

**Guiding National Ocean Research Investment:  
The Development of the Ocean Research Priorities Plan**

**Final - Public Review  
March 27 – May 15, 2006**

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### **General Comments**

The Science and Technical Advisory Committee of the Albemarle-Pamlico National Estuary Program at its 3 May 2006 meeting adopted a resolution as follows:

"The APNEP STAC strongly endorses the development of resources adequate to implement and maintain effective, science-based observation and monitoring programs needed to understand and manage America's estuaries and their linkages to broader coastal and oceanic ecosystems. Significantly enhanced investment is particularly needed in the basic hydrology, physics, chemistry, biology and ecology of these essential systems at a variety of scales."

Background and explanation:

The coastal ocean observing systems, associated with the US Integrated Oceans Observing System (US IOOS), have begun to provide important services to our understanding of the state of the coast and our ability to predict change. However, the coastal ocean is only a component of the "coast." The land, freshwaters, wetlands, estuaries and coastal lagoons are also critical components of what functions as a holistic coast and what people value. Thus, there is a critical need for sufficient resources to be committed to linking these components in both research and observation programs.

In North Carolina and Southeastern Virginia, this critical need is manifested especially in the Albemarle-Pamlico Sound ecosystem (APS). The APS is largely isolated from the coastal ocean with hydrodynamics quite independent of the ocean's. It is highly valued by the people of North Carolina and Virginia for its natural resources and economic contributions. It is also a region subject to changes in natural stresses and disturbances (e.g., increased hurricanes and sea-level rise) and human impacts (e.g., increased numbers of concentrated animal-feeding operations and shore-line stabilization). As a result, it is the site of considerable research and study by scientists associated with numerous educational, governmental and non-governmental organizations.

However, there remain critical gaps to our understanding and ability to predict the effects of these changes. We recommend that the tools, technologies and capabilities for long-term observations and research within APS be given high priority in allocating funds for coastal research and observations.

One glaring gap in our observations is the lack of sustained water level measurements within APS. Although there are NOAA-supported measurements along the ocean side of our coastline, none of the current water-level stations are capable of predicting levels within Albemarle or Pamlico Sound, where astronomical tides are minimal and wind-driven tides dominate.

Storm surge and flooding can be dramatic from the long fetch and shallow depths of the sounds, causing damage to human and natural systems. A NOAA-supported, water-level station would provide sustained measurement and analyzed products of not only changes in

water elevation but also weather. Needs for elevation and related weather data have been identified for emergency management, land-use planning, transportation, and geological and ecological research. A minimum of one such station is critically necessary, but it would only provide products for part of this large and segmented system. Thus, more than one water-level station and related technologies should be considered.

**APNEP, White (UNC Coastal Studies Institute) and Rikard (USNPS), co-chairs**

#### General Comments

This report is a good start on developing a national plan that addresses watershed issues. However, there needs to be more emphasis on human-induced changes and researching what humans are doing to our aquatic systems to determine the detrimental impacts we are having on your ecosystems. Words like anthropogenic used to consolidate a large number of human aspects with the environment are okay, but we need to make a clear emphasis on human-induced impact; if not, we fear it will get put to the wayside.

**Algalita Marine Research Foundation, Francis and Moore**

In general, there is considerable discussion about linking human health to risks and remedies from the sea. Carefully assessing the relative public health impacts from exposures to the oceans will require a significant trans-agency collaboration. The plan should probably include an activity to develop new ways for federal agencies, universities, private laboratories, and public health officials to collaborate (perhaps through joint funding mechanisms that might be similar to the PO1 model used by NIEHS).

**Backer, National Center for Environmental Health**

I am writing as a retired University of Washington professor, who from 1964-1970 served as the biological oceanographer of the Committee on Oceanography of the NAS/NRC (“NASCO”), but who largely withdrew from science policy and politics because they were not his real interest.

Encouraged by the JSOST Ocean Research Priorities Plan and Implementation Strategy Development, I wish to address the theme “Enhancing our Basic Understanding of the Ocean” (p. 39, lines 10 and 22), and more specifically, the theme “Sustaining Natural Resources”, p. 20-23 [Expected Results], to “combine characterization, monitoring, and” [especially] “modeling .... to enable multiple-use decisions” based on a more mechanistic and realistic biological understanding of the functioning of pelagic ecosystems than is available now. *I wish to point out that better modeling and an enormous accumulation of data on natural history and rate coefficients will be needed, and that toward this end, we face a research problem which requires a large, concerted and maintained effort well beyond what we are accustomed to in marine biology.*

By way of background, using actual biological measurements we cannot yet compute/predict the near-steady state concentrations of phytoplankton which satellites show to prevail almost year-round over more than half of the oceans: Why are the concentrations not one-third or three times those measured? Similarly, we cannot truly understand and

predict the seemingly periodic (on the scale of decades) changes of abundance, by several orders of magnitude and in part near-synchronized across ocean basins, of major fish populations like herring or sardines, although fish are the best-studied marine animals.

A large part of this lack of understanding of ecosystem functioning, especially in the temporal (e.g., seasonal) domain, is the insufficient quantitative knowledge of the rate processes, which drive the lives of the dominant species even for the half-dozen (or fewer) best-studied zoogeographic regions of the sea where research has been conducted for 1.5 centuries. We do not yet possess models and, particularly, the experimentally determined input data, for a sufficiently accurate regional, mechanistic production model of, for example, cool-temperate offshore plankton. For the meso-zooplankton part such a model may incorporate functional types like “a small, non-migratory crustacean ambush predator” and “a medium-sized continually moving non-migratory, fast-growing suspension-feeding crustacean”, and include the mortality of the various developmental stages driven by the life cycles of the predators. For sufficient accuracy, would such life-types for the dominants even have to be replaced by actual species, i.e., *Oithona* sp. and *Paracalanus* sp., or would it be realistic enough (and testable in the field) to model the biological complexity by grouping the two types into a simple guild?

Regardless of the detailed choice, the prevailing, almost haphazard, accumulation of quantitative data on life histories and rates has not yielded the basic input for predictive models of community production and composition. In view of the specter of a changing ocean and the ensuing demand for a materially better biological understanding, we can no longer leave the solution of the quandary to chance, that is, to individual or transient groups of scientists who essentially continue to do their own thing. For the results to be anticipated from that approach during the next few decades, see the accumulated inadequate results of, say, the last half-century. Instead, a guided focusing of effort must be contemplated that should be a major new feature of research administration. The intellectual guidance would come from continuing contact and interaction between modelers and experimentalists studying life histories, etc., while the maintenance of continuity of effort and funding is an institutional task.

To make headway, we must concentrate on the few best-studied zoogeographic regions (like the Pacific Northwest of the U.S. and Canada, or the Baltic with its fewer species), within which experimentally measured physiological coefficients are believed to be constant. If sufficiently accurate and testable biological models cannot be built even for such areas, what are oceanographers to do about biological predictions for the rest of the oceans?

I suggest a strategic approach with clear scientific objectives. Unless guided by an intellectual framework, i.e., mathematical models that permit sensitivity analyses, studies of taxonomy and natural history toward such goals are almost bottomless pits. Not all members of planktonic communities are equally important for their functioning, so ways are needed to facilitate choices. The danger of guided research, of course, is that creativity may be stifled, but measuring the rates of egg-laying, feeding, respiration, growth, etc., under

various food and temperature regimes for one dominant species after another simply is not greatly stimulating and will require unusual discipline by workers and funding agencies. The drudgery will be leavened, though, when the models that in their first incarnations are to precede the experimental work, are recognized as the unifying, guiding lights and provide more and more context.

Some of the above, not written by a sociologist of science, has been taken from K. Banse (1994) *Oceanography* 7(1): 13-20.

**Banse, University of Washington (retired)**

In order for the Research Priorities Plan to have a significant impact it should make a clear distinction between the long list of research needs and priorities associated with each theme and a short list of specific Grand Challenges. The former would provide guidance for the community, planners and researchers, but the latter, a small number (maybe only one, at a time anyway) of specific Grand Challenges is what is needed to inspire the public and legislators to action.

A “true” Grand Challenge is one that it encompasses an effort that is of high national priority, high impact (and likely high risk), captures the imagination of the research community as well as the general public, and has a finite duration and a clear identifiable goal. Regarding the duration I would suggest a 10-year effort, as this is a period in which goals can be reasonably conceived and programs can be developed within a realistic political, economic, and funding horizon.

Viable Grand Challenges for the ocean sciences must address issues of current concern such as the research priorities and challenges listed in the draft report. These challenges should also focus on enhancing our understanding of the ocean beyond immediate concerns and contribute to allaying these concerns. Casting the research priorities in a form that meets the criteria for a Grand Challenge is a formidable task, especially meeting the criterion for establishing a specific identifiable goal, one that will clearly signify completion and success. However, if we want to capture the imagination and thus support of the nation we must clarify and focus our ideas, and “bite the bullet” by selecting only one or a few specific Grand Challenges.

**Brandt, Johns Hopkins University Applied Physics Laboratory**

The document is ambitious and offers tremendous potential. In a time of decreased financial resources for research, all efforts must be made to maximize efficiency and the use of pre-existing resources. Both the U.S. and Pew Ocean Commissions addressed this need in part through recommendations to implement more cooperative research. A great deal of work has been accomplished in applied fisheries research in New England since 1999 through these collaborations. Through this work we have confirmed that commercial fishermen and their vessels are powerful, cost-effective research partners. Beyond the research work they also demonstrate an ability to serve as effective ocean stewards and as ambassadors for ocean issues. Innovative models have been implemented in which the sale of legal and

marketable harvest incidental to research cruises is sold to help fund the work- this financially sustainable approach merits further consideration and testing. Serious consideration should also be given to the ability of commercial fishermen to conduct high quality, collaborative environmental monitoring, in addition to applied fisheries research. As one of the groups bearing the costs of climate change and pollution, they are vested in increased knowledge of the problems. Their knowledge base and skillset, along with problem solving ability, makes them strong partners. Their daily interaction with the ocean and with living marine resources makes their vessels ideal monitoring platforms, with significant cost savings over research vessels.

### **CCCHFA, Rudolph**

On December 17, 2004, the Administration released the *U.S. Ocean Action Plan*, representing its response to the final report of the US Commission on Ocean Policy (USCOP). Among other things, the *Plan* recognized the importance of exploration for discovery, hypothesis-based science, infrastructure, and technology development that support management strategies to improve conservation, sustain economic viability, and better predict environmental change. Five-years into the global Census of Marine Life research initiative, information has begun to emerge that points to the need for further investment to improve societal benefits. The Census of Marine Life collectively represents more than 1000 U.S. scientists, with a cumulative investment of over \$100 million from U.S. sources alone. Its advisory body, the U.S. National Committee for the Census of Marine Life, urges the Office of Management and Budget to take a visionary approach to expending limited public monies to support future research and urges you to provide particular focus in the priority areas outlined below in the Ocean Research Priorities Plan (ORPP).

## **BACKGROUND**

Meeting many of the thematic challenges outlined in the final report of the USCOP, the Census of Marine Life seeks to EXPLORE new and provocative marine ecosystems, EXPLAIN the dynamic role of species over space and time, and provide information in usable form to APPLY to resource management, policy development, and ocean education.

Participants in the Census of Marine Life initiative currently include scientists from 73 countries. The global effort is guided by an international Scientific Steering Committee, while National and Regional Committees complement those efforts. Seventeen international collaborative projects combine with many national and regional activities to elucidate marine biodiversity from three principal perspectives: What lived in the oceans in the past? What lives in the oceans now? What will live in the oceans in the future? The History of Marine Animal Populations projects build historical time series to understand how the oceans became what they are today. Ocean Realm Field projects develop and promulgate efficient ways of collecting marine diversity data. Future of Marine Animal Populations projects focus on mathematical modeling approaches to project how human and natural influences will alter ocean life in the future. Underlying many of the field projects is the

development and testing of new technologies for research and monitoring, as well as making marine species data available through a common global data management infrastructure, the Ocean Biogeographic Information System.

Working with Congress, the Administration, the academic community, and the private sector, the U.S. National Committee of the Census of Marine Life seeks to establish a long-term, sustained program on marine biodiversity in the U.S. with three principal components – RESEARCH AND EXPLORATION of all regions and topics providing societal benefits, improved TOOLS AND TECHNOLOGIES for projecting ecosystem change, and EDUCATIONAL INFORMATION to create an ocean literate society and foster wise use of resources.

## **CRITICAL PRIORITIES**

### **Research and Exploration**

- **Undertake regional or topical marine studies to create baseline information to assess biodiversity and better understand its functional roles in maintaining ecosystems .**

The USCOP set forth many laudable goals for the U.S., including developing better understanding of the links between oceans and human health, maintaining healthy ecosystems, reducing the impacts natural hazards, sustaining living resources through ecosystem-based approaches, and establishing sustained monitoring of coastal and ocean resources for informed decision-making. Achieving each of these goals is currently inhibited by a lack of information about the presence, distribution, and diversity of marine species over time and at appropriate management scales, and also by a severely limited understanding of the functional roles most species play in maintaining ecosystem services. Regional studies and monitoring programs that focus on gathering and assimilating such information are necessary, particularly studies that integrate biological data with other data-types and those that foster interdisciplinary collaborations. Such studies could greatly improve our understanding of provisioning services, regulatory and environmental support services, coastal and ocean linkages, and changes in productivity that are necessary to accomplish the USCOP's progressive goals. .

Such interdisciplinary studies must be specifically targeted in the ORPP. They should form the basis for the development of ecosystem-based management approaches. The Census of Marine Life can be an important contributor to such studies because of our success in fostering interdisciplinary research

- **Foster the development, adaptation, and application of biosensor technologies that identify the abundance, distribution, movement, and diversity of marine species.**

Recent advances have been made in optical and acoustic sensor technologies, genetic sequencing, and tagging marine species; however, further technological development is

needed to adequately measure, monitor, and predict changes in marine populations or ecosystem composition on a real time basis. Advancing biosensor technology to the level of full and seamless integration with physical data-types within coastal and ocean observing systems is critical to capacity building and development of an ocean observation system that can be used for both interdisciplinary research and scientific advice for policy making. Increased investment is necessary to address these gaps to provide substantial societal benefits; particular attention is needed in the areas of biological sensor development, sensor to signal processing, integration across sensors, and integration across data-types.

- **Improve public understanding of ocean exploration as a driver of discovery, technology, and scientific collaboration.**

As space programs have demonstrated, exploration is a driving force behind discovery of the unknown, engagement of the public interest, development of new technologies, increased national competitiveness, and improved scientific understanding of the world. The USCOP characterized Earth's ocean as poorly understood, and recommended a doubling of U.S. investment in research. Advances in discovery, ocean literacy, technology development, science education, medical treatments, ocean and coastal management, and national competitiveness could be achieved with relatively modest investment in ocean exploration, particularly when compared to cost of space exploration. The Census of Marine Life has exploration as a central theme. The final ORPP should ensure that exploration programs are diverse, contribute to the larger mission of ocean science, and are accessible to the public.

### **Tools and Technologies**

- **Promote the establishment and maintenance of a data management system of marine biodiversity data that is interoperable with ocean observing systems.**

Ocean and coastal research observing and monitoring activities are generating extraordinary amounts of biological data. Additionally, a wealth of marine biodiversity data from previous efforts already exist in public and private repositories, but currently contribute little outside their original purposes. New approaches tested during the Census of Marine Life increasingly include data synthesis and integration, analysis of temporal or spatial change, and interdisciplinary studies. Development of a data management system for marine biodiversity information, and establishment of interoperability of this system with a common national system (e.g. Integrated Ocean Observing System), could greatly aid academic studies, resources managers, and policy-makers. The Ocean Biogeographic Information System can be a major contributor to this effort.

- **Develop improved tools for using marine species data and providing information that explains and applies marine biodiversity research.**

Effective management and policy decisions depend on effective tools to understand past change and better predict future change at the genetic, species, population, and community levels. Equally important is our understanding of functional relationships within ecosystems, interrelationships of biological, chemical, geological, and physical ecosystem components, and the resilience and adaptability of individual ecosystems. Developing

national capacity to reach an effective level of understanding both externally and internally within federal agencies will require increased investment to develop and improve tools that effectively measure (e.g. biological metrics), identify (e.g. automated genomic sequencing), monitor (e.g. biological sensors), and model populations, communities, and ecosystems.

- **Extend temporal baseline information and clarify long-term change in marine ecosystems through retrospective analysis based on historical records.**

A new and growing field of predictive modeling has emerged under the Census of Marine Life at the intersection of marine ecology, human history, and paleo-ecology – the History of Marine Animal Populations. The research methods and analytical perspectives offer a unique approach to testing theories concerning the effects of human activities and natural environmental changes on living marine resources. The research has been particularly effective at extending baselines of species abundance, size, and distribution, as well as elucidating the impacts of human interaction with marine ecosystems. This information is vital for building the understanding necessary for policy decisions related to ecosystem-based management. For a relatively small national investment, temporal baselines could be extended, anthropogenic drivers could be distinguished from natural change, and better predictive models could be developed and tested to meet societal goals.

## **Education**

- **Promote incorporation of marine biodiversity information into formal education.**

Ocean literacy has been identified as a priority by both the USCOP and the President's Ocean Action Plan for enhancing knowledge that influences human behavior that results in sustainable use of living resources. Marine exploration is exciting to children, and marine species elicit a range of human responses from awe to fear. The ORPP should encourage the incorporation of marine biodiversity into the national science standards to both accomplish the goals of the USCOP and Administration, and to foster lifelong behavior that supports maintaining essential ecological services through conservation and sustainable use. In addition, support for educational activities through colleges and universities will be necessary to foster continued growth in marine sciences essential to maintaining national competitiveness.

- **Promote incorporation of marine biodiversity information into informal education.**

For the same reasons as increasing investment in formal education, informal education through aquaria, zoos, museums, the internet, and other means will be essential to build ocean literacy. Encouraging and supporting federal investment in these activities will be necessary to achieve the goal of an ocean literate society, as will encouraging public-private collaborations to effectively develop a common ocean message.

- **Improve mechanisms to engage and communicate with the scientific community.**

Five years into the global Census of Marine Life research initiative, scientific information has grown and improved research methodologies have been developed. Translating that scientific information so it is used by regulatory managers and policy-makers remains a significant barrier to effective change in human behavior – perhaps a larger barrier than obtaining the scientific information itself. Developing and supporting the institutional relationships and technological platforms for policy-makers to engage with the scientific community should be among the highest priorities of the Administration. The Interagency Committee of Ocean Science and Resource Management Integration (ICOSRMI) and its subordinate bodies should be encouraged to foster improved mechanisms to engage and communicate with the external scientific community.

**Census of Marine Life Program, Fautin, Chair, U.S. National Committee**

The Ocean Blueprint and the Millennium Ecosystem Assessment report address cultural resources and their significance to community well-being, quality of life, religion and spirituality, sense of place, recreation and tourism, education and knowledge, and social and civic relations. Why are cultural issues, resources, and values so poorly represented in the ORPP?

**Claesson, University of New Hampshire**

CORE believes that the plan should include research priorities that promote the guiding principles of sustainability, ecosystem-based management, preservation of marine biodiversity, and adaptive management. We support Admiral Watkin's suggestion that the plan focus on two or three high-priority, high-visibility initiatives that hold the greatest potential for communicating a compelling vision, generating public and political support, while providing the greatest benefit to the diverse ocean community. CORE supports the idea of three overarching themes: (1) Ocean Exploration; (2) An Ecosystem Research Initiative; and (3) An Integrated Ocean Observing System. The existing societal themes and cross-cuts could fold into these broad initiatives.

Regarding integration, when the U.S. Commission on Ocean Policy stressed the need for ecosystem-based management as its central recommendation it was referring not just to ecosystem health or natural resources, but suggested this is the framework in which to integrate, resolve, and harmonize all human activities. So, the strategy will require considerable cross-bridging not only among the seven themes, but also among federal agencies and federal, academic and private research and development sectors. At this stage in the strategy development there is not much sign of that integration, but it will surely fail if the plan calls for just integrating things at the end.

CORE strives for a national consensus where citizens and decision-makers recognize the importance of reliable science-based ocean data upon which to base our ocean policy decisions. This requires a sound science plan with strong investment in physical, biological, social, and economic research of our oceans, coasts and Great Lakes. The wonders of our universe do not just lie in space, but also in the exploration of our planet's oceans. The Administration must have a call-to-arms and a strong commitment to ocean research and

exploration as a national priority. Without this commitment to the research, conservation, and management of our world's oceans, the cost to human health and the ecological damage to our oceans will be immeasurable and may be irreparable. The ocean research community must put our individual interests aside to develop a focused set of priorities and an implementation strategy that will allow our collective interests to be recognized and acted upon at the highest levels of government and industry—we must come together to support one common research plan. To that end, CORE commends the JSOST for its outstanding work on the ORPP working document, appreciates the opportunity to provide our input on this important plan, and stands ready to help throughout the process to ensure the successful completion of this plan.

## **CORE**

I write on behalf of the Coastal States Organization (CSO) to thank you for inviting input on the Ocean Research Priorities Plan (ORPP). As you know, CSO is a non-profit, bi-partisan organization that represents the interests of the thirty-five Governors of the coastal, ocean, and Great Lakes states and territories on legislative and policy issues. We appreciate this opportunity to provide general comments on the ORPP.

First and foremost, CSO applauds the JSOST for its commitment in drafting a national plan that will align federal activities and provide renewed focus on the important priorities and themes you have laid out in the ORPP. We know it is a challenge to develop a thoughtful and encompassing plan, and recognize the hard work and time you have dedicated thus far. We also appreciate the opportunities you have provided for transparency and public comment. CSO looks forward to working with you to address the suggestions and questions below.

### Federal-State Task Team

For the past three years, CSO has been implementing an initiative aimed at bringing together the coastal management and science community to bridge communication gaps, share emerging scientific findings, and identify managers' research priorities. Our initiative, called Science to Management, began with a survey of over 230 state coastal managers with interests as diverse as wetlands, floodplains, fisheries, water quality, and coastal zone management. The survey overwhelmingly demonstrated that the top issue facing state managers in the next five years is land use (97%) and habitat change (95%). Following the survey, CSO embarked on a series of regional workshops to further investigate the states' land use and habitat change science needs. In addition, CSO has held two workshops and is currently planning two more to identify states' needs for the emerging integrated ocean observation systems (IOOS).

I mention this CSO initiative because it is intimately linked to the work conducted by the Federal-State Task Team (FSTT) in its early review of the draft ORPP. The FSTT compiled CSO's assessments along with 70+ other state-based needs assessments. The assessments were used to review and determine whether the priorities proposed in the ORPP aligned well with states' priorities and needs. The resulting FSTT report is accurate and thorough. CSO

**endorses the FSTT report and its conclusions, and recommends that the JSOST incorporate the report’s findings into the next draft of the ORPP.**

#### New Cross-Cut Theme on Human Dimension

**CSO feels strongly that a new Cross-Cut Theme on the Human Dimension should be added to the ORPP.** This was a conclusion of the FSTT and reiterated in the discussions and recommendations arising from the workshop in Denver, Colorado. Understanding humans’ contribution, effect, response, and adaptation to changes in the coastal and ocean ecosystem should be an issue that cross-cuts all of the ORPP themes.

#### Near-Shore and Watershed Science

**CSO recommends the ORPP “bring the science closer to shore” and increase the report’s focus on near-shore, estuarine, and watershed science.** It is in the near-shore environment where human impacts are concentrated. More than one-half the nation's population now lives and works within 50 miles of the coastline. In recent years, 40 percent of new commercial development and 46 percent of new residential development has happened near the coast. The stress on the ecosystem by these and other changes include degrading water quality, habitat fragmentation and destruction, declining fisheries and wildlife populations, increasing risk to property and life, and impacts to the economies of coastal communities that rely upon coastal resources for their livelihoods, tourism, and recreation. It is critical that coastal managers have a better understanding of the links and cumulative impacts between terrestrial and near-shore uses and coastal resources.

#### Delivering Information to Policy-Makers

The ORPP states (pg. 1) that the Plan should deliver the “information required for policy-makers to make informed decisions on the use and protection of the ocean.” The ORPP as currently written does not provide direction on how and by what process “science translation” will occur. **CSO proposes the ORPP be revised to provide an explicit and clear process for turning scientific findings into useful information for decision-makers.** A process laid out in the ORPP should address incentives and recommend changes necessary to institutionalize and accelerate the delivery of scientific findings, products, and tools to coastal decision-makers.

Through CSO’s Science to Management initiative, it has become apparent that key decision-makers are largely unaware and do not know how to access federally-funded science. Further, scientists have noted that incentives to translate science are limited and there are few mechanisms that foster science based upon end-user needs. Unless a process and incentives are established, the impact of federal investment in applied science will remain largely unrealized.

#### Socio-Economic and Cultural Science

The ORPP should incorporate increased focus on understanding the contributions of oceans and coasts to our nation’s economy. The United States’ coastal and ocean resources are an immense driver of our economy, but the full magnitude of those contributions is not adequately understood and quantified. **CSO recommends the**

**ORPP be amended to recognize the need for more economic, social, and cultural studies and analyses to better understand and quantify the value of coastal and ocean resources.** Included in this field of science should be methods or performance measures that allow managers to determine how resource decisions may create socio-economic benefits and impacts.

#### Other Concerns and Questions

While reviewing the ORPP, several questions and concerns arose among the CSO membership. I bring these to your attention as issues we look forward to working with you to explore and resolve.

- Is the vision set forth in the ORPP inspirational and compelling?
- Does the ORPP present a strong enough case for increased financial investment? Without additional or more efficient use of existing financial resources, is the ORPP in danger of becoming a report that sits on a shelf?
- Will the ORPP include a cost estimate for full implementation of this Plan?
- In the likely event of too few dollars to carry out the ORPP, what is the process for choosing among the priorities?
- Will metrics be established to measure progress on these priorities?
- How does the ORPP correspond with investments in infrastructure and technology?
- Is the ORPP confined to setting priorities or will it also include steps for implementation as called for in the President's Ocean Action Plan?
- Will the ORPP establish a new governance process? The current ORPP is so broad and encompassing that all current research activities could fall within its scope. As such the Plan may not prove to be a driver of change or improvement. It is unclear what commitment, if any, the federal agencies have made to do something "new" based upon this Plan to create efficiency and results.
- Will the ORPP lead to federal programs redirecting existing research dollars to the identified priorities?

We look forward to working with you on these issues, and again thank you for the opportunity to comment on the Ocean Research Priorities Plan. If you have any questions, please do not hesitate to contact me at 202-508-3860 or [csso@ssso.org](mailto:csso@ssso.org).

#### **Coastal States Organization**

The sections on research needs need to specifically address the challenges sections.

The 3 sections on cross-cutting themes should precede the specific themes because they should be considered as each of the specific themes are discussed. Moreover, there should be more specific mentioning and addressing of these elements in each of the thematic section to highlight their (the cross-cutting theme's) connection to each research area. For instance, it may be useful to add these three cross-cutting themes as subsections to the framework as outlined in Fig. 2. COFS graduate students, University of Washington

**COFS graduate students, University of Washington**

While I applaud the efforts to develop a national research priorities plan I must agree with the preliminary findings of the Federal-State Team on Research Priorities that this plan must encompass not only the blue water of the ocean but also extend inland from the coastal and estuarine brown water to the upstream limits of coastal watersheds. In addition to addressing open ocean concerns, this approach is critical to understanding and addressing the variety of issues considered by the Commission on Ocean Policy.

Toward that end, I would suggest incorporating the text found in endnote i in the opening text of the document to ensure that the reader understands that the term “ocean” includes coastal areas, estuaries, the Great Lakes and their watersheds. In addition, within the text of the document it was noted that although the term “coast” or “coastal” was used in several areas, “estuary/estuarine” was used infrequently and “watershed” was used but once. To some, this may indicate a lower priority for research/monitoring in these vital areas. I would suggest incorporating these terms in appropriate areas to ensure that it is clear that estuaries and watersheds are included in the research priorities plan.

**Day, Indian River Lagoon Nat’l Estuary Program/St. Johns River Water Mgmt**

\*I chaired one of the breakout sessions at the workshop (Natural Resources) and thought the attendees were very cooperative and energetic to develop an ocean priorities plan. Having said that, I think the cooperative attitude came about because the plan tends to be very general rather than research specific. I understand that specific research projects are not an objective of the plan, but I worry that the document will not capture the hearts (and pocket books) of the legislators if it remains very general. There was also a lack of ties to the big projects presently being funded. For example, tens of millions are being spent by NSF on the Integrated Ocean Drilling Program (IODP). There was no mention of this program in any of the general presentations. In the final document, I would suggest at least some "for examples" be used to illustrate that the big projects have already had a role in ocean research priorities.

All-in-all I commend this effort and think it's a terrific idea to work on things that are a priority to the nation.

**Doyle (no affiliation mentioned)**

- 1) Environmental Defense strongly endorses the creation and implementation of a coordinated and integrated national oceans research priorities plan.
- 2) The planning document developed by JSOST staff in general provides a strong and appropriate framework for developing the draft of that plan. We look forward to working with JSOST staff as that plan is developed, and to reviewing the draft once completed.
- 3) We appreciate the opportunity to participate in the recent three-day meeting in Denver to work directly on the planning document. In general, we concur with the recommendations that emerged from that workshop, especially the need to develop and maintain the investment in science and monitoring required to manage coastal and ocean ecosystems effectively.
- 4) We strongly endorse the conclusions reached by Admiral James Watkins and presented at that workshop. Building the political momentum required to sustain an

investment in science necessary to protect the nation's seas and coasts will require the development of resonant and exciting messages to which the public can relate. His analogy to the space-race of the 1950s and 1960s, and his insistence on no more than three exciting and broad-based public initiatives, were profound.

5) We concur with Admiral Watkins that the three central thrusts ought to be:

a) exploration of "inner" space, both within the sea and within marine and estuarine organisms

b) the development of tracking and systems ample to keep our collective fingers on the pulse of critical ocean ecosystems (building on recent investments in ocean observing systems, but expanded to more fully track status and trends in living marine resources, and linking more effectively to coastal and estuary observation systems), and

c) the nourishment of basic and applied science needed to build working models of those ecosystems, and the development of management protocols adequate to sustain them at ecologically important scales.

**Environmental Defense, Rader**

The instructions for the participants in the public comment period states: "We believe that we will make the most progress by establishing a small number of priorities in each of the theme areas that, if funded, would allow us to make substantial progress." Ignoring the "circularity" implied in the statement that "most progress" will be made by selecting those projects that will allow the community to make the most progress I believe that the coordinators of the workshop and parallel public comment period could greatly enhance the value of this process by elaborating on what would constitute "progress", such as providing specific metrics that are being sought through enhanced observational programs or research efforts. Let me elaborate on this point by reference to the Theme Section on "The Ocean's Role in Climate Variability and Change" (pages 27 – 31), with which I am most familiar professionally. I consider this section to be extremely well written, and, to me, all of the proposed activities seem well-motivated and worthwhile. But, how to prioritize among them? Without further guidance on what metrics should be used to define progress, I fear that the workshop groups will "degenerate" into subjective evaluations determined by the "luck of the draw" determined by which participants from which scientific disciplines are in attendance in Denver. (FYI – I will not be able to attend the Denver workshop, due to a long-standing family commitment). Thus, I would urge the JSOST Committee to provide additional guidelines (through a second posting to the Federal Register?) on some preferred methods for defining and evaluating progress in the various research themes.

**Hakkarinen, retired, Belmont, California**

You fail to mention that many programs/challenges must be international in scope and participation. Gulf of maine with Canada, Bering Sea with Russia and Gulf of Mexico with Mexico. WE can not do it alone and the ocean does not respect political boudaries. We must join the LOS!!!!

**Johnson, University of Alaska Fairbanks**

I've read the March, 2006 version of the Ocean Research Priorities Plan. Overall, this plan offers a concise overview that was understandable and clear. The definition of

“ocean” is shown in the Endnotes is broad, including open ocean, coasts and estuaries, Great Lakes and coastal watersheds. An overall comment is that the majority of challenges identified in the themes are associated with watershed sources of coastal problems. Too often, research needs identify open ocean topics. And infrastructural and technological needs are seen as open ocean tools that are likely not applicable to coastal investigations. I would make a recommendation to create a table for each theme that directly links the research needs and infrastructure to the challenges identified.

**Keough, USEPA**

This document is little more than an incomplete repackaging of old ideas. There is no vision, and it is full of jargon and long, complex sentences that are often difficult to understand

No attention is given to the cross-cutting challenge of data telemetry, management and communications – cyber infrastructure. Emphasis is on measurements and modeling with no mention of the “stuff” that connects the two. In regard to the latter, it would be a shame to fund a new suite of programs that independently develop program-specific data management systems. These issues should at least be addressed in sections on “Infrastructure and Technical Needs.”

In terms of “vision”, there is no discussion of the kinds of environmental interactions that impact multiple themes and should be high priorities for research. This is where the action will be over the next decade. For example, we know that habitat modification and loss across the land-sea interface (due to natural forces as well as land-use practices) influence the susceptibility to coastal inundation, public health risks, ecosystem health and the capacity of ecosystems to support living marine resources. Yet research priorities (from observations to models) needed to develop ecosystem-based, adaptive management practices that address all four themes in a more holistic fashion are not discussed. We know that long-term time series observations of key ocean properties and processes are needed to add value to more short-term, hypothesis-driven research; yet this is not addressed. Where’s the vision here?

Public Health, Ecosystem Health and Natural Resources: Developing the capability to engage in ecosystem-based management of living marine resources and water quality was identified as a high priority in the Ocean Commission’s report and in the IOOS Development Plan, yet there is no mention of this important approach in the plan. This is a major oversight.

**Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

I have included a specific comment below. Overall, I believe the document is a good one that addresses all of the major issues facing the oceans today. Apart from climate change, the greatest impact to the oceans comes from fishing. Thus I believe it is important to be careful and clear on the topics related to fisheries.

**Mann, University of Florida**

I have some first impressions on the document as a whole. I should say that I wasn't part of USCOP, or part of the preparation of OAP, and not a member of JSOST. And, unfortunately, a prior commitment prevented me from attending the April meeting which produced this document.

Primarily, in my opinion, the ORPP has its priorities reversed. It lists several 'themes', which are subjects of applied research and marine policy (e.g, promoting marine operations), and then lists several cross-cutting 'elements.' In my view, the so-called 'elements' should be given the first, and highest priority to the nation's ocean research agenda. The reversal is also seen in the number of pages devoted to each theme and element. 'Enhancing Our Basic Understanding of the Ocean' gets only a little over a page and a half!

I would like to see the themes and elements reversed in terms of priorities, or at least given equal standing. Clearly, the mission agencies (NOAA, NASA, EPA, DOE) are working toward solutions to specific problems under the various themes. NSF is working on 'basic understanding' and 'education' and 'observational infrastructure'. We need both, but it seems to me that the elements are used to inform, and create solutions for, the problems mentioned in the themes.

A lot of this is the usual tension between those involved in basic vs. applied research. One way of reconciling the two would be to use the themes to drive research on basic understanding. One type of answer to a problem of applied research is basic understanding of the processes involved. For example, do we understand how deep-sea coral reef systems work? The challenges discussed in the document (p. 10) are really policy matters. Again, the priority would be to conduct basic research on these ecosystems, and when their value is revealed, a policy of protection of the reefs can be promulgated.

As with 'basic understanding', education is given little space. Much of what is happening in the ocean is out of sight (out of mind?) of the vast majority of US citizens. We desperately need to educate both children and reach out to adults to make sure that the next generation is not surprised by what they will see of the ocean.

**Marra, Lamont-Doherty Earth Observatory**

\*None of the ocean priorities listed can be effectively studied-- nor the challenges met -- without the tools provided by 21st century marine technology. Provision of these tools and instruments is furthermore tied to a sustained marine technology research and development effort -- to ensure that the state-of-the-art paces and stays relevant to ocean observations, exploration and utilization -- and to ensure a healthy educational pipeline for providing the engineers, technicians, designers, scientists and operators who will create and employ these tools and technologies

We must emphasize in the plan that success is contingent upon having sustained access to the tools and techniques provided by advanced and available technology. As such, it would be appropriate to recognize that having advanced and available technology is a

significant 'challenge' to most of the plan themes and this acknowledgement should be incorporated more clearly into the "infrastructural and technological needs" section of each priority chapter.

The implementation strategy should also address the requirement to identify existing advanced and available technologies as well as those that are readily adaptable to the ocean research in question versus those that are deemed applicable but require development. By identifying applicable technologies and focusing effort in a concentrated range, development and iteration on successful deployments can be magnified, costs can be lowered, and return on investment maximized.

Additionally, we suggest that the following be considered and incorporated into the plan:

- 1) Educational systems need to be invested in to insure the continued expertise on the part of future infrastructure [i.e., technology] users. [note: we offer this because technology is useless if the scientist, biologist or other end user can not interpret results or identify hardware discrepancies]
- 2) Technology development and transfer issues should be addressed-or at the very least, mentioned.
- 3) It should be clearly stated that there must be the means for a robust ocean industrial sector to find encouragement in its efforts to contribute to the development and delivery of needed hardware and software technology.

#### **Marine Technology Society, Krauthamer**

We commend the committee for composing such a comprehensive plan for research into the physical characteristics of our oceans systems. Such knowledge is crucial for our present and future enjoyment of the benefits provided by ocean resources. Nevertheless, as social scientists actively studying oceans systems, we urge you to more fully integrate human and marine science in the proposed research and education plan. Our perspective is partly informed by our experience as collaborators in Working Group 5 (Socioeconomic Aspects and Management Strategies) of the GLOBEC, Climate Impacts on Oceanic Top Predators (CLIOTOP) Project. However, the opinions expressed are our own and should not be attributed to GLOBEC or to CLIOTOP.

We hope these comments will promote a more complex understanding of coupled human/environment marine systems. This fully integrated approach is already well-represented in research on climate and land cover change. Given the rapid rise in use of ocean space for transport, mineral extraction, and development of renewable energy (wind, tidal, wave), among other uses, we need a set of research priorities that fully integrates the human sciences with biological and geophysical sciences. As one of the most influential countries in the world, the US has an excellent opportunity to optimize our own ocean policy, learn from others, and foster international collaboration. To address critical problems of ocean governance, from local communities to international agreements, we need a more detailed research agenda, that fully integrates physical, biological, and social science research.

To this end, we propose three additional themes be included in the ORPP:

- Basic understanding of ocean use and governance
- Linkages between physical, biological, and social analysis of oceans systems
- The interaction of international and US Ocean Policies: impacts and implications

While uncertainty regarding the ecological impacts of policies is one barrier to effectiveness, social dynamics and pressures make policy making far more complex than a matter of reducing uncertainty. Management is more than the application of scientific advice; it is also a balancing act, both externally, as multiple interests vie for their preferred values and policies, and internally, as budget limitations and institutional structures force decision makers to prioritize. As such, management is also often less than the application of scientific advice, because knowledge claims and meaning are frequently disputed. That makes it imperative to develop a unified approach to the study of oceans issues. Ultimately, it is important to recognize that good science does not automatically transform into good policy because decision making is often not rational, is complicated by power politics, and is riddled with socioeconomic uncertainties that exist apart from scientific knowledge claims. For example, McCright and Dunlap (2000; 2003) describe how a social movement directed the fate of the United States policy on the Kyoto Protocol by exploiting climate skeptics who were established scientists. Here a partisan project prevailed over mainstream science, despite a strong community consensus on anthropogenic drivers of climate change. This is not unusual, but a regular function of social nonlinear instabilities (Brown 1994).

In the past decades, great strides have been made in understanding various aspects of the human-environment nexus. (Clark, 1990; Ostrom, 1990; Haas, Keohane, and Levy, 1993; Young, 1997). As in the bio-physical sciences, many aspects of oceans use and governance are not well understood. Each of the ORPP's research themes could be improved with further attention to collection of quantitative and qualitative information on public perceptions of the issues, economic valuations, political decision-making, institutional structures, and compliance and enforcement mechanisms. For instance, in small-scale studies such as Pendleton, et al. (2001), researchers found that public perceptions of beach pollution in Los Angeles, including hazardous effluents, remain skewed toward visual indicators such as trash in spite of targeted educational campaigns and readily available information on contaminants. Moreover, even those respondents who regularly engaged in ocean-based activities rated issues such as air pollution, crime, and education as more important than marine water quality. Such results suggest that additional scientific information alone will not create the political will to solve serious oceans problems.

