused on the possibility of engaging fishers and other resource users in the research and monitoring process, with oversight and technical advice provided by agency representatives and scientists who are capable of addressing the various cross-cultural challenges likely to be encountered around the islands. It was asserted that by involving local stakeholders in the science and management process, the community in question will inevitably become more empowered and its residents will gain a sense of trust in the management process.

One potential challenge relates to the concomitant desirability for locally-staffed long-term monitoring and the uncertain probability of finding local persons able to sustain their involvement over the course of time. However, intense local dedication, as exemplified in the 'aha moku process being implemented in the Hawaiian Archipelago, may well serve to minimize such challenges. Long-term dedication and vested interest coupled with the multi-generational scope and educational emphasis of the 'aha moku process render it a useful model with potential for guiding stakeholder involvement in research, monitoring, and management of marine resources elsewhere in the Pacific.

An effective element of the 'aha moku process is its attention to variation in the historical background and contemporary interests of stakeholders, and its capacity to enable effective representation at a regional level. The process benefits from the manner in which the Council has been able to provide leadership and enable authority to be enjoined by the participants.

Issues of geographic scope and scale were considered by workshop participants in formulating a recommendation to the Council to avoid an initial undertaking that is overly encompassing. While it was agreed that the Council will need to address some issues at a broad scale, it was asserted that it may be beneficial to experiment at a more localized place level and to address dynamic relationships between stakeholders and the marine and community environments at that modest scale. A related recommendation to build upon existing strategies or groups was seen as potentially useful by some participants, but potentially complicating by others.

While there was general appreciation for the potential utility of traditional ecological knowledge in contributing meaningfully to the ecosystem-based approach to management, it was felt by some that such knowledge, of itself, may be insufficient for understanding certain ecosystem processes. Formalized science may also be insufficient for addressing certain largely unknown environmental processes, including global climate change and its implications for the status of marine ecosystems and resources. Knowledge uncertainties notwithstanding, participants tended to express respect for and advocate use of the full suite of knowledge gathering tools available to resource managers in the region. In the event formalized science and traditional ecological knowledge are not in agreement, the disparity should be taken as a learning opportunity and a rationale for formulating and testing hypotheses.

Trial and error was recognized as fundamental to an adaptive approach to management. It was felt that mistakes are inevitable, and that the point of scientific method was to learn from failed trials. This applies to stakeholder involvement and development and use of various forms of knowledge associated with or deriving from that involvement.

The REAC process is amenable to assessment and evaluation. Valid indicators that a successful institutional ecology has been established through the process include: (a) level of sustained participation, (b) ongoing internal commitment of resources, (c) willingness to engage in formal partnerships, and (d) positive feedback from the community that the process is yielding successful results. Indicators of community well-being, such as nutritional status and educational success may also be useful for assessing the benefits of the program.

Policy Workshop Recommendations for Identifying Fiscal and Human Resources. Workshop participants also worked to identify options for resources needed to conduct an expanded program of ecosystem research and monitoring and stakeholder involvement across the region. For instance, it was determined that human resources could include properly administered undergraduate internship programs through which students could gain experience and exposure to traditional knowledge while contributing to scientific research and monitoring efforts. As described above, it was also suggested that human resources available in a given community could be applied to formal scientific research and monitoring. This could be organized so that the data collection process is conducted with technical assistance and data management provided

by dedicated staff from local agencies and with sufficient ongoing interaction between those agencies and persons actually using the information for analysis of marine fisheries and marine ecosystems in the region. Again, this would ideally involve a reciprocal arrangement wherein the data and analyses are shared between all parties, with due attention to issues of proprietary and confidential information.

Interaction with local fishery participants and cultural practitioners in this context would require use of appropriate cultural protocol and procedures that attend to the cultural sensitivities of sharing and disseminating such information. Council on-site island coordinators, consulting cultural practitioners, and social scientists familiar with the cultural and linguistic subtleties of island societies in the Western Pacific would ideally play central roles in the interface between the Council and prospective sources of local and traditional knowledge relevant to understanding marine ecosystems and managing marine fisheries across the archipelagos, including those of the deep sea.

A range of options for funding an expanding realm of ecosystem-relevant scientific inquiry and monitoring were discussed by participants at the policy workshop. These included: Work Force Training Act funds, a variety of non-traditional sources of federal funds, and funds and research partnerships with non-governmental organizations, including philanthropic institutions. It was noted that in the absence of novel funding options, difficult tradeoffs were likely to affect implementation of certain research and monitoring priorities.

Of significance to this discussion and to the Council's interest in empowering communities and expanding connections with stakeholders around the region, new stipulations in the reauthorized Magnuson Act allow for provision of monies to support fishery demonstration projects "that foster and promote traditional indigenous fishing practices," and qualifying Community Development Programs in Alaska and the Western Pacific. Readers are encouraged to consult the Magnuson-Stevens Fishery Conservation and Management Act, Public Law 94-265, as amended by the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act, Public Law 109-479. The Act was available at the time of this writing at the following address: http://www.nmfs.noaa.gov/msa2005/docs/MSA_amended_msa%20_20070112_FINAL.pdf

Conclusions and Final Recommendations. The ecosystem workshop series convened by the Council has enabled collection and dissemination of the na'auao (knowledge or wisdom) of scientists, managers, fishery participants, cultural practitioners, and policy experts from around the nation and region. The preceding pages have reviewed and synthesized select elements of that base of knowledge to provide the Council with a concise source of information of utility for managers, staff, and scientists seeking to apply ecosystem principles around the region. Readers are reminded that a broad range of additional summary information is available in the full reports on the biophysical and social science workshops held in 2005 and 2006, respectively. The policy advice and recommendations generated during the course of the previous workshops remain viable and have thus been provided in the concluding section of this report.