We need substantial theoretical and applied research on human responses to environmental changes, in addition to research on human impacts on the environment. For example, we need better models of decision making in the face of risk and uncertainty. We need to understand collective choice and the interaction of policy makers, interest groups, and the public. As mentioned above, people may prefer to ignore predicted costs rather than invest in changing the status quo. Many cases show that knowledge of an eventual catastrophe, such as a major category 5 hurricane hitting New Orleans, may be insufficient to motivate action when precautionary measures are costly.

Alternately, some environmental changes occur more gradually, such as the depletion of the ozone layer, the overexploitation of living marine resources, and the degradation of coastal ecosystems. How can governance systems be adjusted to engender behavioral changes? How do actors relate to each other, and what impact do their perceptions of costs and benefits have on the system as a whole? These are complicated questions with complex answers.

Interdisciplinary linkages are expanding among social scientists who study environmental issues because of the interconnectedness of political, economic, social and even psychological elements in this issue area. At the same time, there are many feed-back effects that have been observed between humans and their environments, including the oceans. The overexploitation of a typical open-access fishery is a good example. At first fishing increases recruitment, since biological competition is easier, but eventually productivity is reduced. What is the fishers' response to this? They work harder to catch fewer fish because price increases as the quantity supplied declines. Whether or not the stock collapses depends on multiple, sometimes stochastic events, including technological capabilities, the political climate, and the potential for effective regulation, as well as oceanographic conditions and other, less anthropogenic factors. (Berkes, et al., 2006; De Sombre, 2005). In spite of such deep interdependence, collaborative efforts between physical and social scientists studying oceans issues are quite rare.

In summary, we are enthusiastic about the advancement of scientific knowledge in oceans studies. This is a crucial time of structural changes in the ocean, many of which stem from human decisions and behavior. Social science can be integrated with biophysical science to produce better models and a more nuanced understanding of ocean systems. Moreover, we are sure that if ocean studies are not driven by a coupled program of marine natural and social science, efforts to make scientific advancement meaningful in policy-making will be frustrated.

**Miller, et. al**

I congratulate the Administration in taking the important step of developing the Ocean Action Plan and the Ocean Research Priorities Plan (ORPP). The ORRP is a very important process and document that can help implement the vision of the US Commission on Ocean Policy for a robust national economy anchored on ecosystem-based management and supported by strong science.

The U.S. Commission on Ocean Policy identified a critical national need for improved ocean research, observation, and ecosystem-based management, for education, governance, and international leadership. Each chapter of the Commission's report identifies critical issues, each of which requires a research focus. The Ocean Research Priorities plan should be checked against each chapter and ensure the underlying research programs are enabled.

The ORPP states the importance of biology and biogeochemistry in setting priorities on page 15, lines 8-11 (Improving Ecosystem Health, under Challenges). The ocean research

priorities and the themes listed could be organized around two major areas to focus an implementation plan:

- 1) Ocean biology and biogeochemistry: human and other life, cycles of elements and how chemicals move through the environment. The ultimate objective is to ensure our health on a healthy planet. This is the research basis for ecosystem-based management, specifically addressing research on solutions of how society affects the rest of the ecosystem.
- 2) International leadership, cooperation and capacity building

The ORRP needs to be more explicit in defining research on linkages between land and land use patterns and change, as well as atmosphere inputs and exchanges (gases, aerosols).

The UN Convention on the Law of the Sea has major research provisions. The Administration needs to provide strong leadership for Congress, and particularly the Senate Majority Leader, to call for a vote to ratify the UNCLOS.

Elements that need to be included in an implementation plan:

\*The U.S. Commission on Ocean Policy concluded that our nation needs to invest a modest \$1-4 billion per year of new funding to ensure we protect life and property, sustain the businesses that use ocean resources, and maintain a position of technical strength in the international arena. This is a small investment that will provide large returns.

\*Regional implementation through national coordination:

As mentioned above, focus research through regional academic, private and State entities, coordinated and funded through the Federal agencies. We need to streamline and minimize centralizing and internalizing implementation of research within the Federal government. The Federal agencies should fund activities extramurally through peer-reviewed competitive processes that are based on defined agency and other stakeholder needs. This will ensure:

- best possible research in the nation through a healthy and well coordinated national infrastructure focused on regional issues, addressing local and regional needs
- best possible operations by federal and State agencies

\*Satellites: We need to fully integrate ocean satellites (ocean color, infrared, wind scatterometry, advanced altimetry) into the Integrated Ocean Observing System and GOOS/GEOSS planning, including budget planning.

\*Data policy:

Ensure that data collected through Federal funding is immediately released to the rest of the science community and the public, except when national security is at issue. There should be no waiting period, no indefinite holding of data.

**\*Information infrastructure:**

Ensure that the NOAA NODC is a functional, modern data repository to which people want to send data - this is not the case now. The NODC should be linked and operate jointly with other databases/centers now located outside the Federal government (academia, states, private industry) as well as within the Federal government (other agencies but all part of the same executive)

**\*Allow the ORPP to remain a living plan which is reviewed through participation of the public, government, private industry and research entities.**

**Muller-Karger, USF**

The National Association of Marine Laboratories (NAML) is pleased to submit its comments to the National Science and Technology Council (NSTC) Joint Subcommittee on Ocean Science and Technology (JSOST) on the Ocean Research Priorities Plan (ORPP). We offer our baseline comments in this letter and more detailed section-by-section comments on the framework document in the attachment to this letter.

NAML commends the Administration and the JSOST for initiating this open and participatory policy development process and for recognizing the vital importance of the oceans, coasts, and Great Lakes to the overall health, security, economy and quality of life of the United States. NAML, a nonprofit organization of over 120 member institutions representing coastal, marine, and Great Lakes laboratories in every coastal state, believes that the oceans, coasts, and Great Lakes are inextricably linked to the health, safety and well-being of all living organisms, including humans. NAML believes that the JSOST has a unique opportunity to influence the continued development of U.S. ocean policy to more adequately support vital research, infrastructure, and education activities important to the ocean, coastal, and Great Lakes research and education community. The outcome of such activities promises to provide improvements in quality of life – as it relates to people and our social institutions as well as the natural environment in which society and our institutions operate.

Though “ocean” is defined in the first endnote of the developing document as including “open ocean, coasts and estuaries, Great Lakes and coastal watersheds,” the term “ocean, coastal, and Great Lakes research and education in the natural and social sciences” should be explicitly used throughout the document. The inclusion of common language, such as “ocean, coastal, and Great Lakes,” would not only acknowledge the Great Lakes clearly as the Nation’s fourth coast and the millions of people who live, work and utilize this fourth coast, but it would more accurately reflect the scope, the scholarship and complex dimensions of this research endeavor.

NAML believes, as do many others in the community as demonstrated at the ORPP workshop in Denver last month, that the needs of the public and how advances in research and education can lead to improvements in human quality of life should be one of the key overarching themes throughout any ocean, coastal, and Great Lakes research priorities plan. It is essential that the final plan address this topic in detail and that it set real targets for success in the area of quality of life, which includes the integrity of both

natural and built environments. This may or may not be accomplished through making quality of life a cross-cutting theme as opposed to a societal theme. Either way, quality of life, as one of the most important markers in the public valuation of science and of the ocean, should be carefully addressed, with improvements in the quality of life identified as a prominent outcome of the plan.

Basic and cutting-edge scientific discovery, driven by competitive, merit-based investigations should always be at the foundation of our research and education enterprise – for a variety of very important reasons. Our Nation’s ability to continue to successfully compete in today’s global marketplace is dependent on the strength and output of our science and engineering research and education enterprise. The Administration’s multi-year American Competitiveness Initiative (ACI) recognizes this with its stated intent to double the federal investment in the physical sciences over the next ten years. NAML strongly supports the ACI.

At the same time, NAML strongly supports extending the ACI to the full spectrum of the natural sciences. Enhanced support for cutting edge ocean, coastal, and Great Lakes research in the natural and social sciences, and its application to education, outreach, and related infrastructure will also greatly improve the Nation’s competitiveness in the global marketplace. These disciplines have much to offer the Nation as it seeks to strengthen its ability to innovate and compete in today’s global economy and provide a vehicle for applying and illustrating the real-world relevance of mathematics and technology. They are inherently interdisciplinary, push the envelope in terms of technology development, test the boundaries of our data collection and analysis systems, and offer an effective training ground for future scientists and engineers. As the Nation seeks to augment its investment in the physical sciences to increase its international competitiveness, NAML calls on the JSOST to promote the integrated nature of the marine sciences and send a clarion call for enhanced investment in these as well as other science and engineering disciplines as part of the ORPP and the Administration’s long term economic competitiveness policy.

As important as basic research is, translating research results and discoveries into practical applications must become a more integral part of the way the academic research community operates. NAML feels that a cultural change that recognizes and rewards these important contributions is needed throughout the scientific community. The translation of research and discovery to usable information for policy makers and local resource managers is crucial, and the ORPP process provides an important opportunity for encouraging and supporting this cultural change.

In addition to this need for cutting-edge discovery and effective translation and application is the need for “timely” research. Understanding the factors that lead to “regime shifts” or “tipping points” is important but often not sufficient. The ocean, coastal, and Great Lakes research community must develop an understanding of such processes before severe damage or irretrievable change has occurred. Therefore, some research needs must be placed on a more urgent or preemptive track in order to gain the ability to understand the factors that contribute to a tipping point before it is reached.

A key outcome of the Denver workshop was an emphasis on the integration of the natural and social sciences. Across all themes, it will be important that the report addresses the effects of human activities and resource use patterns on the oceans, coasts, and Great Lakes and vice versa. The only element of coastal ecosystems we substantially control is human behavior. Ecosystem-based approaches to management – an integral part of this public policy exercise – will fail if we do not include humans as part of the ecosystem, including their economic and sociological motivations. An understanding that all human and natural systems are complex, non-linear, dynamical, and adaptive and the need for basic and applied research on this larger aspect of “systems” across all themes and questions will improve the final plan.

The connection from what we study to the needs and activities of society must be front and center in any priority-setting plan. For that reason, NAML is pleased that the developing document includes throughout its societal themes discussions on education, outreach, the blend of basic science to decision-making, the nestling of scholarship in communities, and the need to reach out and engage the full strength and diversity of our society. Each aspect is complemented and strengthened by the others; this must continue to be encouraged and embedded in the final plan. In addition, the academic community should be utilized where ever possible, both for its own strengths and as effective partners, in educating the public, including policy makers. Further, competitive, peer-reviewed scholarship and education programs should be encouraged throughout the plan to ensure that decisions affecting the overall population are based on the most reliable science available.

Finally, NAML was pleased at the response at the Denver workshop to broaden the scope of infrastructure within the plan. For many of the most important discoveries and education activities, shore-based marine labs provide the needed infrastructure. In addition, marine labs have a unique capability, a capability that needs to be nourished, to connect to human needs and to communities through education and outreach, making them a particularly critical part of the ocean research and education infrastructure. Recognizing all types of infrastructure, including shore-based facilities, is crucial if the plan is to be truly comprehensive and effective.

(NOTE: End of cover letter from President Anthony Michaels, NAML)

- General Comments: NAML supports the overall goal of identifying key science and education needs and setting priorities to guide the investments. Prioritization should be driven primarily by its impact on improving quality of life (including economy) and improving ecosystem health and integrity (equally). An essential consideration is how urgent the issue may be and how much of a return will occur for a defined investment.
- NAML feels that some of the overall issues embedded in the American Competitiveness Initiative (ACI) should be strongly reflected in this plan, particularly because the interdisciplinary training in ocean sciences and technology is a prime example of the skills needed by the future US workforce.

- The plan could be improved by engaging, in a comprehensive and thoughtful manner, the next generation of great advances in academic research - advances that will produce huge positive changes in the conduct of ocean, coastal, and Great Lakes research. These include:
  - genomics, proteomics and environmental genomics
  - robotics
  - nanotechnology
  - research in complex dynamical systems (living, engineered, physical)
  - advanced computational approaches
  
- The plan could be improved by changing its organizational structure. As the document currently stands, some topics are placed arbitrarily within certain themes while others are under-emphasized altogether. For example:
  - Fisheries management is placed in natural resources when one of the largest contributions to impacts on ecosystem health is the removal of fish, and the approaches to understanding it have more to do with ecosystem dynamics than extractive minerals and energy.
  - Aquaculture, the fastest growing source of new food production in the planet, is nearly absent except as it relates to negative impacts.
  
- Regional and geographic issues should be handled more comprehensively and carefully throughout the final report:
  - The Great Lakes are not handled evenly as a fourth coast.
  - Estuarine and coastal science is also under-emphasized compared to the definition of the word ocean.
  - Common language such as, “ocean, coastal, and Great Lakes,” if inserted everywhere, would alleviate these inequities.
  - The document must also understand and reflect regional differences.
  - Essential to a number of “themes” (ecosystem health, natural hazards, etc.) is the need to understand the connection between coasts and the watershed. This issue is not currently dealt with in the draft document.
  
- For many of the most important discoveries and education activities, marine labs provide key infrastructure. Marine labs should be explicitly mentioned where appropriate in the infrastructure sections as a valuable part of the nation's capability.
  
- Overall, the plan seems to codify what is already being done in federal agencies rather than charting a course for the future. The final plan should act as a map for future research, science, discovery and policy development.

- The plan could be improved by taking a more positive tone overall. Instead of focusing on mitigating problems, it should concentrate on the many ways in which research can create opportunities for individuals, companies, communities and the nation, including job creation and improvements to quality of life. In addition, JSOST should keep in mind that although the plan seeks to address “challenges,” these challenges do not necessarily mean “problems.” There is value in learning about the unknown, whose ultimate applications and significance often cannot be predicted. Any priorities plan should view these challenges as opportunities to further ocean, coastal, and Great Lakes knowledge and advance discovery of the unknown.
- The document should mention U.S. maritime heritage. Significant research, exploration, and monitoring is needed to better understand our nation’s maritime history.

### **National Association of Marine Laboratories**

While the plan includes an endnote that defines the term “ocean” to include “open ocean, coasts and estuaries, Great Lakes and coastal watersheds,” this language should be included in the Introduction and reiterated throughout the plan. We agree with the preliminary findings of the Federal-State Task Team that this plan must not only include blue water, but must also emphasize coasts, estuaries, Great Lakes, and watersheds. Because much of the impact humans have on the oceans occurs along the coasts and in estuaries, the ORPP should mention the components of the ocean ecosystem (watershed, estuary, coasts, open ocean) and emphasize that research is needed in all components to better understand and protect the oceans and coasts. The plan should recognize the linkage between watersheds and the ocean, particularly with regard to the impact of land-based decisions on the oceans.

The plan should more strongly highlight the importance of assessing the research and information needs of coastal resource managers and the type of information and products they could utilize to better inform their decision-making.

The importance of cross-sector connectivity, such as integrating different disciplines (biology, physics, sociology, etc.) and different stakeholders (science, education, management) should be included throughout the plan.

It is recommended that the plan be more inclusive of one of the ideal users of this plan—coastal managers. This group’s input in the process is vital for a document of this type to consider/incorporate coastal management issues and priorities.

The plan should focus additional attention on the human dimension and clearly outline the understanding (or lack of understanding) of human impacts/linkages and changes occurring within the environment.

A chapter should be included that clearly articulates how the results of ocean and coastal research are accurately and effectively incorporated into national policy decisions and

locally with coastal management decisions. Without that, we can do all the research we want while our oceans, coasts, and estuaries continue to degrade.

### **National Estuarine Research Reserve Association**

As co-chairs of the National Federation of Regional Associations (NFRA), we provide the following comments on the “Planning Document for the Ocean Research Priorities Plan” as a whole. NFRA is a relatively new organization that represents the 11 Regional Associations that are being formed to bring relevant ocean and Great Lakes information to users through an integrated ocean observing system (IOOS). We provide these comments from our regional IOOS perspective with the goal of contributing to the dialogue anticipated at the Denver workshop.

Overall, our impression is that the document does not present a compelling case for the heightened investments in coastal ocean sciences that we feel are necessary to improve our sensing and predictive capabilities to meet current and future societal needs. Further, while it provides compilations of research needs within societal thematic areas, the document does not articulate a path or plan to address these needs. It is possible that the Ocean Research Priorities Plan Workshop will be tasked to recommend active strategies to augment our ocean research capabilities, but the Workshop agenda is a bit unclear in this regard. Fundamentally, we note that the President’s Ocean Action Plan explicitly calls for:

**“Develop an Ocean Research Priorities Plan and Implementation Strategy.** The NSTC Joint Subcommittee on Ocean Science and Technology will develop an Ocean Research Priorities Plan and Implementation Strategy by December 31, 2006. The Ocean Research Priorities Plan and Implementation Strategy will seek enhanced collaboration, coordination, cooperation, and synergies, and will identify gaps and deficiencies along with related infrastructure needs.”

The document as written does not provide guidance on the Implementation Strategy called for in the Ocean Action Plan, so we are unable to comment on how any envisioned federal methodology to improve regional coastal ocean research will be executed. Without an understanding of that overall federal implementation strategy, participants at the Ocean Research Priorities Plan Workshop will not know what the impacts of their efforts in suggesting ocean research priorities will be. We understand that the Implementation Strategy could be designed following the development of research priorities at the upcoming Workshop, but note that no information has been provided to the regional IOOS community on when or how this development will occur before the December 31, 2006 deadline.

In light of this and the guidance to reviewers on page eight of the document to “make the most progress by establishing a small number of priorities in each of the theme areas that, if funded, would allow us to make substantial progress”, we suggest the approach of using ‘Grand Challenges’ in each of the thematic areas (e.g., Enhancing human health, Improving ecosystem health, Sustaining natural resources, etc.) to frame the discussion

on ocean research. We suggest that agreeing to a number of Grand Challenges within thematic areas, which by their nature will be interdisciplinary and involve both basic and applied research, could be more advantageous than trying to list a few research topics within each area. In this regard, we define Grand Challenges as being inherently difficult, and, though necessary, beyond our present capabilities to execute. Additionally, Grand Challenges are quantifiable and are designed to make it obvious to see if one has succeeded in addressing them. Below, we offer examples of Grand Challenges for each thematic area that could serve as points of departure for further discussion and refinement.

### **Example Grand Challenges**

- **Enhancing human health:** Within the next decade, develop the capability to competently detect in real time the occurrence, and predict the future state of HAB events out to 72 hours in our regional coastal waters.
- **Improving ecosystem health:** Within the next decade, develop the capability to consistently assess the status of the top five keystone organisms in various regional coastal ecosystems and detect any 10% change in their population or areal coverage; determine the proximate agent(s) of change responsible for such changes.
- **Sustaining natural resources:** Within the next decade, develop the capability to predict the strength of major managed fish stocks six months into the future.
- **Promoting marine operations:** Within the next decade, develop the capability to observe and predict winds, waves, depth varying currents, and bottom type/depths in both regional U.S. and foreign coastal waters.
- **Ocean's role in climate change & variability:** Within the next decade, develop the capability to competently observe and predict regionally specific impacts of ENSO, PDO, etc. climate variability events.
- **Mitigating effects of natural hazards:** Within the next decade, develop the capability to competently predict the landfall strength (w/in 10 knots), landfall time (w/in 4 hours), and landfall location (w/in 50miles) of tropical storms on the U.S. within 48 hours of the event.
- **Improving quality of life:** Within the next decade, develop automated modeling systems capable of assimilating proposed land use changes and accurately predicting their impacts on watershed and coastal zones sufficiently rapidly to allow their use in regional zoning decisions.

As co-chairs of NFRA, we provide this initial input based on our review of the “Planning Document for the Ocean Research Priorities Plan”. We intend to provide additional input from the entire NFRA membership following our review of the output from the Workshop in Denver, CO focusing on ocean research priorities.

## **National Federation of Regional Associations (NFRA), Martin and McCammon**

Broadly, this report is clear, well written, and conveys issues of importance for “ocean” research, conservation, and stewardship. Structurally, the Vision, Rationale, and Challenges parts of each chapter were good, although the specific Research Needs could have been more tightly coupled to these.

This plan should clearly identify the major audience(s) for the document. If the major audience includes a ‘lay person’ and/or personnel from a governmental office of management/budget then the definition given for “oceans” on page 1 is inappropriate and likely misleading. As it is, the broad use of “ocean” will probably lead to ignore/forget the important components of coasts, estuaries, Great Lakes, and coastal watersheds as opposed to *just* “oceans”. In addition, this definition of “oceans” is not useful as an educative term for most readers/users. The document itself is not consistent on the use of its own definition of “ocean”, as in several occasions makes a differentiation between oceans and coasts (i.e., p. 18 lines 25). We strongly recommend separating the terms coast and ocean and provide a definition for each term, where a broad definition of coast would include estuaries, coastal watersheds and Great Lakes. Considering this, the document could be named a “U.S. Coastal and Ocean Research Priority Plan”.

The importance of cross-sector connectivity, such as integrating different disciplines (biology, physics, sociology, etc.) and different stakeholders (science, education, management) is *desperately* needed to be included throughout this document. Every section could be greatly improved by adding in explicit mention of these issues.

As it is, this research priorities plan will likely not be easily accepted by one of the ideal “main users and beneficiaries” of this plan: the coastal managers/coastal decision-makers. It is recommended to be more inclusive of this group’s input in the process and it is vital for a document of this type to consider/incorporate top coastal management issues/priorities. Additional efforts should be made to include this group’s input; a single workshop in Denver seems insufficient effort to reach necessary input from desired interested groups.

It is recommended to strengthen/improve/increase/develop the informational content that outlines the importance of linkages between the watershed, coasts and oceans and the atmosphere and coastal/ocean ecosystems. The linkages among and between components of these systems drive the majority of the issues outlined within the plan. Inland uses impact downstream resources heavily. Clearly outline the understanding (or lack of understanding) of human impacts/linkages and changes occurring within the environment. This theme is an important consideration for both ocean and coastal managers, which are in the end the ones that need to be supported with improved data/information.

This document should make a stronger connection between the data that is to be collected and the delivery of that information to a wide range of users, which are at the end side of the process for improving decision making, understanding, and “protection” of our

human and natural environment. Data collection should occur not only to increase knowledge of these systems, but it has to be transferred to end users. Any information generated would be largely useless without synthesis and communication/education efforts that could lead to improved decisions, planning, protection, and management of our resources. The pervasive concept of “end-to-end” needs to be included in this document to contain an educative effort and an assessment effort to report back on efficacy of research and adaptations made as a result of research efforts.

There must be a chapter that clearly articulates how the results of ocean and coastal research are accurately and effectively incorporated into national policy decisions and locally with coastal management decisions. Without that, we can do all the research we want while our oceans and estuaries continue to degrade.

While the emphasis of this document is necessarily on U.S. waters, explicit recognition of the international nature of issues facing the U.S. would be good. For example, the need to collaborate with Mexico, Canada, and other countries to deal with invasive species, pollution, habitat loss, fisheries issues, and virtually every issue discussed in the report, would benefit from working with international partners.

Additionally, the transfer of data/technology, etc. across borders (especially nearby borders with Mexico and Canada) could improve coastal and ocean systems greatly as we impact each other’s resources (economics/environmental, etc) regularly. This is true on the entire ocean basin scale as well. Improved collaborations are desirable and cost-effective. Perhaps additional content framing where the U.S. “sits” in the international ocean/coastal research community would be useful (and enlightening in both good and bad ways for many readers given how behind/ahead the U.S. claims to be in a number of research areas).

#### **NOAA-NOS-Estuarine Reserves Division**

##### **Tone:**

NOAA Fisheries is pleased to see many of our 1<sup>st</sup> round written comments were incorporated, and overall, the new document is easy to read and very upbeat in tone.

The Ocean Research Priorities Plan (ORPP) has the potential to influence the national agenda with respect to science supporting societal goals for the oceans. In particular, the plan emphasizes the importance of some plan goals as they affect national and regional efforts aimed at achieving energy security, improving national security, and ensuring economic and food security. Natural resources and ecosystem health objectives of the plan include a number of these items but the current version of the plan and its structure do not easily allow linking of specific programs to be undertaken and their importance in achieving these and potentially other high priority societal outcomes. The ORPP can have an important impact on funding and priorities going into ocean science IF the results of this science can be linked to very practical outcomes affecting food, security, energy, etc. Most importantly, while these are resource-based outcomes, understanding them in an ecosystem context allows fair consideration of the many

tradeoffs that must be considered to achieve some portfolio of ocean ecosystem goods and services. The plan should have as a central theme improving understanding the complex links among species and the complex links between oceans and human activities (social and economic factors). Ultimately, we need a full accounting of the risks, benefits and outcomes of the increasingly contentious multiple uses to which oceans are being asked to serve. The outcome of the plan should deliver this level of understanding.

**Scope:**

In general, there is still an emphasis on traditional oceanography as the overriding priority for ocean research. In the next ten years, major strides in integrated ecosystem research, including understanding basic ecological processes, will be necessary if we are to begin producing the integrated ecosystem assessment products discussed in the plan.

Several of the Expected Results sections in the Plan raise concerns. Due to extreme technical difficulties we face in developing models that produce reliable predictions for impacts of climate change and anthropogenic effects (e.g., fishing), it may not be appropriate to be as optimistic as the Plan is in so short a time frame. The authors suggest relatively spectacular achievements and progress.

The lack of references to the general cost of the envisioned research program (relative to current funding) make it unclear to the reader whether this proposed research program is enhancing existing research programs or replacing existing research programs with an entirely new approach much more focused on ocean observing (i.e., physical oceanography). This should be clarified.

Although the document mentions the need for exploration and the importance of biodiversity several times each, there is still a need (1) to identify the organisms in marine ecosystems and (2) to understand the relationships among these organisms. In other words, both taxonomy and systematics are not apparent. Also, the need for new tools is mentioned without reference to development of DNA-based methods, such as barcoding, etc.

Social science research appears to be aimed solely at estimating the value of the ecosystem's goods and services. The ORPP presents an opportunity to call for research in behavioral and social science to better refine the suite of priorities society deems desirable, and what people are willing to pay for different end-states of the oceans. This should be a clear and key driver of the plan; this point was made rather clearly at the Workshop.

**Governance:**

Although marine ecosystems are noted in the document, research is not directed toward the changes in governance and public policy that would be necessary to address large marine ecosystems (LME) on a holistic scale. The current lack of information on how governance structures might change, and what changes are necessary to existing laws, is probably a principal reason why ecosystem-based management has yet to gain traction.

The focus of the LME should be included. When considering anthropogenic impacts of utilizing non-renewable resources or harvesting living marine resources, we should be evaluating the impacts of both in the context of ecosystem health.

**Risk Analysis/Tradeoffs:**

The seven themes appear to be treated as independent entities, and as such, the trade offs, compromises, priorities and competing objectives associated with the research agenda are not well recognized. As presented, the plan assumes all the challenges and outcomes are simultaneously achievable. We need to develop means of expressing risks using terms that stakeholders understand, so our ocean governing structures can begin to make the necessary decisions involving resources. One suggestion for this plan is to create a figure (e.g. a table) that crosshatches the Theme areas against the priorities for research needs.

**Format, Definitions & Consistency:**

The authors have confounded marine ecosystems, coastal ecosystems and the Great Lakes ecosystem. There is a footnote that defines ocean. Perhaps expand this footnote to include “marine” and then eliminate references to coastal or Great Lake ecosystems. Other option: be consistent throughout the document.

Suggest including an executive summary and perhaps a conclusion at the end of each section of the report, and a final conclusion.

Consider shortening the opening quotes in each section and attributing them to a celebrity or otherwise recognizable person, injecting some humor or anecdote, and including some figures that should be used to make various points.

Use the terms “fishery” and “fish stock” correctly in the plan. Fishery = 1) activity leading to harvesting of fish; 2) the combination of fish and fishers in a region. Fish stock = The living resources in the community or population from which catches are taken in a fishery.

Themes: There is still some consistency to be gained among the several themes. Also, the tenor of many of them implies that ocean-related improvements are needed (e.g. enhance, improve). Suggest naming the required activity and eliminating terminology that judges current status. For example, change “Enhancing human health” to “Protect human health”. In addition, too many themes are named. Reducing the number of themes would make the message easier to convey. Recommend the following list of themes:

- Understand climate change
- Protect human health
- Sustain healthy ecosystems
- Sustain natural resources
- Safe and efficient ocean transportation

**Lack of International Role:**

There is a lack of reference and a seemingly low priority regarding international research. There should be mention of the United States' International Role in Ocean Research and Assessment activities that provides leadership among nations beyond the actions implied

under the IOOS and global change research objectives. The language in the President's Ocean Action Plan should be repeated in the ORRP.

**Priority research areas:**

The following comment applies to three themes: Improving Ecosystem Health, Sustaining Natural Resources, and The Ocean's Role in Climate Variability and Change. NOAA has the legal responsibility to manage living marine resources through legislative authorities. Living marine resources (fish, birds, mammals) most often are managed as single species with only limited understanding of their ecological relationships. **A priority research and management need is a deeper scientific understanding of the ecosystem in order to manage and sustain renewable resources.** The outcome is sustainability of utility values (commercial, subsistence, recreational, including non-consumptive recreational) of renewable resources and their supporting ecosystem. The infrastructure needs are monitoring (including fisheries research vessels), process studies for understanding, and modeling to integrate information and predict future states. ( **NOAA Fisheries**

1. There seems to be an inordinate emphasis on Harmful Algal Blooms in the document. Although important, this area of research should not be such a high priority.
2. There is still a need to adjust our thinking and consider the oceans and atmosphere as more highly interconnected. Similarly, the oceans need to be considered as an ecosystem. Much of the discussion of research priorities seems to ignore the interconnections between physical and chemical oceanography, living marine resources, and humans.
3. The organization of the document into seven societal themes is confusing and causes extensive overlap. In contrast, the three overarching themes of a) enhancing our basic understanding of the ocean, b) observations/infrastructure, and c) ocean education make a clearer distinction among tasks.
4. Sociological research should be emphasized more in the plan. We know that human activity is having dramatic effects on the global and ocean ecosystems. We need better information on how to properly inform the public to do the "right" thing in regard to the sustainability of these systems.

**NOAA-Fisheries; Southeast Fisheries Science Center, Schull**

We believe that reorganizing and revitalizing the United State's ocean science enterprise - with a clear vision of research priorities and a strong financial commitment - is a particularly important recommendation of the U.S. Commission on Ocean Policy (USCOP) and a crucial step in establishing an effective and coordinated national ocean policy. The Ocean Research Priorities Plan (ORPP) represents significant progress towards that goal. Strengths of the draft plan are the inclusion of a good mix of basic and applied research in all scientific disciplines (physical, chemical, biological, geological, mathematical, social, and engineering) across a variety of temporal and spatial scales. Importantly, the need to integrate across disciplines, scales, and ecosystems is emphasized. The definition of "ocean" aptly includes coasts, estuaries, coastal watersheds, and great lakes. Lastly, we are pleased to see equal importance given to the

different modes of scientific inquiry including, the acquisition of basic information, new knowledge regarding dynamics, monitoring and assessment, and analytical tools.

As currently outlined, however, the multiplicity of research priorities in the plan, and their equal weighting, has prevented the formulation of a cohesive and integrated research agenda. Identifying all themes and related research questions as having equally high importance could have the unintended effect of reinforcing the status quo - a fragmented portfolio of high quality, short-term, research that competes intensely for insufficient funds. The structure of the plan should better reflect its important goals of prioritizing research and promoting integration across disciplines.

In addition, the success of the ORPP depends on the availability of sufficient funds to support the research vision. The document should make a more direct and compelling argument for USCOP's recommendation to double the ocean science budget. To utilize the document as a tool to justify the necessary increased investments, a brief but comprehensive discussion of the current degradation of ocean ecosystems should be inserted. Additionally, the incorporation of a historical review of the declining commitment of the U.S. government to fund ocean science could provide important perspective (USCOP noted a decline from 7% of the federal research budget in the 70s to less than 3.5% of the current research budget. Thus a doubling is required merely to restore ocean research to the level it once had).

We agree with Admiral Watkins' statements in his opening remarks at the JSOST workshop, that this plan presents a critical opportunity to stimulate broad public support for ocean research as well as to unify the ocean research community. As he suggested, promoting public interest and galvanizing the ocean science community can best be accomplished by simplifying the plan and organizing it around fewer overarching programs. The three initiatives identified by the Admiral - ocean exploration, ecosystem research, and Integrated Ocean Observing System (IOOS) - are excellent candidates to achieve these goals (One caveat: The IOOS initiative is too narrow; it should be broadened to include the monitoring of biological parameters in addition to physical and chemical parameters - as well as include the analytical tools required to synthesize the information. An alternative title could be "Monitoring and Assessment".) As many of remaining themes require directed research in each of these three overarching areas, they are naturally subsumed. Importantly, this framework can also accommodate creative, exploratory research ventures whose immediate application is not clear.

Finally, in this highly competitive environment of budget allocations, we think the ORPP might benefit from following the structure of a grant proposal more closely: a succinct proposal of a focused research agenda with clear questions, measurable goals, and a strong budget justification. This approach would provide a clear linkage between investment in research and measurable outcomes that could be expected to be achieved.

**NRDC, Suatoni**

\* On behalf of the 20 Treaty Indian Tribes served by the Northwest Indian Fisheries Commission, we wish to commend the authors of this planning document for the Ocean

Research Priorities Plan. This is an excellent planning document. It is well thought out and the issues are presented with outstanding depth and comprehension.

We look forward to the next phase of the project as the committee begins prioritization and implementation discussions. The ocean community is going to benefit greatly from this research strategy across disciplines. The results of this work has the potential to greatly assist us in our current strategic planning efforts and initiatives.

**Northwest Indian Fisheries Commission**

\* An excellent document, very thoughtful and articulate. My research deals with Priority Area 1, and you have covered all the points fantastically in that field. I only hope that the Implementation Plan can go so well. My main criticism is that there is a need to think about the total dollars needed in each of these priority areas, and will they be open to competition by the general scientific community, or lost in funding of the infrastructure of the federal government. I obviously favor the former and not the latter. That is, I hope this results in new funding initiatives, particularly those that might favor individual and small groups of researchers, focusing on distinct problems. The large cross cutting initiatives were interesting, but we also need to encourage (=fund) hypothesis-driven, high risk research which has led to the greatest levels of breakthroughs in the past.

**Paul, University of South Florida**

The broad plan for research and management fails to incorporate stakeholders in a plan that has management, cultural, economic ownership, and management responsibilities. Addressing each of these the following is noted:

1. Fishermen do not have a place in the development of research and proposed outcomes of that research. For the past 150 years science and the fishing industry have been inseparable in working together to provide opportunities for fishermen to make a living from the ocean resources. Native Americans suffer unequally in the loss of fishing opportunity and the degradation of the environment on which those resources depend. Grass roots participation includes using fishing vessels as platforms of opportunity on which to conduct research can be effectively conducted as it has been in the past and provides cost-wise management opportunities. The number of vessels available to Federal, State, private, Tribes, and others that need to get to sea is limited in comparison to the available fishing fleet. More efficient use of this resource will provide resource management data on which management of resource decisions can be made.
2. The cultural aspects of fisheries: Many of the coastal towns and cities rely on the ocean for products that attract tourists, provide jobs, access to the ocean and many other aspects relating to their position. Decisions concerning the water and its value to those stakeholders certainly needs to have community input. The coastal Native Americans are especially affected by uses of the water that may conflict with or enhance their use of the water. The Town Hall presentation acknowledged the need to involve Native Americans but does not follow up with specific involvement by Native Americans that result from

their Treaty Rights. As actual owners and managers of Natural Resources, Native Americans must be involved from the ground up in decisions, research, management, etc. Of all the groups, Native Americans are involved in every theme that has been identified by JSOST. Elements that cut across all the themes are also identified as important for coastal Tribes in the Pacific Northwest, who are granted by their Treaties the right to 50 percent of the fisheries resources, education and rights to health benefits. In other words the Native Americans are inseparable from the use and management of the oceans and the sustainability of the systems that contribute.

3. Enhancing human health: Native Americans use the fish and wildlife for jobs, ceremonial and subsistence more than any other group. If the system is sick the first people to be impacted will be the Native American. Improving human health and ecosystem health are inseparable as far as the Native American is concerned. Marine hazards, natural or man-made, impact the resources on which the Native American depends. Measurement of the quality of life in the Native American Community become a direct measure of the health of the ecosystem as their dependence on those resources will be reflected by community health.

The cross cutting themes of ocean understanding, research and education have a significant meaning to the Tribes who need to be fully involved in those areas. The education and research directions are presently carried out by non-Indian biologists due to the lack of science education available in their communities. It has been shown that education opportunities available in a Native setting are more effective than relying on the colleges and universities aimed at education of students with different backgrounds and for different types of jobs. The question is do we turn away from resources as they are depleted or do we more effectively manage them to insure their availability in the future. Because of their stake in those resources Native Americans have the right to fully explore that direction through education and research opportunities.

**Science in Decisions:** Native Americans must have research capabilities in order to properly participate in ecosystem based management and sustainable fisheries. Fully funded Native institutions directed at the needs of Natives are required. Both water and air quality monitoring and control of fish and shellfish disease require special attention because Natives rely on the health of the water for their own health.

**Recommendations:**

1. Build a Native institution in a Native setting that will meet the science, agricultural and natural resource requirement of coastal native people including forest management, and habitat restoration.
2. Provide extension service capabilities for the Native institution for outreach to all the coastal Tribes with Sea Grant as a model.
3. Provide line item funding for the institution.

Provide a water and air quality lab for research and monitoring of water/air quality with health capabilities at the institute including participation in Ocean Monitoring programs.

**Build Sustainable Fisheries:** Sustainable fisheries practices are not new to Native fishermen who are the most reliant of any group on the resource. To shift from best catch tactics to best sustainable tactics requires changing the behavior of fishermen. Value added products, handling, processing, and business sense will all contribute to a successful Native fishermen in the 21<sup>st</sup> century. Consistent with national goals for sustainable fisheries, allowance must be made for flexibility in fisheries management for Tribal fisheries that have special needs such as ceremonial and subsistence harvests. Tribal Fisheries management research must be fully funded. To ensure that Native fishermen can continue to participate in our ocean harvest and sustainable aquaculture, hatchery facilities must be provided. Environmental maintenance and restoration through innovative habitat restoration projects must be developed in order to stop and reverse the downward trends in fisheries, wildlife and water quality.

**Recommendations:**

1. Provide funding to the Tribes for Tribal management biologists and scientists on a level that is consistent with their needs.
2. Provide for flexibility of special Tribal needs such as ceremonial and subsistence.
3. Provide Native fishermen assistance in product development, marketing, handling, and business development.
4. Provide assistance in aquaculture ventures to transfer technology to Native fishermen.
5. Provide resources for conservation hatcheries to build and maintain stocks that need support.
6. Build and update Native processing facilities.

**Education:** Education is the capstone to strengthening the ability of Natives to participate in many aspects of ocean policy development and implementation including ocean research, harvest planning, resource allocation, and government-to-government relations. Natives can contribute to a better understanding of the relationships of the Native community to the environment and provide diversity in the work force. The education process must begin early on with ocean programs in the K-12 environment as well as the Native institute of higher education. The Native community and the environment are intertwined and a coalition of elders, community and Indian scholars will design and create Native roles in the ocean environment.

**Recommendations:**

1. Support the development of a Native Institution of higher education at a Native location (through doctorate levels) that will serve coastal Natives.
2. Provide funding for K-12 ocean education programs in Native schools.
3. Provide extension opportunities for Natives in their own setting to assist students, fishermen and communities to be aware of and solve ocean related problems and issues.

4. Form collaborative relationships with other land grant colleges (1862, 1890 and 1994's), universities for the development of best education opportunities for natives.

Initiation of these recommendations will ensure Natives participate in the oceans health and long-term use. The goal of an ecosystem that includes humans must certainly not disregard Natives. The importance of cultural heritage (includes all aspects) in connection with the ocean must be fully recognized. Emphasis on full participation by Native Americans will provide the commitment needed to insure their involvement and participation.

**Poole, Northwest Indian College**

\*The research priorities of general and vague. It would be useful through regional (?) workshops to develop a detailed list of priority research for our oceans.

**Rozsa, CT Depart. of Environmental Protection**

\*I cannot attend the meeting but do have comments for the public record of the meeting. First and foremost the issue should be protection of the ocean. Protection - first and foremost. The assault on the ocean taking place is so severe that it possibly could be lost forever before we do anything else.

**Sachau, private citizen**

I remember the cash registers in stores when I was a kid – large brass and glass machines in the middle of a store. About all that remains of that mid-20<sup>th</sup> Century icon today is the cash drawer that holds only paper money. Had there been an applied research program in the 1950's to improve the cash register, we'd have a better register—but it would have been little improved if the design hadn't been able to take advantage of basic research in lasers, modern computers as exemplified by tiny microprocessors, and the Internet.

Basic (or *fundamental* or *pure*) research is driven by scientists' curiosity about scientific questions, and although there is little perceived commercial or applications value in finding to the answers to those questions, it is accepted that a strong base of fundamental scientific knowledge is essential to the practical applications that arise from it.

Eight scientists from Scripps Institution of Oceanography attended the JSOST ORPP workshop in Denver this past month and a lively series of discussions have been held at Scripps since then. This letter represents the Institution's review of the ORPP report as posted on the WWW. While we will also provide comments in the established format, this format is too limited for the major rewrite of the Plan we recommend. One of the Scripps scientists who attended the meeting observed:

*I was a participant in the Denver meetings, in the Basic crosscut and the Oceans & Climate sessions. In my opinion, science was somewhat short-changed in the documents resulting from those sessions, and is certainly given an almost invisible place in the Plan. The attention given to social, economic and educational aspects of the plan are strong, while science is underplayed, in what purports to be a Research Plan. I strongly recommend that the Plan be re-edited to strengthen substantially the role of*

science, both applied and basic, to avoid the real risk that the report will not be taken seriously by the scientific community.

The Introduction to the ORPP cites the importance of both basic and applied research by stating:

*To survive, humankind needs a healthy and biologically diverse ocean. This can only happen if we have a broad understanding of the ocean environment. Such understanding makes possible management of our interaction with it and sound use of the ocean's resources. The United States will advance basic and applied ocean science research by developing a comprehensive national oceanographic research strategy that establishes ocean research priorities that address pressing national and global issues, capitalizes on existing infrastructure, and identifies future needs.*

However, it is not possible or even desirable to link basic research specifically to “pressing national and global issues.” Furthermore, it will not be possible to advance science using only existing infrastructure. Therefore, I strongly recommend removing much of the last sentence to read:

*To survive, humankind needs a healthy and biologically diverse ocean. This can only happen if we have a broad understanding of the ocean environment. Such understanding makes possible management of our interaction with it and sound use of the ocean's resources. The United States will advance basic and applied ocean science research by developing a comprehensive national oceanographic research strategy.*

ADM James Watkins, in his address to the JSOST open meeting in Denver, recommended that we “...carve out a role within President’s ‘American Competitiveness Initiative,’ clarifying the benefits that the biological and ecological communities can bring to the new national charge to advance our research and science education capabilities.” In fact, the recent NRC report chaired by Norman Augustine has made four recommendations including “Increase the federal investment in long-term basic research by 10% each year over the next 7 years through reallocation of existing funds or, if necessary, through the investment of new funds.” The President’s American Competitiveness Initiative singled out the National Science Foundation, Commerce’s National Institute of Standards and Technology, and the Department of Energy’s Office of Science for significant increases in support for basic research. My presentation to Congress of the American Geophysical Union’s new position on the U.S. Ocean Commission Report was entitled “Boosting U.S. Competitiveness through Ocean Research” and concentrated on significant new ocean science research ([http://www.agu.org/sci\\_soc/prrl/prrl0602.html](http://www.agu.org/sci_soc/prrl/prrl0602.html)). In particular, the FY2007 President’s budget funded more than \$0.5B in ocean research infrastructure including the completion of the conversion of a ship for the Integrated Ocean Drilling Program (SODV), a new Arctic research ship (ARRV), and the Ocean Observatories Initiative (OOI). This new infrastructure, coupled with significant increases in the Geosciences Division budget,

represents the largest increase for any field for basic research. This grows further when considering the importance of significant new funding for DOE's Joint Genome Institute, upon which ocean science relies greatly for sequencing. The briefing was received very positively and subsequent visits to the Hill, OMB and OSTP indicate continuing strong support for basic research in oceanography.

In environmental sciences, it is often felt that turning away from basic to applied research is necessary to deal with growing problems such as overpopulation, pollution, overexploitation of natural resources, etc. Unfortunately, this leaves behind the need to develop the base of fundamental research in the field, and the investments made often contribute little to the goal of competitiveness and innovation for all the reasons given above. Furthermore, the public's view of the environmental sciences, while positive, is that extensive funding for science isn't required as much as government (federal, state, regional and local) regulation. This tends, in turn, to lessen industry's interest in the environmental sciences since the perception is that investment generally leads to more regulation. While this may be patently unfair, the perception is important. Rather than starting the document with applied research needs associated with:

- Enhancing human health
- Improving ecosystem health
- Sustaining natural resources
- Promoting marine operations
- The ocean's role in climate change and variability
- Mitigating effects of natural hazards
- Improving quality of life

the document should begin with a few (3-4) major science questions. A good starting place would be biology.

The bulk of life in the oceans comprise microbes from the bacteria, archaea, and eucarya branches of the "tree of life" – microbes are the most abundant form of life and most of evolutionary time was spent in the microbial world. Large samples, for example a m<sup>3</sup> sample of perhaps 10<sup>12</sup> bacteria, will likely contain all (most) marine bacterial diversity. However, most species will be in very small numbers. The environmental conditions (e.g. nutrients, temperature, salinity, light) can be manipulated to change the species' numbers. Metagenomic analyses of each resulting assemblage can be performed to study the influence of environment on the specific assembly that results. At the same time, careful global sampling in both space and time can be used to likewise understand the role of the environment. These analyses can be used to address the fundamental question in microbial biology of how the environment affects bacterial diversity (and vice-versa). Even hydrothermal vent bacteria would, in principle, be present in surface samples collected off a pier.

Metagenomics is a growing tool in oceanography – "Meta" simply refers to the environmental metadata that need to be attached to the sample and subsequently the genome analyses. The challenges are substantial. A single sample as described above

contains as much genetic material as the human genome – sequencing is presently expensive, but a version of “Moore’s Law” applies in which the cost of sequencing a given base pair is decreasing exponentially. The first microbe was sequenced in 1995, by 2000 the rate of sequencing had advanced to 15 microbes/month and in 2003, the rate was 10/day. Sequencing the human genome cost \$10’s of millions a few years ago – the equivalent cost will soon be \$1,000. Presently, the major genome databases contain no environmental metadata, but this is changing as well with a recent grant to UCSD and the Venter Institute from the Moore Foundation to build the cyberinfrastructure needed to support marine metagenomics on a large scale. Most microbes can’t be cultured – sequencing the environmental genetics in samples provides a new tool that will in the foreseeable future be possible in a remote sensor and which can be applied effectively for timely sampling of contamination at a beach. The basic research in genomics and associated technologies, however, is paramount in importance.

Other large scale questions include the study of the circulation of the mantle and its impact on planetary evolution; the impact of climate variability (El Niño – Southern Oscillation, Pacific Decadal Oscillation, North Atlantic Oscillation, and variability of the Gulf Stream) on the carbon cycle and ecosystem variability; and how does turbulent mixing across ocean boundaries (ocean-atmosphere, interior ocean [e.g. internal wave scattering by ocean ridges, and ocean-seafloor turbulence) affect gas, life, and energy exchanges?

These are all fundamental scientific (and instrumentation) challenges and it’s not difficult to understand the downstream impact on applied research and applications – including those listed in the draft ORPP.

Writing a meaningful Ocean Research Priority Plan is an important undertaking. However, interagency committees comprising solely government employees can’t successfully undertake this. Because of the basic and applied research nature of such a plan, it’s important to involve academic bodies, especially the National Research Council, in writing, and not simply detailed critiquing, the existing draft plan. A very different approach is essential if the plan is to map effectively the future of ocean sciences.

As it stands now, and as stated, the Ocean Research Priorities Plan is only a starting point. No scientific questions are posed, and this vagueness must be addressed. Without implying exclusivity, nor providing a mere list of research interests of individual investigators, the plan must provide both breadth and explicitness of the most challenging and pressing scientific questions.

### **Scripps Institution of Oceanography, Orcutt**

Members of the Federal-State Task Team (Task Team) of the Subcommittee on Integrated Management of Ocean Resources have reviewed the JSOST Planning Document “*Toward an U.S. Ocean Research Priorities Plan*” and are providing comments. Specifically, the Task Team focused on the following questions:

- To what extent are gaps identified by the Task Team (by theme) in its January 26, 2006 comments on “*Draft 0*” of the Joint Subcommittee on Ocean Science and Technology’s Ocean Research Priorities Plan (JSOST ORPP) still present in the Planning Document?
- How well do the Denver workshop synthesis presentations for each theme align with both the January 2006 Task Team Report, entitled “*A Report on Ocean Research Science and Technology Priorities of the Coastal and Ocean Resource Management Community*” and the January 26, 2006 Task Team comments on “*Draft 0*” of the JSOST ORPP?

Not included in these comments is the priority ranking (high, medium, low) for each theme provided by the Task Team in our January 26, 2006 comments. As the JSOST moves forward in establishing research priorities, we commend our previous work on the research priorities of coastal and ocean resource managers.

**SIMOR FSTT**

Broadly, this report is clear, well written, and conveys many of the issues of importance for ocean research, conservation, and stewardship. The definition of "ocean", as given in the endnote, is appropriately broad, including the critical shallow water and coastal habitats. That said, the document itself has a decidedly "blue water" emphasis, and the report itself does not match the focus suggested by that definition of "ocean". Wetlands, estuaries, and other nearshore and shallow water habitats are given scant attention throughout this document, despite the fact that they are recognized to be so critical for human and ecosystem health. The functional connections between terrestrial, coastal, and open-water systems are crucial, as indicated by the report's statement on page 1 about boundary processes, and yet receive almost no further mention. Further, while the emphasis here is necessarily on U.S. waters, explicit recognition of the international nature of issues facing the U.S. would be good (e.g., the need to collaborate with Mexico, Canada, and other countries to deal with invasive species, pollution, habitat loss, fisheries issues - virtually every issue discussed in the report would benefit from working with international partners).

Finally, I would add that the importance of cross-sector connectivity, such as integrating different disciplines (biology, physics, sociology) and different stakeholders (science, education, management) is *desperately* needed to be included throughout this document. Every section could be greatly improved by adding in explicit mention of these issues.

**Talley, SF Bay NERR/ SFSU**

The potential impact of climate change in ocean ecosystems and sea level rise and how the ocean and atmosphere interact should have top billing in this document, however, it seems to be almost an after thought. Society as a whole is going to be dealing with climate change over the next several decades, and the oceanographic community must be ready to deal with questions that will be asked of us.

**Thompson, University of Washington**

I applaud the development of a thoughtful framework and rationale for budgeting within ocean science and the invitation to the community to comment on the ORPP. My expertise is in basic oceanographic research and exploration, but I also am involved in ocean education at the undergraduate and graduate levels, and I am a concerned citizen of a coastal community.

Progress by establishment of a small number of priorities (p. 8) might seem like a sound approach on paper and in Congress, but I urge the JSOST to identify and celebrate alternative (not exclusive) means of ensuring that essential research (basic and applied) outside of the priority areas is supportable and supported. This work should be fundable through peer-reviewed competition to ensure quality; relevance to a short list of priorities within themes should not be a requirement for ALL ocean science. Without a thoughtful balance between creative and directed research, we begin a path toward mediocrity. The crafters of the final ORPP should also be exquisitely sensitive to our inability to identify now all of the priorities of the future; words that acknowledge the need for ocean science priorities to be dynamic and responsive rather than weighted with bureaucratic inertia are imperative. We should not allow ourselves to be forced into science solely or even primarily driven by regional politics.

**Van Dover, Biology Department, The College of William & Mary**

I congratulate the Administration in taking the important step of developing the Ocean Action Plan and the Ocean Research Priorities Plan (ORPP). The ORPP is a very important process and document that can help implement the recommendations of the US Commission on Ocean Policy for a robust national economy anchored on ecosystem-based management and framed by strong science.

The U.S. Commission on Ocean Policy identified a critical national need for improved ocean research, observation, and ecosystem-based management for education, governance, and international leadership. Each chapter of the Commission's report identifies critical issues, each of which requires a research focus. The Ocean Research Priorities plan should be checked against each chapter and ensure the underlying research programs are enabled.

The ORPP needs to be more explicit in defining research on linkages between land and land use patterns and change, as well as atmosphere inputs and exchanges (gases, aerosols).

The UN Convention on the Law of the Sea has major research provisions. The Administration needs to provide strong leadership for Congress, and particularly the Senate Majority Leader, to call for a vote to ratify the UNCLOS. This is also an important step towards strengthening international leadership and partnerships.

Elements that need to be included in an implementation plan:

\*The U.S. Commission on Ocean Policy concluded that our nation needs to invest a modest \$1-4 billion per year of new funding to ensure we protect life and property,

sustain the businesses that use ocean resources, and maintain a position of technical strength in the international arena. This small investment will provide large returns.

**\*Regional implementation through national coordination:**

As mentioned above, focus research through regional academic, private and State entities, coordinated and funded through the Federal agencies. We need to streamline and minimize centralizing and internalizing implementation of research within the Federal government. The Federal agencies should fund activities extramurally through peer-reviewed competitive processes that are based on defined agency and other stakeholder needs. This will ensure:

- best possible research in the nation through a healthy and well coordinated national infrastructure focused on regional issues, addressing local and regional needs
- best possible operations by federal and State agencies

**\*Satellites:** We need to fully integrate ocean satellites (ocean color, infrared, wind scatterometry, advanced altimetry) into the Integrated Ocean Observing System and GOOS/GEOSS planning, including budget planning.

**\*Data policy:**

Ensure that data collected through Federal funding is immediately released to the rest of the science community and the public, except when national security is at issue. There should be no waiting period, no indefinite holding of data.

**\*Information infrastructure:**

Ensure that the NOAA NODC is a functional, modern data repository to which people want to send data - this is not the case now. The NODC should be linked and operate jointly with other databases/centers now located outside the Federal government (academia, states, private industry) as well as within the Federal government (other agencies but all part of the same executive)

**\*Allow the ORPP to remain a living plan reviewed through participation of the public, government, private industry and research entities.**

**Wall, USF**

Overall the report is well done and thanks are due for providing multiple reviews and scheduling a workshop to gain input from stakeholders. There is, however, a major shortcoming thus far in that basic data collection is not included in the report. Previous work should be examined to ensure compatibility with other ongoing efforts [e.g., Atlantic Coastal Cooperative Statistics Program (ACCSP; regional data collection program between NOAA, FWS, States & Councils), Fishery Information System (FIS; 1999 NMFS Report to Congress)]. Specific comments are provided below. In addition, the products of the workshop are supported here by reference.

The workshop was well-run and provided many opportunities to learn more and to provide stakeholder input. The SIMOR Work Plan Town Hall meeting also provided an additional opportunity for questions and input.

A presentation to the South Atlantic Fishery Management Council would be very productive. Our meeting schedule is posted on our web site: [www.safmc.net](http://www.safmc.net).

**Waugh, SAFMC**

Replace 'ocean' with 'ocean, coastal and Great Lakes' throughout the document. Priorities in coastal and estuarine research and issues related to the land-sea interface are under-represented throughout the document.

**Yochem, HSWRI**

## **SECTION COMMENTS**

### **INTRODUCTION-GENERAL**

Introduction: The overarching goal of ORPP should be to make the ocean compelling to our citizens, establish the connection between human activity and the oceans, and create an ocean literate citizenry. The introduction must capture the readers attention, convey the awe, wonder, and importance of the oceans and make a strong case for increased support for ocean research and education. JSOST should consider placing a sidebar box that contains compelling information about the ocean and how it impacts our daily lives such as:

#### **Did you know the ocean---**

- covers over 71% of the Earth's surface
- contains 97% of the planet's water
- provides 99% of the Earth's habitat
- supports the life of 25-50% of all species on earth; 80% of these life forms are found ONLY in the ocean
- provides 20% of the animal protein and 5% of the total protein in the human diet globally
- contains more of the sun's heat in only the first few hundred feet than the entire atmosphere
- is a fundamental source of water vapor
- is responsible for the world's climate and weather patterns
- supports more than 95% of US foreign trade (by weight)

#### **SOME WAYS THE OCEAN IMPACTS YOU—**

- without the greenhouse effect of water vapor in the atmosphere, the planet would be frozen like Mars
- any big weather event such as a hurricane, flood or drought is generated by ocean conditions, impacting everything from your personal safety to the cost of fruits, vegetables, and grain
- an acre of coastal waters can produce more food than the best mid-western farm land
- 1 out of every 6 jobs in the US is marine-related
- 33% of the US Gross National Product is produced in coastal areas
- ~25% of the natural gas production and ~17% of the US oil production come from the outer continental shelf
- marine-based drugs are vital because infectious organisms have developed resistant strains to soil and plant-based drugs
- and, last, but not least, the carrageenan from red algae makes peanut butter more spreadable and gives tooth paste its consistency

The introduction should also frame the national investment in the oceans. For example, only 0.0003% of the United States federal budget is spent on understanding our oceans and an annual investment of \$1.5 billion (or .0005% of the annual federal budget) would

double the ocean research and development capability of the United States, thus increasing our competitiveness.

The oceans are critical to the well-being of the nation and its people. Our lack of investment in ocean science and education is a national problem, a problem that continues to grow and resulted in the USCOP reporting that ‘our oceans are in trouble’. If our oceans are to sustain the nation we must invest in scientific tools and technologies, including well-equipped research vessels, remote ocean sensing, and an integrated ocean observing system.

#### **CORE**

Page 1: This plan should clearly identify the major audience(s) for the document. If the major audience includes a ‘lay person’ and/or personnel from a governmental office of management/budget then the definition given for “oceans” on page 1 is inappropriate and likely misleading. As it is, the broad use of “ocean” will probably lead to ignore/forget the important components of coasts, estuaries, Great Lakes, and coastal watersheds as opposed to *just* “oceans”. In addition, this definition of “oceans” is not useful as an educative term for most readers/users. The document itself is not consistent on the use of its own definition of “ocean”, as in several occasions makes a differentiation between oceans and coasts (i.e., p. 18 lines 25). We strongly recommend separating the terms coast and ocean and provide a definition for each term, where a broad definition of coast would include estuaries, coastal watersheds and Great Lakes. Considering this, the document could be named a “U.S. Coastal and Ocean Research Priority Plan”.

#### **NOAA-NOS-Estuarine Reserves Division**

## **INTRODUCTION-PAGE/LINE SPECIFIC**

Page 1, line 1. The first sentence (in italics) under the “INTRODUCTION” cannot be believed at face value. It may be intended as alarmism and hyperbole to get attention but there is nothing given to support the demise of humans on earth if the oceans are not healthy; there are more pressing problems that will determine survival.

### **NOAA Fisheries**

Page 1, Line 2-9: Introduction. Change to read: “To survive, humankind needs a healthy and biologically diverse ocean. This can only happen if we have a broad understanding of the ocean environment. Such understanding makes possible management of our interaction with it and sound use of the ocean’s resources. *The United States will advance basic and applied ocean science research by developing a comprehensive national oceanographic research strategy.*”

It is not possible or even desirable to link basic research specifically to “pressing national and global issues.” Furthermore, it will not be possible to advance science using only existing infrastructure.

### **Scripps Institution of Oceanography**

Page 1, Lines 12-14: Introduction. Change to read: “Ocean processes vary on a wide range of temporal and spatial scales—from *microseconds* to decades, from micrometers to *megameters*—and many processes are linked in ways we have yet to understand.”

Page 1, Line 15-16: Change to read: “Our recognition of the complexity of the ocean environment, and our interaction with it, led to significant investments in oceanographic research in the 20th century.”

### **Scripps Institution of Oceanography.**

Page 1, Line 18-20: Change to read: “These programs were followed by major advances during the International Geophysical Year, the International Decade of Ocean Exploration, and the Cold War, and during the growth of *autonomous instruments and* satellite observations of the ocean.”

### **Scripps Institution of Oceanography**

Page 1, Lines 29-33: Change to read: “What started as independent research activities addressing singular issues (e.g., resource deposit distributions, fisheries-stock assessments, ocean-current structure) is expanding into interdisciplinary research on some of today’s most pressing global Earth system *societal* challenges (climate change, ecosystem *variability*, public health, hazard mitigation).”

### **Scripps Institution of Oceanography**

Page 1, Line 34 to Page 2, Line 1: Change to read: “This evolution demands an ocean research plan that maximizes the opportunities to collect, manage, and analyze ocean data; that provides ways to share assets (e.g., personnel, platforms, *information technology*); and that ultimately delivers the information required *to inform* policy-makers *in making science-based* decisions on the use and protection of the ocean.”

### **Scripps Institution of Oceanography**

Page 2, Line 1 to Page 2, Line 3: Change to read: “Central to this effort is identifying *basic research questions* and prioritizing oceanographic *applied* research objectives that address pressing national and global issues ~~for domestic policy, economic policy, homeland security, and national security.”~~

### **Scripps Institution of Oceanography**

\*Page 2, Line 4: It would be useful to briefly acknowledge that implementing any ocean plan will require extensive integration of activities across many agencies and present this as a true “trans-agency” plan.

### **Backer, National Center for Environmental Health**

## **BACKGROUND-GENERAL**

Pages 3-4. It would be helpful to expand/ change figure 1 to make it more readable as well as adding a glossary of all acronyms at the end of the document for easy referencing.  
**CCCHFA, Slifka**

Page 4, Figure: Some of the acronyms indicated in Figure 1 need to be spelled out, since not every reader is familiar with their meaning.  
**NOAA-NOS-Estuarine Reserves Division**

## **BACKGROUND-PAGE/LINE SPECIFIC**

\*Page 4, Lines 13-19: One aspect of climate that seems to be missing from the overall themes is that of the ocean's response to climate change and its impacts on health, resources, ecosystems, etc. The theme "ocean's role in climate change & variability" stands out as a detached scientific curiosity topic, rather than being an integral part of what we will be doing as the climate changes, e.g., answering questions like "how are hurricanes and storms responding to a warmer ocean and is this predictable?", "how will large-scale changes in ocean chemistry affect fisheries?", etc  
**Kelly, University of Washington**

\*Page 4, Line 13 to Page 5, Line 5: Mitigating effects of natural hazards is a cross-cutting theme in that it involves the human health, ecosystem health, natural resources and quality of life themes. Change this to "Predicting the effects of natural hazards." Designing and implementing the IOOS is a cross-cutting theme in that it is to provide data and information required to address all 7 themes. Likewise, the design and implementation of a data management and communications system that provides rapid access to data and information (from both research and operational systems regardless of the funding agency or agencies) required to address all 7 themes should be a cross-cutting theme.  
**Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

\*Page 5, Line 2: The importance of technology and infrastructure that provides access to the oceans as a true cross-cutting theme is not captured in the current outline. While the document discusses advanced technology and infrastructure within each section, it does not comprehensively address how priorities for the broad suite of technology and infrastructure capabilities will be addressed. Recommend that the cross-cutting priorities be reorganized:

Basic Understanding of the Ocean  
    Ocean Observations  
    Exploration  
Ocean Technology and Infrastructure  
Expanded Ocean Education

Remaining comments are editorial notes to begin implementing this recommendation.

**Kohanowich, NOAA's Undersea Research Program**

Page 6, Line 5: It seems that the Figure to be referenced here is Figure 2 not Figure 1.

**NOAA-NOS-Estuarine Reserves Division**

Page 6, Line 33: Background to Planning Materials. Page 6, line 33. The lack of discussion of major issues such as replacement of aged ice breaker capability, replacement plans for existing oceanographic research vessels, and information technology/cyberinfrastructure makes it difficult to believe that this draft report does, in fact, address "...the most pressing ocean science and technology issues facing the United States."

**Scripps Institution of Oceanography**

Page 6, Line 37: Delete "for."

**Scripps Institution of Oceanography**

Page 7, Line 5: Use of Plan- meaning of last bullet is unclear: "enhanced identification of expected ocean-research based educational products"; suggest "recommendations for ocean-research-based education and outreach products that promote ocean literacy"

**Shepard, University of North Carolina at Wilmington**

## **ENHANCING HUMAN HEALTH-GENERAL**

Page 9: CORE supports the U.S. Commission on Ocean Policy recommendation that "Significant investment must be put into developing a coordinated national research effort to better understand the links between the oceans and human health ...." We are just beginning to understand the numerous and complex ways in which humans can affect the oceans, and the oceans, in turn, can affect human health. However, while cases of human illness linked directly or indirectly to stressed estuarine and coastal environments are being documented with increasing frequency, the risks to human health from continued and expanded impairment of coastal and ocean environments remain very poorly understood. Therefore CORE urges JSOST to expand research and development efforts to encourage multidisciplinary studies of the evolution, ecology, chemistry, and molecular biology of marine species, discover potential marine bio-products, and develop practical compounds.

### **CORE**

Page 9. The research needs relating to seafood risks are focused solely on identifying pathogens and contaminants existing in seafood. Proactive research is also needed on packaging and processing options that increase the value of seafood, reduce waste and reduce health risks. For example, some research should be focused on the safety of modified atmosphere packaging (MAP) for raw seafood. MAP is used increasingly outside the US and has reduced waste and improved quality of seafood thereby increasing the value generated by marine resources for producers and consumers. However, MAP for raw seafood in the US has been prohibited over concerns about botulism. Research is needed to verify whether these concerns are justifiable or whether risks of MAP for raw seafood can be mitigated in some way. Research on irradiation of seafood might also be useful.

### **Holland, Gulf of Maine Research Institute**

\*Page 9:

- The balance between health benefits and health risks is narrowly targeted on known health risks.
- Positive health effects of seafood should be a major area of research (benefits of seafood consumption far outweigh the negative effects of most contaminants in the seafood).
- All health research should include behavioral, economic and other social science contributions.
- The drug and health discovery section understates the enormous opportunities gained from genomics. For example, using environmental genomics in common ecosystems, like open ocean planktonic systems, presents vast opportunities that must be exploited.
- NAML applauds the emphasis on HAB and pathogens and the recognition that there is a need for rapid detection of harmful compounds and a need to have similar detection capability for the organisms themselves.

- The plan should address the need to develop an understanding of planktonic systems as complex adaptive systems to predict the future outbreaks of HABs and fates of other pathogens.
- Freshwater systems (Great Lakes and estuaries) play a special human-health role as they affect human drinking water supplies.
- It is absolutely critical to do real epidemiology of human health issues, both positive and negative, to get away from the anecdotal and to build efficient programs and policies to improve health based on these data.

#### **NAML**

Page 9-13: While there is lots of overlap among sections, it seems that many human health aspects of wetlands and coastal systems (e.g., wetlands as buffers protecting human development; improving our understanding of how wetlands filter and sequester pollutants; coastal waters as locations for extraction of human food) could be covered in this chapter.

#### **NOAA-NOS-Estuarine Reserves Division**

\*Page 9 - All assaults on the ocean are human caused. It is clear there is little to no protection of the ocean or the creatures that live in it. Our govt agencies encourage this assault on living creatures continually so that the decimation of one marine species after another is continually taking place. NOAA, NMFS, the regional fishing councils all engaged to see who can take the most the fastest are harming American citizens through their overfishing policies. They refuse to set up sanctuaries where no vessels can go.

#### **Sachau, private citizen**

Page 9, Line 1 to Page 13, Line 8: Generally, this theme reviewed well. One comment reveals the applied research nature of the theme as noted earlier: While this priority is indeed applied, there are a number of basic science questions that could be addressed in applying to this section. I thought the report was a bit slanted toward HABs however.

#### **Scripps Institution of Oceanography**

#### **Societal Theme: Enhancing Human Health**

**To what extent are the gaps FSTT identified in this theme from Draft 0 still present in the Planning Document?**

The Planning Document addressed the following Task Team comments:

- Priority should be given to existing human health issues, while new drug development should be a lower priority and justification for research.
- Greater emphasis on chemical contaminants is warranted.
- Resource managers have greater concern with human health hazards than with the potential for new sources of pharmaceuticals. **The Planning Document reduces the emphasis of new pharmaceuticals and more appropriately focuses on known human health hazards.**
- This theme includes the need for predictive/forecasting modeling and tools for managers in an attempt to anticipate management responses to human health threats. **The Planning Document identifies further development of predictive models and risk assessment techniques.**

- Additional research on the human health effects of chemical contaminants is needed as is additional research on contaminant pathways. **The Planning Document identifies the need to conduct food-web assessments and develop models focusing on bio-accumulation and bio-magnification of contaminants. It also identifies the need to expand risk assessments of contaminants in seafood.**

**How well are the workshop recommendations for this theme aligned with both the FSTT Report on research priorities and the FSTT comments on Draft 0?**

The Task Team report focuses on existing human health issues, but does not identify the development of new pharmaceuticals as a high priority, as identified at the workshop: “Optimize marine bio-product acquisition, characterization, and production using cross-disciplinary methods.”

Other research needs identified at the workshop are closely aligned with Task Team priorities.

- Develop the best tools and methods to assess microbes and chemicals of public health interest.
- Conduct basic science studies to understand mechanisms of oceans and human health interactions and impacts.

Integrate ocean data and models with human epidemiologic studies. The FSST final report did not identify specifically epidemiologic studies, but did highlight the need to evaluate the health risks from swimming and the consumption of seafood.

**SIMOR FSTT**

\*Page 9: While there is lots of overlap among sections, it strikes me that many human health aspects of wetlands and coastal systems (e.g., wetlands as buffers protecting human development; improving our understanding of how wetlands filter and sequester pollutants; coastal waters as locations for extraction of human food) that could be covered here.

**Talley, SF Bay NERR/ SFSU**

\*Page 9, Enhancing Human Health: How the ocean will respond to climate change and how that will impact Human Health is not emphasized enough. The biggest challenge that the oceanographic community and society has in the coming decades is global warming and how that will impact ocean ecosystems. This simply has to be emphasized in this document.

**Thompson, University of Washington**

\*Page 9: There is nothing here on researching the benefits of eating seafood. The entire section seems to be focused on combating potential ills.

**Western Pacific Regional Fishery Management Council**

Pages 9-13. Negative health effects of seafood (e.g., pathogens, contaminants) are over-emphasized relative to health benefits. Positive effects include the nutritional benefits of seafood’s high-quality protein, vitamins and minerals and a wide variety of positive

effects attributed to omega-3 polyunsaturated fatty acids such as reduced risk of heart disease and stroke. Seafood safety in general compares favorably to other food commodities.

Page 9-17. [NOTE: Repeated in Improving Ecosystem Health] Include a discussion of the connections/links between ecosystem health and human health in the sections on “Enhancing Human Health” and “Improving Ecosystem Health”.

**Yochem, HSWRI**

## **ENHANCING HUMAN HEALTH-PAGE/LINE SPECIFIC**

\*Page 9, Lines 6-11: The vision presented under “Enhancing Human Health” is limited in scope as it is written. The health hazards noted (contaminated shellfish, polluted waters, and HABs) are important public health issues. However, we also need to be aware of the potentially huge health, social, and economic impacts from storms and flooding along coastlines. We also need to have mechanisms in place to recognize and respond to emerging oceans and human health issues, whether they are associated with new diseases or new pharmaceuticals from the sea.

**Backer, National Center for Environmental Health**

\*Page 9, Lines 6-11: ‘.. will lead to fewer illnesses from contaminated shellfish, polluted waters, and HABs’. I am missing a reference/awareness that the ingestion/uptake of pollutants will also result in detrimental effects on humans (e.g., endocrine disruption, lower birth weights etc) which are not necessarily defined illnesses. As the Great Lakes are considered ‘oceans’ in this document, the adverse effects of (persistent) organic pollutants on ecosystems and humans has to be included. In a similar manner, there is no reference to the dangers species face through ‘endocrine disruption’, such as the feminization of male fish.

**Lohmann, University of Rhode Island**

Page 9, line 9: Fish (not just shellfish) can lead to health risks.

**Crooks, TR NERR**

\*Page 9, Line 9: Exploration of new habitats,  
Replace new with recently discovered. The habitat has probably been there a long time.

**Western Pacific Regional Fishery Management Council**

\*Page 9, Line 13: New bullet? Desertification changes in response to NAO have produced more frequent and intense African dust events leading to increase Asthma in the Caribbean, and health warnings are issued routinely in Florida. Coral diebacks and red tide bloom have been linked to African Dust.

Citation for Red Tide:

**Iron Fertilization and the Trichodesmium Response on the West Florida Shelf.**

Jason M. Lenos, Brian P. Darrow, Christopher Cattrall, Cynthia A. Heil, Michael Callahan, Gabriel A. Vargo, Robert H. Byrne, Joseph M. Prospero, David E. Bates, Kent A. Fanning, John J. Walsh *Limnology and Oceanography*, Vol. 46, No. 6 (Sep., 2001), pp. 1261-1277

**Rozsa, CT Depart. of Environmental Protection**

Page 9. Line 14. Change sentence to read: The oceans coasts, and Great Lakes place humans at risk from consuming contaminated seafood, contacting water-borne pathogens, and through indirect contact by breathing algal toxin aerosols.

**CORE**

Page 9. Line 19. Change the sentence to read: These illnesses combined are estimated to affect between 13,000 to 40,000 individuals per year, leading to some 10 to 20 deaths.  
**CORE**

Page 9, line 21. Recommend deleting this bullet. It appears to refer to terrestrial mammals and perhaps birds as vectors for human pathogens. It's unclear whether this model applies to the marine environment, where toxins are perhaps as important a problem as pathogens.

**NOAA Fisheries**

\*Page 9, Lines 21-23: This entire bullet is preposterous. To suggest that the ocean is a major source of pathogens is ludicrous. To say that the ocean is "a major potential reservoir..." is a weasel word way of stimulating unnecessary concern.

**Western Pacific Regional Fishery Management Council**

\*Page 9, Line 22: Why single out vertebrates? *Vibrio cholerae* (that causes cholera), for example, associates with crustacean invertebrates.

**Jumars, University of Maine**

\*Page 9, Lines 24-28: The rationale should include not only acknowledging that what happens in the oceans may be related to human health effects but also the need to identify data gaps and create the medical/veterinary/public health infrastructure to create the links between people and other animal populations that might serve as sentinels for changes in ecological or human health.

**Backer, National Center for Environmental Health**

\*Page 9, Lines 26-28: "These events may be increasing in frequency and severity, suggesting that health threats may also be increasing in many coastal environments."

If the events may be increasing, then they may equally be not increasing, or may be decreasing. In that case there is no reason to suggest anything. Better to say you do not know the status of frequency and severity of these 'events', and if that is the case, then what is needed is good basic reporting and analysis, thereby removing uncertainty. It may then be possible to determine the level of priority that should be given to related research.

**Western Pacific Regional Fishery Management Council**

\*Page 9, Lines 29-30: The rationale should be expanded to include not only seafood, but other ocean-associated exposures (i.e., exposures to marine toxins in aerosols, dermal exposures, etc.).

**Backer, National Center for Environmental Health**

Page 9. Line 29. Change the sentence to read: There are major gaps in the number of illnesses reported and epidemiological knowledge of seafood-caused human illnesses.  
**CORE**

\*Page 9, Lines 31-32: I am missing that polychlorinated biphenyls are named as key pollutants which pose a huge risk to humans, ecosystems and the economy of (shell)fisheries (such as in the Great Lakes, in the Hudson River, or in farmed salmon).

**Lohmann, University of Rhode Island**

\*Page 9, Line 33: The rationale for enhancing human health should also note the risks from anthropogenic activity on our coastlines (e.g., how does our migration to the coasts affect ocean water quality, coastal runoff, etc.).

**Backer, National Center for Environmental Health**

Page 9, line 36. This line states that “the ocean also holds a bounty of potential assets.” The oceans not only hold “potential” assets, but also real and currently utilized assets. I recommend rewording and augmenting line 36 to the following:

“In addition to possible dangers, the ocean also holds a bounty of assets that are vital to human health or that have the potential to contribute to human health. Subsequent sections discuss many important contributions of the oceans to human health, ranging from fish harvests to oxygen production.”

**Schultz, CCSP**

\*Page 10: add the following:

1. Lack of knowledge regarding human perceptions of the oceans and potential health risks, which affects both the level of overall health problems and the demand for related public policies.
2. Lack of knowledge regarding the economic value of polluting industries.

**Miller, et al**

\* Page 10 - The drug companies are allowed to decimate marine creatures like the horseshoe crab to drain them of blood. They particularly take and decimate the females most likely to restore the horseshoe crab population. Decimating the horseshoe crab population means the red knot bird dies and who knows what the next environmental decimation after that is. We cannot allow profiteers from drug companies to do this.

**Sachau, private citizen**

Page 10, line 1. Unwise to imply that oceanographers recently discovered new species and to a lesser extent new marine communities, as this has been a long standing succession of such findings (at least for the former). Suggest: “Marine biologists continue to discover new species and ecological communities with unexpected biochemical systems in the ocean.”

**NOAA Fisheries**

Page 10, line 1: The ORPP should not just emphasize new discoveries (ie, “new species and new...”) but also the long track record of discoveries in these areas which clearly show the utility and future promise of such research investments.

**Schmale, RSMAS**

Page 10, line 1-9: Another key asset to add to the list of “processes and products” here is “marine animal models of human diseases.” The value of specific aquatic animals as model systems to facilitate studies of human disease mechanisms and facilitate development of potential therapies can be recognized for a variety of fields including, but not limited to: toxicology, carcinogenesis, mutations and genetic diseases. Indeed the potential here appears to be at least as large as drugs from the sea.

**Schmale, RSMAS**

Page 10. Line 2. Clarify the phrase: “ with unexpected biochemical systems in the oceans”

**CORE**

Page 10, line 5; Page 11, lines 29-30. “Molecular probes (used in biochemical process/disease research)”, and “Incorporating genome sequencing, proteomics and bioinformatics with non-culture-based methods for environmental surveying and screening of uncultured microbes”. This is one of the few sections in this document where the importance of newer and emerging research tools such as genetics/genomics and proteomics is mentioned. These techniques have applications for ocean and coastal science that extend well beyond disease research.

**Yochem, HSWRI**

Pages 10-11, lines 25-12. Largely absent from analysis of the human health theme is the impact on the commercial and recreational fishing communities of marine pollution and seafood-borne contaminants and pathogens. Socioeconomic studies of these incidents and problems should include a focus on the health of fishermen and their industry. Marine operators of all sorts, including fishermen, ply their trade in a unique workplace- this should be recognized as a significant exposure possibility and research conducted into the implications.

**CCCHFA, Rudolph**

\*Page 10, Line 10 to Page 13, Line 7: The challenges, priority expected results, priority research needs, and priority infrastructure needs developed by the two sessions on “Enhancing Human Health” at the workshop in Denver represent a more integrated approach and identify a fairly short list of priority needs. The workshop report from these groups should be incorporated into the Ocean Plan.

**Backer, National Center for Environmental Health**

Page 10, lines 19-20: Ballast water should be considered a source of HAB outbreak.

**Crooks, TR NERR**

Page 10, lines 21-22. Addition after sentence: Plastic pieces sorb pollutants up to a million times their level in ambient seawater<sup>1</sup> and many species ingest the plastic bits, slowly working its way up the food web.

**Algalita Marine Research Foundation, Francis and Moore**

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<sup>1</sup> Mato, Yukie, Tomohilo Isobe, Hideshige Takada, et al. “Plastic Resin Pellets as a Transport Medium for Toxic Chemicals in the Marine Environment,” in *Environmental Science & Technology* 35 (2001): 318-324.

\*Page 10, line 23: – “Expanding monitoring and assessment of pathogens, HABs, and contaminants.”

This speaks to the need for enhancing monitoring and assessment of a number of health related factors. However, the integration of these monitoring efforts with environmental/observational monitoring of other parameters, such as oceanographic and meteorological measurements, also needs to be enhanced. This will require data management development to accommodate the diverse range of physical, biological, and chemical factors that are relevant to the broad range of phenomena.