The final workshop that is the focus of this report led to generation of additional insight into a number of issues of pertinence to the formation of ecosystem-related policy in the Western Pacific and other regions around the nation. Participants generated a number of practical results for the WPRFMC. These included options, recommendations, and insights particularly useful

for: (a) meeting the Council’s goal of empowering communities and working with local governments to undertake place-based ecosystem fishery management, (b) establishing effective long-term consultation with communities through the Council’s Regional Ecosystem Advisory Committee or REAC process, (c) documenting Traditional Ecological Knowledge or TEK through effective and culturally-sensitive collaboration with indigenous practitioners, and (d) identifying possible venues for funding and human resources needed to enable long-term ecosystem research and monitoring across the region.

As noted above, the focused attention of the final workshop on issues related to community empowerment and the potentialities of traditional knowledge and expanded local involvement in the management process was in keeping with new stipulations in the reauthorized Magnuson Act. That attention gave pragmatic advice to a process that recognizes the value of local and indigenous systems of knowledge, and the potential benefits of expanding connections between the Council and its constituent stakeholders and adjacent governing bodies. Witherell (2004) underscores the importance of these processes in a manner appropriate to the diversity of island communities in the Western Pacific. The editor of the *Proceedings of the Conference on Fisheries Management in the United States*⁵ asserts that:

“The differences between various fishing communities are important to document: the history, geography, relative level of dependence on the fishing industry, values and norms, and long-term goals of the community are all significant factors in determining an appropriate action. The involvement of stakeholders through collaborative research is one way to incorporate community needs and knowledge into the decision-making process . . . Use of local, cultural, and traditional knowledge is critically important to achieving a better understanding of the impacts of a proposed regulatory change and potentially innovative solutions. In this way, including local traditional knowledge is beneficial to both the resource and the participants in the process, and can stimulate community-driven initiatives that are well supported and successful . . . Because fishing communities are so variable, it is inherently understood that communities both within and among regions will require different protection measures. One way to respond to this need is by incorporating local and traditional knowledge into the analytical and public policymaking process, in part by providing for a stronger community presence in the Council’s advisory panels and appointed committees.” (Witherell 2004: 166-176)

A multitude of issues, policy options, and recommendations have been advanced through the Council’s ecosystem workshop series. An integrating theme from each workshop was the desirability and value of valid science-based data and analyses with which resource manager can make optimally informed decisions about the future of marine ecosystems and associated resources and user groups across the region. Such information can take many forms, including but not limited to: traditional ecological knowledge of marine resources, stakeholder input on salient issues and challenges, biological stock assessments, risk and susceptibility analyses, analysis of the effects of oceanic regime shifts on marine fisheries, economic modeling of fleet costs and revenues, food web analysis, geographic depiction of total ecosystems, socio-

⁵ The meetings were sponsored by the Regional Fishery Management Councils, the Fisheries Commissions, and NOAA Fisheries. in 2003 and 2005. The full proceedings are available in a two-volume series titled *Managing Our Nation’s Fisheries: Past, Present, and Future*.

demographic profiling, and analysis of the institutional ecology of fishery management. Returning to the original premise of this report, the endeavors of fisheries-relevant science are as or more complex and comprehensive as those of any formalized field of inquiry, and an ecosystem approach may serve to yield deeper understanding of those complexities.

Yet, as indicated throughout the workshop series, an ecosystem approach to management further expands the information requirements of the various fishery sciences and disciplines. It therefore necessitates an even wider range of formalized research methods, analytical approaches, areas of inquiry, and modes of interaction with persons who are highly knowledgeable of and/or directly involved with the ocean, its resources, and the range of factors that can impinge on the sustainability and productivity of marine ecosystems and fishing societies.

Given this expanding realm of inquiry, and the desirability of using the full suite of science-based means for improving fishery management through application of ecosystem principles, a final recommendation of the workshop series relates to the need for a formalized ecosystem research and monitoring plan for contributing directly to the Council's ecosystem-based management goals and objectives across the region. Such a plan would address the need to: (a) inventory existing relevant biophysical, social science, and traditional ecological knowledge data and research programs and projects, (b) identify management objectives specific to implementation of the ecosystem approach across the archipelagos, (c) identify sources of funding for new research, analysis, ongoing monitoring, and programmatic evaluation, (d) articulate ongoing and new research, data management, and data analysis strategies with specific management objectives, and (e) develop means for disseminating the analyses in a manner that would best support implementation of the Council's ecosystem approach and associated projects and programs. Finally, such a plan should be designed to contribute to the full range of ecosystem management goals of the Council, with particular attention to the unique and highly varied attributes of human communities and their integral relationship with marine ecosystems and resources across the Western Pacific.

References

Adams, Tim

1998 The interface between traditional and modern methods of fishery management in the Pacific islands. *Ocean & Coastal Management*, Vol. 40, No. 2-3, pp. 99-270.

Agrawal, A.

2001 Common property institutions and sustainable governance of resources. *World Development*, Vol. 29, No. 10, pp. 1649-1672.

Agrawal, A., and C.C. Gibson

1999 Enchantment and disenchantment: the role of community in natural resource conservation. *World Development*, Volume 27, No. 4, pp. 629-649.

Allison, E.H. and M. Badjeck

2004 Fisheries Co-management in Inland Waters: a Review of International Experience. Sustainable Fisheries Livelihoods Programme (SFLP) (GCP/INT/735/UK). Food and Agriculture Organization of the United Nations, Department of International Development. 125 pp.

Berkes, F.

1999 *Sacred Ecology - Traditional Ecological Knowledge and Resource Management*. London: Taylor & Francis Group.

Brady, J.

2004 An Overview of the Alaska Salmon Management Program. Technical Report prepared under contract for the Wild Salmon Center. North Cape Fisheries Consulting. Anchorage.

Brown, D., D. Staples, and S. Funge-Smith

2005 Mainstreaming fisheries co-management in the Asia-Pacific. Paper prepared for the APFIC Regional Workshop on Mainstreaming Fisheries Co-management in Asia-Pacific, Siem Reap, Cambodia, 9-12 August 2005. Food and Agriculture Organization of the United Nations, Regional Office for Asia and the Pacific. Bangkok.

Brown, K., E. Tompkins, and W.N. Adger

2001 *Trade-off Analysis for Participatory Coastal Zone Decision Making*. Norwich: University of East Anglia, Overseas Development Group.