**NAML**

\*Page 10, Line 24: Something is missing. I think you mean improving demographic data on illnesses.

**Jumars, University of Maine**

\*Page 10, Line 24: ‘Improve demographics of illnesses from marine food and marine environmental exposures’. I think this needs to be broadened to include the effects organic pollutants, and how they affect certain sub-populations with special diets, and how it impacts the health of them and their children.

**Lohmann, University of Rhode Island**

Page 10, Line 27-29: This sentence does not have a proper subject or verb - it doesn't make sense. What's missing? Something between "...systems are timely..." and "...assessment and preservation...".

**Scripps Institution of Oceanography**

\*Page 11: add the following:

1. Perceptions & valuations surveys to gage the public's awareness of risks, their level of concern, and the effects of these factors on their participation in the political process.
2. Develop database of anthropogenic sources of oceans health concerns, including economic data on the value of the activity and cost of abatement.
3. Investigate the role of governance in identifying and preventing threats, developing warning systems and responses to harmful algal blooms (HABs).
5. research on the human role in water-borne hazards, determining human drivers of ecological changes (economic, social, political, cultural)

**Miller, et al**

\*Page 11, Research Needs:

- The importance of genetic and proteomic techniques for understanding/producing bioactive compound production could be emphasized.
- Research on the positive health impacts of seafood and interaction with the ocean should be conducted.
- Human health impacts should be studied quantitatively through epidemiological and other modern medical approaches.

**NAML**

Pages 11-12. There are superscripts that apparently refer to footnotes that aren't in the same format as the others (i.e., Roman numerals). In some cases the footnotes aren't included at the end of the report (e.g., 49, 50, 71).

**NOAA Fisheries**

Page 11, lines 3-32: Natural and anthropogenic transport of hazardous species is a research need.

**Crooks, TR NERR**

Page 11, Line 3: Existing national and regional monitoring and assessment programs have focused on the measurement of persistent chemicals, particularly in deeper estuarine sediments. Much more attention should be paid to assessing known or potential human pathogens and contaminants and emerging contaminants of concern such as newly registered pesticides, pharmaceuticals, and fire retardants in shallow estuarine and marine waters, coastal retention ponds, continental shelf environments, and the open ocean.

**CORE**

Page 11, lines 3-32. There is too much discussion concerning researching impacts of pathogens and assessing the impacts of pathogens and not adequate discussion about eliminating or controlling the outbreaks of these incidents by controlling the factors responsible for causing them.

**National Estuarine Research Reserve Association**

\*Page 11, Line 6-21: These needs strike me as being very passive and observational. Even in 1998, ocean ecologists had agreed (OEUVRE) that progress on HABs and other health issues would be greatly accelerated through attempts at intervention that also served as hypothesis tests (in the form of adaptive management). A draft bullet might read: Developing intervention and control methods for specific HABs and pathogens that also serve to test specific hypothesis about their etiology and population regulation.

**Jumars, University of Maine**

\*Page 11, Lines 9-10: I appreciate the research need to improve our ability to conduct and develop models focusing on bioaccumulation and biomagnifications. I would argue that we should even go further towards being able to predict bioaccumulation and biomagnification in the field, for current and emerging compounds.

**Lohmann, University of Rhode Island**

\*Page 11, Line 19: Assessment should include African Dust. Rationale: The oceans play a significant role in the generation of African dust. Scientists are only just beginning to understand the role of such dust in the transport of pathogens around the globe. In Europe, scientists are assessing the role of dust in the transport of hoof and mouth disease. At this time, little if really known about human risks from African dust and its associated pathogens.

From the standpoint of the next chapter (Improving Ecosystem Health), one cannot dismiss the role of dust in the health of our oceans and estuaries. Dust is implicated in

coral dieoff (*Aspergillus*) and red tide blooms. Sudden wetland dieback is now associated with the Gulf and Atlantic Coasts. Did African dust play a role in the 2006 red tide blooms in the Gulf of Maine? A plant pathologist in Louisiana has isolated a new pathogen from tidal wetlands plants of the genus *Fusarium*. In the laboratory, plant mortality occurs at elevated salinity. This is a modern phenomenon occurring within the latest NAO changes. Coincidentally, USGS scientists have isolated *Fusarium* from African dust making landfall in the US. Curious that eelgrass wasting disease began the same year as the US dust bowl.

Research:

Further studies of pathogen component of dust.

Improved monitoring of dust events and their distribution. Is there a need for health alerts in areas other than Florida and the Caribbean? (Spring time is when African dust moves into northern).

**Rozsa, CT Depart. of Environmental Protection**

Page 11. Line 21. Insert the following new bullets:

- “expand research and exploration efforts in marine microbiology and virology to discover, document, and describe new marine bacteria, algae, and viruses and determine their potential negative effects on the health of humans and marine organisms and the identify the inter-relations, pathways, and causal effects of marine pollution, harmful algal blooms, ecosystem degradation and alteration, emerging marine diseases, and climate change in disease events;
- improve and develop accurate and cost-effective methods for detecting, monitoring, and identifying pathogens, contaminants, and chemical toxins in ocean and coastal waters and organisms.

**CORE**

Page 11, line 22-23: Add “animal models” to list on line 22, ie: “...new drugs, materials and animal model systems depends...”

Page 11, line 24-25: Suggest also expanding here the reference to drugs to include other materials as well as animal models.

**Schmale, RSMAS**

\*Page 11, Line 26: Of new habitats

Replace new with recently discovered for reasons given above.

**Western Pacific Regional Fishery Management Council**

Page 11, line 26-27. Change to read: “Intensive exploration of new habitats combined with discovery (*e.g. metagenomics*) and culture of new marine microorganisms.”

**Scripps Institution of Oceanography**

Page 11. Line 27. Include the following new bullet: “Extensive research into deep water corals that includes mapping, monitoring, assessment, expanded surveys of deep-water corals distribution and abundance and research on the major threats to their continued existence.

## CORE

Page 11, line 29-31: For discovery of biomaterials as well as animal models for study of human disease, genomics efforts should NOT be limited to microbes but should include other marine organisms as appropriate.

**Schmale, RSMAS**

\*Page 11, Line 34:

- This section speaks to the importance of coordinating federal and state data systems. This effort will also require the development of standards as well as integration with the monitoring and research capacities of IOOS and OOI.
- The last part of the section supports coupling to shore-based labs. This should be emphasized since the obvious benefits of marine labs include proximity to sampling sources and the capability to quickly deal with perishable organisms and systems.

## NAML

\*Page 11, Line 34 to Page 12, Line 6: When discussing the development of infrastructure needs, it would be useful to note that all relevant stakeholders (i.e., not only the engineers producing the data collection instruments, but also the people who might be using the data to support public health decision-making), need to be involved early in the process (i.e., when the purpose of the instrument or data collection is defined).

**Backer, National Center for Environmental Health**

\*Page 12: add the following:

1. Improved understanding of the pressures faced by policy makers and sources of political will.
2. (cross-over with education) Better idea of what the public knows, what they need to know, and what they will actually do with that information if it is provided.

**Miller et al**

\* Page 12 - Mandate that all toxic surface paints must never be used again. Any ship that uses it must stay out of U.S. ports. Do this now.

**Sachau, private citizen**

Page 12, Line 1: Insert after “in situ monitoring. . .*at multiple time and spatial scales. . .*”

**Shepard, University of North Carolina at Wilmington**

Page 12, line 10-13. Change to read: “These capabilities should be coupled to and shared with shore-based laboratories ~~with dedicated facilities and instrumentation~~ (e.g., gene sequencing) ~~and~~ *with* scientific staff capable of successfully investigating the biology and physiology of the recovered organisms and symbiotic systems.”

Why "dedicated?" Dedicated facilities are usually expensive and difficult to maintain. In some cases this may make sense, but in other will probably not (e.g. gene sequencing).

## **Scripps Institution of Oceanography**

Page 12. Line 14. Insert a new paragraph as follows: “Monitoring and mitigating human activities in the ocean environment to enhance human health will require the development of new tools for measuring human and environmental health indicators in the marine environment—specifically mechanisms and indicators to monitor and assess pollution inputs, ecosystem health, and human health impacts. It will also require the development of models and strategies for predicting and mitigating pollutant loadings, harmful algal blooms, and infectious disease potential in the marine environment and to develop new technologies to protect human health from contaminated seafood and coastal waters. Finally, it will require the development of technologies to reduce concentrations of pharmaceuticals, personal care product ingredients, nutrients from animal wastes, and other biologically active contaminants in wastewater treatment plant discharges.”

### **CORE**

\*Page 12, Line 16 to Page 13, Line 7: Assuming research achieves a better understanding of the bioaccumulation and biomagnification of pollutants in a combination of laboratory, field and modeling efforts, then a major outcome will be the ability to predict the background concentrations humans will be exposed to as a function of their dietary intake. This is key to being able to advise and, if needed, implement mitigation strategies.

### **Lohmann, University of Rhode Island**

Page 12, line 18-20. Change to read: “Research to understand and model the dynamics and effects of these risks will serve to protect human health, help mitigate potential effects of these hazards, and help increase public confidence in the safety of their food supplies and coastal areas:”

### **Scripps Institution of Oceanography**

\*Page 12, Line 21: First bullet: Indicators are available now, and they aren’t very good. Should this say “New and more effective indicators...”

From a sensing perspective, the development of pathogen- and toxin-specific sensor techniques should be a high priority.

### **Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

Page 13, line 2. Delete “Biological remediation of oil spills will become feasible”, as we already have some capability in biological remediation. Major improvements in this capability in the next 10 years are not likely.

### **NOAA Fisheries**

Page 13, line 3-6. Change to read: “Technological advancements in ocean exploration, such as underwater vehicles with greater depth capabilities, combined with improved assessment (e.g., genomics) and culturing techniques will allow for more efficient and expansive discovery while preserving intact ecosystems.”

Why greater depth capabilities?

**Scripps Institution of Oceanography**

## **IMPROVING ECOSYSTEM HEALTH-GENERAL**

### Page 14: General Comments for Improving Ecosystem Health

A major detrimental human impact is the marine debris problem, with nearly 80% of this debris coming from land-based sources.<sup>2</sup> Specifically, plastics (pre- and post-consumer) are the largest part of the marine debris problem: 90% of floating marine debris is comprised of plastic materials, 60-80% overall.<sup>3</sup> Any solutions the committee adopts must address this issue. Due to photo-degradation, the materials become smaller bits of plastic that persist in the ocean. Since there is no viable way to remove small plastic debris from the ocean, we must focus our efforts on preventing the parent materials from entering watersheds. The committee must provide more research in this area. There are many places within the themes that these issues tie into, not just Improving Ecosystem Health as can be seen with the Specific Comments.

**Algalita Marine Research Foundation, Francis and Moore**

Page 14: U.S. ocean and coastal resources should be managed to reflect the relationships among all ecosystem components, including humans and nonhuman species and the environments in which they live. Applying an ecosystem-based management principle will require coordinating the development of procedures for the practical application of the precautionary approach and adaptive management to preserve and restore marine biodiversity within well-defined relevant geographic management areas based on an ideal model for a healthy ocean and coastal ecosystem. The research should further the development of regional, ecosystem-based research plans to help protect ocean ecosystems, guide agency research funding, and be incorporated into the design and implementation of the national monitoring network and the Integrated Ocean Observing System.

### **CORE**

Page 14: (NOTE: this comment is repeated in Sustaining Natural Resources)

1) The need for basic science cannot be overstated. While advances have been made in the fundamental habitat mapping in the Northwest Hawaiian Islands and the Puerto Rico Shelf, many other regions remain woefully under-mapped. In addition, despite recent improvements in protocols and programs, a significantly greater investment is needed in basic biology to support stock assessments for target species. Current information on energy flow pathways (including predator-prey relations) and on the effects of changing habitat conditions in coastal and marine ecosystems remains inadequate to support effective management of complex marine ecosystems. Prioritization of efforts to fill those gaps in a timely and sensible way must be a key element of the national plan.

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<sup>2</sup> U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of Public and Constituent Affairs, "Turning to the Sea: America's Ocean Future" (1999): 56. See also, UNEP, United Nations Environment Programme (1995) "Global Programme of Action for the Protection of the Marine Environment from Land-based Activities." Note by the secretariat. UNEP (OCA) /LBA/IG.2/7

<sup>3</sup> J.G.B. Derraik, "The pollution of the marine environment by plastic debris: a review" *Marine Pollution Bulletin* 44 (2002):843; Gregory, M.R., Ryan, P.G. "Pelagic plastics and other seaborne persistent synthetic debris: a review of Southern Hemisphere perspectives" in Coe, J.M. Rogers, D.B. (Eds.), *Marine Debris- Sources, Impacts and Solutions*, (1997) Springer-Verlag, New York, pp. 49-66

2) Important progress toward these goals can be achieved by fully implementing existing priority research plans developed by regional management entities. Specific examples of great importance include: 1) the Atlantic Coast Cooperative Statistics Program, 2) the research priority plans of the regional fishery management councils (including in the US Southeast the Oculina Banks Evaluation Plan, and the soon-to-be-completed Deepwater Coral Research and Evaluation Plan and Marine Protected Area Evaluation Plan), 3) research priority plans of the interstate fishery management commissions (as laid out in their fishery management plans and related documents) and 4) research priorities of the national estuary programs.

3) While improved coverage is recommended in several of the documents listed above, special attention is needed to quantify bycatch relationships in existing and developing fisheries with priority given to improving observer coverage in all fleet components. In addition, investments must be made to improve the accuracy and timeliness of information related to recreational fishing mortality.

4) A concerted effort is needed to identify and characterize deepwater resources in the US EEZ, with special emphasis on areas subjected to existing deepwater fisheries or potentially subjected to developing frontier fisheries.

5) Finally, a major investment is required in social science to support the development of an adequate understanding of the forces which drive decision-making in natural resource using populations including commercial and recreational fishers, necessary to develop more holistic management programs.

**Environmental Defense, Rader**

Page 14. (NOTE: This comment is repeated in Sustaining Natural Resources) We need to concentrate on developing management strategies for use of marine resources that are robust to the high level of uncertainty about ecosystem processes and states and the state and productivity of specific marine resources such as fish stocks. Much of this uncertainty is unlikely to be resolved even with greatly increased research. Model based evaluation methods that explicitly address the uncertainty in ecosystem processes and states and in human responses to management actions can be useful in identifying management strategies that work reasonably well even when information is limited and very noisy and natural processes themselves are highly variable and unpredictable. Because many sources of uncertainty and variation may be correlated, we need to develop a better understanding of these correlations and attempt to include them in evaluation tools. An important aspect of this is understanding how individuals and groups respond to uncertainty in making decisions that affect resource use. This includes individual decisions such as fishing location choice, whether to discard fish, etc., and group decisions such as how to set aggregate catch targets.

**Holland, Gulf of Maine Research Institute**

\*Page 14: Restoration techniques and technologies should be added to this section. Many systems are degraded to a point that they will not return to an improved status without intervention. For example, returning structure to damaged reefs or transplanting grasses in a seagrass bed. There are great gaps in knowledge in reference to what restoration methods are the most efficient and effective.

**McDevitt, FWC**

\*Page 14:

- The land-water interface is an important area for focus in order to better characterize ecosystem health. These margins are critical modifiers of biological, environmental, and physical processes which influence and modify coastal ecosystems.
- This margin is also the main conduit for anthropogenic influence on marine ecosystems. Efforts should focus first on understanding the role of this interface.
- More effort is needed in developing and implementing sensors for key properties in shallow systems.
- NAML strongly supports the intent for examination of cumulative effects, not just single stressors.
- There needs to be an increase on the emphasis of the connection between ecosystem health and human health throughout this document.
- “Energy” should be included within the definition of "goods and services," since it can include oil deposits, methane hydrates, wind farms, waves, etc.
- Ecosystem health is so fundamentally impacted by extractive uses, like fisheries, that these need to be included in this section as well.

## **NAML**

Page 14: The importance of supporting long-term monitoring cannot be over-emphasized as a necessary tool to understand trends, etc.

### **NOAA-NOS-Estuarine Reserves Division**

Page 14. Throughout the document the need for assessment and prediction or forecasting is well stated; however, there is a need to add a research component that moves beyond prediction to one that helps implement policies to counter or mitigate undesirable, predicted outcomes. To implement corrective actions requires research to test and explore various approaches to determine the best. Suggest adding a bullet under Research Needs:

- Undertake research to determine best approaches to counter or mitigate undesirable, predicted outcomes.

*Other suggested research needs to be considered under Improving Ecosystem Health:*

- Inventory and describe elemental components (i.e., Who’s there and in what quantity?)
- Determine how individual components work together (i.e., How do they function?)
- Identify choke points and sensitivity of the individual components in relationship to one another (i.e., What regulates the system?)

Determine how natural and anthropogenic impacts, stressors and stimulants, individually and cumulatively, affect system, its individual components and control points, resiliency, and stability at various temporal and spatial scales.

### **NOAA Fisheries**

Page 14: Improving Ecosystem Health: We are pleased to see the emphasis on the need to understand cumulative impacts in the rationale, challenges, and research needs sections.

Improving Ecosystem Health: We would also include the investigation and evaluation of area management (or marine protected areas) as a tool to protect marine ecosystem health in this section. This research should include the proper location and design of these areas as well as an evaluation of the efficacy of this tool.

**NRDC, Suatoni**

Page 14, (general comment on Ecosystem Health) Improving Ecosystem Health. It is inferred that a sustainable ecosystem is a healthy ecosystem. Therefore we should aim to have "...a stable and sustainable biosphere." This defies ecosystem history that shows continual patterns of change caused by climate, evolutionary and anthropogenic influences. It is desirable to study ecosystem changes to understand their causes but it is unnecessary to equate health with stability.

**Royer, Old Dominion University**

### **Societal Theme: Improving Ecosystem Health**

#### **To what extent are the gaps FSTT identified in this theme from Draft 0 still present in the Planning Document?**

The research needs articulated within the JSOST Planning Document (Improving Ecosystem Health / pp. 14-17) are in fairly close alignment with the research needs identified by the FSTT. In particular, the FSTT identified six broad categories for research that include: 1. improved understanding of the transport, fate, and impact of pollutants; 2. assessment and restoration of ecosystem services; 3. development of a robust approach for adaptive science-based management; 4. assessment of human uses of coastal land and water resources; 5. prevention, control, and eradication of invasive species; and 6. improved understanding of coastal socio-economics. By comparison, the list of five research priorities identified by the JSOST Planning Document is more specific and tightly focused on development of indicators of the status and condition of the oceans, marine ecosystems, and coastal habitats. Two primary gaps have been identified by the FSTT review of coastal resource management programs. The first gap is the need for a realistic and operational adaptive management approach that will integrate information from baseline surveys, experimental work, modeling and ocean observing databases. The second gap recognizes the need to conduct integrative landscape-level studies of the ecosystem impacts of land and water use in coastal watersheds, estuaries, and the marine environment.

**The Infrastructural and Technological Needs section of the JSOST Planning Document should be expanded beyond its current and limited focus on ocean observing systems.** Other infrastructure and technological needs identified by FSTT for the US marine and coastal environment include marine mapping and biological and socio-economic monitoring, and these activities should be added to the planning document.

**How well are the workshop recommendations for this theme aligned with both the FSTT final report on research priorities and the FSTT comments on Draft 0?**

Recommendations developed during the workshop are very closely aligned with the research priorities articulated by the FSTT. The overarching research need identified by the workshop participants is for improved interdisciplinary research efforts within marine ecosystems and for national/international collaborations. The workshop participants also placed a high priority on future research to improve our understanding of the complexity of marine ecosystems, to develop measureable indicators of ecosystem status, to characterize key ecosystem issues and threats, to understand the role of biodiversity in marine ecosystem health, and to investigate economic and social drivers in conjunction with natural processes. The FSTT report also emphasized the need for research on anthropogenic impacts on ecosystems and alternative management strategies. The workshop recommendations could be strengthened to cover these needs.

**SIMOR FSTT**

\*Page 14: This is one of the areas where both the issue of habitat connectivity and wetland/shallow water habitats really should be addressed more explicitly and in depth. Even where connectivity gets brief mention here, the examples given are broad, and mentioned only under "Challenges", not Research Needs.

**Talley, SF Bay NERR/ SFSU**

\*Page 14: (General comment on Ecosystem Health): Overall, the identified Research needs are extremely important if we are ever to address the growing list of Challenges before us. However, research needs must be tailored uniquely to each marine and Great Lake ecosystems.

**Western Pacific Regional Fishery Management Council**

Page 9-17. [NOTE: Repeated in Enhancing Human Health] Include a discussion of the connections/links between ecosystem health and human health in the sections on "Enhancing Human Health" and "Improving Ecosystem Health".

Page 14-17. "Improving Ecosystem Health" section needs to address the complex and dynamic nature of ecosystems.

**Yochem, HSWRI**

## **IMPROVING ECOSYSTEM HEALTH-PAGE/LINE SPECIFIC**

Page 14, Line 1 to Page 15, Line 27: To improve health, priorities for restoration of ecosystems health including research and development /testing of new health enhancement techniques. There are emerging and exciting new technologies particularly in the field of oyster restoration, coral reef restoration, reef restoration and erosion control (protecting ecosystem health).

**Reef Ball Foundation, Inc., Barber**

Page 14, Line 3: The vision of “Improving Ecosystem Health” leaves the impression that the challenges are protecting what we have. Rather, a much more formidable challenge is restoring already degraded ecosystems and rebuilding already depleted living resources. That should be implicit in “improving,” yet restoration is not mentioned in the vision nor is it a major scientific challenge. In many ways restoration is quite a different challenge, both because the ocean research community does not have as much knowledge about “putting Humpty Dumpty” back together again as it does about what happened to him in the first place and also because it provides different opportunities for experimental learning.

**CORE**

\*Page 14, Lines 4-6: Terms such as “marine ecosystem health” and “ecosystem integrity” must be explicitly defined if they are to be used. To the extent practicable, development of the definitions should be based on a facilitated, community-based and scientifically informed process for deciding the desired state of the ecosystem. Additionally, every effort should be made to quantify the threshold level at which “marine ecosystem health” and “ecosystem integrity” is compromised or negatively affected (e.g. percent coral cover falls below 20% of historical levels) and the specific activities contributing to the effect in order to determine the appropriate management response.

**Western Pacific Regional Fishery Management Council**

\*Page 14, Lines 4-9: Change the VISION statement to read “Research into...sustainability of these systems and the goods and services (including living marine resources) they support. Comprehensive, well-focused,...and to better predict, manage and mitigate impacts to ecosystems.

**Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

Page 14, Line 5: Insert after “the integrity. . . , *resiliency*, . . .”

**Shepard, University of North Carolina at Wilmington**

Page 14, lines 8-14. The term “ocean resource managers” should be expanded to include “ocean and coastal resource managers”.

**National Estuarine Research Reserve Association**

Page 14, line 9. Remove “better.”

**Scripps Institution of Oceanography**

\*Page 14, Lines 12-15: In terms of “interfacing”, atmospheric teleconnections (such as those caused by ENSO events) should also be mentioned here.

**Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

Page 14, line 12. Here and elsewhere, the authors have confounded marine ecosystems, coastal ecosystems and the Great Lakes ecosystem. See pg 2 of our comments.

**NOAA Fisheries**

Page 14, line 12: "Marine ecosystems ..... They range from deep ocean waters to Great Lakes, to coastal waters (including bays, estuaries, and wetlands)." Because of the important impact headwaters have on coastal and estuarine systems, we recommend including coastal watersheds in the description of marine ecosystems.

**NRDC, Suatoni**

Page 14, Line 13- The start of the sentence at the end of this line should read: Marine, **coastal**, and Great Lakes ecosystems...

**NOAA-NOS-Estuarine Reserves Division**

Page 14, Line 17-19: The end of this sentence should read: ...multitude of human activities occurring in the oceans **and inland**.

**NOAA-NOS-Estuarine Reserves Division**

\*Page 14, Lines 17-19: Strike “the” before oceans and add “and watersheds” to the end of the sentence, so it reads: “However, these ecosystems are finite and vulnerable to overuse or misuse from the multitude of human activities occurring in oceans and watersheds.”  
RATIONALE: From herring runs to pollution concerns, we are continually managing our resources with clear distinctions between land, river, and ocean. The impacts of development pressure and a variety of land-derived pollutants is poorly understood and inadequately linked to marine resources.

**Ford, Massachusetts Division of Marine Fisheries**

Pages 14-17, lines 1-11: Invasive species science and management merits much more attention

Pages 14-17, lines 1-11: Restoration science needs to be explicitly recognized as a major class of needed research.

Pages 14-17, lines 1-11: A major class of ecosystem service provider are so-called "ecosystem engineers," organisms that shape the environment through their ability to control the abiotic physical and chemical structure of ecosystems (e.g. coral reefs and kelp beds). The incorporation of this important concept into basic and applied efforts has yet be fully achieved, however, and more research is needed on the subject.

**Crooks, TR NERR**

Page 14, Line 19- This last sentence should read: The goods and services provided by marine, **coastal**, and Great Lakes ecosystems include: ...

**NOAA-NOS-Estuarine Reserves Division**

Page 14, Line 21-35: Four main goods and services are included in this section (from line 21 to line 35). It would be good to make mention about the great importance that coastal ecosystems have regarding coastal protection and as habitat and nursery grounds for many species of marine organisms, many of economic importance.

**NOAA-NOS-Estuarine Reserves Division**

Page 14, line 22. Marine photosynthesis is the original source of oxygen on Earth and has been in production for at least 2 billion years.

**COFS graduate students, University of Washington**

Page 14. Line 23. Add a sentence to the climate discussion as follows: The ocean and coastal environment buffers coastal communities against the effects of storms.

**CORE**

Page 14, line 22-23.

Oxygen production does not contribute to climate regulation, as implied here.

Page 14, line 27.

It's a bit of a stretch to directly relate all of the money expended on recreational boating (\$30 billion) to the improvement of ecosystem health. No need to overstate the importance.

**Schultz, CCSP**

Page 14, lines 25-28: The plan correctly points to tourism as one of the largest and most important economic sectors operating in the marine environment. However, this community has not become aware of its potential for impact. Tourism is seen mainly as a benefit to the environment because it supports less consumptive uses of ecosystems, particularly in parts of the world where humans have few sources of income. However, tourism can also affect ecosystem health through a variety of influences such as displacement of target and non-target animals from favored habitat (disturbance), artificial provisioning of opportunistic predators or other weedy species (e.g., chumming, for sharks), takes by collisions with recreational vessels (pleasure craft, hydrofoils, etc.), impact of fish-finding and navigational sonars, direct and indirect catch from recreational fishing, takes in nets set to protect swimmers, and punitive deaths of species that steal from recreational fishers. The Ocean Research Priorities Plan should recognize the important economic contribution of this industry, but also mandate responsible usage by supporting research on activities that have the potential to cause impact on marine biodiversity and ecosystem health.

**Bowles, Hubbs-SeaWorld Research Institute**

\*Page 14, Lines 28-30: This bullet confuses two modes of pollution control, i.e., isolation and dilution. A modest revision would be: "Coastal and deepwater ecosystems are often sites of solid and hazardous waste dumping in attempts to either isolate or dilute wastes that in some cases alter or destroy ecological communities."

**Jumars, University of Maine**

Page 14. Line 29. Insert after "wastes" "and filters pollutants from runoff"

## **CORE**

Page 14. Line 34. Insert the following sentence. Ocean and coastal habitats are spawning grounds, nurseries, shelter, and food for marine life, including a disproportionate number of endangered or commercially important species.

## **CORE**

Page 14. Line 36. Insert the following: Our ocean and coastal habitats are under increasing stress. According to the Ocean Commission “Over the past several decades the nation has lost millions of acres of wetlands, seen the destruction of seagrass and kelp beds, and faced a loss of significant mangrove forests.

## **CORE**

Page 15-16: 4 out of 5 Research needs for improving ecosystem health address coastal questions and phenomena. Infrastructure needs are almost all open ocean / deep water technologies. The infrastructure needs section needs to be re-written to identify tools and infrastructure to address coastal research.

## **Keough, USEPA**

\*Page 15, Lines 1-2: CHANGE SENTENCE BEGINNING “Advanced understanding ...” TO : Understanding of mismatches of scale of government and ecosystem scale (spatially and temporally) will enable redesign of management systems to address ecosystem health.

## **Miller et al**

Page 15 lines 3-4 says, "Human activities that are informed by scientific understanding will help ensure the sustained productivity...." But what is the evidence for this idealistic and naïve statement? If the governance systems are fragmented and the management systems are not scaled to address "patchiness" (eg sufficiently local) as well as sufficiently large in the case of highly migratory species, all the science informing the system won't make a any difference.

## **Miller et al**

Page 15, lines 7-26. Particular attention should be paid to human-driven effects on food web structure, for example the depletion of forage fish or other fish stocks through harvesting. Consideration should also be given to food web changes due to managed rebuilding of certain fish stocks, predators, or protected species

## **CCCHFA, Rudolph**

\*Page 15, Lines 7-27: I think a key challenge is missing – how can we identify parameters on the species or molecular level that can tell us how far anthropogenic compounds have disturbed a given species and/or ecosystem. For example, the threat of pharmaceuticals affecting the sex of fish near waste-water treatment plants dramatically affects ecosystem health, and the same holds true for other contaminants.

## **Lohmann, University of Rhode Island**

\*Page 15, Line 7:

- Add: "Understand the relationship among the pelagic ocean, coastal regions, and the watershed."
- Add: "Understand ecosystems as complex dynamical systems and develop a capability to predict their future state."

**NAML**

\*Page 15, Lines 7-27: The list of challenges should include basic data collection on the number of fishermen & vessels (recreational and commercial); quantify what they catch & land in terms of pounds from both the recreational and commercial sectors; quantify what they discard; quantify fishing effort; collect biological samples of the catch and discards (length, age & reproductive data); collect gut content data (for food web analyses); collect and related environmental data; and collect the necessary social and economic data from fishermen, dealers & retailers. We cannot make the jump to ecosystem management without first collecting basic data necessary for single species management.

**Waugh, SAFMC**

\*Page 15, Line 7: add the following (p. 15):

1. Valuing the marine environment.
2. Predicting human response to ecosystem change at multiple levels including industry, recreation, and conservation interest groups, the public, and policy makers.

**Miller et al**

Page 15. Lines 8-27. The concept of LME and the evolutionary nature of change from traditional fishery management to an ecosystem approach should be mentioned in this section. Also, mention the critical importance of appropriately conservative single species-based management in the current management of LMRs and its role in an ecosystem approach to management. **NOAA Fisheries**

Page 15. Line 11. Insert "restoration and" before the word "management"

Page 15. Line 12. This bullet reads more as a research need and should be included as such.

**CORE**

\*Page 15, Lines 12-15: ADD social, economic, political, legal

**Miller et al**

Page 15, line 15. After line 15, insert the following: "Human forcing often interacts with natural variations in climate, ocean circulation, sea level, and others in a synergistic manner, exacerbating the effects of population fluctuation (e.g. fishing or food web alternation) or hydrologic changes (via nutrient input, water removal, and coastal structures)."

**Scripps Institution of Oceanography**

Page 15. Line 20. Delete this bullet as it does not represent a challenge to improving ecosystem management.

**CORE**

Page 15, line 20: "Exploring the marine environment to identify and evaluate ecosystem products and services to enhance human life ... as well as the capacity of these ecosystems to provide such goods and services." We suggest adding - "in a sustainable, or non- environmentally destructive manner" at the end of the sentence.

**NRDC, Suatoni**

Page 15, lines 23-25; lines 33-37: Research priorities discussed here and in other sections of the document focus on the importance of resource extraction and use of marine habitats and the potential of these activities to produce impact. While they cite many examples of modifications such as contaminants and global temperature change, they do not explicitly include modifications to the sensory environment. Sensory regimes are as much a part of the environment to which species have adapted as water quality or temperature. Noise in the environment has recently garnered attention because it appears to produce deaths of some deep-diving species local to activities that produce noise. However, it can also degrade the environment over much larger areas. It has the potential to impact every aspect of marine vertebrate functioning, including communication, navigation, predator avoidance, prey detection, and overall physical health. Numerous National Research Council and agency reviews have cited lack of knowledge as the most important limitation in our current efforts to manage noise in the oceans. The sensory environment, including natural levels of light, noise, and chemical composition should also be a priority of future research efforts.

**Bowles, Hubbs-SeaWorld Research Institute**

Page 15, line 25. insert resource recovery after "human use"

**Algalita Marine Research Foundation, Francis and Moore**

Page 15. Line 28. Insert a new paragraph. Another key challenge is how to approach research needs for ecosystem affects that transcend environmental media, for example, the regional-global scale fixed nitrogen problem that is causing widespread degradation of U.S. coastal waters, depleting cations in forest soils, and affecting ozone hazards in cities.

Page 15, Line 29: Federal, state, and local agencies must expand cost-effective conservation and restoration programs according to a national research strategy that sets goals and priorities, enhances the effectiveness and coordination of individual efforts, and periodically evaluates progress. CORE recommends research in five areas—Marine Protected Areas, Sediment Management, Pollution Monitoring and Prevention, and Preventing the Spread of Invasive Species--that should be included in the ORPP to improve ecosystem health ocean through coastal habitat conservation and restoration.

**CORE**

\*Page 15, Line 29: add the following (p. 15):

1. Data collection on costs/benefits of various uses of the oceans

2. Perceptions studies need to be undertaken for all of these groups. Theoretical work on preference formation and learning would also be useful

**Miller et al**

Page 15, Line 33: If one uses the pressure/state/response approach for developing indicators for ecosystem health, then one needs to go beyond ecological status (state) to include pressure indicators (human induced stressors) and response of system to management actions to mitigate/reverse adverse effects from these stressors. This would allow a tie in to ecological risk assessment which links: Problem Formulation-Risk Analysis-Risk Communication-Risk Management.

**Dow- NMFS/NEFSC**

\*Page 15, Line 33 to Page 17, Line 4: In terms of Ocean monitoring, the US should take note of the long-term monitoring approaches of the UK – which have been used to demonstrate the changes resulting from climate change and can be used to model future changes. Once the strategic indicators have been identified, it is important to develop a catalogue of existing long-term monitoring sites. For example, numerous sites have been collecting data far longer than the National Estuarine Research Reserves for example. Here are just two CT examples. Barn Island Wildlife Management Area in Stonington CT has seen over 50 years of continuous tidal wetlands research including baseline vegetation mapping in the 1940's. Subsequent surveys are showing that this ecosystem is becoming wetter (a potential prelude to submergence and indicator of global warming?). Dominion (aka Millstone) has been monitoring temperature data and various estuarine habitats for 30 years – this is one of the few long-term datasets for the Sound and the temperature data are showing a statistically significant warming trend. It should be a national priority to have a national network of long-term monitoring sites – and therefore it would be useful to conduct a national survey to catalogue the long-term monitoring/research sites and then identify a national monitoring network to answer strategic questions.

**Rozsa, CT Depart. of Environmental Protection**

\*Page 15, Line 33 to Page 16, Line 10: It is a major oversight not to identify modeling in general and modeling in support of ecosystem-based, adaptive management in particular, as a high priority research need. This would include data assimilation.

**Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

\*Page 15, Lines 33-35: We've been doing this for at least 2 decades and there are a plethora of indicators in the published literature. The need now is to assess these indicators, determine which ones are best for each application, and specify data requirements.

**Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

Page 15, line 33: "Develop measurable indicator of ecosystem status ...." We view this as a very high priority. We would also include the assembling of historic data and "back-casting" to establish historic baseline information for these indicators in this research priority.

**NRDC, Suatoni**

Page 15, line 37: "Identify and characterize key ecosystem issues and threats to ecosystem status (e.g., occurrence of regime shifts, introduction of cycling contaminants ...)." Though this research need is critically important, it is overly vague as currently written. Sufficient information exists to identify the largest current threats to marine ecosystem structure and function. This plan should begin to prioritize these threats for directed research (e.g., overfishing, nutrient enrichment, climate change). The word "characterize" should be made clearer by identifying specific mechanisms of interest for each priority threat.

**NRDC, Suatoni**

Page 15, line 38. insert marine-debris, namely plastics after "cycling of contaminants"  
**Algalita Marine Research Foundation, Francis and Moore**

Page 16. Fishing vessels offer tremendous benefits as research platforms- they should be included in the list of assets which might contribute to IOOS.

**CCCHFA, Rudolph**

Page 16. Recommend adding a paragraph about cooperation with the international research community working on impacts of climate change on marine ecosystems, fishery management organizations, regional management organizations, and protected species organizations. A similar comment should be added to the next section on Expected Results.

**NOAA Fisheries**

Page 16, line 1.

An important issue to add to the final list is ocean acidification. However, no need to change the document here since what's given is an "e.g." list.

**Schultz, CCSP**

Page 16, line 5: "Establish research efforts that recognize ecosystem complexity and are addressed at the appropriate spatial ... and temporal scales ...." A central challenge to researching complex ecosystems is the statistical treatment of uncertainty. How one identifies, measures, and characterizes the various forms of uncertainty should be listed as a specific research priority.

**NRDC, Suatoni**

Page 16, lines 9-10. This research need should address the issue of relaying information to decision makers so that better, more informed decisions can be made.

**National Estuarine Research Reserve Association**

Page 16. Line 11. Insert the following new bullets:

- provide for a comprehensive research program for marine protected areas that results in the effective design, implementation, and evaluation of marine protected areas, to ensure that an area is appropriate for its intended purpose, including

periodic assessment, monitoring, and modification to ensure continuing ecological and socioeconomic effectiveness of marine protected areas;

- improve assessments, monitoring, research, and technology development to enhance sediment management and conduct coordinated strategies to better understand how contaminated sediment is created and transported;
- mandate a comprehensive national risk assessment, biological survey, and monitoring program for early detection of invasive species that includes the gathering of baseline taxonomic information; performing of quantitative assessments of ecosystems; identifying invasive pathogens and vectors of introduction; and determining how invasive species disrupt ecosystem functions; and
- a vigorous, coordinated research program on the fates and impacts of vessel pollution, the results of which should be used to guide management priorities, develop new control technologies, determine best management practices, and create more effective regulatory regimes as needed to improve U.S. ballast water technology, on-board ship-testing, and testing of experimental treatment systems.

## **CORE**

\*Page 16, Line 12: Improved shore-based facilities and infrastructure will be a critical component for all the studies conducted under this theme.

## **NAML**

Page 16, lines 13-16. The Integrated Ocean Observing (IOOS) will aid in the assessment of human impacts on key resource properties, however in addition to IOOS, research and all monitoring, and observing will be needed to determine changes at various time and spatial scales and to explain the mechanisms or determine the links to these changes. In addition, the elements of ocean and coastal observing should also include the tracking of essential habitats (e.g., tidal marshes, important benthic geophysical properties) for marine and estuarine species through remote sensing technology. This also requires a lot of research to identify what these essential habitats are so we can track them.

## **National Estuarine Research Reserve Association**

Page 16, lines 13-29. Recommend adding a paragraph about cooperation with the international research community working on impacts of climate change on marine ecosystems, fishery management organizations, regional management organizations, and protected species organizations. A similar comment should be added to the next section on Expected Results.

## **NOAA Fisheries**

\*Page 16, Lines 12-29: We strongly support continued development and implementation of an integrated ocean observing system that includes satellites, vessels (oceanic, coastal & internal waters), remote undersea vessels, buoys, and humans. We are particularly interested in seeing this implemented in the South Atlantic Council's area of jurisdiction to provide data necessary for our ongoing work developing and implementing a Fishery Ecosystem Plan.

## **Waugh, SAFMC**

\*Page 16, Line 12: add the following:

1. Data collection system (close to real-time) for costs/benefits
2. Models (either purely mathematical or agent based) of human behavior that may be linked to "ecosystem assessment products"

### **Miller et al**

\*Page 16, Lines 13-29: Critical needs are to sustain continuity of satellite-based Earth observations and to increase resolution (spectral, time and space) for coastal applications. This should be addressed.

### **Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

Page 16, line 13-16. Change to read: "The continued development and implementation of an integrated ocean observing system (IOOS), *including the NSF contribution, the Ocean Observatories Initiative (OOI),* are key components for assessing physical, chemical, *geological*, and ecological properties of marine ecosystems over time, as well as for assessing human impacts on key properties including productivity, diversity, and resilience."

### **Scripps Institution of Oceanography**

Page 16, lines 17-24. It would be economically beneficial to take into consideration the use of commercial fishing vessels as ocean monitoring systems and the benefits they could provide assisting with automated buoy maintenance. Fishermen have a vested interest in preserving and monitoring ocean health related to physical and chemical parameters. Teaching fishermen or training a technician how to operate basic electronics and having them deploy monitors on their gear will increase data available to scientists.

### **CCCHFA, Slifka**

Page 16, line 17-20. Change to read: "Key physical elements of ecosystem observing systems include ships for observing oceanic properties, satellite-based assessment of key surface properties, automated buoys *and autonomous vehicles (e.g. gliders)* to determine long-term trends in oceanic properties, *in situ* observatories in the ocean and on the seafloor, and a range of survey methods. Plans for deploying ~~these~~ *extensive* observation systems are in development."

### **Scripps Institution of Oceanography**

\*Page 16, Line 23: What is meant by "below the surface" needs to be clarified. I suggest: "especially below the sediment-water interface..."

### **Jumars, University of Maine**

\*Page 16, Line 31:

1. Better idea of both short-run and long-run economic costs of adjustment to ecosystem shifts
2. Better idea of both short-run and long-run *political* costs of adjustment to ecosystem

shifts

3. More practical expectations regarding the impact of new science on oceans policy

**Miller, et al**

\*Page 16, Lines 31 to Page 17, Line 11: We strongly support adding collecting data to the list.

**Waugh, SAFMC**

Page 16, line 34. Remove “specific.”

**Scripps Institution of Oceanography**

\*Page 16, Lines 36-38: See last comment on developing more indicators.

**Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

\*Page 16, Lines 37—38: These “squishy” ecosystem structural properties (that have been debated for over 30 yr as measures of ill-defined “ecosystem health”) likely will be replaced with measures of ecosystem function (e.g., net nitrification rate) over explicit time and space scales. Function and functional diversity are better foci for the future than is structure.

**Jumars, University of Maine**

\*Page 17: Also on page 17 the coastal and ocean research community should be developing materials, tools and processes to educate local, state and federal elected officials on the need for mitigation, not just response and recovery. Often times they do not understand the need to fund technologies because they don't the important, correlation or need. We have lots of tools for citizen education but the policy makers lack focused publications to generate leadership in these areas.

**Jones, DNR**

\*Page 17, Lines 5-6: Should include state governments.

**Jones, DNR**

Page 17, Line 8: The statement “methods for integrating marine biological data...” should read “methods for integrating marine biological data collection...” to reflect the need to collect biological information in a manner that is spatially and temporally consistent with the collection of physical and other data. WS Arnold, FWRI

**Arnold, Florida FWCC Fish & Wildlife Research**

## **SUSTAINING NATURAL RESOURCES-GENERAL**

Page 18. The section on „Sustaining Natural Resources% places an emphasis on fisheries resources, but fails to explicitly describe the impact of fisheries bycatch on overall ecosystem health. Fisheries impact ecosystems not only through direct harvest of target species but also by a nearly-equal and indiscriminate take of other species at all trophic levels, referred to as bycatch, or discards, depending on the type of species taken. The impact of non-target takes is poorly understood and deserves explicit emphasis in the Ocean Research Priorities Plan. Current evidence suggests that this impact can take decades to be fully appreciated and is part of a general trend in the continuing reduction of the marine ecosystem at upper trophic levels. Bycatch includes not only losses in active fishing gear such as trawls, gillnets, pots, and longlines, but also long-term losses caused by ghost, fishing gear. The extent of lost gear is usually unknown. In one documented assessment in the state of Florida, ghost gear from the blue crab fishery was estimated at a million lost pots. Monofilament fishing line used by recreational fishers also represents an important source of takes. Research on the effects of direct and ghost, bycatch are essential to understanding the cumulative impact of fisheries on the environment and also the causes of species declines.

**Bowles, Hubbs-SeaWorld Research Institute**

Page 18. Commercial fishing industry based surveys (IBS) should be an integral part of the assessment protocols for living marine resources. These surveys, especially in conjunction with research vessel based surveys, offer powerful information for stock assessments. Since mobile gear surveys, both industry and research vessel based, cannot survey hard-bottom areas effectively, fixed gear (ie. longlines and gillnets) should also be integrated into IBS. These tolls should be implemented on a long-term basis to develop time-series datasets.

**CCCHFA, Rudolph**

Page 18: Although the objective of the ORPP “is to formulate the priorities for ocean science and technology initiatives across the wide scope of societal interests,” and to identify “specific themes that would incorporate the scope of the use, impact, and interaction of the ocean, coasts, and Great lakes with society,” social and cultural, or anthropological sciences are poorly represented in the ORPP. The only explicit statement regarding these sciences is on page 19, line 28-29, which states that “A critical aspect of any decision-making process in resource management must be supported by research into the human dimension (i.e., economic, social, cultural).” However, the current list of themes does not identify a vision, rationale, challenges, or research needs for the human dimension. There are minimally three themes that must explicitly address this dimension: “Sustaining Natural Resources,” “Improving Quality of Life,” and “Mitigating Effects of Natural Hazards.” The human dimension could be more fully represented in the ORPP under the theme “Sustaining Natural Resources.” The majority of the text under the subheadings of this theme also applies to cultural resources, tangible and intangible, renewable and non-renewable. These resources may include historic and living waterfronts, archaeological resources, cultural landscapes, and maritime lifeways and

traditions. The title of this theme should be changed to “Sustaining Natural **and Cultural** Resources.”

Page 18. Cultural resources can be addressed within the “Sustaining Natural Resources” theme by explicitly including the word “cultural” within the theme title and statements. For example, page 18, line 25-26, could read “Healthy ocean and coastal natural [and cultural] resources provide the foundation for a huge coastal tourism industry that is continuing to grow rapidly.” Furthermore, page 19, line 38 and page 20, line 1-2, could read “Developing capabilities to map the extent and quantity of natural [and cultural] resources (both living and non-living) in marine, coastal, estuarine, wetland, and atmospheric (avian) systems, particularly across the EEZ and the delineated limits of the U.S. continental shelf.” Another example might be on, page 20, lines 33-36 “Different geographic regions inherently have diverse natural [and cultural] resources, such as abundant energy sources [and relict prehistoric landscapes and archaeological sites] in the Gulf of Mexico, a significant freshwater supply [and shipwrecks] in the Great Lakes, and large fisheries habitats [and historic/living waterfronts] off the East Coast, and thus various resulting management needs.” The goods and services provided by cultural resources are undervalued in terms of the benefits to quality of life and social stability. Therefore, it is recommended that cultural resources are also addressed in the theme “Improving Quality of Life.” Appropriate places to address these resources could be on page 36, lines 26-28: “The factors that underlie quality of life are the main focus of the U.S. Ocean Action Plan: economic productivity, human and ecosystem health, recreation, pollution mitigation, marine debris cleanup, and conservation of [cultural] resources”; and page 38, line 10-12, “Development of a computer-based geographic information system (GIS) that integrates diverse social, [cultural], economic, geographic, and environmental data, along with an information portal for integrated data dissemination.”  
**Claesson, University of New Hampshire**

Pages 18-22, lines 1-9: The role of Marine Protected Areas in conservation efforts needs to be addressed, including research into the development and management of such areas.  
**Crooks, TR NERR.**

Page 18. (NOTE: This comment is repeated in Improving Ecosystem Health) We need to concentrate on developing management strategies for use of marine resources that are robust to the high level of uncertainty about ecosystem processes and states and the state and productivity of specific marine resources such as fish stocks. Much of this uncertainty is unlikely to be resolved even with greatly increased research. Model based evaluation methods that explicitly address the uncertainty in ecosystem processes and states and in human responses to management actions can be useful in identifying management strategies that work reasonably well even when information is limited and very noisy and natural processes themselves are highly variable and unpredictable. Because many sources of uncertainty and variation may be correlated, we need to develop a better understanding of these correlations and attempt to include them in evaluation tools. An important aspect of this is understanding how individuals and groups respond to uncertainty in making decisions that affect resource use. This includes

individual decisions such as fishing location choice, whether to discard fish, etc., and group decisions such as how to set aggregate catch targets.

**Holland, Gulf of Maine Research Institute**

Page 18: (NOTE: this comment is repeated in Improving Ecosystem Health)

1) The need for basic science cannot be overstated. While advances have been made in the fundamental habitat mapping in the Northwest Hawaiian Islands and the Puerto Rico Shelf, many other regions remain woefully under-mapped. In addition, despite recent improvements in protocols and programs, a significantly greater investment is needed in basic biology to support stock assessments for target species. Current information on energy flow pathways (including predator-prey relations) and on the effects of changing habitat conditions in coastal and marine ecosystems remains inadequate to support effective management of complex marine ecosystems. Prioritization of efforts to fill those gaps in a timely and sensible way must be a key element of the national plan.

2) Important progress toward these goals can be achieved by fully implementing existing priority research plans developed by regional management entities. Specific examples of great importance include: 1) the Atlantic Coast Cooperative Statistics Program, 2) the research priority plans of the regional fishery management councils (including in the US Southeast the Oculina Banks Evaluation Plan, and the soon-to-be-completed Deepwater Coral Research and Evaluation Plan and Marine Protected Area Evaluation Plan), 3) research priority plans of the interstate fishery management commissions (as laid out in their fishery management plans and related documents) and 4) research priorities of the national estuary programs.

3) While improved coverage is recommended in several of the documents listed above, special attention is needed to quantify bycatch relationships in existing and developing fisheries with priority given to improving observer coverage in all fleet components. In addition, investments must be made to improve the accuracy and timeliness of information related to recreational fishing mortality.

4) A concerted effort is needed to identify and characterize deepwater resources in the US EEZ, with special emphasis on areas subjected to existing deepwater fisheries or potentially subjected to developing frontier fisheries.

5) Finally, a major investment is required in social science to support the development of an adequate understanding of the forces which drive decision-making in natural resource using populations including commercial and recreational fishers, necessary to develop more holistic management programs.

**Environmental Defense, Rader**

Page 18-21. Most of the rationale and challenges associated with sustaining natural resources are coastal (EEZ and continuous inshore waters). None of the description addresses the Great Lakes, yet the GL provide important natural resources for sport fishing and some commercial fishing, as well as clean water for drinking and other uses. Over half of the research needs address coastal issues. The infrastructure needs are too heavily weighted toward open ocean technology, when all of the changes and ecosystem activity is in the coastal zone. Suggest this section be re-written to recognize the needs for information in coastal waters.

**Keough, USEPA**

\*Pages 18-19: **Challenges** (implied but not specified in text -- add):

1. Dealing with inherent uncertainties, either due to stochastic or deeply complex phenomena

See ecosystem health. In fact, the links between these two themes could be substantially enhanced.

**Miller et al**

\*Page 18:

- Essentially, this section takes the view that sustaining natural resources will be accomplished by better models, better assessments, greater technology, better environmental data, an ocean observation system, and vague references to risk management. While these are important, investment in science and technology alone will not be sufficient in sustaining vital resources.
- This section should address crises facing many of our marine fisheries, the ecosystems in which they reside, and/or an acknowledgement of the root causes for their decline.
- Sustaining natural resources is not only about managing the resource; it's about managing people, now the top predator in virtually all ocean ecosystems. The only element of coastal ecosystems we can control is human behavior. Ecosystem-based approaches to management will fail if we do not include humans as part of the ecosystem, including their economic and sociological motivations. This section should address the roles of economics, sociology, and political science in developing plans for sustainable use of living resources.
- The mining of non-living, non-renewable resources should not be lumped in with exploitation of living resources in this section. Doing so may inadvertently portray a lack of understanding of the real issues that confront the development of ecosystem-based sustainable practices.
- Aquaculture should be adequately addressed in this section, given that (1) there is legislation pending that would permit major offshore aquaculture operations on the continental shelves, (2) aquaculture is now approaching half of the seafood supply, and (3) it represents a significant component of the U.S. trade imbalance.
- NAML facilities are part of the social fabric of the communities in which they are embedded. NAML institutions are uniquely positioned to understand both the ecological and social impacts of changes in resource abundance and to communicate with stakeholders, the public, and policy makers about the need for changes in societal impacts on ecosystems.
- The human dimensions of "sustainability science" cannot be overlooked in the oceans anymore than they can on land or in the atmosphere. NAML can play an important role in this arena.

**NAML**

Page 18-22: It might be useful to include some discussion of the "precautionary" approach to making coastal and ocean resource decisions in the face of continued uncertainty about impacts from multiple sources. This plan seems like the appropriate

place to mention this kind of effort and the appropriate means to educate new audiences on its use.

There should be more discussion about how to establish and evaluate Marine Protected Areas.

Related to ecosystem services and the importance of doing research to increase understanding and valuation: it is being increasingly recognized that a major class of ecosystem service provider are so-called "ecosystem engineers," organisms that shape the environment through their ability to control the abiotic physical and chemical structure of ecosystems (as opposed to food webs). Major marine ecosystem engineers include oysters, corals, and kelp. There is a common set of principles which will allow us to understand how these species shape abiotic systems, and subsequently, other species. It is not yet a well-developed field, though, but it will behoove us to work more on this (eventually bringing it on par with the body of work related to trophic dynamics).

This chapter should include more discussion related to determining the carrying capacity of coastal water bodies, separating natural variability from anthropogenic impacts, and how coastal communities are being changed from traditional uses by new development.  
**NOAA-NOS-Estuarine Reserves Division**

Page 18. Recommend adding a paragraph about the importance of evaluating ecosystem health at the LME scale.

**NOAA Fisheries**

Page 18: Combining all resource extraction in this section (renewable and non-renewable, living and non-living) results in unnecessary generalizing and vagueness relating to challenges and research needs. Because the research needs for these different resources are often very different, we suggest subdividing this section and addressing the different resource groups separately.

**NRDC, Suatoni**

**Societal Theme: Sustaining Natural Resources**

**To what extent are the gaps FSTT identified in this theme from Draft 0 still present in the Planning Document?**

**The JSOST Planning Document is generally consistent with the research priorities for living and non-living resources identified by the Task Team.**

- Both the JSOST and Task Team place a high priority on the collection of baseline information to document and map the extent and quality of habitats and living resources throughout the marine, coastal, estuarine, and atmospheric environment encompassed by the US EEZ.
- In addition, both JSOST and Task Team place a high priority on the characterization of biological resources, assessments of fisheries stocks, prediction of the impacts of human activities on ecological interactions, recovery of depleted populations, and enhanced modeling and forecasting capabilities.

- Consistent with the Task Team recommendations, JSOST has also added the understanding of the cumulative impacts of human activities to the list of priority research needs.

**Four specific categories of research needs or gaps were identified by Task Team that are not addressed by the JSOST Planning Document.** These include:

- **Baseline Surveys:** assessments of marine and estuarine biodiversity and non-indigenous species; greater understanding of nutrient dynamics in estuaries and nearshore waters; development of marine bioproducts and pharmaceuticals; and continued exploration of poorly studied and novel marine habitats.
- **Sustainable Fisheries:** new research on bioaccumulation of toxins in fishery species; evaluation of special marine managed areas / marine protected areas as fishery management tools; and control of fishery and aquaculture diseases.
- **Coastal Land-Uses:** scientific approaches to restoration, remediation and enhancement of marine and estuarine habitats; improved understanding of sediment supplies, erosion, and beach nourishment; and progress with hydrodynamic circulation and discharges from adjacent uplands.
- **Infrastructure for Science and Management:** Comprehensive ocean monitoring and research plan; development of molecular biosensors; and implementation of the ocean observing system

**The JSOST Planning Document differed from the Task Team report by specifically identifying advancement of strategies to allow for transition from non-renewable (e.g., fossil fuels) to renewable (e.g., wind, waves, current, thermal, tides) energy sources, while simultaneously assessing their economic and ecological impacts. The JSOST Planning Document also identified the need to develop spatial resource evaluation tools for renewable energy as a priority research need.**

**How well are the workshop recommendations for this theme aligned with both the FSTT Report on research priorities and the FSTT comments on Draft 0?**

- The Workshop participants held a common view with the Task Team in their recognition of the need for an improved socio-economic framework and governance structure that can integrate science and human activities into an ecosystem-based approach to ocean resource management.
- The workshop participants also agreed that the high priority research needs include assessments and monitoring of the status and condition of marine and estuarine habitats and living resources; enhanced capabilities for modeling and ecological forecasting; improved understanding of the cumulative impacts of human activities; and integrative studies that focus on the interface of oceans, estuaries, watersheds, and the atmosphere.
- Neither the JSOST Planning Document nor the workshop participants identified the Task Team priority for marine and estuarine biodiversity assessments and surveys of the extent, distribution, and spread of aquatic non-indigenous species.

**SIMOR FSTT**

\*Page 18, Sustaining Natural Resources: Once again, the impact of global warming on the resources in the ocean is must be emphasized in the planning for oceanographic research. The impact of ocean acification was not even mentioned in this section. This can potentially have a huge impact on the food chain in the ocean.

**Thompson, University of Washington**

Page 18: Coastal development and sprawl:

- o Develop/rapidly implement improved smart growth polices for coastal development
- o Include a strong coastal research program aimed at land/water conservation for our nation's future generations
- o Develop/implement economic studies to monitor the impact of insurance policy change by insurance companies.
- o Fund other economic studies of coastal ocean/offshore economic impacts

**Wall, USF**

\*Page 18: The rationale section (page 18) does not mention the health benefits of a seafood diet, which is important to recognize when discussing the values of sustainable marine resources.

The rationale section (page 18) should also include a conservation ethic of not exporting environmental problems to other nations or regions. This section is very U.S.-centric, but what we practice here should also be practiced in other areas. For example, implementing no-take marine reserves that curtail U.S. fisheries production often increases seafood imports from areas or nations that likely do not practice sustainable fishing methods, or methods to reduce bycatch or protected species interactions. We should encourage (perhaps through seafood labeling) that imported seafood be harvested using sustainable practices.

**Western Pacific Regional Fishery Management Council**

Page 18-22. "Sustaining Natural Resources" section needs to address the complex and dynamic nature of ocean and coastal ecosystems. It needs to include a discussion of the social and economic forces that drive anthropogenic impacts on ocean and coastal resources.

**Yochem, HSWRI**

## **SUSTAINING NATURAL RESOURCES-PAGE/LINE SPECIFIC**

Page 18, Line 1 to Page 19, Line 39: Nowhere in the document are included any priorities for physical restoration of ecosystems are research and development /testing of new restoration techniques. There are emerging and exciting new technologies in the field of aquatic reef restoration including the use of designed artificial habitats.

**Reef Ball Foundation, Inc., Barber**

\*Page 18, Lines 4-9: Developing the scientific basis (including models) needed to engage in ecosystem-based, adaptive management should be mentioned in the vision statement. This is a high priority as articulated in the Ocean Commission report.

**Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

Page 18, line 4: "Our management of the diverse use of the ocean's renewable and non-renewable living and non-living resources will be guided by resource and ecosystem assessment and prediction ...." We are pleased to see that resource use will be guided by ecosystem assessment. Direct reference to Ecosystem Based Management may make this section more clear.

**NRDC, Suatoni**

Page 18. Line 6. Delete the word "based" and insert "adverse and sustainable"

**CORE**

Page 18, Line 6: Replace "risk-based" with "risk-assessing."

**Jumars, University of Maine**

Page 18, Line 12: The Rationale section should include an overarching paragraph that creates a sense of urgency and frames the problems related to natural resource management. CORE suggests the following addition.

Page 18. Line 12. Insert: "Over the last thirty years, our ocean resources have suffered--overexploitation of many fish stocks and degradation of habitats have had negative consequences for too many ecosystems and fishing communities. Recent reports regarding the world's fish populations suggest that commercially and recreationally important creatures, such as tuna, marlin, and swordfish, have decline by as much as 90%. Globally, fisheries discard 8 percent of the total catch—that's 7.3 million tons of marine life thrown back into the sea dead or dying. Worldwide, 25 to 30 percent of the world's major fish stocks are overexploited. To ensure the long-term sustainability of U.S. fisheries, maximize social and economic benefits, and conserve ecosystem integrity and marine biodiversity fishery management must be improved. Fisheries management must move toward an ecosystem-based approach, but that will require better information about the ecosystem and its various components, it will also require better integration of ecosystem data in improved collection and processing of such data."

**CORE**

Page 18. Lines 12-32. Recommend adding a paragraph about the importance of evaluating ecosystem health at the LME scale.

## **NOAA Fisheries**

\*Page 18, Line 12: The word “wealth” should be replaced by the word “benefits.”

### **Western Pacific Regional Fishery Management Council**

Page 18, line 18. Section on Rationale: In the bullets it is noted that 2006 revenue is \$70 billion from oil and gas production, and that the total market value is \$6 trillion. Suggest adding that over the next 100 years our \$80 billion fishery (commercial and recreational) would be worth \$8 trillion to the US economy. A more technical and comparable value would be to provide the net present value of the living and non-living resources

### **NOAA Fisheries**

\*Page 18, Line 22-23: **Rationale.** The present high economic value of the fishing industry hides the fact that this is a commercial industry that has a long history of being very badly managed. The fisheries commissions charged with responsibility for managing the world’s great fisheries have largely based their decisions on modeled predictions obtained from data. It is an elementary fact of logic that decisions together with goals (such as Maximum Sustainable Yields) and standards (such as the precautionary principle) cannot (i) be reduced to facts or data or (ii) be produced from facts or data.

### **Corkett, Dalhousie University**

Page 18, lines 23-24. “Aquaculture provides a large and increasing proportion of our seafood supply” does not do this topic justice. Farmed fish and shellfish production has increased dramatically in recent years, doubling worldwide in the past 15 years and now providing approximately one-third of all fish consumed by humans. Our nation is currently importing more than \$11 billion worth of seafood annually resulting in a negative balance of \$8 billion; legislation is pending to partially address this trade imbalance by encouraging increased domestic production via major offshore aquaculture operations in the U.S.

### **Yochem, HSWRI**

Page 18, Line 27-29: This sentence states that “the ocean’s systems provide incalculable services”. This plan should highlight the importance of supporting continuing research to estimate values for those services. By estimating these values we will better understand the services that ocean’s systems provide and the costs of losing them.

### **NOAA-NOS-Estuarine Reserves Division**

Page 18, Line 32: Insert after “tidal). . .and new marine natural products, . . .”

### **Shepard, University of North Carolina at Wilmington**

Page 18, Line 34: The challenges provided under this theme are comprehensive and adequately reflect those related to Sustaining Natural Resources; however, for consistency CORE recommends that they appear in a bulleted format similar to the other themes.

## CORE

Page 19. An additional challenge is the need to integrate the various marine statutes. The Marine Mammal Protection Act and the Magnuson Stevens Fishery Conservation and Management Act focus on single-species management and in some case have conflicting objectives. To improve better resource conservation and management a more effective and efficient governance structure must be developed that both integrates the various marine resource statutes and policies and facilitates interagency collaboration and management. In the end, efforts to reduce overexploitation of ocean resources, restore habitat, and conserve and manage natural resources must be ecosystem-based, precautionary, and adaptive, using risk-adverse conservation and management models.

## CORE

\*Page 19-20: **Research Needs (in addition to those mentioned above):**

1. Explore organizational structures in decision-making systems (see Walsh 2004)
2. Search for alternatives to risk assessment in decision-making (see O'Brien 2002)

**Miller et al**

\*Page 19, Lines 7-8: **Challenges** Under a rational method of resource science the distinctive roles of resource manager and social scientist have to be better understood. Just as the laws of physics guide the physical engineer by explaining what cannot be accomplished so the situational logic of a theoretical economic model shows the resource manager what cannot be achieved and should not therefore be attempted.

**Corkett, Dalhousie University**

Page 19, line 8. After line 8, include the following text:

“Healthy ecosystems require successful recruitment of all key players. Fundamental to this is knowledge of connectivity among populations: its intensity, variability and forcing mechanisms. Identification of recruit sources, sinks and ideally, larval trajectories is necessary to insure that regulatory, conservation, observing and monitoring efforts are most effective. Because most marine populations rely on planktonic larvae, ocean physics, hydrology and biology play a major mechanistic role in determining the transport and fate of larvae. Large-scale efforts are required to link these disciplines to answer connectivity questions. A variety of genetic, oceanographic and chemical approaches exist, many in early developmental phases (e.g., trace elemental fingerprinting; numerical simulation of larval movements). A concerted effort is required to integrate the approaches and generate the information necessary for research to reflect reality (e.g., larval behavior; surf zone dynamics). We need to create a generation of scientists capable of communicating across disciplines to answer these questions. Student training programs, support of interdisciplinary research and cross-agency funding must all contribute. The outputs of this research are applicable to:

- fundamental understanding of how populations persist and evolve,
- regulating fished resources,
- managing the introduction, establishment and spread of invasive species, and
- design of marine reserves regulation of human activities (habitat modification, water quality etc.)”

Include a Paragraph break here.

**Scripps Institution of Oceanography**

Page 19, lines 9-19. These lines indicate that improving our understanding of the oceans will result in improved resource management. While additional research, assessment, and monitoring will certainly help inform resource management, this discussion should also emphasize that improving resource management will also require a better way to incorporate the best and most recent research findings into policy and regulation.

**National Estuarine Research Reserve Association**

\*Page 19, Lines 9-12: The use of “magnitude” is confusing. While do not know actual abundance of fish populations, much work has been conducted on the relative abundance of many fish populations. In addition, there is adequate understanding of trophic relationships based on food web models. What we don’t know is the response of species to depleted predators or prey and how that affects ecosystem function, if at all.

**Western Pacific Regional Fishery Management Council**

Page 19, line 12. after sentence insert: We need to identify human induced geographic “hot spots” for the production of litter and marine debris and better characterize trash in urban runoff

**Algalita Marine Research Foundation, Francis and Moore**

Page 19, line 12. After “Improvements” add “and enhancements”, as we need both “better technology” and more Days At Sea to achieve our mission.

**NOAA Fisheries**

Page 19, line 12-14: "Currently, our ability to assess, and by extension manage, commercial and non-commercial resources is limited by our lack of understanding of the magnitude of those resources ... Improvements are needed to our existing observing systems (e.g., ships, remote sensing systems, personnel) as well as to our modeling capabilities, including model development and computational resources." Because this sentence refers directly to the need to improve our "understanding of the magnitude of these resources", it should include direct reference to the need for basic fish population data. Without baseline population data, the value of improved modeling capabilities and an improved understanding of environmental variables to resource management can not be realized.

**NRDC, Suatoni**

\*Page 19, Lines 14-15: **Challenges.** Under a rational method of resource management the reliable assessments of individual fisheries will depend on an objective assessment of (i) the decisions and policies that have been taken and (ii) the goals that have been chosen. The goal has to be chosen by management and the policy developed by management before these decisions can be assessed by the evidence – a management method known as ‘trial and error’ or ‘decision and feedback’. Quite simply decisions and norms cannot be predicted they have to be taken.

**Corkett, Dalhousie University**

Page 19, line 15. There is an inconsistency in the way LMRs are referenced (i.e., individual fisheries, avian resources, and protected species). Suggest: "...allow for reliable assessments of populations of living marine resources (e.g., fish, shellfish, pinnipeds, cetaceans, seabirds, marine turtles, marine plants, etc.). Original implies US citizens don't utilize protected species (e.g., bowhead whales, sea ducks), which of course isn't true.

**NOAA Fisheries**

Page 19, lines 18-19. We need to advance our resource understanding, forecasting, and adaptive resource management to incorporate the results of new findings quickly and efficiently.

**National Estuarine Research Reserve Association**

\*Page 19, Line 24: Remove the superfluous "and" at the end of the line.

**Jumars, University of Maine**

Page 19, lines 28-29. The plan states that, "A critical aspect of any decision-making process in resource management must be supported by research into the human dimension (i.e. economic, social, cultural)," yet there are no research goals linked to this statement.

**National Estuarine Research Reserve Association**

Page 19, line 28-29: "A critical aspect of any decision-making process in resource management must be supported by research into the human dimension (i.e., economic, social, cultural)." The inclusion of this notion in the very last sentence of this section reads as an after-thought. Because understanding the human dimension of resource use is vitally important to establishing sustainable management, the specific challenges that this research faces should be more explicitly detailed.

**NRDC, Suatoni**

Page 19, Line 31: For living marine resources, ocean research priorities should foster a policy that allows decision-makers to meet the needs of the present generation without compromising the ability of future generations to meet their needs. As part of an ecosystem-based management regime, marine biodiversity is a priority and downward trends in marine biodiversity should be reversed where they exist, with a desired end of maintaining or recovering natural levels of biological diversity and ecosystem services. Overall the various federal agencies responsible for resource management should move toward comprehensive synoptic ecological biodiversity surveys rather than individual stock assessments for fish and marine mammals. Research must better elucidate the cumulative impacts of human use of ocean resources.

**CORE**

Page 19, lines 32 through Page 20, line 37. This critical section requires more focus on basic understanding of natural resources. There should be a clear requirement for research toward:

- understanding the biology, ecology, and life history of important species and the ecosystem resources that support and affect them.
- investigating the causal relationships among ecosystem resource productivity, habitat quality and quantity, oceanographic and climate processes, and natural and anthropogenic stressors that affect ecosystem resources.

## **NOAA Fisheries**

Page 19, line 32. At the beginning of the “Research Needs” section, include the following:

“The US continental margins (200-4000 m) encompass a vast area of ocean floor with a diverse array of ecological settings and an enormous biological diversity: sediment-covered slopes, steep canyons, gullies and seamounts, ledges and plateaus, methane and hydrocarbon seeps and coral mounds. The margins are also a growing area of anthropogenic influence. Activities such as fisheries harvest, habitat modification associated with fishing, oil and gas exploitation, sewage and dredge spoil disposal, inadvertent waste introduction, and minerals mining are all intensifying, placing increased pressure on margin ecosystems.

Within the US, biological research on continental slope ecosystems has been spotty and limited in focus, with the most thorough taxonomic studies conducted by the MMS in areas of oil and gas lease. Many areas of the US continental margin remain unexplored, in part because few researchers have focused on these settings within recent decades.

The high heterogeneity of slope systems guarantees the existence of habitats, organisms, biochemical pathways and many fragile ecosystems that have yet to be discovered. At present there are a limited number of scientists with the skill and training to conduct biological research in this environment; the majority will retire within the next decade. This is partly because funding and research in the deep-sea have focused largely on reducing environments such as hydrothermal vents and seeps, or on geological and geohazard aspects of margins. The US research community has fall far behind the Europeans and Japanese in its ability to address basic and applied scientific research questions related to continental margins.

There is a growing imperative to focus US research on our margin habitats, ideally through a multiagency initiative directed towards the exploration, understanding, and protection of margin ecosystems in US waters. This should involve sharing of resources and expertise across agencies responsible for margin activities, with the ultimate goals of supporting exploratory and integrative field efforts, promoting basic research on the dynamic processes specific to margins, addressing security needs, collating environmental and taxonomic data bases, and training a new generation of scientists to address pressing margin issues. Agencies such as the US National Science Foundation, the Office of Naval Research, NOAA (National Marine Fisheries Service, the National Underwater Research Program, the Office of Ocean Exploration, SeaGrant), the Minerals Management Service, the Department of Energy, and the US Environmental Protection Agency all should be considered as possible participants in a concerted biological margins initiative. Such an initiative would provide fundamental efforts towards

sustaining the health of ecosystems and populations in US territorial deep-water environments.

Specific issues that could/should be addressed on US Continental margins are:

- Consequences of fishing pressure on the health and stability of margin ecosystems. Effects of predator loss, substrate modification, biogenic structure alteration, and rates of population and ecosystem recovery are all issues that need attention.
- Distribution, rate of formation and resilience of vulnerable habitats including those likely to be modified by energy (oil, gas, methane hydrate) exploration and exploitation.
- Consequences of anthropogenic input of sediments, hydrocarbons, other chemical contaminants, and organics via intentional dumping, spills and river flooding.
- Effects of natural and anthropogenically induced hypoxia on community structure and stability.
- Contributions of margins to global biodiversity, and the functional consequences of this diversity for nutrient cycling, carbon burial and secondary production.
- Interaction of margin species, habitats and ecosystems (transfers of energy, organisms, materials) to promote understanding of how changes in one setting affect the others.
- Documentation of species ranges, rates of gene flow, and connectivity of populations, particularly those subject to exploitation.
- Identification of margin ecosystem stressors and indicators of ecosystem health.
- Documentation of natural spatial and temporal scales variability in populations and communities (from small to large scales) and response to climate change.”

#### **Scripps Institution of Oceanography**

\*Page 19, Line 38 to Page 20, Line 2: “Developing capabilities to map the extent and quantity of natural resources (both living and non-living) in marine, coastal, estuarine, wetland, and atmospheric (avian) systems, particularly across the EEZ and the delineated limits of the U.S. continental shelf.”

COMMENT: Strong agreement with this need.

#### **Ford, Massachusetts Division of Marine Fisheries**

\*Page 19, Lines 38 – Page 20, Line 31: This section does not capture the emphasis of both ocean commissions’ reports on ecosystem-based management. It sounds too fragmented and too much like business as usual. I recommend a leading bullet something like: Through concerted efforts in modeling, data assimilation, prediction and measurement, developing a documented ability to manage resources at the ecosystem level.

#### **Jumars, University of Maine**

\*Page 19, Line 38 to Page 20, Line 2: We need to map the extend and quantity of natural resources not merely develop the capabilities to map.

## **Waugh, SAFMC**

Page 20-21: General Comment: Research needs section should include a socioeconomic component related to overcapacity (too many boats chasing too few fish) and latent capacity (vessels not currently fishing, but which have licenses to fish if the stocks recover). Moving towards an ecosystem approach to management (EAM) for living marine resources (LMRs) will probably include spatial management techniques which will necessitate better understanding of the characteristic spatial/temporal scales of environmental drivers and harvesting by commercial/recreational fishermen/women in relationship to the distribution/abundance of the LMR populations (fish and protected resources).

## **Dow- NMFS/NEFSC**

Page 20, lines 1-31. Additional discussion is needed related to determining the carrying capacity of coastal water bodies, separating natural variability from anthropogenic impacts, and how coastal communities are being changed from traditional uses by new development.

## **National Estuarine Research Reserve Association**

Page 20, line 1. Remove “atmospheric (avian)”. Avian are part of the living natural resources.

## **COFS graduate students, University of Washington**

Page 20, lines 2-17. Suggest adding mention of traditional data collection methods, such as trawl surveys.

## **NOAA Fisheries**

Page 20, line 2. At the end of line 2, insert the following:

“There is an increasing realization, at least for research in the deep sea, that advances in are greatest when intellectual, financial and infrastructure resources are shared across countries. The Census of Marine Life has played a major role in bringing scientists together from around the world, to identify key scientific issues and develop collaborative programs to address them. Several such working groups address the deep sea: CeDAMar (abyssal plains), ChEss (chemosynthetic ecosystems), CoMARGE (continental margins) and CenSEAM (seamounts), Mar ECO (Mid Atlantic research). These programs generate international collaborative field programs, global data bases, and extensive outreach efforts in multiple languages. While the Census does not provide research funds, it makes possible the exchange of information, systematic expertise, and in some cases field access on an international scale that is unprecedented. US participation in these programs should be encouraged and where possible, links to US research, funding and intellectual resources should be facilitated.”

## **Scripps Institution of Oceanography**

Page 20. Line 3. Insert at the beginning of the sentence “long-term and sustained characterization of” and delete “characterizing”

## **CORE**

Page 20, Lines 3-4: habitat characterization of biological resources should include both structural and functional components.

**Dow- NMFS/NEFSC**

Page 20, lines 3-4: "Characterizing habitats of biological resources, both temporally and spatially ...." In addition to identifying and characterizing habitats of particular concern for fish populations, which we view as a high priority, the impact of fishing on these habitats should be researched.

Page 20, line 5: "Examining predator-prey and competitive interactions among species, and predicting the impacts of human activities on these interactions and overall community structure." We view this research as a very high priority and a necessary line of research to move towards an ecosystem based approach to fisheries management.

**NRDC, Suatoni.**

Page 20, lines 5-6. Management mandated and/or induced changes in biomass structure are a good example of research direction in this area. For instance, the implications of spiny dogfish rebuilding in the northwest Atlantic could be examined for effects on predator-prey relationships and competitive interactions with other stocks.

**CCCHFA, Rudolph**

Page 20, lines 5-6. Clarify the type of human activity, e.g. commercial activity, managed vs unmanaged.

**COFS graduate students, University of Washington**

\*Page 20, Lines 5 & 6: We need to conduct gut content studies to provide data to examine predator-prey and competitive interactions. Too much emphasis is being placed on conducting analyses and computer simulations and not on basic data collection/research.

**Waugh, SAFMC**

Page 20. Line 7. After the term status, insert "of ocean resources"

**CORE**

\*Page 20, Lines 7-9: **Research Needs** Under a rational method of science the empirical evidence takes the logical form of a premise. The only way this premise can be transformed into useful information 'supporting management' is by taking the form of a potential falsifier, the higher the number of potential falsifiers that contradict the fishery model the more potential information that is available to management. The theoretical models of fisheries economics, for example, are NOT fitted to data. They are universal. They give the manager an understanding of the prejudicial nature of derby fishing. This world wide understanding is not limited in time and space by being derived from a particular database obtained from a particular stock.

**Corkett, Dalhousie University**

Page 20, Lines 7-9: stock status information should be linked to spatial distribution (historic versus current range); essential fish habitat (EFH) layers in the water column and on the bottom; and distribution/abundance of prey species.

**Dow- NMFS/NEFSC**

\*Page 20, Lines 7-9: “Developing more complete and timely information on stock status, with a focus on user friendly data integration and dissemination formats to enable the transformation of data into useful information supporting management.”

COMMENT: Strong agreement with this need.

**Ford, Massachusetts Division of Marine Fisheries**

Page 20, lines 7-9. The plan states that there is a need to “focus on user friendly data integration and dissemination formats to enable the transformation of data into useful information supporting management.” This phrase should be related to an overarching goal of ocean education.

**National Estuarine Research Reserve Association**

Page 20, lines 7-9: "Developing more complete and timely information on stock status ...." The need for improved basic data on fish populations can not be overemphasized. Stock status is unknown in 2/3's of federally managed fish stocks. This research need should receive highest priority. The minimum requirements for achieving this goal are commitments to supporting the acquisition of fishery independent data (e.g., trawl surveys), improved estimations of total catch through sufficient observer coverage, and improved methodologies for estimating recreational catch. In addition, population structure and spatial distribution of fish populations are important factors in determining effective management techniques - particularly if spatial management techniques are going to be pursued. We recommend that these specific research needs be explicitly stated in the ORPP due to their high importance.

**NRDC, Suatoni**

\*Page 20, Lines 7-9: Developing more complete and timely information on stock status should be expanded to include basic data collection on the number of fishermen & vessels (recreational and commercial); quantify what they catch & land in terms of pounds from both the recreational and commercial sectors; quantify what they discard; quantify fishing effort; collect biological samples of the catch and discards (length, age & reproductive data); collect gut content data (for food web analyses); collect and related environmental data; and collect the necessary social and economic data from fishermen, dealers & retailers. Information on basic growth rates is also needed. We cannot make the jump to ecosystem management without first collecting basic data necessary for single species management.

**Waugh, SAFMC**

Page 21, line 8. Referring to migrating birds and schools of fish as biological parameters is overly simplistic. Either delete the parenthetical phrases after “biological” and “physical” or clarify (e.g., biomass of commercially important fish, trends in abundance of seabirds, etc.)”.

## **NOAA Fisheries**

Page 20, lines 11-14: "Concurrent management aimed at recovering depleted populations to their sustainable optima through living resource management activities and technological development to increase efficiency and decrease impact may also be necessary." We agree that "rebuilding" science and investigations of bycatch reduction techniques are high priority.

**NRDC, Suatoni**

Page 20, line 11-14. Change to read: "Concurrent management aimed at recovering depleted populations ~~to their sustainable optima~~ *to the extent allowed by their natural variability* through living resource management activities and technological development to increase efficiency and decrease impact may also be necessary."