Cassidy, M.

2000 Fisheries management: fishing for a language. *Samudra*, April 2000. pp. 18-23.

Cohen, F.

1989 Treaty Indian Tribes and Washington State: the Evolution of Tribal Involvement in Fisheries Management in the U.S. Pacific Northwest. In Evelyn Pinkerton (ed.), *Co-operative Management of Local Fisheries*, pp. 37-48. University of British Columbia Press: Vancouver.

Ecosystem Principles Advisory Panel

1999 Ecosystems Based Fishery Management: A Report to Congress by the Ecosystem Principles Advisory Panel. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Silver Spring.

Elmqvist, T.

2000 Indigenous institutions, resilience, and failure of co-management of rain forest preserves in Samoa. Presented at "Constituting the Commons: Crafting Sustainable Commons in the New Millennium," the Eighth Conference of the International Association for the Study of Common Property. Bloomington, Indiana.

Harte, M.

2000 Fisher Participation in Rights-Based Fisheries Management: The New Zealand Experience. In *Use of Property Rights in Fisheries Management: Proceedings of the FishRights99 Conference*. Fremantle, Western Australia, 11-19 November 1999. FAO Fisheries Technical Paper 404/1, R. Shotton (Ed.) Rome: Food and Agriculture Organization of the United Nations.

Howard, C., and R.I. Arthur

2005 Lessons for Co-management: Experiences from the FMSP Programme. MRAG Ltd. London. Available online at: www.streaminitiative.org/Library/pdf/organizations/Co-managementSummaryBrief.pdf.

Hurst, L.

No Date Co-Management: A Community and Resource Management Tool in New Zealand. Regional and Resource Planning Programme. Department of Geography, University of Otago.

Hilborn, R.

2006 Fisheries success and failure: the case of the Bristol Bay salmon fishery. *Bulletin of Marine Science*, Volume 78: 487-498.

Hilborn, R., T. P. Quinn, D.E. Schindler, and D.E. Rogers

2003 Biocomplexity and fisheries sustainability. *Proceedings of the National Academy of the Sciences* (PNAS), Volume 100, Number 11, pp. 6564-6568.

Impact Assessment, Inc.

2007 Summary of Socioeconomic Trends and Current Conditions in the North Aleutian Basin Planning Area. Prepared for the Information and Research Planning Meeting for the North Aleutian Basin. U.S. Department of the Interior, Minerals Management Service, Alaska OCS Region. 85 pp. La Jolla, CA, and Honolulu, HI.

2006 Western Pacific Regional Fishery Management Council Ecosystem Social Science Workshop. Final Report. Prepared for the Western Pacific Regional Fishery Management Council under Contract Number 05-WPC-00. Pacific Islands Office of Impact Assessment, Inc. Honolulu.

International Center for Living Aquatic Resource Management (ICLARM)

1998 Analysis of Co-management Arrangements in Fisheries and Related Coastal Resources: a Research Framework. The Coastal Resources Co-management Research Project. Penang, Malaysia.

Jordan, D.

1989 Negotiating Salmon Management on the Klamath River. In Evelyn Pinkerton (ed.), *Co-operative Management of Local Fisheries*, pp. 73-81. Vancouver: University of British Columbia Press.

Kirch, P.V.

1985 *Feathered Gods and Fishhooks: An Introduction to Hawaiian Archaeology and Prehistory*. Honolulu: University of Hawai'i Press.

Kirch, P.V. and T.L. Hunt (eds.)

1997 *Historical Ecology in the Pacific Islands – Prehistoric Environmental and Landscape Change*. New Haven and London: Yale University Press.

Mees, C. and J.D. Anderson

1999 The Performance of Customary Marine Tenure in the Management of Community Fishery Resources in Melanesia. In *Guidelines toward Effective Co-Management of CoralReef Fisheries in the Pacific Region*. Marine Resources and Fisheries Consultants.

Minerbi, L.

1999 Indigenous management models and protection of the ahupua'a. *Social Process in Hawai'i*. Volume 39, pp. 209-225.

National Marine Fisheries Service, NOAA Fisheries

2005 Draft Programmatic Environmental Impact Statement. Towards an Ecosystem Approach for the Western Pacific Region: From Species-based Fishery Management Plans to Placed-Based Fishery Ecosystem Plans. NMFS Pacific Islands Region. Honolulu.

Pinkerton, E. (ed.)

1989 Introduction: Attaining Better Fisheries through Co-management – Prospects, Problems, and Propositions. In *Co-operative Management of Local Fisheries*. University of British Columbia Press: Vancouver.

Poepoe K., P. Bartram, and A. Friedlander

2003 The Use of Traditional Knowledge in the Contemporary Management of a Hawaiian Community's Marine Resources. In: *Putting Fisher's Knowledge to Work*. N. Haggan, C. Brignall, L. Wood (eds). *Fisheries Centre Research Reports*, Volume 11(1), p. 328.

Pomeroy, R.S., B.M. Katon and I. Harkes

2001 Conditions affecting the success of fisheries co-management: lessons from Asia. *Marine Policy*, Volume 25 (3), pp. 197-208.

Prystupa, M.V.

1998 Barriers and strategies to the development of co-management regimes in New Zealand: the case of Te Waihora. *Human Organization*, Volume 57(2), pp. 134-144.

Raakjær N.J.

2003 An analytical framework for studying compliance and legitimacy in fisheries management. *Marine Policy*, Volume 27(5), pp. 425-432.

Raakjær N.J., P. Degnbol, K.K. Viswanathan, M. Ahmed, M. Hara, and N.M.R. Abdullah

2004 Fisheries co-management—an institutional innovation? - lessons from Southeast Asia and Southern Africa. *Marine Policy*, Volume 28(2), pp. 151-160.

Sibert, J. and J. Hampton

2003 Mobility of tropical tunas and the implications for fisheries management. *Marine Policy*, Volume 27, pp. 87-95.

Te Rūnunga o Ngāi Tahu

2007 About Ngāi Tahu. Available online at: <http://www.ngaitahu.iwi.nz/Home>.

Viner, K., M. Ahmed, T. Bjørndal and K. Lorenzen

2006 Development of Fisheries Co-management in Cambodia: a Case Study and its Implications. WorldFish Center Discussion Series No. 2. 39 pp.