**Scripps Institution of Oceanography**

Page 20, Line 12 to Page 21, Line 37: I find the use of the word 'optimal' in this section concerning. Optimum sustainable yield has a long and checkered history in fisheries biology—and has ignored species interactions. The 'optimum' for fisheries yield for a particular species and the 'optimum' populations for ecosystem integrity including non-commercial species could be different things. These are dynamic systems and understanding the dynamics is important. I would avoid using the term 'optimal' altogether and just use the word 'sustainable'.

**Mann, University of Florida**

\*Page 20, Line 15-17: "Understanding the cumulative impacts of human activities (e.g., exploration, development, extraction, and enhancements such as aquaculture) on water quality and the ocean's ability to support living marine resources."

COMMENT: This implies that status-quo in resource extraction and human impact on resources will be considered acceptable. Every ocean resource document must address, examine, and encourage both understanding and improving human decision-making, from water use, to boating, to purchasing eco-friendly technologies, thereby lessening our impact on oceans and watersheds. How do we turn around the extremely short-sighted decisions made by most or all of us on a daily basis? Small behavioral changes in large populations can have dramatic results.

**Ford, Massachusetts Division of Marine Fisheries**

Page 20, line 15-17. Change to read: "Understanding the cumulative impacts of human activities (e.g., *transportation, recreation*, exploration, development, extraction, and enhancements such as aquaculture) on water quality and the ocean's ability to support living marine resources."

**Scripps Institution of Oceanography**

Page 20. Line 16. Insert "and habitat" after "water"

**CORE**

Page 21, line 19. Expected Results: As was the case for the last section, a reference should be made to the need to cooperate with international organizations responsible for sustained management of natural resources.

**NOAA Fisheries**

Page 21, line 21. Here is where the full reference to “ocean, coastal, and Great Lakes” is used, while in other areas it is referred to as “ocean” or “marine” ecosystems. Be consistent with reference to footnote or not.

**NOAA Fisheries**

Page 20, line 21: "Enhancing modeling and forecasting capabilities, incorporating multiple living and non-living resources and multiple uses." This statement is too broad. Particularly important aspects of modeling capabilities should be detailed. Of particular importance is the treatment of uncertainty in population and management analyses.

**NRDC, Suatoni**

Page 20, lines 29-31. It should be articulated in the plan that this research need will only help support more robust policy frameworks if the information is delivered in such a way that promotes not only understanding but also action.

**National Estuarine Research Reserve Association**

\*Page 20, Lines 29-31: We need to need to collect basic social and economic data. Too much emphasis is being placed on conducting analyses and computer simulations and not on basic data collection/research.

**Waugh, SAFMC**

Page 20. Line 31. Add the following new bullets:

- improve information on fish stock status and health, socioeconomic impacts of management measures, sustainability of fishing practices, identify essential fish habitats and important habitats in such a way as to define optimum-sized areas to protect vulnerable life-history stages of commercially and recreationally important species;
- acquire data on all by-catch of species captured by commercial and recreational fisheries, assess the broad ecosystem impacts of bycatch, and develop conservation engineering to help reduce the impacts of fishing on ecosystems; and
- conduct research, monitoring, and assessments to better understand the basic biology, physiology, life history, and population dynamics of marine mammals, sea turtles, and other endangered or vulnerable marine species and improve our response to and understanding of the causes of strandings and unusual mortality events of marine mammals and sea turtles to better understand how disease, contaminants, harmful algal blooms, ocean acoustics and noise, human activities and other stressors may impact these animals.

**CORE**

\*Page 20, Line 32:

Include: Coral reefs are an important ecosystem that supports significant economies and diverse forms of life in U.S. waters, as well as internationally. The research priorities plan needs to include dealing with this declining resource.

- ❖ Focus an ocean observatory on coral reefs, spanning the NW Hawaii islands to the Florida Keys

Coastal development and sprawl:

- Develop and rapidly implement improved smart growth polices for coastal development
- Include a strong coastal research program aimed at land/water conservation for our nation's future generations
- Develop/implement economic studies to monitor the impact of insurance policy change by insurance companies.
- Fund other economic studies of coastal ocean/offshore economic impacts

**Muller-Karger, USF**

Page 20, line 32. Include: Coral reefs are an important ecosystem that supports significant economies and diverse forms of life in U.S. and international waters. The research priorities plan needs to include protecting, preserving, and reserving this declining resource.

- o Focus an ocean observatory on coral reefs, spanning the NW Hawaii islands to the Florida Keys

**Wall, USF**

Page 20, line 36. Remove "resulting."

**Scripps Institution of Oceanography**

\*Page 21: **Infrastructure/technology (in addition to those mentioned above)** (p. 21):

1. Models of organizational decision-making that may be linked to user/conservation/public models and "ecosystem assessment products"

Additional output:

2. Better use of adaptive research efforts and management protocols.

NOTE: This section is generally less well articulated than previous sections. Fewer specifics in all elements. Partly due to overall skew toward physical sciences, but also because these issues have not been dealt with very well in studies of environmental economics/policy. There is a lot of work to be done here.

**Miller et al**

Page 21, lines 1-7. The stated inadequacy of the national fleet of research ships could be remedied through increased use of fishing vessels- they are versatile, well-equipped, cost-effective research platforms.

**CCCHFA, Rudolph**

Page 21, lines 1-17. There should be a discussion concerning the connection/calibration between new sensor development, primarily biological sensors, and historical techniques of data collection. For instance, if new sensors are developed to determine abundance and

distribution of fisheries stocks, how does the new data compare to historical data collected utilizing nets and trawling gear.

**National Estuarine Research Reserve Association**

\*Page 21, Lines 2 & 3: We need to expand basic data collection/research. Too much emphasis is being placed on conducting analyses and computer simulations and not on basic data collection/research.

**Waugh, SAFMC**

Page 21. Line 3. Prior to the end of the sentence add: “ and refine existing analytical methods and develop additional means to assess species abundance and identify habitats critical to sustainability and biodiversity goals.

**CORE**

\*Page 21, Line 3: Drop one of the periods.

**Jumars, University of Maine**

\*Page 21, Lines 6 & 7: We need to also include human resources so we can collect basic data and conduct basic research.

**Waugh, SAFMC**

Page 21, Line 10: Insert after “expand the. . . *fleet and. . .*”

**Shepard, University of North Carolina at Wilmington**

\*Page 21, Lines 10 to Page 21, Line 12: We strongly support including biological and chemical sensors as well as advanced acoustics to enhance fish surveys. Remote observing systems including advanced acoustics could also enhance enforcement. We also support vessel monitoring systems for data collection and enforcement.

**Waugh, SAFMC**

Page 21. Line 12. Insert a new paragraph. There is also the need for research into technology and conservation engineering programs to help reduce the impacts of fishing on ecosystems and a high priority should be placed on those programs that investigate ways to reduce bycatch in fisheries that interact with endangered species.

**CORE**

Page 21, Line 19: The “Expected Results” section is vague. More concrete statements are needed.

**Arnold, Florida FWCC Fish & Wildlife Research**

\*Page 21, Line 20: Supposedly, I guess, the research outlined here will be conducted “in conjunction” with that outlined in “Improving Ecosystem Health.” How will this be done? Unless this is addressed explicitly, the next 10 years will be business as usual.

\*Page 21, Line 20 to Page 22, Line 10: Expected results should be the development of models needed to support ecosystem-based management and the specification of their data requirements.

## **Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

Pages 21-22, lines 20-9. Rather than promising “higher and more sustainable fishery yields...”, which is not likely, suggest alternative language such as “more predictable and manageable yields that maintain ecosystem integrity and function.”

### **NOAA Fisheries**

Page 21, Line 33: Besides examining the effects of fishing on target species, it is important to examine the impacts of bycatch of prey forage fish species (non-target) on the target fish/species, since these non-target species are part of the pelagic Essential Fish Habitat of the managed species.

### **Dow- NMFS/NEFSC**

Page 21. Line 33. Insert after “structure” the phrase “and the ecosystem as a whole”

### **CORE**

\*Page 21, Line 33: It is speculative to say that we expect results that say fishing efforts permanently alter fisheries’ population structure. The word “permanently” should be replaced by “may.”

### **Western Pacific Regional Fishery Management Council**

Page 21, lines 34-36. Cautionary analysis of the potential effects of offshore aquaculture on wild living marine resources and the industries which depend on them would be advisable.

### **CCCHFA, Rudolph**

Page 21. Line 34. Delete the phrase “Higher and more”

### **CORE**

Page 21, Line 34-37: The phrase ‘higher and more sustainable’ is a bit like having your cake and eating it too. There are limits on fishery yields related to how much energy is entering the food web. We have clearly already exceeded maximum fishery yields. I recommend deleting the word ‘higher’.

I would also delete the reference to ‘expanded production from offshore aquaculture’ or minimally qualify it with the word ‘sustainable’. Elementary ecological principles would argue that offshore aquaculture based on the culture of fish at higher trophic levels would be unsustainable if the fish have to be fed other fish. To effectively increase fishery yields, offshore aquaculture would have to focus on the culture of fish at lower trophic levels.

Habitat Alteration: One of the issues that I could not see specifically addressed in this section was habitat alteration/destruction from fishing activities, particularly trawling.

### **Mann, University of Florida**

Page 21, lines 34-37: "Higher and more sustainable fishery yields from the US EEZ, including expanded production from offshore aquaculture, improved management of living resources including reduction of overfishing to ensure sustainability, and restoration of fisheries and protected species to their optimal population sizes." We suggest making it more clear that "higher and more sustainable fishery yields" is the result of rebuilding depleted stocks. In addition, we recommend that investigations of the risks of expanded production of offshore aquaculture, in addition to thorough cost-benefit analyses, be conducted prior to its implementation.

**NRDC, Suatoni**

\*Page 21, Lines 35-36: **Expected Results** A reduction of overfishing to ensure the sustainability and restoration of the fisheries will only be achieved with a better understanding of the role rational method plays in decision making. Presently a decision making in the fisheries is flawed in three basic ways:

1. Management decisions have been guided by models that model fish populations (and more recently describe ecosystems); while we need to understand fish populations and ecosystems, these are not the models needed to guide political and management decisions; social science models, universal models that allow us to understand the prejudicial behavior of derby fishing, are needed for guiding management decisions.
2. Management decisions have been guided by positive predictions; while positive predictions (such as a prediction of the weather) exist, these are not the predictions based on evidence that are needed to guide decisions; negative predictions, conditional predictions that outline what cannot be achieved are needed for guiding policy decisions.
3. It has been generally assumed that the goals and standards of the fisheries may be reduced to facts or data. Fishery goals (such as sustainability) and fishery standards (such as the precautionary principle) form normative laws (not scientific laws); like decisions, normative laws or norms reflect the values of the proponents and cannot be produced from, or be reduced to, facts or data.

**Corkett, Dalhousie University**

Page 22, lines 1-9. One of the expected results of this new information should be the ability to differentiate between the natural variability of biological communities and anthropogenic impacts.

**National Estuarine Research Reserve Association**

Page 22, Line 5-7: To support an Ecosystem Approach to Management (EAM), one needs to develop indicators of both ecological health and management effectiveness if one plans to utilize an adaptive management approach.

**Dow- NMFS/NEFSC**

\*Page 22, Lines 8-9: “A better-informed public with the next generation of ocean scientists and resource managers leading an integrative resource management-science approach.”

COMMENT: “A better-informed public” is an awfully general statement. How about “A reduction in human impact to the coastal environment through improvements in human decision-making.”

**Ford, Massachusetts Division of Marine Fisheries**

\*Page 22, Lines 8-9: The phrasing here is ambiguous. If I guess correctly, it means: A better-informed public and a next generation of ocean scientists and resource managers who will integrate scientific understanding into resource management.

**Jumars, University of Maine**

Page 22, Line 8-9: This last bullet regarding “a better informed public” should be integrated within each section of the plan more strongly. This is one of the efforts where the long-term change in expectations/decisions starts.

**NOAA-NOS-Estuarine Reserves Division**

## **PROMOTING MARINE OPERATIONS-GENERAL**

\*Page 23: Focus on improving multimodal systems

**Muller-Karger, USF**

\*Page 23:

- Improvements to maritime efficiency and safety through improvements to routing, search and rescue, sea state prediction, sea level, etc. will lower transportation costs and expand trade, among other things.

### **Air Pollution**

- As ship operations become concentrated in load centers around the world, we need improved methods of reducing ship-generated pollutants (NO<sub>x</sub>, CO, SO<sub>x</sub> and particulates); these load center ports absorb a disproportionate air pollution burden.
- The political nature of this problem is that the U.S. and other major trading nations have considerable clout in the International Maritime Organization (IMO) in London, the body that sets air emission standards worldwide for the shipping fleet. Those standards need to be strengthened by the IMO for carriers to significantly improve their emissions.
- Another effect of load centering is that these same seaports absorb a disproportionate burden of traffic congestion (and therefore, air pollution) as marine freight movement is concentrated in fewer, larger seaports. Ocean research in this respect intersects with terrestrial transportation research funded by the U.S. Department of Transportation and those connections need to be made stronger.

### **Dredging & Dredge Material Disposal**

- There is a national crisis for seaports as they struggle to find methods of disposing of contaminated sediments created by both construction and maintenance dredging. U.S. policies for disposal place the financial burden for landside disposal on local governments, many of whom cannot afford the high cost of remediation techniques. There is a crying need for low-cost remediation technologies as well as a need to consider deep-ocean disposal of these materials.

### **Integration of Seaport Planning into Coastal Management**

- Many U.S. states give only lip service to integrating seaport plans into their coastal management regimes. Additional emphasis should be placed on having states develop comprehensive seaport plans and then in integrating those plans into their coastal management regimes.

### **Abatement of Invasive Species in Vessel Ballast Water**

- Regional ballast water abatement schemes are needed for coastwise traffic (traffic that does not sail sufficiently offshore to exchange ballast water according to federal standards). Moreover, close-in (closer than 200 nm offshore) areas need to be identified where it is safe to exchange ballast water and those areas need to be identified on U.S. navigation charts.

### **Abatement of Invasive Species in Cruise Ships**

- Because of frequent port calls and coastal routes, cruise ships pose a particularly nettlesome problem for ballast water exchange. The industry needs a technique that will allow these vessels to bunker in port and yet abate the invasive species contained within their ballast tanks.

### **Create Centralized Clearinghouse for Maritime Transportation Research**

- The Transportation Research Board and the Marine Board of the National Academy of Sciences currently are the leaders in promoting marine transportation research. Their role should be strengthened but also better linked to the larger marine research community. Issues that are apparently obvious to the marine science community often have unforeseen consequences on the marine transportation community and vice-versa. There needs to be better communication between researchers working different sides of similar problems.

### **Short-sea Shipping – Port Issues**

- There are a multitude of opportunities and problems posed by the use of greater numbers of smaller freight handling vessels serving small seaports and linking them to the constellation of load center ports around the world. This is a movement that is gaining traction and additional research is needed to address issues of distribution of invasive species, navigation hazards from increased ship traffic, pollution from undercapitalized operators, new and innovative propulsion technologies, new and efficient vessel design and port and harbor design to accommodate these vessels.

### **Short-sea Shipping – Landside Issues**

- Short-sea shipping may also have a landside component where cargo is quickly moved from load centers to inland destinations for sorting and routing to distant consignees. Additional research is called for in this area to discern whether these techniques are effective at ameliorating the impacts on load center ports.

### **Railroads**

- A robust rail network can ameliorate some of the impacts of a heavy marine freight burden on coastal cities that are major ports entry. How much of an infrastructure investment would be required to upgrade existing rail routes to accommodate full double-stacked container service at high speeds? What is the role of the federal government in facilitating these new or expanded rail links? A number of major U.S. coastal ports are already burdened by inadequate rail links. If marine freight is expected to double by 2020, then this is a critical issue for freight movement in the country.

### **NAML**

Page 23-26: The theme “Promoting Marine Operations” does not seem to flow as well as other themes within the document and it seems out of place. It may be the title of the section, or the emphasis on national security, but it is questionable if a research plan is an appropriate document for the type of discussion presented here?

## NOAA-NOS-Estuarine Reserves Division

\*Page 23 - I do not want to "promote" marine operations. They are already destructive. They should in fact be cut. We should be making and producing here in the U.S. more of what we use. The trade is too big and too environmentally destructive. The international merchandise must be cut. I object to any "tripling" of U.S. trade by 2020. Use of oil and gas is polluting our air/water and soil.

**Sachau, private citizen**

### **Societal Theme: Promoting Marine Operations**

**To what extent are the gaps FSTT identified in this theme from Draft 0 still present in the Planning Document?**

- The Task Team recommended clarifying the title of this section to either omit the word "Promote" or add a word like "Sustaining" after "Promoting". Others had made this recommendation, as well. **Neither of these changes was made in the Planning document.** Also, other titles are given on the JSOST website and in other places for this section (e.g. Marine Transportation and Security).
- Most other Task Team identified gaps were incorporated, either verbatim or combined with other identified gaps.
- **Specific outstanding issues that remain unaddressed in the Planning document include:**
  - Port retrofit/expansion/development plan issues related to the environment. Many of the key issues identified in the JSOST paper (e.g., introduced species, pollution, safety, security, dredging) are important to coastal managers in making port-related decisions.
  - Creating a stronger information bridge between the research and management communities must be a priority.

### **How well are the workshop recommendations for this theme aligned with both the FSTT Report on research priorities and the FSTT comments on Draft 0?**

Eight of twelve 'Consensus' workshop recommendations on marine operations are in some way aligned to either the Task Team report, comments, or both, as noted below:

- Minimize negative impacts on ocean ecosystems (e.g. pollution, noise, ship strikes, introduction of invasive species, etc) (*Task Team Report and Task Team Comments*)
- Improve the efficiency, operations, and maintenance of new and existing harbors and ports (*Task Team Comments*)
- Increased security protection, safer and higher-efficiency MOPS, and improved environmental protection (*Task Team Report & Task Team Comments*)
- Increased capacity of ports to meet the demands of domestic and international trade in an environmentally-sustainable manner (*Task Team Comments*)
- Improved understanding of how MOPS affects the marine ecosystem; and the integration of that knowledge into decision-making
- Impact of MOPS on ecosystems and development of mitigation strategies (*Task Team Report and Task Team Comments*)

- Improve sediment transport models to establish rapid, efficient and environmentally-sustainable dredging operations (*Task Team Report and Task Team Comments*)
- Tools to simulate “What If” scenarios to determine the impact on MOPS (*Task Team Report and Task Team Comments*)

Specific outstanding Task Team issues that remain unaddressed in the Planning document or any of the workshops output include:

- Complete development of a comprehensive Digital Oceans and Coasts database for use in decisions on pipeline routes and platform locations, improved navigational safety and decreased environmental impact from marine operations (*Task Team Report*).
- Develop integrated oil and other hazardous material spill trajectory and decision support models to improve prevention and recovery (*Task Team Report*). (Note: there is one example given in the Plan of a short-wave radio-based mapping of surface currents and waves having oil spill trajectory as an ancillary benefit; however, more attention could be paid to developing tools.)

**SIMOR FSTT**

## **PROMOTING MARINE OPERATIONS-PAGE/LINE SPECIFIC**

Page 23, line 20-21. Remove bullet “A strategic scenario of a terrorist event conducted in 2002 demonstrated the potential for \$60 billion in losses in the case of a closure of all ports in the nation.” The likelihood of this sort of a comprehensive terrorist action is so small as to challenge credibility.

**Scripps Institution of Oceanography**

Page 23, line 37. “...the majority of our commerce (by weight) moves by ocean” should be modified to “is moved by ocean-going vessels”. Also, should “commerce” be replaced by “goods”?

**NOAA Fisheries**

\*Page 24 - As to navigation safety - it is clear negligence in shipping is rampant. Every day there is another oil spill in our waters. Every single day. Sometimes twice a day. We need much higher fines paid promptly for any spill. We need bonds set up front to pay those fines immediately. Exxon still has not paid up from the Valdez thirty years ago. Why this horrendous situation when their exec just retired with hundreds of millions of dollars in payout?

**Sachau, private citizen**

\*Page 24: The section ‘Research Needs’ (page 24) should include research to investigate integrating existing systems such VMS and AIS, or other systems could be used for both enforcement as well as maritime safety. Integrating technology reduces the economic burden on the users.

**Western Pacific Regional Fishery Management Council**

\*Page 24, Lines 5-22: We strongly support identification of all fishing vessels. We are currently exploring options to require vessel monitoring systems on all commercial vessels and some sort of vessel identification capability on all recreational vessels.

**Waugh, SAFMC**

Page 24. Line 7: Provide an example of the type of data and information products needed in this challenge.

**CORE**

Page 24, line 13. insert marine debris (specifically plastic) between, “dredged materials,” and “invasive species”

**Algalita Marine Research Foundation, Francis and Moore**

Page 24. Line 15. Insert at the beginning of the sentence: “Improved efficiency, operations, and maintenance of new and existing harbors and ports and...”

**CORE**

\*Page 25 - I see "investigations" and "endless research" proposed. This is unnecessary. What is really needed here is action!!!!!!!!!!

We need high fines for whale strikes, etc. These vessels all have systems to prevent strikes - they should fear not using these systems to avoid strikes. How about vessel seizures?

Stop studying pollution. We know enough already to take steps now - not an eternity down the road.

**Sachau, private citizen**

\*Page 25, Line 1-4: “Investigating interactions of marine operations with marine life...”

COMMENT: I recommend this be changed to “Improved assessments of activity for marine life that is vulnerable to shipstrike and/or marine noise (e.g. migratory birds, whales, turtles, etc) is needed. This should include an increased capacity of ships to identify and avoid such marine life. These activities should be focused on sensitive areas such as the Great Lakes, coastal areas with low tidal exchange, coral reef systems, and areas with whale activity.”

**Ford, Massachusetts Division of Marine Fisheries**

Page 25. Line 5. Delete the word “identifying” and insert at the beginning of the sentence: “Improving sediment transport models to establish...”

**CORE**

Page 25, Line 16: CORE concurs with the recommends workshop participants generated that include the following:

- Advanced sensor and technology development (autonomous, persistent)
- Tools to simulate “What If” scenarios to determine the impact on MOPS
- Expand the national complement of oceanographic research vessels, satellites, autonomous underwater vehicles and unmanned aerial vehicles
- Rapid assessment methods of detecting marine contaminants/pollutants and harmful non-indigenous species
- Expand the use of high-frequency radars along the coast to monitor, record and present real-time current data in near-shore environments
- Long-term observing systems that are transportable and relocatable; that collect data anywhere on the globe as needed.

In addition, the future success of ocean and coastal research, management, enforcement, and observations in the United States will depend on the availability of modern ships, undersea vehicles, aircraft, satellites, laboratories, and observing systems, as well as the continuous development and integration of new technologies into these facilities. The nation needs a renewed commitment, a clear national strategy, and significant interagency coordination to plan for the acquisition, maintenance, and operation of our ocean infrastructure and technology. The IOOS, along with traditional expedition-based research, requires the support of a modern and capable research fleet. Most currently operating research vessels will be obsolete in less than 10 years, which leaves little time

for planning, funding and building the next generation of research vessels. CORE recommends that the ORPP include in this section the following bullets:

- a dedicated funding stream for critical ocean science infrastructure and technology needs related to ocean and coastal research, conservation, management, operations, and enforcement—specifically the creation of a modernization fund in the NOAA, NSF, and DOD budgets that will support renewal of the University National Oceanographic Laboratory System (UNOLS), NOAA fleets, the international ocean drilling ship, and new manned and unmanned submergence vehicles;
- a national ocean and coastal infrastructure and technology strategy that includes an assessment<sup>4</sup> of all U.S. federal, state, academic, and private ocean and coastal infrastructure and technology;
- a detailed plan (that would be updated every five years) for funding and implementation to support science, resource management, assessments, enforcement, and education; and
- specific priorities for acquiring and upgrading ocean and coastal infrastructure, including vessels, facilities, instrumentation, equipment, and identification of emerging technologies that should be incorporated into agency operations.

## **CORE**

Page 25, line 20-21. Re: item (3), developing automated and autonomous bottom mapping capabilities for change detection to improve rapid, full-scale survey scheduling. This has been done.

### **Scripps Institution of Oceanography**

\*Page 25, Line 26: “also contribute to tracking ships, improving search and rescue, and provide....”

### **Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

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<sup>4</sup> The assessment should include the location, ownership, availability, remaining service life, and replacement cost for a wide range of ocean infrastructure assets: □maintenance and operational costs associated with these assets; associated human resource needs and the outcomes of past federal investments in ocean technology and infrastructure, with recommendations for improvements.

## **THE OCEAN'S ROLE IN CLIMATE VARIABILITY AND CHANGE-GENERAL**

Page 27. Commercial fishermen are uniquely positioned to study and steward the marine environment. In particular, they are concerned about the effects of climate change on their livelihoods and the ocean. They could potentially be a major resource in this area, monitoring ocean conditions and living resource parameters (ie. range shifts).

**CCCHFA, Rudolph**

Page 27. The changing pH of the oceans is an important area of research in dire need, as well as interspecific interactions between organisms and populations that will change with environmental variables.

Page 27. The need for new observations to develop, set initial and boundary conditions and validate models is not adequately addressed. Also the distinction between operational and predictive models is not made.

**COFS graduate students, University of Washington**

Page 27: 1) While good work by NOAA and others has begun to improve our understanding of the implications of global warming for some large-scale oceanic ecosystems, considerable investment is required in the science needed to understand and predict the cascading implications of these processes for smaller-scale coastal ecosystems all around the United States. Changing current patterns, rising seas and altered salinity patterns have profound implications for the health and integrity of those systems, and for the prospects for recovering and maintaining component species. Special attention should be placed on those systems that are dominated by coral-related faunas, or by other faunas with cross-shelf ontogenetic movement, where vulnerabilities are especially high. Examples include tropical mangrove/coral reef ecosystems, but also Southeast and Gulf estuaries.

2) A major gap exists in our knowledge of discrete events that so profoundly shape the coastal zone. Major new scientific capacity is needed to build and support the next generation of models to enhance prediction of episodic events, and their cascading ecological consequences.

3) Implications of changing conditions in the sea for carbonate skeleton builders deserves immediate investment, both for shallow-water and deep-water forms.

**Environmental Defense, Rader**

U.S. CLIVAR is the U.S. national contribution to the international CLIVAR (CLimate VARIability and Predictability) project of the international World Climate Research Programme (WCRP). The CLIVAR program aims to improve our predictive understanding of climate variability and predictability on seasonal, interannual, decadal, and centennial time-scales, through the collection and analysis of observations, as well the development and application of models of the coupled climate system. The aims of our program also include improving our capabilities to monitor and predict the earth's coupled climate system. In practice, CLIVAR encourages and coordinates scientific and programmatic activities in support of these goals.

Overall the ORPP document describes compelling research needs in a number of focused areas. The Climate theme chapter does a fair job in motivating and summarizing research needs. The priorities for this chapter should emphasize:

- 1) Completing and sustaining the global ocean observing system, both in-situ and satellite components. The continuation of critical ocean observing capabilities from space is no longer certain. This document and the subsequent implementation plan should aim to identify responsibilities amongst the federal agencies (and others) on building and sustaining the ocean observing system. Transitioning observing responsibilities across agencies (e.g. from NASA to NOAA) has shown little sign of success for oceanography. Finally, the data from the systems as well as informative data-based and model-based products must be routinely accessible by the wider community – a capability not yet developed.
- 2) Developing improved numerical models (which describe various aspects of the ocean), coupled climate prediction systems, and assimilative frameworks which synthesize observations and models to produce informative products.
- 3) Coupled to these efforts must be a healthy and vibrant basic research enterprise that sustains the long-term improvement of predictive capabilities and tools by exploring and testing new hypotheses, improving our fundamental understanding of the ocean in the context of the coupled ocean-atm-land-ice system, and guiding future development and refinement of the observing system.

Finally, the ocean is a global feature. The ORPP must recognize the need to coordinate activities with those from other countries. CLIVAR and the WCRP stand ready to continue their roles in coordinating international research and observational efforts. Our connections to sister programs within WCRP that focus on the cryosphere, the global water and energy cycles, as well as to other research programs focusing on marine ecosystems, marine forecasting, and the carbon cycle will contribute significantly to the visions described in the ORPP.

**Legler, U.S. CLIVAR Office**

\*Page 27: An additional research element should focus on human influence on the climate and how that in turn affects the oceans. It is a feedback loop and without considering that humans are accelerating climate change is to leave out a large piece of the puzzle. Changes in our actions will change the system and that needs to be studied and incorporated into global climate models.

**McDevitt, FWC**

\*Page 27:

- This section is comprehensive and consistent with the Climate Change Science Program that has been vetted by the academic and federal research community.

**Key regions:**

- Coastal/continental margins should be highlighted as a key location where present uncertainty is preventing further improvements in estimates of oceanic CO<sub>2</sub> uptake and prediction of future atmospheric CO<sub>2</sub> levels and climate.

**Processes and research needs:**

The following should be emphasized:

- Advancing the analysis of the paleoceanographic record. Without an improved record, predicted change cannot be placed in a temporal context.
- Acidification of the surface ocean and potential impact on species composition.
- Sea water - pore water exchange and interactions with CaCO<sub>3</sub> minerals which represents the long-term capture capacity of the ocean through neutralization of anthropogenic CO<sub>2</sub>.
- Possible destabilization of hydrates along continental margins.

#### **NAML**

Page 27-31: Understanding how ocean and coastal ecosystems **respond** to climate change is as important as understanding their role on climate change and variability. This chapter should reflect necessary research needs to address this gap. The main theme could then be renamed to read: “The ocean’s role and response to climate change and variability”.

Page 27-31: The role of coastal waters and habitats gets no mention in this chapter, despite the fact there is recent interest in the role of wetlands in methane production, and that coastal habitats affect, to some degree, much of the flow of carbon and freshwater to the ocean, which is mentioned in this section as important to the global carbon cycle. Clearly, including some mention of coastal habitats is needed here.

Page 27-31: Again, this chapter seems to be missing a stronger coastal component, which is of great interest to coastal managers (i.e., climate change impacts on coasts, etc.). Although there is some mention in this chapter, it could be described in better detail to address priority coastal issues (i.e., coastal habitat “squeeze” or land loss as a result of development in the upland and sea-level rise at the water’s edge, changes in fishery productivity, etc). This is an example where the use of the word “ocean” is likely misleading to certain readers.

#### **NOAA-NOS-Estuarine Reserves Division**

##### **\*Page 27-31: The Ocean’s Role in Climate Variability and Change**

See ecosystems & resource management

Again, there is no reference here to human response, either to new information resulting from the proposed studies or the expected events themselves. Perceptions, economic impacts, policy, and organizational studies are all indicated.

**Miller et al**

##### **Societal Theme: The Ocean’s Role in Climate Variability and Change**

**To what extent are the gaps FSTT identified in this theme from Draft 0 still present in the Planning Document?**

- The Planning Document incorporates many of the critical elements identified by the Task Team, including:
  - the need for developing and integrating observing systems for coastal regions and their linkage to adjacent watersheds, specifically to support expanded forecasting capabilities and prediction of effects of sea level change and storm intensity and frequency; and

- the need for better understanding of climate impacts on marine ecosystems, including coastal and estuarine habitats, and advances in ecosystem forecasting to enhance ecosystem-based management of marine living resources.
- The Planning Document also recognizes the importance of better prediction of major climatic events to allow adequate lead-time for adaptive measures and long-term planning of coastal infrastructure and land use, important priorities identified by resource managers.
- **A priority identified by the Task Team which was not as well addressed in the Planning Document, and therefore should continue to be identified as a gap between resource managers' research needs and issues identified by JSOST, is the interrelationships among land use, predicted climate change, freshwater inflow and nutrient and pollutant loading.**
- A challenge identified by both the Denver Workshop participants and the Task Team, but not clearly articulated in the Planning Document, is the need for sufficient understanding to allow separation of natural variability and anthropogenic effects as related to climate and oceans.

**How well are the workshop recommendations for this theme aligned with both the FSTT Report on research priorities and the FSTT comments on Draft 0?**

- Both the Planning Document and the Workshop participants addressed a number of priorities identified by the Task Team, including:
  - the need to better understand and predict large-scale non-linear behavior, such as abrupt climate changes or “tipping points”;
  - improved understanding of key regional ocean and climatic processes, especially polar, tropical and coastal areas; and
  - translation of research results to information easily accessible to resource managers and decision makers.

Neither Workshop participants nor the Planning Document identified the Task Team priority of the need for better understanding of interrelationships between land use, freshwater inflow, and climate change and variability.

**SIMOR FSTT**

\*Page 27: Again, the role of coastal waters and habitats gets no mention here, despite the fact there is recent interest in the role of wetlands in methane production, and that coastal habitats affect, to some degree, much of the flow of carbon and freshwater to the ocean, which is mentioned in this section as important to the global carbon cycle. Clearly, including some mention of coastal habitats is needed here.

**Talley, SF Bay NERR/ SFSU**

\*Page 27, The Ocean's role in climate variability and change: In this section, once again, the impact of climate change in ecosystems was not emphasized enough. The impact of ocean acidification was not discussed. The role of the ocean as a sink for Carbon and heat has become of secondary importance as we know that global warming is occurring. Regional impacts of climate change are becoming more important.

**Thompson, University of Washington**

**THE OCEAN'S ROLE IN CLIMATE VARIABILITY AND CHANGE-**  
**PAGE/LINE SPECIFIC**

Page 27, Line 1 – Page 28, Line 2: I suggest revising to read: “Recently, major ocean regime shifts have been demonstrated to affect marine ecosystems, causing, for example, large swings in the populations of major commercial fisheries.”

**Jumars, University of Maine**

\*Page 27, Lines 5-7: This section seems light on the effects of sea ice, which have a big role in climate change, as suggested by coupled climate models. Frozen water is part of the ocean.

**Kelly, University of Washington**

Page 27, line 7.

Change to “...our ability to predict climate VARIABILITY AND change.”

**Schultz, CCSP**

Page 27, line 9.

Change “variability” to the more general term “variations,” which encompasses both variability and change.

**Schultz, CCSP**

Page 27, lines 21-23.

Change to “...combined with rising sea ~~and lake~~-level makes it...”

**Schultz, CCSP**

Page 27, line 27

Change “predictability” to “prediction.” (It is not possible for us to “improve predictability.” Things that can be improved are our understanding of predictability and the ability to make predictions, but not predictability itself.)

Page 27, lines 27-28. Recommend changing to: “...these features will enhance society’s ability to prepare and adapt cities and other public infrastructure for the inevitable arrival of a-severe eventS AND TO TAKE ADVANTAGE OF OPPORTUNITIES PRESENTED BY FAVORABLE CLIMATE CONDITIONS.”

**Schultz, CCSP**

Page 27, line 33.

Delete “known to be”

**Schultz, CCSP**

\*Page 27, Line 34: “Fresh water” when used as a noun is two words (in U.S. English).

**Jumars, University of Maine**

Page 27, lines 34-36.

Recommend changing to: "...it receives and redistributes freshwater from rivers, continental and ice runoff discharge; and it provides moisture (through evaporation) to the atmosphere that enhances precipitation over the oceans and continents."

Page 27, line 37.

Recommend changing to: "...important ocean feature with regards to both long-term GRADUAL and possible abrupt changes in climate."

**Schultz, CCSP**

\*Page 28 - Major fish species are in the process of extinction because of commercial fish profiteers raping the ocean of all life to immediately enrich themselves.

**Sachau, private citizen**

Page 28-30. A large proportion of the effects of climate change occur along the land-ocean margins, while continental-scale climate is greatly influenced / caused by open ocean phenomena. Coastal observing systems need to be enhanced to detect changes in sea level and environmental changes in coastal watersheds and land margins associated with oceanic drivers. This section might further consider how to couple open ocean information with land-margin effects.

**Keough, USEPA**

\*Page 28, Lines 5-7: While "changes in ocean chemistry" is mentioned, "acidification" should be discussed explicitly.

**Kelly, University of Washington**

\*Page 28, Line 6: After "ecosystems." Add: Rising atmospheric CO<sub>2</sub> levels have demonstrably lowered ocean-water pH, with impacts on calcifying organisms.

**Jumars, University of Maine**

Page 28, line 6.

Change to: "...relationships..."

**Schultz, CCSP**

Page 28, Line 9: The challenges section places a great emphasis on the need for an Integrated Ocean Observing System. While this is important to climate change forecasting, this section could be reduced to focus only on those challenges related to climate change forecasting, and move the remainder of the text to the ocean observation cross-cut. Finally, there are several broad challenges that are missing from this section, (as noted below).

**CORE**

\*Page 28, Lines 10-26: Under CHALLENGES the importance of predictive models is not called out in the bullets. There is a caveat about prediction after the bullets, but there are some predictive models already and prediction is certainly a challenge.

**Kelly, University of Washington**

Page 28. Research Challenges: Add a reference to the need to evaluate the threat to marine ecosystem health and function of ocean acidification over the next 30 years. There is the potential for this to be as important as increases in SST and sea level.

**NOAA Fisheries**

Page 28. Line 11. Insert the following before the sentence “The continuing... The scientific challenges related to climate variability and change are the need to:

- develop a fundamental understanding of ocean circulation and its role in climate, and of sea level rise;
- understand the role of chemical cycles in the bio-sphere in regulating and responding to climate and ocean circulation;
- identify potential for abrupt change or "tipping points" (e.g., release of methane, biomass distribution, ecosystem regime shifts); and
- understand the Earth system to separate natural and anthropogenic effects on climate, and ocean climate effects on humans.

**CORE**

Page 28, Line 17-19: I am not sure what this section is saying. Is it saying that the goal should be an assimilative system, similar to numerical weather prediction output? The step to providing ecosystem models that have prognostic capabilities is a big one, and one that I think the community does not know how to do. It may be that entirely new approaches are needed.

**Thompson, University of Washington**

Page 28, lines 20-22.

Recommend changing to: “...the technology and vision for ~~this~~ A COMPREHENSIVE global ocean observing system... ..conditions) for ~~predicting~~ TAKING ADVANTAGE OF THE PREDICTABILITY OF climate variability and change.”

**Schultz, CCSP**

Page 28, lines 27-35. The "Deep Ocean" should be included in the “Regions” subsection, because of the lack of knowledge about the deep ocean and its potential importance in mitigating (e.g. via carbon sequestration) climate change.

**COFS graduate students, University of Washington**

\*Page 28, Lines 27-35: Under REGIONS, both the tropics and the polar regions are called out, but the mid-latitudes are not. Since this is where most people live and where climate change will be most noticed, it is an odd call. However, then all of the oceans have been called out, except "coastal." Maybe these topics should be folded into the Processes section.

**Kelly, University of Washington**

Page 28, line 36. Additions to the “Processes” section:

Benthic-Pelagic coupling (flux from the sea to the seafloor)

The Match-Mismatch hypothesis and its potential implications for ecosystem changes with climate changes and variability

**COFS graduate students, University of Washington**

Page 29, Line 3-7: Attribution of abrupt climate change to changes in ocean circulation is unwarranted. The role of sea-ice feedback should be emphasized, and is after all part of ocean sciences. The concern for abrupt climate change in the future has been a bit overblown and can lead to misunderstanding of the public of the problem of climate change. This second should be changed to include the role of sea-ice changes in glacial times, and to make clear that the causes of for the abrupt changes in temperature at high latitudes is still very much under debate and that for the moment, it seems that abrupt climate change is likely to only have region impact.

**Thompson, University of Washington**

Page 29, lines 5-7.

Recommend changing to: “The OBSERVATIONS, theory, and record of such phenomena need to be improved to GIVE WARNING OF THE ONSET OF POTENTIAL ABRUPT CHANGES AND TO refine long-term projections and assessments of the risk of future abrupt changes.”

Page 29, lines 9-10.

Recommend adding: “...on the ocean, INCLUDING SHORT- AND LONG-TERM VARIATIONS IN HORIZONTAL MOTIONS AS WELL AS VERTICAL CONVECTION.”

**Schultz, CCSP**

Page 29, lines 9-10, bullet 3: References to footnotes that are not in proper format (Roman numerals) and appear to apply to footnotes not included in the report.

**NOAA Fisheries**

\*Page 29, Lines 11-13: Current wording is ambiguous. I suggest: “Their roles in regulating response of the large-scale ocean to changes in forcing and their roles in establishing the mean state of the ocean are still poorly modeled...”

**Jumars, University of Maine**

\*Page 29, Lines 11-13: "Mesoscale eddies": Isn't this really just about improving observational and model resolution? Much of the mesoscale variability is really changes in frontal strength and location, whereas the term "eddies" calls to mind Gulf Stream rings. I suggest a change to "Mesoscale variability."

**Kelly, University of Washington**

Page 29, line 13.

Recommend adding: “...and SIGNIFICANT energetics.”

Page 29, lines 14-15.

Recommend replacing the two occurrences of “scales” with “systems.”

**Schultz, CCSP**

\*Page 29, Line 17: “Ocean-atmosphere” (both nouns) and “Fresh water” not “freshwater”

**Jumars, University of Maine**

\*Page 29, Line 24: The effect of CO<sub>2</sub> on calcification *is* defined. How about changing the wording to read “but still largely unquantified,”

**Jumars, University of Maine**

Page 29, Line 25: Insert new bullet: “*Ocean ‘hot spots’— locations of high flux, productivity, and boundary change that require integrated process oriented studies and monitoring over multiple time and spatial scales; examples include HTVs, cold seeps, gas hydrate beds, water mass confluences*”

**Shepard, University of North Carolina at Wilmington**

Pages 29-30, lines 26-19. Use paleo-oceanography to understand past climate variability in order to place current variability and change in context.

**COFS graduate students, University of Washington**

Page 29, line 27. A priority research need specific to the Climate Variability and Change theme is a region-specific understanding of how climate change will affect living marine resources (fish, birds, mammals) and prediction of their future abundance levels. **Region-specific process studies are needed because climate effects will manifest through region-specific ocean effects.** For example, three nationally important marine ecosystems probably differing in climate response are the seasonal sea ice system of the Bering Sea, the upwelling system of the California Current, and the Labrador Current affected Northwest Atlantic.

**NOAA Fisheries**

Page 29, line 31.

Recommend changing to: “...of the polar seas, ~~and~~ ocean-ice interactions, AND DEEP WATER FORMATION through those activities...”

**Schultz, CCSP**

\*Page 29, Line 36: Change “biological” to “physiological” (because biology includes ecology).

**Jumars, University of Maine**

\*Page 30, Lines 2-4: Overall, the range of climate research in the priority list appears well thought out and sensible. However, I'm struck that the focus on improving model resolution here does not appear to reflect all current research priorities. The research community has also embraced efforts to improve model physics by drawing on results of field programs through the framework of “Climate process teams”. In the foreseeable future, these physically-based efforts seem likely to be as important as resolution increases.

**Gille, UCSD (Scripps Institution of Oceanography)**

Page 30, line 5: A new bullet for Key Ocean Research Requirements:”  
Conduct Observing System Simulation Experiments (OSSE) to evaluate and

improve the Ocean Observing Systems for weather, ecosystems and Climate.

**Garzoli, NOAA-AOML**

\*Page 30, Lines 5-8: The statement about historical data is somewhat ambiguous with regard to non-model based data analysis. The second sentence in this item clearly identifies the importance of modeling and data assimilation. To date, data-only analyses have also proved important, and there should be no implication that data are only useful in the context of models.

**Gille, UCSD (Scripps Institution of Oceanography)**

Page 30, lines 5-8. Recommend revising to: "PRODUCE OBSERVATIONS AND assemble analyses of ~~historical data~~ to provide a consistent LONG-TERM HISTORICAL AND REAL-TIME DEpictIONSures of the role of the ocean in climate variability and change... especially for initializing coupled climate predictiveON models. THE COMPREHENSIVENESS OF THE ANALYSES SHOULD BE INCREASES BY INCLUDING BIOLOGICAL AND CHEMICAL VARIABLES, ALONG WITH THE STANDARD PHYSICAL VARIABLES."

**Schultz, CCSP**

\*Page 30, Lines 9-14: Under RESEARCH NEEDS, a bullet beginning with "Develop a tropical ocean observing system..." contains the only reference to satellite observations: "Finally, continue critical satellite observational capabilities.." Currently, no US agency is responsible for satellite observations of the ocean, which is a HUGE infrastructure issue (mentioned in that section briefly as a technological issue). NASA does "technology innovation" and may make new measurements, but has no obligation to "continue critical satellite observational capabilities." NOAA has neither the budget, not the expertise to do this. The only routine climate measurement for which NASA is responsible is for ozone and that took an act of Congress. The ORPP should make a similar strong statement about the need for NASA to do sea level measurements indefinitely. Also, the reprocessing of satellite observations for a climate record (because sensor technology constantly changes) is a large expenditure and funds need to be appropriated for this beyond the lifetime of any given mission. This problem deserves not only a full bullet, but a separate paragraph.

**Kelly, University of Washington**

Page 30, lines 15-19. In addition to observing systems, the continuation of current time-series, and the careful ground-truthing between historical sampling techniques and new automated techniques is essential to understanding climate changes with ecosystems.

**COFS graduate students, University of Washington**

\*Page 30, Lines 21-36: The two satellite sensors that have made the biggest changes in atmosphere-ocean interaction studies, the altimeter and the scatterometer, are poised to cross the line between the Global observing system and the Coastal observing system (this is also a comment on the Ocean section of the ORPP). The next generation scatterometer will have 1-5 km resolution and a swath altimeter would have 5-10km resolution. Coastal researchers (and hydrologists) have not used either of these sensors

extensively because of the resolution limitations. The new sensors will change the paradigm here by supplying massive amounts of data that will affect the design of coastal observing systems.

**Kelly, University of Washington**

\*Page 30, Line 22 to Page 31, Line 4: Sustaining continuity of satellite observations and improving resolution should be high priorities and should be addressed here.

**Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

Page 30, line 22. The phrase “The growing ability to deploy a sustainable global ocean observing system” is hard to understand. Does sustainable refer to cost? As the statement refers to “a major achievement” suggest change to “The deployment of global observing systems for climate and oceanographic research programs has been a major achievement ...”.

**NOAA Fisheries**

Page 30, lines 26-27.

Recommend revising to: “...which is especially important for CLIMATE PREDICTION AND FOR determining the carbon budget...”

**Schultz, CCSP**

Page 30, Line 35: Insert new text/paragraph: “*GOOS and COOS must be maintained. Sensors that put out bad data due to corrosion fouling, and physical disturbance are worse than no sensors at all. Expensive equipment is routinely displaced or lost. Related services are lacking on a national basis. Investment is needed support assets (ships, undersea vehicles) needed to sustain the growing IOOS.*”

**Shepard, University of North Carolina at Wilmington**

Page 30. Line 37. Before the sentence that begins “In addition... insert the following sentence “This data system should have the capability to develop climate data records for physical, biological, and biogeochemical data sets as well as the ability to reconstruct past states of the ocean, including the development and refinement of climate proxies.”

**CORE**

\*Page 31, Lines 6-33: Under EXPECTED RESULTS, I suggest adding a bullet: Satellite observations of coastal dynamics and improved understanding of ecosystem responses.

**Kelly, University of Washington**

Page 31, lines 7-8.

“Sea-ice reduction” is not a good example of a potential driver, since sea ice reductions can be *caused* by ocean changes. Better examples of potential drivers are: “atmospheric warming, changes in wind stress.” Also, “ocean-atmosphere coupling” is better given as an example of a “process” than as an example of a “feedback.” A good example of a feedback is “ice extent–reflectivity.”

Page 31, line 11. Change “diffuse” to “defuse.”  
**Schultz, CCSP**

\*Page 31, Lines 13-14: Also, modify the first bullet on "hurricanes" to include "hurricane-force winds" in the extratropics. QuikSCAT (the currently flying scatterometer) has shown that there are hurricane-force winds in the extratropics and has caused the Ocean Prediction Center of NCEP to add an additional level of warnings for ships at sea.

**Kelly, University of Washington**

\*Page 31, Lines 16-18: Reword: “Advances in intraseasonal to interannual climate predictions (e.g., El Niño events) will allow greater lead time for adaptation measures that will limit negative economic impacts.”

**Jumars, University of Maine**

Page 31 line 32: A new Expected Outcome: “Improved design of the Observing Systems to represent the State of the Earth System in an accurate and cost effective manner”.

**Garzoli, NOAA-AOML**

## **MITIGATING EFFECTS OF NATURAL HAZARDS-GENERAL**

Page 32. Current experience in the Gulf States has demonstrated the vulnerability of fishing fleets and infrastructure to natural disasters.

**CCCHFA, Rudolph**

Page 32: “Mitigating Effects of Natural Resources” is a critical theme for sustaining the goods and services of cultural resources and conserving their contribution to human well-being and quality of life. Hazard-mitigation plans are needed for cultural resources in “at-risk communities.” Such plans could address prioritization, protection, research and recovery of paleo- and archaeological data from at-risk sites such as Gay Head Aquinnah on Marthas Vineyard, or they could prioritize maritime cultural sites, buildings, landscapes and events for reconstruction or redevelopment in the event of a natural disaster – resource that are vital to community identity and socio-economic development.

**Claesson, University of New Hampshire**

Page 32: As our shorelines become more densely populated, people and property are increasingly vulnerable to costly natural hazards. According to the Ocean Commission report: “Before 1989, no single coastal storm had caused insured losses greater than \$1 billion” and since “then, at least ten storms have resulted in such losses, including Hurricane Andrew, with insured losses of \$15.5 billion and total economic losses estimated at \$30 billion (in 1992 dollars).” Now the losses associated with hurricanes Katrina, Rita, and Wilma are likely in the hundreds of billions of dollars and Florida estimates that to evacuate one mile of coastline costs one million dollars. Coastal erosion, storm surges, tsunamis, and sea level rise are serious threats to coastal residents. The loss of wetlands and other shoreline vegetation increases susceptibility to erosion and flooding. The installation of seawalls, groins, and other coastal armoring structures can alter patterns of sediment and current flow, eventually accelerating erosion, rather than preventing it. Climate change may increase storms and sea-level rise, making the coastal zone even more vulnerable.

For the nation, effective and accurate weather forecasting and ocean observing are vital to oceanic real-time data for management, assessments, and predictions.

CORE supports the provisions as drafted and in particular supports activities that will significantly improve the quality and timeliness of weather-related warnings, increasing the lead time for protective measures and evacuations. CORE believes that the nation, as a matter of urgency, needs the full development and implementation of the Integrated Ocean Observing System (IOOS) (discussed below under cross-cutting issues). IOOS would improve weather-related warnings and provide additional predictive capabilities for floods, hurricanes, tsunamis, and for chemical and biological hazards, such as sudden pollutant loadings, harmful algal blooms, and pathogens.

**CORE**

\*Page 32: GENERAL COMMENT: Most of this section appears to better enable people to live in hazardous locations. The best way to mitigate effects of natural hazards seems

to me to encourage people to move away from hazardous areas. Or, at the very least, build very very inexpensive homes and other infrastructure in hazardous locations.

**Ford, Massachusetts Division of Marine Fisheries**

**\*Page 32-35: Mitigating Effects of Natural Hazards**

The document omits discussion of finding adequate political will to fund these laudable protective measures. As above, studies of public concern and political will could be useful. We need to focus on our inability to apply mitigation measures for known hazards, as well as increasing detection of unexpected events.

**Miller et al**

**Page 33, Line 2: Challenges:**

- Add: “Develop mechanisms for application of improved understanding and predictive power to social planning.”
- Understanding coastal hazards as a way to improve zoning and building codes which will save all communities money.

**NAML**

Page 32-35: Mitigation of effects of natural impacts cannot be regarded independently from the need of mitigation from human impacts. The cumulative effects from both natural and human impacts should be studied together if a more effective mitigation is to be implemented. This theme could read “Mitigating effects from natural hazards and human impacts”.

Page 32-35: Adaptive management should go hand in hand with mitigation science and deserves to be incorporated as part of this chapter.

**NOAA-NOS-Estuarine Reserves Division**

\*Page 32 - Manmade effects are so much worse than natural hazards. Stop the manmade effects now. Do the natural later. They are not as severe.

**Sachau, private citizen**

**Societal Theme: Mitigating Effects of Natural Hazards**

**To what extent are the gaps FSTT identified in this theme from Draft 0 still present in the Planning Document?**

- Draft 0 was well aligned with the Task Team analysis and the Planning Document is fully complementary.
- The Task Team emphasized the need for cost/benefit analyses of improved infrastructure, and the **Planning Document contains new statements about support for “cost effective strategies” and “effective and affordable systems...for hazard-resilient infrastructure.”**
- It is appropriate that the Research Needs in the **Planning Document now prescribes “...models and assessments of the efficacy of natural (e.g., wetlands, reefs, barrier islands) and engineered systems....”** This aligns well with the Task Team recommendation for “[enhanced] restoration strategies with measures of their effectiveness [in hazard impacts risk reduction].”

**How well are the workshop recommendations for this theme aligned with both the FSTT Report on research priorities and the FSTT comments on Draft 0?**

- The workshop described an overarching need to understand fundamental processes associated with storms, floods, earthquakes, tsunami, and volcano hazards, and identified key research and technical needs relating to the following:
  - Improved communication tools
  - Better data integration, high-resolution coupled models, and decision support tools
  - Timely post hazard impact assessments
  - Market-based approaches (incentives and cost/benefits)
  - Operational monitoring systems spanning the watershed-coastal interface
  - Enhanced human capital, facilities, and computing power
  - Resilient materials and technologies
- Although phrased differently, all of the above topics overlap with Task Team reports in calling for the following, respectively:
  - Fundamental process studies
  - Improved information management and dissemination and improved visualization techniques
  - Better data acquisition, data delivery and integration
  - [Timely] evaluation of events
  - Cost effective, science-based response, mitigation and restoration strategies
  - Timely, accurate and reliable monitoring information...synthesized into improved warning systems and models
  - Development and deployment of new ocean sensors, tools and techniques
  - Cost/benefit analyses as applied to improving or retrofitting buildings, infrastructure, and strengthening building codes

**SIMOR FSTT**

\*Page 32: I note only one passing reference to education – P. 34 line 9.

I appreciate that this is a research oriented document, but communicating the implications of the research to managers, and as appropriate, to those at risk, is imperative.

**Western Pacific Regional Fishery Management Council**

## **MITIGATING EFFECTS OF NATURAL HAZARDS-PAGE/LINE SPECIFIC**

\*Page 32, Lines 5-7: “Minimize and reduce” is redundant. I suggest using only “reduce.” Also, reword to “...lead to reduced exposure to hazards, lives...”

**Jumars, University of Maine**

\*Page 33, Line 3: It should read “...devastation inflicted by multiple...”

**Jumars, University of Maine**

Page 33, line 9-11. Real-time data on offshore water depth to assimilate into models such as SLOSH would be invaluable in prediction of storm surge and degree of inundation, including levees.

**Scripps Institution of Oceanography**

\*Page 33, Line 10: Update this important parenthetical list to include storm intensification and land subsidence, two long-term factors that affected New Orleans and will affect many other regions: “(changes in storm frequency and intensity, sea- and lake-level rise, regional land subsidence, and coastal erosion)” It is amazing how little press land subsidence and sediment bypassing (heading offshore instead of back onto the marshes) from channelization of the Mississippi has gotten with respect to the New Orleans situation.

**Jumars, University of Maine**

\*Page 33, Line 20: I would add a bullet. One significant challenge in managing Natural Hazards is that we that we currently encourage and support people to build in hazardous areas.

**Ford, Massachusetts Division of Marine Fisheries**

Page 33, Line 21: **Research Needs:**

- Add: “Need improved predictive models, e.g. for storm intensity and inundation.”
- Add: “Develop research rapid response systems to capture perishable data immediately after extreme events; at a time when local researchers may be focused on personal ‘survival.’”
- Add: “Requires investments in information management with defined standards and improved (high resolution/accurate) topographic and bathymetric data.”

**NAML**

\*Page 33, Line 24: Elaborate a little on the methodology: “Develop an all-hazards, geographic information system (GIS) resource...”

**Jumars, University of Maine**

Page 33, lines 24-27 – “*Develop an all-hazards information resource...*”

Add: “Requires investments in information management with defined standards and improved (high resolution/accurate) topographic and bathymetric data.”

Page 33, lines 28-33 – “*Enhance hazard understanding...*”

Add: “Assessment, modeling, and prediction of coastal processes also require improved understanding of the connectivity of the coastal zone with the upland watershed and rivers.”

**NAML**

Page 32, Line 30-33: This sentence, which includes a reference to a website, needs to be better stated.

**NOAA-NOS-Estuarine Reserves Division**

\*Page 33, Line 33: Change to read “”response, wave-height...forecasts that include the effects of long-term and storm-induced coastal erosion.

**Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

Page 34, Line 12: Infrastructural and Technological Needs:

- Add: “Improvements in data quality, frequency, and density of marine and coastal observations.”
- Add: “Coastal laboratories are well positioned to house/oversee such monitoring and assessment activities, but they need to be structurally reinforced and prepared to withstand the severe stress of a catastrophic event to the extent possible. Marine laboratories provide a mechanism for mutual back-up, redundancy, and assistance, and protocols for mutual assistance should be developed and implemented in advance.”
- Add: “Need full integration of federal agency observations and regional system contributions through information management processes and software.”

**NAML**

\*Page 34, Lines 22-24: Capitalize “Increased...” and drop the capitalization of “...Earth/ocean/atmosphere...” (Note the conversion of atmospheric to atmosphere to maintain parallel grammar.)

**Jumars, University of Maine**

Page 34, Line 22: Need to capitalize the word “Increased”.

**NOAA-NOS-Estuarine Reserves Division**

\*Page 34, Line 26: Be direct: “...will effectively communicate warnings.”

**Jumars, University of Maine**

\*Page 35, Lines 1-3 “*Risk and vulnerability assessments will be based on coordinated federal efforts to develop and maintain the necessary geospatial framework and characterization of social and environmental conditions and change.*”

- Though this statement is focused on coordinated federal efforts, it needs to include state and research institution input and participation as well.

**NAML**

## **IMPROVING QUALITY OF LIFE-GENERAL**

Page 36 (NOTE: This is a duplicate general response that was also copied into Sustaining Natural Resources, as the author combined the two chapters in his comments) Cultural resources can be addressed within the “Sustaining Natural Resources” theme by explicitly including the word “cultural” within the theme title and statements. For example, page 18, line 25-26, could read “Healthy ocean and coastal natural [and cultural] resources provide the foundation for a huge coastal tourism industry that is continuing to grow rapidly.” Furthermore, page 19, line 38 and page 20, line 1-2, could read “Developing capabilities to map the extent and quantity of natural [and cultural] resources (both living and non-living) in marine, coastal, estuarine, wetland, and atmospheric (avian) systems, particularly across the EEZ and the delineated limits of the U.S. continental shelf.” Another example might be on, page 20, lines 33-36 “Different geographic regions inherently have diverse natural [and cultural] resources, such as abundant energy sources [and relict prehistoric landscapes and archaeological sites] in the Gulf of Mexico, a significant freshwater supply [and shipwrecks] in the Great Lakes, and large fisheries habitats [and historic/living waterfronts] off the East Coast, and thus various resulting management needs.” The goods and services provided by cultural resources are undervalued in terms of the benefits to quality of life and social stability. Therefore, it is recommended that cultural resources are also addressed in the theme “Improving Quality of Life.” Appropriate places to address these resources could be on page 36, lines 26-28: “The factors that underlie quality of life are the main focus of the U.S. Ocean Action Plan: economic productivity, human and ecosystem health, recreation, pollution mitigation, marine debris cleanup, and conservation of [cultural] resources”; and page 38, line 10-12, “Development of a computer-based geographic information system (GIS) that integrates diverse social, [cultural], economic, geographic, and environmental data, along with an information portal for integrated data dissemination.”

**Claesson, University of New Hampshire**

The “Improving Quality of Life” theme appears to be more cross-cutting or an overarching goal rather than a theme with clear research needs. In reality, if the expected outcomes are achieved in the previous themes, the quality of life for our nation will be vastly improved.

Many of the challenges that are outlined in this section are redundant to those found in other themes such as enhancing human health, improving ecosystem health, and the ocean’s role in climate variability and change. The challenges in this theme should focus more on how individual use, value, and perceive the ocean. CORE recommends that JSOST consider instead the following challenges:

- Understand how the value of the oceans contributes to an individual’s quality of life;
- Understand how various ocean industries (e.g. transportation, water management, oil and gas) perceive their role in ocean conservation and improved quality of life;
- Develop a better understanding of what quality of life means to diverse groups and how it changes over time and regions; and

- Provide better linkages between ocean-use decisions and the overall effect on quality of life.

**CORE**

Page 36. The use of waterfront property both in urban and rural areas is rapidly changing. Access and use is driven by markets and ability to pay with the result that less wealthy (lucrative) individuals (activities) are being displaced. Some communities have attempted to forestall these changes through zoning and economic incentives such as current use taxation. Research is needed into whether such efforts increase social value versus produce gains for special interests and how zoning, economic incentives and other regulatory approaches can be designed to ensure that coastal property is managed in the best interest of society. While there may be a great deal of this research already applied to land use in general, coastal property issues and management solutions may differ substantially from inland areas due to the fact that coastal property gains value from and affects use of publicly owned resources (i.e. the ocean and marine resources). Similar questions arise regarding quasi property rights being created on the ocean and for marine resources (e.g., ITQs, aquaculture and marine farm leases, windfarms, etc.). It is important to understand how the structure of these rights will affect not just the value generated directly by the regulated activity for the users, but the wider impacts on value for society.

**Holland, Gulf of Maine Research Institute**

Page 36-38. All of the rationales and all of the challenges associated with improving quality of life are associated with coastal activities. Research needs are nearly all coastal questions. Regional observatories should be fully oriented toward the watershed – coastal continuum of information. In the Great Lakes, for instance, the GLOS is designed as an “open ocean” program. I like the focus on providing watershed-coastal GIS tools for coastal areas.....these are lacking in the Great Lakes and many other regions.

**Keough, USEPA**

\*Page 36-38: See everything above.

Some human elements are incorporated here, but again, there is little detail, for example, regarding the difficulties of: " Conduct(ing) detailed observational and questionnaire-based studies of user groups and resource needs and incorporate results into local, state, and federal planning and management initiatives (e.g., Coastal Zone Management [CZM])." There is a lot that could be deconstructed from this statement and most of the other bullet points in this section.

**Miller et al**

\*Page 36:

- Quality of life is one of the most important characteristics in the public valuation of science and of the ocean; improvements in the quality of life must be identified as one of the most prominent goals/outcomes of the plan.

- Every section of the plan should have quantitative outcomes that are determined by the effect on quality of life. These should be listed in the expected results section as targets, not platitudes.
- Challenges are currently listed as mostly mitigation of problems. Though these are real, this focus does not take into account the large number of positive improvements that are also possible in building better coastal communities, improving coastal economies and connecting the benefits of the ocean to the whole nation, both coastal and inland.
- Infrastructure needs indicate a focus on data correlation; human systems and natural systems are non-linear, complex systems and require fundamentally different approaches.
- Marine labs are a key infrastructure for conducting this research, for training both scholars and citizens and for connecting this scholarship to community needs.
- Quality of life can be enhanced by linking with our past, and promoting the human element of the oceans, coasts, and Great Lakes.

#### **NAML**

\*Page 36-38: : Unlike the other sections of this report, this section failed to mention tribal governments.

#### **Northwest Indian Fisheries Commission**

\*Page 36 - Tourism dollars can vanish quickly if the cost of traveling goes up and it is going up because the price of oil and gas is rising rapidly. We cannot rely on projections that have no fact to them. The u.s. cruise industry has been allowed to pollute and throw their garbage overboard. The u.s. cruise industry should have to account on their coming back to port for every pound of product that went out on that ship. This must be closely watched. I am sick of cruise ships polluting. High fines for a ship that cannot account for every pound.

#### **Sachau, private citizen**

#### **Societal Theme: Improving Quality of Life**

#### **To what extent are the gaps FSTT identified in this theme from Draft 0 still present in the Planning Document?**

Of the four major research gaps identified in the Task Team comments on Draft 0, two issues are addressed in the Planning Document and two are not.

The two issues that are found in both documents are:

- The need for better understanding of cumulative impacts of multiple projects and users on marine systems. (Task Team) Assimilate monitoring data into coastal ecosystem models to predict short-term and long-term cumulative impacts of current and future coastal and watershed development and uses. (Planning Document)
- The interrelationship between land use change and ecosystem condition. (Task Team) Evaluate the effects of development by monitoring direct impacts and indirect impacts. (Planning Document)

#### **The two issues mentioned in the Task Team comments but not in the Planning Document are:**

- Restoration and use of natural systems to provide important flood/storm surge protection.
- Ongoing translation of ocean research into the need for defined coastal management actions.

**How well are the workshop recommendations for this theme aligned with both the FSTT Report on research priorities and the FSTT comments on Draft 0?**

The following workshop recommendations are aligned to either the Task Team final report or our comments or both (as noted):

- Investigate, monitor, forecast effects of human behavior on ocean systems. (Task Team comments)
- Research into development of transfer mechanisms for science-based decision-making: Education, communication, data, information (common to both Task Team reports)
- Develop ecosystem and social system models to predict the short and long-term effects on current and future development and use on oceans, great lakes, and watersheds. (common to both Task Team reports)

**SIMOR FSTT**

\*Page 36: In many areas of the US Pacific Islands, marine ecosystems are productive and diverse and fishery resources are abundant and under utilized due to decades of dependence on US and foreign foods and products. Today, many Pacific island communities are now realizing the potential benefits of their marine resources to improve their dietary and nutritional needs, improve their quality of life and achieve self sustainability.

However, well intended initiatives (often from US mainland organizations) to “protect healthy marine ecosystems” may adversely affect the ability of these island communities to improve their quality of life as these initiatives usually result in large no-fishing marine protected areas thus ensuring the island communities’ continued dependence upon foreign foods and products and tourism dollars.

It must be stressed that to improve quality of life, particularly for Pacific Island communities, any initiative, project or research to “improve quality of life” must always be cognizant of the island communities’ needs and not those of US mainland community’s desires.

**Western Pacific Regional Fishery Management Council**

## **IMPROVING QUALITY OF LIFE-PAGE/LINE SPECIFIC**

\*Page 37, Line 13: It is my understanding that the intensity has increased more statistically significantly than has the number of hurricanes: “(such as summers with increased likelihood of intense hurricanes in the Southeast).”

**Jumars, University of Maine**

Page 37. Line 21. Insert two additional research needs:

- Investigate, monitor, forecast effects of human behavior on ocean systems;
- a national program for social science and economic research to examine the human dimensions and economic value of the nation’s oceans and coasts; and
- More clearly define quality of life metrics across all scales.

**CORE**

Page 37, line 24. insert product and packaging plastic waste generated between, “land-based development,” and “land use”

**Algalita Marine Research Foundation, Francis and Moore**

\*Page 37, Lines 24-27: To evaluate the effect you must have data that currently do not exist. Too much emphasis is being placed on conducting analyses and computer simulations and not on basic data collection/research. We strongly support collecting the basic data/research necessary to do the evaluations discussed.

**Waugh, SAFMC**

Page 37, line 26. insert marine debris after “[point and non-point input]”

**Algalita Marine Research Foundation, Francis and Moore**

\*Page 37, Lines 34-35: Change to read “coastline and...and incorporate results into land-use and coastal inundation models for...”

**Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

\*Page 37, Line 36: The issue of gentrification should be added. Loss of working waterfront is becoming a critical issue.

**Waugh, SAFMC**

\*Page 38, Line 1: We strongly support collecting social and economic data from all user groups.

**Waugh, SAFMC**

\*Page 38, Line 2, please include “tribes.”

**Northwest Indian Fisheries Commission**

Page 38, Line 18: Rewrite “enhancement of *in situ* observatory and vehicle-based educational tools”

**Shepard, University of North Carolina at Wilmington**

\*Page 38, Line 24: Change to "...useful product to significantly advance coastal..."  
**Jumars, University of Maine**

\*Page 38, Line 25: Under the subheading, "Expected Results, please include "tribes."  
Under this same subheading, please include a request/recognition of the need for tribal governments to acquire an integrated system to understand the environmental and social/economic impacts of population growth.  
**Northwest Indian Fisheries Commission**

## **ENHANCING OUR BASIC UNDERSTANDING OF THE OCEAN-GENERAL**

Page 39: Science should be the foundation of ocean and coastal conservation, management and policy. Increased scientific knowledge and better dissemination of information is needed to improve the management of our nation's ocean and coastal resources and its biological diversity. Science-based management and policy is critical to making informed decisions that balance human needs with the protection of ocean and coastal resources and move toward an ecosystem-based management approach. This cross-cut should be renamed "*Promoting Ocean Exploration and Research*". It is in this cross-cut where we must build a strong vibrant case for and excite society about ocean research and new research initiatives that have the potential to produce breakthroughs to improve our understanding the ocean and great societal benefits. There must be a renewed investment in ocean exploration and greater commitment to significantly increase the federal ocean and coastal research budget and this funding should be used to support a balance of basic and applied research and public outreach and education should be integral components of a national plan. The theme should also delineate clear challenges, research needs, and expected outcomes and link these items to the research needs within the other societal themes.

### **CORE**

#### **\*Page 39-40: Enhancing our Basic Understanding the Ocean**

The "best and most complete understanding of how the ocean functions and responds to perturbations" is very important, but the document also needs to be acknowledge both physical and political limits to information. We cannot know everything about the oceans, nor can we predict or plan for every contingency. Also, time and again we have ignored scientific advice until costs have become apparent. Hence, this section should identify the need for understanding the uses and governance of the oceans, as well as their physical properties.

#### **Miller et al**

\*Page 39: This section should take a global perspective and stress the U.S. role as a partner and leader within the global research community.

### **NAML**

Page 39-40: This chapter most clearly integrates the coastal habitats and issues of connectivity of all the sections in the report. Still, this means that only a few lines in what is the shortest section of the entire report receive this attention.

#### **NOAA-NOS-Estuarine Reserves Division**

Page 39. In this section it seems imperative that the US establish a baseline regarding ocean literacy, similar to the baselines established for scientific literacy. Tracking changes in ocean literacy among US citizenry as the % of appropriate responses to a well designed questionnaire seems key to evaluating the success of our outreach programs. Recommend including a paragraph regarding the need to initiate surveys to evaluate the extent of ocean literacy in our citizenry.

Page 39. Balance emphasis on oceanographic/physical/chemical with biological. Scientists involved should include marine biologists, marine ecologist and others, besides oceanographers.

**NOAA Fisheries**

Page 39: Why not call this chapter “*Exploring the Ocean*”—certainly more interesting; this whole chapter needs to be beefed up and have parallel structure with other chapters—at least the cross-cut chapters should be the same; why not have **Vision Statement, Rationale, Challenges, Research Needs, and Expected Results** like other themes? I think its unfortunate that there is no related working group at meeting in Denver—this is an area that is strongly supported by the USCOP report and stands to “float all boats” in ocean science through increasing public interest. It is especially important to emphasize that exploration is an integral part of the scientific method and must be done in a strategic, guided, organized and integrated manner.

**Shepard, University of North Carolina at Wilmington**

\*Page 39 - "Understanding" the ocean - the ocean wont be there if we don't take action - immediate action to clean up the pollution, stop the overfishing - all of which must be immediate. I am tired of the call to research into eternity so that no action ever takes place.

The question on how the ocean responds to human pollution does not need answering - we see the answer every day. We see birds dying in the plastic crap. Didn't you see the page in nature which showed what was in the stomach of the migratory bird that flies thousands of miles. Some stones, lots of plastic crap. It washed up on the beaches from the ocean. We need to stop it - not research it.

The primary cause of change in the ocean is human. Stop the human decimation now.

**Sachau, private citizen**

Page 39, Line 1 to Page 40, Line 31: This is not a well-written section on basic research. It doesn't have a "vision statement" as is the case elsewhere.

**Scripps Institution of Oceanography**

**Cross-cutting Theme: Enhancing our Basic Understanding of the Ocean**

**To what extent are the gaps FSTT identified in this theme from Draft 0 still present in the Planning Document?**

- The clarity of the theme has been improved by making it an overarching, cross-cutting theme, likewise refining its intent and providing additional specifics in terms of the types of questions, investigations and overall development efforts that are necessary to facilitate discovery, exploration and improved understanding.
- A primary gap identified in the previous FSTT feedback was the need to address improved understanding of coastal and nearshore waters, including the Great Lakes. This is now better addressed in the current version of the planning document in terms of introducing this as a specific research question/priority.

- The tools and techniques discussion is still somewhat vague and narrowly focused, however. In particular, it would be worthwhile to discuss the unique observing needs, challenges and opportunities that exist for coastal regions, for example noting that new and significantly improved measurement capabilities are needed from space for these regions, and that existing global-oriented observing assets are inadequate in this regard. Such dedicated space-based capabilities for coastal regions will lead to significant scientific discoveries and enhance our basic understanding.
- It is correctly pointed out that there is a need to explore the ocean for reasons that might not be “directly related to specific products or societal requirements” as the other themes address these. That being said, it is equally crucial to emphasize the importance of maintaining a vibrant link and sustained communication between the research community and resource managers and decision-makers to ensure effective transfer of information from scientific breakthroughs and improved understanding.

**How well are the workshop recommendations for this theme aligned with both the FSTT Report on research priorities and the FSTT comments on Draft 0?**

- The workshop recommendations and the FSTT feedback on this theme are well-aligned.
- Challenges articulated by most of the workshop breakout groups for this theme included ecosystem dynamics, human dimensions and interconnectivity, natural and anthropogenic variability and change, and the need for improved modeling and predictive capabilities; these are all primary challenges in the study of coastal regions (although coastal regions were not specifically mentioned in their report).
- Common themes between both efforts were to consider the ocean and its various constituents as an integrated system (that is part of the broader Earth system), and not from a disciplinary scientific perspective. Further, both efforts highlighted the need to advance the state of knowledge through improved infrastructure, increased cooperation and communication across disciplines and communities (e.g., researchers from disparate academic fields, managers & decision-makers, and the general public).

**SIMOR FSTT**

\*Page 39: This section most clearly integrates the coastal habitats and issues of connectivity of all the sections in the report. Still, this means that only a few lines in what is the shortest section of the entire report receives this attention.

**Talley, SF Bay NERR/ SFSU**

\*Page 39, Line 1 to Page 40, Line 29: We strongly support collecting the data and conducting the research necessary to understand and manage our activities in the ocean.

**Waugh, SAFMC**

## **ENHANCING OUR BASIC UNDERSTANDING OF THE OCEAN-PAGE/LINE SPECIFIC**

Page 39, line 4-11. Replace these lines with: “Basic research provides the foundation for a deeper and more complete and comprehensive understanding of the ocean environment. The oceans are a vast complex system, of which mankind still has far to go in recognizing and understanding the basic principles and relationships governing its behavior. The basic research components, as exemplified by formulating questions, advancing hypotheses, testing through observation and experimentation, and the refinement of theory and models is the foundation for all other activities.”

**Scripps Institution of Oceanography**

Page 39. Line 11. Insert after the word “conclusions” “and manage inappropriately”  
**CORE**

\*Page 39, Line 11: Add: It is for this reason that it is essential that we continue to both conduct systematic measurements of the oceans’ properties, and explore new ideas about the ocean that may not be directly related to specific products or societal requirements or that may challenge existing ideas about the ocean.

**Kohanowich, NOAA’s Undersea Research Program**

Page 39, line 11. Delete “It is for this reason that.”

**Scripps Institution of Oceanography**

\*Page 39, Lines 12-35: Delete (reappended elsewhere)

**Kohanowich, NOAA’s Undersea Research Program**

\*Page 39, Lines 16-17: The sentence is jarring. Try: “Ocean study also leads to deeper understanding of our relationship to the oceans and of the long-term history of Earth and its ocean.”

**Jumars, University of Maine**

\*Page 39, Line 19: Typo: “...can **led** to unforeseen breakthroughs.” Either has led or can lead.

**Western Pacific Regional Fishery Management Council**

Page 39, line 20-35. Remove these lines and replace with:

“The bulk of life in the oceans comprise microbes from the bacteria, archea, and eucarya branches of the “tree of life” – microbes are the most abundant form of life and most of evolutionary time was spent in the microbial world. Large samples, for example a m<sup>3</sup> sample of perhaps 10<sup>12</sup> bacteria, will likely contain all (most) marine bacterial diversity. However, most species will be in very small numbers. The environmental conditions (e.g. nutrients, temperature, salinity, light) can be manipulated to change the species’ numbers. Metagenomic analyses of each resulting assemblage can be performed to study the influence of environment on the specific assembly that results. At the same time, careful global sampling in both space and time can be used to likewise understand the

role of the environment. These analyses can be used to address the fundamental question in microbial biology of how the environment affects bacterial diversity (and vice-versa). Even hydrothermal vent bacteria would, in principle, be present in surface samples collected off a pier.

Metagenomics is a growing tool in oceanography – “Meta” simply refers to the environmental metadata that need to be attached to the sample and subsequently the genome analyses. The challenges are substantial. A single sample as described above contains as much genetic material as the human genome – sequencing is presently expensive, but a version of “Moore’s Law” applies in which the cost of sequencing a given base pair is decreasing exponentially. The first microbe was sequenced in 1995, by 2000 the rate of sequencing had advanced to 15 microbes/month and in 2003, the rate was 10/day. Sequencing the human genome cost \$10’s of millions a few years ago – the equivalent cost will soon be \$1,000. Presently, the major genome databases contain no environmental metadata, but this is changing as well with a recent grant to UCSD and the Venter Institute from the Moore Foundation to build the cyberinfrastructure needed to support marine metagenomics on a large scale. Most microbes can’t be cultured – sequencing the environmental genetics in samples provides a new tool that will in the foreseeable future be possible in a remote sensor and which can be applied effectively for timely sampling of contamination at a beach. The basic research in genomics and associated technologies, however, is paramount in importance.

Other large scale questions include the study of the circulation of the mantle and its impact on planetary evolution; the impact of climate variability (El Niño – Southern Oscillation, Pacific Decadal Oscillation, North Atlantic Oscillation, and variability of the Gulf Stream) on the carbon cycle and ecosystem variability; and how does turbulent mixing across ocean boundaries (ocean-atmosphere, interior ocean [e.g. internal wave scattering by ocean ridges, and ocean-seafloor turbulence) affect gas, life, and energy exchanges?”

### **Scripps Institution of Oceanography**

Page 39. Line 22. Combine the first and third bullets and insert into the first bullet after the word “processes” “and the rates of change”

#### **CORE**

\*Page 39, Lines 22-27: The questions on page 39, lines 22-27 are very similar – all dealing with understanding change. More fundamental issues should be addressed:

- Understanding the 3-dimensional linkages of the ocean systems – i.e. physical with the biological
- Understanding the stability of the oceans
- Understanding the response to stochastic/catastrophic events

#### **NAML**

Page 39. Line 23. Change the second bullet to read: Characterize how the ocean....

#### **CORE**

Page 39, line 25. insert including human induced causes between, “change in the ocean” and “and how will”

**Algalita Marine Research Foundation, Francis and Moore**

\*Page 39, Lines 28-30: *“Marine ecosystem dynamics, the physical complexity of the ocean environment, and biogeochemical processes occurring at boundaries are key to understanding living marine resources.”*

There is much more to understanding living marine resources than physical complexity and biogeochemical processes at boundaries:

- Role of ecological processes, particularly at large scales (i.e. macroecology) and the dynamics of ecological systems as complex, non-linear, multi-scale and adaptive.
- Role of biodiversity in communities – productivity, resilience etc.

**NAML**

Page 39, lines 28-29. This discussion should also include the need to better understand hydrological dynamics in estuaries so that we can better model pollution abatement, oil spill movement, and nonpoint source runoff effects. This requires higher resolution (temporally and spatially) data collection to develop and improve models.