Vitousek, P. M.

1995 The Hawaiian Islands as a model system for ecosystem studies. *Pacific Science*, Volume 49, pp. 2-16.

Western Pacific Regional Fishery Management Council

2007 “Communities Voice Concern about Loss of Traditional Practices.” *Pacific Island Fishery News*. Newsletter of the Western Pacific Regional Fishery Management Council. Spring. Honolulu.

2006 Ecosystem Science and Management Planning Workshop: Development of Ecosystem-based Approaches to Marine Resource Management in the Western Pacific Region. July 18. Honolulu.

Witherell, D. (ed.)

2005 *Managing Our Nation's Fisheries II: Past, Present, and Future*. Proceedings of a Conference on Fisheries Management in the United States held in Washington, D.C., March 2005. Sponsored by the Regional Fishery Management Councils, the Fisheries Commissions, and NOAA Fisheries. Produced by the North Pacific Fishery Management Council under NOAA Award No. NA17FC1111.

2004 *Managing Our Nation's Fisheries: Past, Present, and Future*. Proceedings of a Conference on Fisheries Management in the United States held in Washington, D.C., November 2003. Sponsored by the Regional Fishery Management Councils, the Fisheries Commissions, and NOAA Fisheries. Produced by the North Pacific Fishery Management Council under NOAA Award No. NA03NMF4410302.

Appendix A

Biographies and Contact Information for Consulting Participants

Tim Adams is Director of the Marine Resources Division of the Secretariat of the Pacific Community (SPC), where he oversees provision of scientific, management, and development advice to government entities throughout the Pacific. Dr. Adams is former Director of the Fisheries Division of the government of Fiji. He was educated at St. Andrews University in Scotland, and Exeter University in England. His Ph.D. is in population biology. An ocean generalist, Tim is particularly interested in fisheries management policy, organizational management, and sector review of living marine resources.

Fini Aitaoto is a licensed grant writer and federal grants instructor. He is former Acting Director and MIS Manager for the American Samoa Department of Marine and Wildlife Resources, where he was employed for over 20 years. Mr. Aitaoto has served on all of the WPRFMC Plan Teams and is the Council's American Samoa On-Site Coordinator. He is former Executive Director of two NGOs and is a Samoan High Chief.

Stewart Allen is a senior social scientist with NOAA Fisheries' Pacific Fishery Science Center, and leads the Center's Human Dimensions Research Program. Dr. Allen is also a member of the WPRFMC Science and Statistical Committee. Stewart has worked as social scientist in a variety of natural resource settings since 1980 and has extensive research and analytical experience with human-ecosystem interactions.

Judith R. Amesbury is an archaeologist with Micronesian Archaeological Research Services on Guam. She received her education at the University of Arizona. Before moving to the Pacific, she worked on Native American and Spanish sites in Arizona, and at the Neanderthal cave site of Tabun in Israel. In Hawai'i, Amesbury worked for the Bishop Museum and the State Historic Preservation Division. She has now been conducting archaeological research on Guam and in the CNMI for more than 20 years. Her area of expertise is analysis of archaeological faunal remains, which has led to an interest in long-term fisheries data, indigenous fishing, fishing communities, and marine ecosystems.

Lee G. Anderson earned the Ph.D. in economics from the University of Washington in 1970. He is Professor of Economics and Marine Studies at the University of Delaware. Dr. Anderson has written or edited six books and over 60 scientific papers on fisheries economics and the economics of fisheries management. He is a former member and chairperson of the Mid-Atlantic Fishery Management Council, and past President of the International Institute of Fisheries Economics and Trade. He is currently President-Elect of the North American Association of Fisheries Economists, and a member of the Ocean Studies Board. His current work deals with simulation models, design and implementation of ITQ programs, the economics of fishing in time and space, and marine reserves.

Paul K. Bartram has over 20 years of experience in marine and coastal resources use, assessment, and management throughout the Pacific basin. Mr. Bartram is a member of Hui Mālama o Mo'omomi, a community organization that is revitalizing and applying traditional Hawaiian knowledge to coastal fisheries conservation on the island of Moloka'i. He managed *'Imi 'Ike* ("search for knowledge"), a Native Hawaiian Education project that incorporated traditional Hawaiian learning approaches into public school curricula on Moloka'i. Bartram also serves as an adviser to community-based fishermen's organizations in Guam and American Samoa and he regularly consults for the WPRFMC and other fishery organizations in the region.

Jim Burchfield is Associate Dean at the College of Forestry and Conservation at the University of Montana (UM). He is trained as a rural sociologist and forester, and his major interest centers on how people may reside in and interact with forest and grassland settings in a productive, harmonious manner. His recent work examines the principles of social acceptability in forest management, the effects of wildfires on rural communities, and the implications of stewardship contracting on public lands. Prior to becoming the Associate Dean, Jim was the Director of the Bolle Center for People and Forests at UM. He has also worked for the USDA Forest Service, and has conducted social assessment research in the Columbia River basin, worked in the international division of the Forest Service in Washington, D. C., and helped implement forest management operations on National Forests in Michigan, Ohio, Oregon, and Washington.

Athline Clark is the Special Projects Program Manager for the Hawai'i Division of Aquatic Resources. In this role she is the Governor's appointed liaison for the Northwestern Hawaiian Islands Marine National Monument. The NWHI Marine National Monument is co-managed by the State of Hawai'i, the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration. Ms. Clark is also the Hawai'i designated Point of Contact for the U.S. Coral Reef Task Force and manages the State's coral reef conservation program. Hawai'i has undertaken the development six Local Action Strategies to minimize threats to its coral reefs; these are implemented through steering committees made up of federal, State and community organizations. In her free time, Ms. Clark teaches water aerobics and participates in ocean sports. She received the Master's in Urban and Regional Planning from the University of Hawai'i.

Leimana DaMate has been working to integrate Native Hawaiian cultural values and practices into governmental and regulatory processes since the mid-1970s. She is currently Ocean Resources Program Director for the Association of Hawaiian Civic Clubs, a national confederacy of 51 Native Hawaiian organizations created in 1918 by Prince Jonah Kuhio. Leimana represents Native Hawaiian interests as a member of Governor Lingle's Ocean and Coastal Council, and consults with Native American and Alaska Native groups on various cultural and natural resource issues. Leimana has worked extensively with Hawaiian communities on every island, documenting and researching cultural values and practices as they pertain to conservation of land, ocean, and associated ecosystems. Leimana is currently working to restore ahupua'a lands through various cultural resource management processes.

Robert DaMate is a lifelong practitioner versed in the Hawaiian disciplines of the ahupua'a structure including lawai'a, mahi'ai, and others. He is highly knowledgeable of the ahupua'a system as practiced historically and currently in Hawai'i, and he is proficient in the workings and application of seasonal lunar calendars. Bob has been active for the past 30 years in advocating for the protection and preservation of Native Hawaiian traditional and cultural practices. His advocacy includes the integration of previously undocumented native practices into current government policies. He currently lives and practices on Moku O Keawe, in the Moku of Ka'u, Ahupua'a of Kahuku, an 'āpana of Kanakaloloa.

Leanne Fernandes has extensive academic and professional experience in sustainable use of natural resources and she has conducted related research and applied work in various locations in the Caribbean, North Sea, the Maldives, and Australia. Her Ph.D. involved development of a multi-criteria decision support process for coral reef management, and she holds a masters degree in resource economics. Dr. Fernandes was Manager of the Great Barrier Reef Marine Park Authority (GBRMPA) Representative Areas Program from 1999 to 2005. This program involved the rezoning of the entire Great Barrier Reef Marine Park. Leanne is now Director of the GBRMPA Community Partnerships Group, formed to continue and build upon the Authority's community engagement work conducted through the rezoning process.

David Fluharty is Associate Professor in the School of Marine Affairs at University of Washington. He is also Wakefield Professor of Ocean and Fishery Sciences. David received both his B.A. and his M.A. from the University of Washington, and his Ph.D. from the University of Michigan. His areas on interest include climate variability and fishery management, international management of fisheries and marine animals, nonrenewable (oil, gas, minerals) natural resource management, training programs for natural resource managers from developing countries, and management institutions.

Svein Fougner retired from the National Marine Fisheries Service (NMFS) in November 2004 following 35 years in federal service. He held various NMFS positions between 1975 and November 2004, and at the time of his retirement was Assistant Regional Administrator for Sustainable Fisheries in the Southwest Region. He was involved in development of fishery management plans for the Western Pacific Fishery Management Council until 1998 and for the Pacific Fishery Management Council between 1999 and 2004. He also lead regional involvement in development highly migratory species plan under the South Pacific Tuna Treaty, participated in early negotiation sessions and inter-session meetings for the new Western and Central Pacific Fisheries Commission, and administered support for the Department of State in the Inter-American Tropical Tuna Commission (IATTC) negotiations.

Edward Glazier is Research Director for the Pacific Islands Office of Impact Assessment, Inc. Dr. Glazier has been involved in maritime social scientific research since the late 1970s. His doctoral research addressing social and economic aspects of small boat fishing in Hawai'i is summarized in *Hawaiian Fishermen* (2007; Wadsworth-Thompson Publishers; Belmont, CA). Current research includes work with Hawai'i fleets for the Pelagic Fisheries Research Program at University of Hawai'i at Mānoa; ecosystem planning and documentation of Native Hawaiian fishing-related practices for the WPRFMC; and long-term socioeconomic assessment of the Exxon Valdez oil spill punitive damages settlement for the U.S. Department of the Interior.

John Gourley is owner and principal of Micronesian Environmental Services, a firm specializing in environmental regulatory permitting issues associated with terrestrial and marine environments. Previous training grounds include the Virginia Institute of Marine Science, University of Texas Port Aransas Marine Lab, and the U.S. Fish and Wildlife Service. John arrived in Saipan in 1989, working as a fishery biologist for the Division of Fish and Wildlife. He has been active in the CNMI consulting arena for the past 11 years. A former WPRFMC Advisory Panel and Plan Team member, John is associated with the Industry Advisory Council of the Center for Tropical and Subtropical Aquaculture, and the environmental and government affairs committees of the Saipan Chamber of Commerce.

Michael P. Hamnett is Executive Director and Chief Operating Officer for the Research Corporation of the University of Hawai'i (RCUH). He is former Director of the Social Science Research Institute at the University of Hawai'i at Mānoa. Dr. Hamnett has spent the past 25 years as a researcher and research manager at the University of Hawai'i, the Pacific Basin Development Council, and the East-West Center. He has extensive experience in strategic planning, working with private and public sectors throughout the Pacific Basin, and retains extensive understanding of the research enterprise and its unique challenges and opportunities in the region.

Susan Hanna is Professor of Marine Economics at Oregon State University. Her research and publications are in marine economics and policy, with a focus on economic performance of fishery management, ecosystem-based fishery management, and application of incentive-based tools and institutional design. Dr. Hanna serves on the Science Advisory Board of the National Oceanic and Atmospheric Administration and the Independent Science Advisory Board for Columbia River Basin Salmon Recovery. She is a former member of the Science Advisory Panel, U.S. Commission on Ocean Policy; Ocean Studies Board, National Research Council; Scientific and Statistical Committee, Pacific Fishery Management Council; Marine Fisheries Advisory Committee, National Oceanic and Atmospheric Administration; National Research Council Committee to Review Individual Quotas in Fisheries, and NRC Committee on Protection and Management of Pacific Northwest Anadromous Salmonids.

Colin Kippen is Executive Director of the Native Hawaiian Education Council, and holds an appointment from the secretary of the Department of the Interior as a member of the Review Committee of the Native American Graves Protection and Repatriation Act. He is an advocate for Native people generally, and Native Hawaiians specifically. Colin is former Senior Counsel to the Senate Committee on Indian Affairs, Deputy Director of the Office of Hawaiian Affairs, judge for various Northwest Indian tribes, and a trial lawyer and prosecutor in Washington State.

David Kirby is a cross-disciplinary ocean scientist with additional interests in natural resource management and ocean governance. He studied at the University of Wales (BSc, MSc) and Leicester University (Ph.D.) and has worked in the UK, New Zealand, Germany, and presently in New Caledonia, where he is Senior Fisheries Scientist with the Secretariat of the Pacific Community's Oceanic Fisheries Programme. David is interested in the adaptation of fisheries management and of the science base used to support it in order to better address the ecosystem governance goals that follow from UNCLOS.

John Kirkpatrick is Senior Socioeconomic Analyst with BeltCollins Hawai'i, Ltd., a Honolulu-based planning, engineering, landscape architecture, and environmental consulting firm. He recently served as vice president for SMS Research and Marketing Services, Inc., where he was responsible for preparing socioeconomic impact assessments, market studies, policy analyses, program evaluations, and survey reports. Kirkpatrick received his B.A. in anthropology from Princeton and the M.A. and Ph.D. in anthropology from the University of Chicago. A resident of Honolulu, Kirkpatrick serves as vice president for the Family Educational Center of Hawai'i and secretary for the Affordable Housing and Homeless Alliance.

Arielle Levine is Social Research Project Manager with the Joint Institute for Marine and Atmospheric Research (JIMAR) at the University of Hawai'i. She earned the Ph.D. in Environmental Science, Policy, and Management from the University of California, Berkeley. Dr. Levine's background includes focus on the institutional environment for marine policy in East Africa, and local community involvement in and responses to marine protected areas.

Marc L. Miller is Professor in the School of Marine Affairs and Adjunct Professor in the School of Aquatic and Fishery Sciences and the Department of Anthropology at the University of Washington. Professor Miller has served on the Scientific and Statistical Committees of the North Pacific and the Pacific Regional Fishery Management Councils. His work has concerned social, cultural, and policy aspects of many kinds of fisheries (e.g., commercial, recreational, sport, tournament, subsistence). His research interests also include marine protected area and park management, coastal recreation and tourism management, and associated policy issues.

Michael K. Orbach is Professor of Marine Affairs and Policy and Director of the Duke University Marine Laboratory and the Coastal Environmental Management Program in the School of the Environment at Duke University. His B.A. is in Economics from the University of California at Irvine, and his M.A. and Ph.D. are in Cultural Anthropology from the University of California at San Diego. From 1976-79 he was Social Anthropologist and Social Science Advisor with the National Oceanic and Atmospheric Administration in Washington, D.C. From 1979-82 he was Associate Director of the Center for Coastal Marine Studies at the University of California at Santa Cruz. From 1983-93 he was Professor of Anthropology in the Department of Sociology and Anthropology and Senior Scientist with the Institute for Coastal and Marine Resources at East Carolina University. He joined Duke, with offices at the Duke Marine Laboratory in Beaufort, North Carolina, in 1993, and became Director in 1998. Mike has been involved in development and implementation of coastal and marine policy on all coasts of the U.S. and in Mexico, Central America, the Caribbean, Alaska and the Pacific. He has published widely on social science and policy in coastal and marine environments.

Minling Pan leads the Economics Program for NOAA Fisheries, Pacific Island Fishery Science Center, Fishery Monitoring and Socioeconomics Division. Dr. Pan also serves as a Council plan team member. Minling received both the Masters and Ph.D. in Natural Resources and Agricultural Economics from the University of Hawai'i. She received her bachelor's degree in Environmental Science from Zhongshan University in China. Dr. Pan has been working in some capacity at PIFSC since 1994. Dr. Pan is principal investigator for five ongoing economic studies being conducted for the Joint Institute for Marine and Atmospheric Research at University of Hawai'i.

Frank Parrish has been a fishery biologist with NOAA Fisheries Service, Honolulu Laboratory for over 15 years. His research focuses on benthic and demersal ecology, particularly as it relates to fishery and protected species. His publications include work on reef fish, deepwater snappers, sharks, lobster, monk seals, and diving technology. In recent years his investigations have focused on identifying important foraging habitats of the endangered Hawaiian monk seal and studies of fish assemblages associated with deepwater corals. He serves as a member of the precious coral planning team for the Western Pacific Regional Fishery Management Council and is the NOAA diving supervisor for fisheries operations in Hawai'i and the Western Pacific. He is currently leading development of the Hawai'i Archipelago Ecosystem Research Plan.

John Petterson is President of Impact Assessment, Inc., a firm specializing in maritime social science around the U.S. and abroad. Dr. Petterson has served as Principal Investigator for 24 U.S. Department of the Interior studies conducted across coastal Alaska, throughout the Gulf of Mexico, and along the Mid-Atlantic coast since 1979. He has also completed a wide range of fisheries-specific social and economic studies for NOAA Fisheries Service; the Caribbean, Gulf of Mexico, and North Pacific Fishery Management Councils; and various state and local government agencies. Dr. Petterson also specializes in social scientific assessment of oil spills and high-level nuclear waste storage. He recently assessed the effects of Hurricane Katrina on fishing communities along the Gulf of Mexico for NOAA Fisheries, and completed a study designed to reverse trends of environmental degradation in the Lake Chad Basin for the United Nations Development Program and Lake Chad Basin Commission.

Jeffrey J. Polovina is Division Chief of NOAA Fisheries' Pacific Islands Fisheries Science Center. Dr. Polovina is widely published, with extensive contributions in the biological oceanography of the Central and Western Pacific and with particular focus on the population dynamics of high trophic level animals. His current research employs satellite telemetry and remotely-sensed oceanographic data to investigate migratory behavior and ecosystem habitats of large pelagic animals, including turtles, tunas, whale sharks, and whales. He is also engaged in assessment of the impacts of inter-annual and decadal climatic variation on marine fisheries and ecosystems, and application of satellite remote sensing and ocean circulation models to fisheries and protected species research.

Samuel Pooley is Director of NOAA's Pacific Island Fisheries Science Center (PIFSC) in Honolulu, and U.S. representative to the Governing Council of the North Pacific Marine Science Organization (PICES). Dr. Pooley served for 20 years as the lead economist for NMFS Honolulu Laboratory, with responsibilities ranging from economic analysis of commercial fisheries to evaluation of the benefits of recreational fisheries and conservation of endangered species. He has published papers on bio-economic analysis, alternative fishery management and property rights regimes. He is also affiliate graduate faculty with several departments and programs at the University of Hawai'i, as well as a member of the steering committee for the Joint Institute for Marine and Atmospheric Research (JIMAR). Dr. Pooley received his doctorate in Political Science with a dissertation on economic decision-making from the University of Hawai'i, and the masters in Economics from the University of Birmingham (U.K.).

Craig Severance is a cultural anthropologist at the University of Hawai'i at Hilo, and a member of the Western Pacific Fishery Council Scientific and Statistical Committee. Dr. Severance also sits on the Council's Recreational Fisheries Data Task Force and Social Science Research and Planning Committee. He was a member of the National Research Council's Committee to Evaluate the Community Development Quota Program in Alaska and its relevance to the Western Pacific. Craig has extensive research experience in fishery settings in American Samoa, the Commonwealth of the Northern Marianas Islands, Hawai'i, Chuuk, and Pohnpei. He is also experienced in theoretical and practical-applied aspects of TEK, CMT, MMA, and SIA. He is a board member of Hilo Trollers and a part-time commercial, recreational and subsistence troller-handliner.

Janna M. Shackeroff is a doctoral candidate at Duke University's Nicholas School of the Environment. Her dissertation research involves an in-depth examination of historical ecological change in coral reef ecosystems along the Kona Coast of Hawai'i. Ms. Shackeroff has an extensive background in marine scientific inquiry, including research of coral reef ecology and climate change on the Great Barrier Reef, paleoclimatological work at the Institute of Antarctic and Southern Ocean Studies in Tasmania, and historical and benthic ecology of estuarine systems in Long Island Sound. Ms. Shackeroff is also experienced in various applied research settings, and garnered extensive marine policy experience as a coastal watershed scientist at the California Coastal Commission. Janna's undergraduate work in science and mathematics at Wesleyan University was recognized as the highest academic achievement in her graduating class.

John Sibert is Manager of the Pelagic Fisheries Research Program (PFRP) at the University of Hawai'i. PFRP is a component of the Joint Institute for Marine and Atmospheric Research in the School of Ocean and Earth Science and Technology at University of Hawai'i at Mānoa, and was created to provide the Council with scientific information on pelagic fisheries for use in development of effective fisheries management policy. Dr. Sibert oversees the multi-disciplinary program while also contributing extensively to literature on the movement and migratory behavior of tunas. John is also widely respected for his quantitative modeling work on marine fisheries-pelagic species interactions throughout the tropical and sub-tropical Pacific. He has been active on the Council's Science and Statistical Committee for many years, and recently contributed to conceptual development of ecosystem boundaries and indicators for use by the Western and Central Pacific Fisheries Commission.

Herman Tuiolosega was born and raised in American Samoa, and has lived and worked in New York, Washington State, and finally, the Aloha State. He received the B.A. in political science from Wagner College, Staten Island, New York, and the Masters in Urban and Regional Planning from the University of Hawai'i at Mānoa. Mr. Tuiolosega has prior experience in military service. He has also served as a policy analyst to the American Samoa Coastal Zone Management Program, as Coordinator for the Land Use Permitting System in American Samoa, and as Legislative Research Assistant with the Pacific Basin Development Council. Herman is currently working as a planner for the Hawai'i Department of Health Environmental Planning Office in Honolulu.

Name	Title	Address	Phone	E-Mail
Fini Aitaoto	<i>On-site Island Coordinator</i> Western Pacific Regional Fisheries Management Council (WPRFMC), American Samoa Department of Marine and Wildlife Resources	WPRFMC 1164 Bishop Street, Suite 1400 Honolulu, Hawai'i 96813	011-684-633-5102	fini.aitaoto@noaa.gov
Stewart Allen	<i>Fisheries Monitoring and Socioeconomics Division</i> National Marine Fisheries Service Pacific Islands Fisheries Science Center (PIFSC)	NMFS/PIFSC 2570 Dole Street Honolulu, Hawai'i 96822	(808) 983-5341	stewart.allen@noaa.gov
Judith Amesbury	Micronesian Archaeological Research Services	Micronesian Archaeological Research Services (MARS) P.O. Box 22303 GMF, Guam 96921	(671) 734-1129	judyamesbury@kuentos.guam.net
Lee Anderson	<i>Professor</i> Marine and Earth Studies Applied Mathematics Institute University of Delaware	University of Delaware 308 Robinson Hall Newark, Delaware 19716	(302) 831-2650	lgafish@cms.udel.edu
Paul Bartram	<i>Owner</i> Akala Products, Inc. Specializing in various fresh Hawaiian seafoods	Akala Products Inc. 817 Ekoa Place Honolulu, Hawai'i 96821	(808) 531-5866	hapahaole@tripleb.com
Jim Burchfield	<i>Associate Dean</i> College of Forestry and Conservation <i>Associate Research Professor</i> Forest Social Sciences University of Montana	College of Forestry and Conservation Department of Society and Conservation University of Montana Missoula, Montana 59812	(406) 243-6650	james.burchfield@umontana.edu
Athline Clark	<i>Special Projects Manager</i> State of Hawai'i Department of Land and Natural Resources (DLNR)	DLNR, Division of Aquatic Resources 1151 Punchbowl Street, Room 330 Honolulu, Hawai'i 96813	(808) 587-0099	athline.m.clark@hawaii.gov

Leimana DaMate	<i>Chair</i> Ocean Resources Committee, Association of Hawaiian Civic Clubs	P.O. Box 1135 Honolulu, Hawai'i 96809	(808) 640-3205	leimana@fastnethi.com
Leanne Fernandes	<i>Director</i> Great Barrier Reef Marine Park (GBRMP)	GBRMP 2-68 Flinders Street, Townsville Postal: PO Box 1379, Townsville, Queensland 4810	(07) 4750 0700	leannef@gbmpa.gov.au
David Fluharty	<i>Associate Professor</i> School of Marine Affairs, Wakefield Professor of Ocean and Fishery Sciences; University of Washington	UW School of Marine Affairs 3707 Brooklyn Ave. NE Seattle, Washington 98105-6715	(206) 543-7004	fluharty@u.washington.edu
Svein Fougner	<i>Assistant Administrator</i> Sustainable Fisheries National Marine Fisheries Service (NMFS), Southwest Regional Office (SWRO)	NMFS/SWRO 501 West Ocean Blvd. Long Beach, California 90802-4213	(562) 980-4030	svein.fougner@noaa.gov
Ed Glazier	<i>Research Director</i> Pacific Islands Office Impact Assessment, Inc.	2950-C Pacific Heights Rd Honolulu, Hawai'i 96813	(808) 545-1044	iai@hawaii.rr.com
John Gourley	<i>Owner</i> Micronesian Environmental Services	P.O. Box 502802 Saipan, Northern Mariana Islands 96950 United States	(670) 483-4000	john.gourley@saipan.com
Mike Hamnett	<i>Executive Director</i> Research Corporation of the University of Hawai'i	2800 Woodlawn Drive – Suite 200 Honolulu, Hawai'i 96822	(808) 988-8311	hamnett@hawaii.edu mhamnett@rcuh.com
Susan Hanna	<i>Professor</i> Marine Economics Oregon State University	Agricultural and Resource Economics Oregon State University Corvallis, Oregon 97331-3601	(541) 737-1437	susan.hanna@oregonstate.edu
Colin Kippen	<i>Executive Director</i> Native Hawaiian Education Council	3075 Kalihi Street, #4 Honolulu, Hawai'i 96819	(808) 845-9883	c-kippen@hawaii.rr.com
David Kirby	<i>Senior Fisheries Scientist</i> Oceanic Fisheries Programme Secretariat of the Pacific Community	SPC Headquarters BP D5 95 Promenade Roger Laroque, Anse Vata 98848 Noumea Cedex New-Caledonia	(687) 262-000	davidk@spc.int

John Kirkpatrick	Belt Collins Hawai'i, Ltd.	Belt Collins Hawaii, Ltd. 2153 North King Street, Suite 200 Honolulu, Hawai'i 96819-4554	(808) 521-5361	jkirkpatrick@beltcollins.com
Arielle Levine	<i>Social Research Project Manager</i> Joint Institute for Marine and Atmospheric Research (JIMAR) University of Hawai'i at Mānoa	JIMAR University of Hawai'i at Mānoa 1000 Pope Road, Marine Science Building 312 Honolulu, Hawai'i 96822	(808) 983-5739	arielle.levine@noaa.gov
Marc Miller	<i>Professor</i> School of Marine Affairs <i>Adjunct Professor</i> Department of Anthropology School of Aquatic and Fishery Sciences University of Washington	UW School of Marine Affairs 3707 Brooklyn Ave. NE Seattle, Washington 98105-6715	(206) 543-0113	mlmiller@u.washington.edu
Michael Orbach	<i>Professor</i> Practice of Marine Affairs and Policy Coastal Systems Science and Policy Division Duke University	BRL 201 Duke University Marine Lab 135 Duke Marine Lab Road Beaufort, NC 28516	(252) 504-7606	mko@duke.edu
Minling Pan	<i>Economist</i> National Marine Fisheries Service (NMFS) Pacific Island Fisheries Science Center (PIFSC)	NMFS/PIFSC 2570 Dole Street Honolulu, Hawai'i 96822	(808) 983-5347	minling.pan@noaa.gov
Frank Parrish	<i>Fisheries Biologist</i> NOAA/National Marine Fisheries Service (NMFS) Pacific Islands Fisheries Science Center (PIFSC)	NOAA/NMFS Honolulu Laboratory 2570 Dole St. Honolulu, Hawai'i 96822	(808) 983-5391	frank.parrish@noaa.gov
John Petterson	<i>President</i> Impact Assessment, Inc.	2166 Avenida de la Playa Suite F La Jolla, California 92037-3238	(858) 459-0142	iai@san.rr.com

John Sibert	<i>Manager</i> University of Hawai'i Pelagic Fisheries Research Program (PFRP)	PFRP University of Hawai'i at Mānoa 1000 Pope Road Honolulu, Hawai'i 96822	(808) 956-7895	jsibert@soest.hawaii.edu
Jeff Polovina	<i>Chief</i> Ecosystem & Oceanography Division Pacific Island Fisheries Science Center (PIFSC) NOAA Fisheries	NOAA/PIFSC Ecosystem and Oceanography Division 2570 Dole St. Honolulu, Hawai'i 96822	(808) 983-5390	jeffrey.polovina@noaa.gov
Samuel Pooley	<i>Acting Administrator</i> National Marine Fisheries Service Pacific Island Fisheries Science Center Pacific Island Research Office	NMFS/PIRO 2570 Dole Street Honolulu, Hawai'i 96822	(808) 983- 5301	samuel.pooley@noaa.gov
Craig Severance	<i>Professor</i> Anthropology <i>Coordinator</i> Pacific Island Studies University of Hawai'i at Hilo	University of Hawai'i at Hilo, 200 W. Kawili St., K-266 Hilo, Hawai'i 96720-4091	(808) 974-7472	sevc@hawaii.edu
Janna Shackeroff	<i>Ph.D. Candidate</i> Duke University	BRL 201 Duke University Marine Lab 135 Duke Marine Lab Road Beaufort, NC 28516	(252) 622-1582	js4@duke.edu
Herman Tuiolosega	<i>Planner</i> Environmental Health Hawai'i Department of Health	Environmental Planning Office Department of Health 919 Ala Moana Boulevard, Room 312 Honolulu, Hawai'i 96814	(808) 586-4337	tamahamo@aol.com