**National Estuarine Research Reserve Association**

Page 39. Line 35. In the last sentence strike the phrase “the quality of life in” and insert two new sentences at the end of the paragraph: Ultimately what is needed is for agencies to coordinate federal ocean and coastal mapping and charting activities with the goal of creating standardized, easily accessible national maps with living and nonliving marine resource data, bathymetry, topography, and other natural features, in a seamless data set across the shoreline, coastal zone, nearshore areas, and open ocean waters. Providing such tools and understanding the various ocean processes will promote greater conservation and management of ocean resources and enhance our quality of life.

**CORE**

\*Page 40: Add: “Exploration is also important for understanding the diversity, nature, and extremes of life on the planet, particularly those in deep oceans and highly productive areas, such as corals (reefs and deep corals), hydrothermal vents and methane seeps.”

**NAML**

\*Page 40 - This should not be a call for years of research. The answers are there now. The call for action is what is needed.

**Sachau, private citizen**

Page 40. The following should be mentioned: “Also needed is further development and new innovation associated with biological and physical models of the ocean. These advances require significant enhancements in computational capability.”

**Schultz, CCSP**

\*Page 40, Line 1 Add Subtopic: OCEAN OBSERVATIONS RATIONALE:

Observations are needed for a wide range of physical, biological, chemical, geological and atmospheric variables within U.S. coastal regions, islands and territories, and open ocean regions. Marine ecosystem dynamics, the physical complexity of the ocean environment, and biogeochemical processes occurring at boundaries are key to understanding living marine resources. Oceanic fluxes of heat, water, momentum, and biogeochemical properties are essential to understanding the oceans and the carbon cycle. Ocean circulation, ocean turbulence, and air-sea interactions study is needed to understand how the ocean will respond to climate change. Study of the processes occurring at coastal margins, including estuarine and watershed systems, is necessary to understand how to preserve the quality of life in our coastal environments. Coordination of this information obtained at various time and space scales, and from existing and planned networks, along with indicators, models and decision support systems can provide great benefits to society.

Add remainder of Ocean Observations language from p. 41, line 11, through p. 43.

**Kohanowich, NOAA’s Undersea Research Program**

Page 40, line 1-19. Exploration is not research - they're quite different and shouldn't be confused with paragraphs such as these.

**Scripps Institution of Oceanography**

\*Page 40, Lines 6-10: “*At the opposite end of the spatial spectrum, measurements from remote-sensing platforms, including satellites and aircraft, are needed to enhance in situ data and provide a more comprehensive view of global and regional changes in the ocean environment, particularly in areas where in situ data are limited or unavailable.*”

Need to be able to link the fine scale in situ processes to the larger spatial scales as well.

**NAML**

\*Page 40, Lines 11-16: “*Exploration can also focus on different temporal scales. Sustained time-series observations (including the ability to observe on extremely short and long time scales) are essential for understanding temporal trends in the ocean. For example, repeat measurements of physical processes over several decades in the Atlantic Ocean revealed a decade scale variation in North Atlantic circulation, the North Atlantic Oscillation, which has explained various relationships that had perplexed oceanographers.*”

- Need to be able to link biological responses and trends to the longer temporal scale fluctuations.

## NAML

\*Page 40, Line 21: The following suggestion could be made under several sections of this document but is presented once here. One of the new tools is not so much a tool but a new an improved interface to online tidal data such as that found at <http://tidesandcurrents.noaa.gov/>. An example of an outstanding interface is found at: [http://www.srh.noaa.gov/rfcshare/precip\\_analysis\\_new.php](http://www.srh.noaa.gov/rfcshare/precip_analysis_new.php). This interface allows the users various choices to analyze existing data such as setting the time frame in question.

As a coastal manager, it would be great if this website would autocalculate mlw, msl, mtl, mhw for example on the fly for various periods of time. Annual – to see where sea level is today compared to the predicted. This is particularly important since it appears the planet has exceeded the ‘tipping’ point and with the rapidly at which ice sheets such as Greenland are melting – coastal managers will need real time data – not the averages provided by NOAA for 18.6 years. As a coastal plant ecologist, to understand tidal wetlands response to sea level rise – one also needs to have the ability to quickly analyze datum changes over shorter time periods. Tidal marsh vegetation zones do not shift in according with the metonic cycle. Tidal marsh vegetation zones in New England (with a short growing season) are likely distributed based upon tidal conditions that exist during the months of May – July, the period when plants are actively growing. This is also the period when datums ‘jump’ to a higher elevation due to the thermal warming of the Atlantic. During the 1990’s the New London tide gage shows a decadal trend of 11 mm/yr rise in sea level. Ecologists expect this wet period to accelerate marine transgression but there will be a time delay in plant response. In conclusion, to understand tidal wetland response to tides, better or simple analytical tools are required, and research (improving ecosystem health; enhancing our basic understanding of the ocean) are required to understand the relationship between tidal wetlands and tidal data.  
**Rozsa, CT Depart. of Environmental Protection**

\*Page 40, Lines 21-29: Need to capitalize on information technologies, greater computing power, and improved data transmission technologies/modalities.

Adaptive and smart sensor development based upon key variable thresholds is needed.

## NAML

Page 40, line 23. footnotes are not in the right format and include references to footnotes not included in the report. The same is true on page 42 and 43.

## NOAA Fisheries

## **OBSERVATIONS AND INFRASTRUCTURE-GENERAL**

Page 41: Very little is understood about the workings and interrelationships of the biological, chemical, geological and physical systems of the oceans and how these systems in turn relate to and interact with land and atmospheric systems. The most ambitious ocean research and monitoring initiative recommended by the Commission on Ocean Policy is an integrated ocean observing system (IOOS). The IOOS is envisioned as network of ocean sensors and instruments that will be deployed throughout U.S. waters and eventually linked to a global ocean observing system. The IOOS will connect coastal, ocean, and Great Lakes observing systems, which in turn will supply data to participating federal, state, academic and private research and operations entities. The IOOS is the realization of the confluence of advances in sensors, sensing platforms, as well as data transmission and management that can accelerate and deepen our understanding and management of large and complex systems. Furthermore, ecosystem-based management, which takes into account the relationships among all ecosystem components, will demand more timely and applicable ocean observing capabilities. The IOOS will be an integral component in tracing, understanding and addressing coastal pollution, natural hazards, climate change, weather and storm prediction, coral reef degradation and fisheries depletion. CORE recommends that JSOST make development and implementation of a sustained, national IOOS a research priority within the ORPP.

**CORE**

Page 41-43. The section on observations / infrastructure is far too oriented toward open-ocean components. Most of the Nation's challenges are occurring in coastal waters and coastal watersheds. The RCOOS in the Great Lakes is NOT planning to address coastal waters or watersheds. ....the RCOOS should be directed toward information for research and management in coastal waters. OOI should focus it's resources and planning on coastal problems, as these are far more likely to realize results than additional infrastructure in open ocean waters. It seems to me that "observing systems" has become associated with "open ocean" ....the Nation's states, tribes, and coastal communities would be better served by a focus on coastal waters and watersheds.

**Keough, USEPA**

### **\*Page 41-43: Observations/infrastructure**

There also are considerable difficulties collecting data on policy making, interest group maneuvering, and even public preferences. These are areas that may be drier, but are no less impenetrable than the oceans. Moreover, there are multiple dimensions of spatial and temporal scale in these areas, and our paper trails may be even less complete than say, the geologists' fossil records. There is a dearth of standardized data collection mechanisms, databases, and large scale/complex socio-politico-economic models.

**Miller et al**

\*Page 41, Line 1 to Page 43, Line 37: While this section adequately addresses rationale and progress towards ocean observation systems, it does not address one critical thread: who will implement, maintain and foster growth of the system. As a cornerstone focus and cross-cutting theme of the ORPP, the issue of who will carry this set of efforts out,

clearly needs delineation. Said delineation stated properly provides a strong mechanism for broad based recruitment for support of the plan, and gives participating factions a clear stake in the plan's success.

**In particular, I support phrasing to the effect: *“Implementation of a permanent ocean observing infrastructure will require partnership among a diversity of commercial and public interests including large businesses, small businesses, academia, and local, state and federal agencies.”***

In accordance with this statement, it will prove critical for the government to manage an effective outreach effort to these groups in order to educate them as to the essential aspects and ramifications of the ORPP and moreover, to clearly elucidate that they have a role in the upcoming implementation. I bring this issue up specifically in reference to the potential recruitment of small businesses. It's my observation that over the past years, governmental agencies have been very keen to recruit big companies into the ocean technology infrastructure implementation effort. I understand this need completely - both in terms of the capabilities that the large companies offer, and in terms of the influence that they can bring to bear in legislative processes. That said the arguments for engaging small businesses are equally important, and in general terms, for the same reasons:

- While big businesses certainly bring both architectural design and operations capabilities, small companies bring an immense body of experience in sensor and sensor/system technologies development and implementation, and a close relationship with the research community.
- Lobbying efforts associated with large business involvement, could prove critical to administration buy-in as well as in influencing movement through the appropriations process. Nevertheless, the numbers and distribution of small companies within the US make them potentially useful allies as well. While these companies are "small fish" in a national scope effort, they actually appear reasonably big within the local ponds in which they swim. To an individual congressman in coastal Mississippi or Oregon, the 100 jobs and revenue that might come to their constituency as a result of this plan, may influence his/her vote much more than other factors of national scope. This recently came up with regards to the NW regional IOOS group with which I'm involved. We were having a meeting around the time Senator Snowe was trying to enter her Senate IOOS bill for budget inclusion. Some members of the regional group were trying hard to gain support from their senators to sign the accompanying letter introducing the bill. As far as I know they got one question back from their senators about the bill. "How many jobs will it create for my state?"

In addition to the potentially wide and diverse support that small businesses might offer to the ORPP, it should also be noted that small businesses played a large role in advancing sensor and platform technologies to the point in which the possibility of implementation of a national infrastructure can now be contemplated. They will continue to provide innovation, given the chance. In short, the potential for small business to take

part and contribute to the implementation and operation of the national oceans' infrastructure efforts could supply a very effective grass roots support for this effort as well as supply critical technical support.

On a related but separate issue, I noticed a common theme expressed in the planning sessions that was generally coined as "research to operations support " for various efforts. I contemplated this in specific context in support of new sensors, platforms and other technologies which will ultimately form and evolve the observational infrastructure. In my experience these efforts specifically require close partnering of academic and small business interests. I can think of no current active mechanisms to support this type of effort. Some agencies support longer term funding but limit or, in some cases, exclude small business involvement. Other funding mechanisms support one or both principals but only over limited time-spans. As a result both academia and businesses take on new sensor development efforts at some peril. While subject to some general criticism, the NOPP program appeared to provide a potential solution for these processes. As an example NOPP proved a very successful mechanism in supporting the development of operational bio-optical sensor technologies. These results were recently evidenced by Alliance of Coastal Technologies evaluations. Sensors used in the evaluations, which were borne out of NOPP efforts, clearly demonstrated performance apropos for operational observatory use. **In context of presently slated observatory efforts I think its vital for the Government to assure the continuity required to foster *research to operation* efforts by:**

- **Identifying successful efforts spawned by NOPP and other capability-building funding programs and, whenever applicable, fostering their further advancement and incorporation into currently planned infrastructure efforts (eg OOI, IOOS)**
- **Implementing 5-10 year technology developmental programs which partner academic and industrial (small and large) concerns within the *research to operation* framework.**

**Moore, WET Labs, Inc.**

\*Page 41: An important item included in the draft plan is the need to characterize the shallow-water coastal areas, including the need for bathymetry and habitat maps. I strongly support investing in this area, and supporting biogeochemical research and new technologies (such as remote sensing by an enhanced LDCM) required to map coastal submerged habitat types.

Remote sensing and new observing technologies:

- ❖ Remote sensing provide the only means to observe ecosystems across the range of spatial and time scales required to address local, regional, national and global problems.
- ❖ The suite of satellite systems that is available today looking at the ocean simultaneously or concurrently will not be available in a few years. We need to plan to replace such critical assets to measure ocean conditions continuously.
- ❖ Remote sensing technologies should be improved to enable capabilities which we now know are possible to observe the coastal and global ocean.

- ❖ (Urgent) The Landsat Data Continuity Mission should be enhanced to include a minimum set of narrow and sensitive bands, at sufficient digitization, to observe shallow submerged lands. This will be one of the most important tools for coastal resource managers and by researchers.

**Muller-Karger, USF**

Page 41-43. The section on observations/infrastructure lacks a viable discussion of long-term monitoring. The discussions in this section about ocean observation systems need to be related to the need for and advantage of long-term monitoring programs.

**National Estuarine Research Reserve Association**

Page 41-43: This section lacks a viable discussion of long-term monitoring. The discussions in this section about ocean observation systems need to be related to the need for and advantage of long-term monitoring programs.

The System Wide Monitoring Program of the National Estuarine Research Reserve System (NERRS), a long-term monitoring program, is working hard to integrate into the IOOS, bringing the critically-needed information from the inshore habitats into the broader, blue-water system. The need for this type of effort is not well reflected in this document.

Page 41-43: This chapter should make a particular emphasis in the need to establish effective infrastructure to transfer information to users.

**NOAA-NOS-Estuarine Reserves Division**

Page 41. Includes a need to “standardize fisheries and protected species surveys; and multi-beam sonar measurements”, which were topics at the recent workshop on Integrated Ocean and Coastal Mapping (IOCM) at the University of New Hampshire.

**NOAA Fisheries**

\*Page 41- One has to wonder why you call the ocean "cold dark, high pressure and corrosive". That is not an inclusive definition. It is also the water on a sunny bathing beach.

**Sachau, private citizen**

Page 41, Line 1 to Page 43, Line 37: Technology needs in the areas of sensors, information technology, observational infrastructure and seagoing access were recognized at the April workshop. Unfortunately, this draft does not address specific needs and the paths to meet them. The need for extension of this and the previous section is huge.

Again, there is no vision statement.

**Scripps Institution of Oceanography**

Page 41: Again, use parallel structure for this chapter on Obs Infrastructure, or better yet, **eliminate**; does not add much to OOS items dealt with repeatedly in all the main themes.

**Shepard, University of North Carolina at Wilmington**

### **Cross-cutting Theme: Observations/Infrastructure**

**To what extent are the gaps FSTT identified in this theme from Draft 0 still present in the Planning Document?**

- These sections almost exclusively address blue water issues and needs. Additional attention needs to be given to near shore and estuarine issues and needs. **This has been moderately addressed in the Planning document.**
- These sections should do a better job of articulating a clear set of priorities for developing techniques to minimize adverse impacts on the ocean, near shore and estuarine environments. The sections should focus on developing control technologies and better compliance tools. **The new section in the Planning document on “Research Needs” articulates priorities; however, the priorities do not specifically include research on techniques to minimize adverse impacts on the oceans, near shore and estuarine environments – nor are they in any priority order.**
- The majority of the “cross cuts” focus on the need for basic research in relatively unexplored ocean environments, and address issues such as ocean observing systems, and public and private partnerships to carry out and reap the benefits of basic research. This forward-looking recognition of the benefits associated with exploration of the possibly untapped resources of the open ocean is both appreciated and, to an appropriate extent, supported. However, the information needed by resource managers now and in the foreseeable future speaks more to protection and management of coastal and nearshore waters, including the Great Lakes. Should research efforts and funding be focused too greatly on open ocean monitoring and investigation, the present day needs of state, federal, and local managers will not be met. **While coastal needs are mentioned in this section of the Planning document, there continues to be no real priority placed on information necessary for coastal management that could be derived from coastal observing infrastructure.**

**How well are the workshop recommendations for this theme aligned with both the FSTT Report on research priorities and the FSTT comments on Draft 0?**

- The Task Team Report did not specifically comment on Observations/Infrastructure since there was no Observations/ Infrastructure cross-cut in the original plan. The Task Team Comments on Draft 0 document listed the above comments for all of the cross-cut areas.
- While the Task Team continues to support the JSOST tilt toward basic research in understanding ocean processes in the current Observations/Infrastructure section of the Planning Document, there was only one bullet in the Workshop’s Priorities or Actions slides that addressed the Task Team concerns regarding obs/infrastructure in direct support of coastal management and protection responsibilities (Slide 3 Actions - Implement a robust integrated ocean observing infrastructure that serves National and regional needs).

**SIMOR FSTT**

\*Page 41: The NERR system is working hard to integrate into the IOOS, bringing the critically-needed information from the inshore habitats into the broader, blue-water system. This is not reflected in this document.

### **Talley, SF Bay NERR/ SFSU**

\*Page 41: Observations/Infrastructure

### **Emerging Vessel Capabilities Unmet**

There has been a push by UNOLS to standardize vessel capabilities around the most common long standing missions with several ship size classes like coastal class and ocean class. Equipment has also been standardized including among other things winches and wire. This standardization can save money, reduce required stocks and improve inter-institutional interchangeability. But, the drive to standardize the oceanographic fleet has left many emerging practical scientific observation and engineering infrastructural needs unmet. Here are a few examples:

#### **1) Observatory Construction and Maintenance**

Construction and assembly of complex underwater hardware systems, such as those envisioned in proposed oceanic observatories, will be very difficult with the present inventory of conventional ships. Heavy lifts, measuring in the thousands of pounds, will be needed routinely. To be effective, the lifting platform, at the surface must be equipped with motion stabilizing devices, so that wave forced surface platform motions are not transmitted to the bottom. Otherwise, long delays may occur while awaiting weather windows. Simple cabled devices, like a single hydrophone at the end of a long cable, could be serviced by bringing the entire assembly aboard for maintenance and/or replacement. More complex arrays will have too many cables and interconnections to be serviced by this method. Particularly as water depths increase, slack cable lengths required to bring multiple devices to the surface increase, making fouling of cables more problematic. Connections with cables, data loggers and sensor systems must also be remotely installed during reasonably advanced sea states and strong currents.

#### **2) Precision Sampling beyond the Limits of Routine Diver Operation**

Small scale precision drilling/coring may be required to sample complex topographies and/or install anchoring devices along mid oceanic ridges or deep ancient reefs. The need to collect living specimens at great depth, found within rocks or rocky terrains like ridge and vents structures are becoming more common. ROV operations may be used to carry out many of these missions. An optimal platform, which can support higher powered ROVs, has much in common with the observatory support mission above. Installation and recovery of current and temperature sensors, within a canyon on a mid ocean ridge, to observe mixing processes is an example of missions difficult to do with today's platforms. Manned submersibles are capable of such missions but are increasingly expensive and have limited availability. Direct connection of a cable to a surface ship may overcome heavy lift, power, bandwidth and duration limitations of manned platforms.

#### **3) Coastal Drilling Ship**

Deep sea drilling ships have supported programs, which continue to produce landmark scientific results. Similar results have been produced in shallow water using jack-up drilling rigs, like those used on the Bahama Banks, that have complement results from a deep sea drill ship campaign in the Florida Straits. There are a host of projects which could benefit from economical shallow water drilling or coring capability needed to study proxy climate data stored in coral reefs and coastal lagoon sediments. For example, what is the pre-Columbian climatology of hurricanes in the Caribbean and along the southeastern U.S. and Gulf of Mexico coasts?

#### **4) Ship Bourne Remote and Direct Sensing**

Remote and direct sensing from a ship is contaminated in several ways by wave induced ship motions. Measurements as simple as acoustic depth sounding are contaminated by ship motions changing the distance between the bottom of the ship and the bottom of the ocean. Acoustic Doppler velocity measurements are contaminated as pitch, roll and heave motions change the depths of range bins being averaged to establish the velocity components. Averaging data from several depths reduces the vertical resolution and increases the averaging time. Ship coupled motion smears data measured by CTDs or other sensors suspended from wires. In addition to the blurring produced by the turbulent motions of the ocean and atmosphere, ship bourn images are more seriously blurred ship motion during what ever averaging time is required to produce clear images both in the water and the atmosphere above. By mounting sensing systems on motion compensating devices the signal to noise figures may be improved for a host of measurements. Such improvements may be especially useful for observing bottom boundary layer velocity structure and recent sedimentary layers in the bottom. Repeated images of the bottom of a shipping channel could be compared to detect changes for homeland security applications if the signal to noise is sufficiently improved.

#### **5) Gear Handling Safety**

Scientists, engineers and technicians are still handling large loads such as CTD/rosettes or large syntactic floats by hand or with restraining lines as they careen around forced by the ship's pitching and rolling. Frequently they are standing under an A-frame or on a Hero platform over the side or waist deep water rushing across the deck. Winch and Wire accidents at sea are among the most dangerous parts of marine science apart from the occasional outright loss of a vessel. If an inattentive winch operator two blocks a heavy load it often comes crashing down on the people below. Isn't it about time we put robotic devices in harms way rather than people? In many ways we are no safer handling gear than oceanographers were 50 or 100 years ago.

#### **6) Platform Motion Attenuation Solutions**

Most mono-hull research vessels deploy gear over the side or stern where wave coupled hull motions are maximum, because these positions are remote from the pitch and roll center of the vessel. Sensors or complex devices like ROVs deployed at the end of a wire are moved by the vertical component of wave forced platform motion even when deployed at great depths. ROVs are often launched in "garages" to prevent damage and are deployed at depth on umbilical cords to effectively decouple wave motion. However, the garage is still subject to the wave motion, with resultant stresses. These

cyclic stresses can lead to fatigue of wire terminations and loss of gear even by experienced operators like Robert Ballard. Motion compensated winches have been quite limited in their ability to remove complex wave forced ship motions. Drill ships on the other hand deploy their drill strings through a “moon pool” at the pitch and roll center which is required by stability limitations and reduces wave induced motions to the single heave component. (Which is usually compensated by a heave stabilized drilling floor)

Small Water-plane Twin Hull (SWATH) vessels are available in some coastal regions like Hawaii as described by Roberson Dinsmore\* (Section 11 - **SWATH**). SWATH vessels attempt to control the motion of the entire ship and usually rely on conventional over the side/stern sampling. However, the SWATH vessel operated by the Monterey Bay Aquarium in California deploys gear through a center well, where motions are minimal, and additionally uses motion compensating gear to perform most of the missions described above.

The utter ease and safety of using the central elevator aboard the Catamaran Lu Lu (submersible Alvin’s original mother ship), to lower/recover gear through its pitch and roll center convinced this writer to investigate catamarans as launching platforms. To test the dynamic response of wire lowered gear in center wells, this writer built a center well in his 36’ catamaran. The well was straddled by a tripod, which had a turning block located at the center of pitch and roll. Six hundred and sixty pound lead anchors were routinely launched from this 4,000 pound catamaran in 4 to 6 foot seas. The anchor motion during launch/recovery was so gentle that restraining lines were scarcely needed. This conclusively demonstrated the ease and safety of using a passive pendulum, located at the pitch and roll center of the vessel. Imagine how much active hydraulic controls could further reduce wave forced pendulum motions.

Thus catamaran platforms with robotic devices, operated through a center well at its pitch and roll center, should offer a lower cost alternative to Swaths as described in Van Leer\* (Section 12 – **Multihulls-Catamarans**). Here only about 1 percent of the vessel’s mass is motion compensated in the form of a pitch, roll and heave stabilized pendulum. Devices are deployed from this pendulous robotic manipulator which controls motion during launch/recovery. Such an arrangement stabilizes payloads while connected by wire to the vessel. Scientists, engineers and technicians can watch from the bridge while the hatch covering the center well is retracted and their gear is deployed by the motion compensated pendulum. When the gear is safely below the keels and lowered away, AUVs and ROVs are launched/caged below the wave orbital zone from a nearly stationary wire. These catamaran vessels also offer exceptional station keeping and fuel economy with diesel electric propulsion. With spuds such a catamaran is an economical shallow water drilling/coring vessel.

### **Recommendations**

A least one vessel with advanced gear handling capabilities should be maintained on the Atlantic, Pacific and Gulf coasts as well as the Great Lakes. A catamaran vessel with robotic capability should be built as a prototype in a small or coastal sized vessel.

This vessel should be sponsored and operated by a coastal observatory group with significant engineering capabilities.

**\*UNOLS Small Research Vessel Compendium** (2004) Edited by Jack Bash and available electronically on the UNOLS website at:

<http://www.unols.org/publications/manuals/SBCompendium/index.html>

**Van Leer, RSMAS/MPO/University of Miami**

An important item included in the draft plan is the need to characterize the shallow-water coastal areas, including the need for bathymetry and habitat maps. I strongly support investing in this area, and supporting biogeochemical research and new technologies (such as remote sensing by an enhanced LDCM) required to map coastal submerged habitat types.

Remote sensing and new observing technologies:

- o Remote sensing provides the only means to observe ecosystems across the range of spatial and time scales required to address local, regional, national and global problems.

- o The suite of satellite systems looking at the ocean that is available today will not be available in a few years. We need to plan to replace such critical assets to measure ocean conditions continuously.

- o Remote sensing technologies should be improved to enable known capabilities to observe the coastal and global ocean.

- o (Urgent) The Landsat Data Continuity Mission should be enhanced to include a minimum set of narrow and sensitive bands, at sufficient digitization, to observe shallow submerged lands. This will be one of the most important tools for coastal resource managers and by researchers.

**Wall, USF**

\*Page 41, Line 1 top Page 43, Line 35: We strongly support observing systems and the infrastructure necessary to support these efforts. This includes the necessary human resources to adequately man the programs and collect the necessary data.

**Waugh, SAFMC**

\*Page 41: Observational and modeling efforts must be done in close coordination with federal and local ocean resource management agencies. Because of the enormous amount of data that will be collected through these complex and innovative technologies, ocean resource management agencies must understand how the information is collected, assimilated and produced if they are to be used in decision making.

**Western Pacific Regional Fishery Management Council**

## **OBSERVATIONS AND INFRASTRUCTURE-PAGE/LINE SPECIFIC**

\*Page 41, Line 18 to Page 42, Line 17: OBSERVING SYSTEMS:

Currently, no US agency is responsible for satellite observations of the ocean, which is a HUGE infrastructure issue. NASA does "technology innovation" and may make new measurements, but has no obligation to "continue critical satellite observational capabilities." NOAA has neither the budget, not the expertise to do this. The only routine climate measurement for which NASA is responsible is for ozone and that took an act of Congress. The ORPP should make a similar strong statement about the need for NASA to do sea level measurements indefinitely, as well as cooperating with NOAA on other satellite observations. This problem deserves a separate paragraph.

\*Page 41, Line 18 to Page 42, Line 17: The two satellite sensors that have made the biggest changes in atmosphere-ocean interaction studies, the altimeter and the scatterometer, are poised to cross the line between the Global observing system and the Coastal observing system, which is how GOOS is structured. The next generation scatterometer will have 1-5 km resolution and a swath altimeter would have 5-10km resolution. Coastal researchers (and hydrologists) have not used either of these sensors extensively because of the resolution. The new sensors will change supply massive amounts of data and it will affect the design of coastal observing systems.

**Kelly, University of Washington**

\*Page 41, Line 19 to Page 42, Line 16: This is ok as far as it goes, but there is no discussion of infrastructure requirements or even of a process to assess infrastructure requirements across the board for all 7 themes.

**Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

Page 41, line 32-35. Change to read: "The coastal component is designed to detect, assess, and predict the effects of weather, *geological*, climate, and human activities on the state of the coastal ocean, its ecosystems and living resources, and the U.S. economy."

**Scripps Institution of Oceanography**

Page 42. The document mentions the need for a "robust research fleet." Such a fleet should maximize the use of vessels belonging to other marine operators, for example fishermen. Such use, under cooperative agreements, provides tremendous economic and social benefits and can return superior research product.

**CCCHFA, Rudolph**

\*Page 42 - Hypoxia in Gulf of Mexico – U.S. allowed this to happen. It shows the situation is extreme.

**Sachau, private citizen**

\*Page 42, Lines 7-16: Clearly, OOI will provide important new infrastructure for basic research. At the same time, this could provide new platforms that could support "operational" sensors and telemetry (just as research vessels support both at times). Is this not a possibility? If so, this paragraph should be modified accordingly.

## **Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

Page 42, line 7-8. Delete “Although the IOOS will have a research and development element, a future basic research component of the IOOS will be the Ocean Observatories Initiative (OOI)” and replace with “The NSF OOI is the basic research component of the IOOS comprising fully integrated coastal, regional and global observations.”

### **Scripps Institution of Oceanography**

Page 42, line 10-13. Remove the following text: “Similar to the IOOS, the OOI has global, regional, and coastal components. The technological foundation of the regional OOI—a fiber-optic cable that transmits data to shore in real time—is based on several successful pilot and test-bed projects.”

### **Scripps Institution of Oceanography**

\*Page 42, Lines 18-24: The necessity of land-based marine labs is acknowledged. Add: “The coastal and marine laboratories can meet this need, and connectivity enhancements (optic fiber, satellite receivers) need to be in place.”

### **NAML**

Page 42, line 18-25. UNOLS has documented a projected increased need for research ship support in near decades. Even remote observing systems must be implanted and "truthed" with reliable observations, plus many of the lines of inquiry addressed in the plan will require sustained in situ observations, process cruises, and so forth. This is a significant problem and should be addressed head on. For example, construction and 20 years of operation of a new polar icebreaker to support US polar research and other US needs in the polar regions in the billion dollar range. Keeping alive a cadre of technical specialists is becoming ever more challenging - will we have the expertise to make the measurements in decades to come?

### **Scripps Institution of Oceanography**

\*Page 42, Lines 29-30: “*Questions about how the ocean will react to conditions in the future or about the oceans of the past cannot be answered by observation.*”

Add: "They do require, however, long-term databases, and these need to be supported through older database restoration, metadata documentation, standards development, and archival procedures and infrastructure. The nation's marine and coastal laboratories are a major resource for long-term databases."

### **NAML**

\*Page 42, Line 35: The abbreviations for hours and years are h and yr (no s).

### **Jumars, University of Maine**

\*Page 43 - Enhanced "sensor" packages must not harm marine life in any way. I am sick of whales being hemorrhaged from sonar and washing up dead on the beach.

### **Sachau, private citizen**

\*Page 43, Line 1: Add EXPLORATION subtopic after Ocean Observations section:  
RATIONALE:

Experience has certainly shown that benefits in the form of new products and services often result from unexpected discoveries. Equally interesting, some ocean study leads to deeper understanding of our relationship to the oceans and to understanding the long-term history of Earth and its ocean. Our strategy must include “room for creative individuals to pursue the kind of fundamental scientific research that can lead to unforeseen breakthroughs.”xlili

Replace Exploration language from p. 40, line 2-19.

Add additional text on Ocean Exploration to include need for coordinated, national, interagency program and means of identifying priorities.

**Kohanowich, NOAA’s Undersea Research Program**

Page 43, line 2.

Before the first full sentence on page 43, I recommend adding the following: “In order to produce the best synthesized description of the state of the oceans (and the Earth system) and how they are evolving over time, the capacity must be improved to assimilate current and planned future observations from disparate observing systems into Earth system models that include physical, chemical, and biological processes.”

**Schultz, CCSP**

\*Page 43, Lines 9-30: The need to develop sensors to being able to remotely measure pollutants should be included here. Ideally, this would include means to being able to detect oil spills by automatic detectors to protect critical habitats.

**Lohmann, University of Rhode Island**

\*Page 43, Line 12: The second bullet stands out as rather different from the rest. One way to fix it is by pointing out the other grossly sensor-deficient science, which is biology. One could add a following bullet: improving sensors for automated identification and quantification of organisms, from bacteria to whales. (Line 19 should start “expanding..” to preserve parallel grammar.)

**Jumars, University of Maine**

Page 43. Line 13. Insert the following additional bullets:

- define a set biological, chemical, geological, and physical core variables to be collected by all components of the national IOOS and requires investigators who receive federal funding related to ocean observatories, including the NSF Ocean Observatories Initiative, to plan for the transfer of successful technologies to an operational mode in IOOS;
- consider mechanisms to establish priorities, budgeting and scheduling for space-based missions as an essential component of the national IOOS;
- improve the capacity to calibrate, collect, and disseminate satellite data and to integrate satellite-derived information with traditional ocean and coastal databases;

- establish a suitable archive to preserve historical satellite and ocean observational data, particularly those related to long-term trends such as climate;
- enhance coordination with other existing and planned terrestrial, watershed, atmospheric, and biological observation and information collection systems; and
- promote strong partnerships among federal, state, territorial, tribal, and local governments, nongovernmental organizations, industry, regional associations, and academia, drawing upon the strengths and capabilities of each sector in the design, development, and operation of the IOOS;

## **CORE**

\*Page 43, Lines 14-15: Modify this bullet to say “”deploy...are automated, have improved power systems for longer life, and...”

### **Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

\*Page 43, Lines 14-15: *“deploying enhanced sensor packages that are more precise and accurate, are automated, and require less maintenance...”*

- This addresses the need for sensors that are more precise and accurate; however, they also need to be more robust.
- We will also need expanded/cost effective ship support for instrumentation/platform deployment and maintenance as IOOS and OOI are implemented.
- Also, we’ll need cost effective communications support, e.g. access to satellite telemetry.

## **NAML**

\*Page 43, Lines 16-17: The bullet beginning “improved remote sensing measurements”. Does this refer to better calibration or better satellite sensors? For satellite sensors, stressing higher spatial resolution would be timely and helpful. “ Better coordination between satellite missions and in situ efforts for calibration” would be a good recommendation, as NASA and NOAA routinely underfund in situ calibration efforts.

### **Kelly, University of Washington**

Page 43, line 17. Educational Assessments: As noted before the methodology for conducting the baseline assessment needs to be spelled out in more detail. **NOAA Fisheries**

\*Page 43, Lines 24-25: *“advancing necessary aspects of observing data management, including data assimilation, distribution, and archiving...”*

- This addresses some data management needs; this should include quality control/assessment and standards development.
- Add: “Increased interaction and collaboration among physical oceanographers and modelers and biological scientists, including not only biological and chemical

oceanographers, but also resource (e.g. fisheries) assessors, social scientists, molecular scientists, and physiological, evolutionary, and behavioral biologists.”

## **NAML**

Page 43, Line 30: Ocean and coastal research, observing, and monitoring activities are generating new data at ever-increasing rates—data that must eventually be analyzed, distributed, and stored. CORE concurs with the Ocean Commission “The nation’s ocean and coastal data management systems should be modernized and integrated to promote interdisciplinary studies and provide useful information products for policy makers, resource managers, and the general public.” Agencies need to coordinate federal data management and develop an information management and communications program that will effectively store, access, integrate, and use a wide and disparate range of data needed to better understand the environment and to translate and deliver scientific results and information products in a timely way to national, regional, and local decision-makers. CORE recommends that the ORPP create a subsection under the Observations/Infrastructure cross-cut to address the needs associated with modernizing ocean data and information systems.

Page 43. Line 30. Insert a new subsection entitled: Ocean Data and Information Systems Needs that include the following bullets:

- improve coordination between the existing data centers and to integrate ocean and coastal data from different agencies, academic and private institutions, the goal of which would be the creation of an ocean and coastal information management and communications partnership to generate information products relevant to national, regional, state, and local operational needs;
- set priorities for archiving historical and nondigital data;
- provide incentives to attract information technology expertise into the ocean sciences community; and
- set common requirements, data certification procedures, and deadlines for investigators to submit data acquired during federally funded ocean research projects.

## **CORE**

## **OCEAN EDUCATION-GENERAL**

\*Page 44: The linkage between research and education/outreach makes ocean, coastal and Great Lakes education and outreach programs more exciting and memorable (enhances retention of the information) and more applicable to real-world problems; but it also greatly increases the value and impact of the research and the likelihood that research results will be rapidly put to use to improve management, quality of life, and economic competitiveness. The education section of the report should reflect these points.

In addition to the educational programs outlined in the plan, emphasis should be placed on ensuring strong federal programs and financial support for graduate education in a variety of federal agencies and in fields important to ocean, coastal and Great Lakes research efforts. The research programs that will be developed through this overall plan will require an enlarged, and highly trained, workforce. Additional emphasis on graduate education will help to provide the skills and individuals that will be necessary in coming years.

Page 44: As a nation, we rely on high caliber programs for undergraduate and graduate students to maintain U.S. leadership in the ocean sciences and ensure our capacity to address ocean issues related to environmental quality, economic well being, and national security. Toward that end, research experiences at the undergraduate level must be expanded, graduate student support in the ocean sciences must be diversified and at a level comparable to the life sciences. A major thrust of the Commission report was the national need to strengthen ocean-related public education and outreach programs, to facilitate coordination of ocean-related education among federal agencies, and enhance collaboration among the research community, state and local education authorities, and the private sector. A primary objective of the ORPP should be to create an ocean literate public. There are challenges to achieving this objective and CORE concurs with the challenges outlined in the workshop on Guiding National Ocean Research Investment and recommends that they be reflected in the text.

### **CORE**

\*Page 44: GENERAL COMMENT: This section would benefit from specific research actions directed toward improving human decision-making with respect to ocean resources, and other activities that affect ocean resources.

### **Ford, Massachusetts Division of Marine Fisheries**

\*Page 44: Ocean Education: This section needs references to lend credibility to many of the general statements. There is no mention of education to develop future technologists (e.g., engineering, computer science, information systems). This is where the employment shortages already exist, where the fastest growth in new jobs exist, where an even faster growth is predicted for the future, where salaries are highest, and where diversity issues (except for Asians) are the most disconcerting. There is no mention of mathematics education--science and engineering cannot be done without the math skills. Where's the "systems" thinking? Education is a complex system and therefore requires a

systems approach to resolve challenges. Systems thinking is our only hope to achieve a positive effect on science/technology education or on the public's knowledge in any discipline. The whole idea of building on the "best of what already exists" seems to have been lost here. There is only a sideways reference to it in the Educational Assessments sub-section. In addition, there seems to be no recognition that to achieve improvements in education resulting in knowledgeable citizens, stewards, and a workforce, efforts must be sustained for long periods (18-20 years--the time to matriculate through the education system).

### **Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

#### **\*Page 44-45: Ocean Education**

One more time, it's not just about information, it's about limited resources and opportunity costs. In that light, it might be useful to explicitly include a search for relatively cheap actions that can be taken by these newly educated individuals so that they will be willing & able to put this new information to good use.

K-12 education should include education on decision making, collective choice and the role on governance. Students need a foundation to understand how coastal and ocean governance systems operate, where and how ordinary people can participate in decision making and make their voices heard (not only as consumers in the marketplace and volunteers in beach clean-up programs, but in city, county, state, and federal government bodies. They need to understand the role of human behavior and decision making processes that affect oceans. Ocean civics should be a part of every classroom alongside ocean ecosystem studies.

#### **Miller et al**

#### **General Comments: Diversity in Ocean, Coastal, and Great Lakes Research**

The education crosscut should be expanded to include a discussion on diversity in the context of the ocean, coastal, and Great Lakes workforce. In view of the rapidly changing demography of the U.S. and persistently low diversity of the ocean science workforce, efforts are needed to expand opportunities to groups currently underrepresented in ocean sciences.

Greater coordination of education efforts, a holistic or at least inclusive view of education from informal to post-doctoral, and looking to what has worked for less diffusely organized enterprises such as human health for guidance, especially with respect to programs designed to increase representation from underrepresented groups are other important notions that rise from these policy documents.

Field courses and field research experiences offered at field stations and marine laboratories are often life-changing for many students because they provide a highly focused venue for actually doing science, and for experiencing inquiry-based learning.

#### **NAML**

Page 44-45. The plan does not adequately address the need to translate and transfer the research results to the coastal and ocean management community. In the Ocean

Education section, an additional audience comprised of coastal decision makers should be included. Coastal decision makers can generally be defined as individuals who are responsible for making decisions that affect coastal resources, including: government staff and elected or appointed officials; coastal businesses; non-governmental organizations; land use managers; and resource management agencies.

The plan contains multiple references to research products impacting management of ocean and coastal resources, yet those people who make daily decisions on how these resources are managed are not included as a focal audience of education. To improve ecosystem health and sustain natural resources, it is critical that decision makers be equipped with science-based information and up-to-date technical skills.

To move science from the world of research to the world of action, educators must understand more completely the needs of their audiences and match the development of research-based educational products to those needs. The plan refers to a number of tools these research priorities will produce, but there is little discussion about how the need for, or distribution of, these tools will complement both audience needs and research priorities. Research dollars spent on the delivery of the package and evaluating the needs of the audience for whom the package is intended need equal research attention. Otherwise, our present state will continue—warehouses full of research ‘packages’ awaiting delivery and application. To achieve the vision of this plan, education directed at individuals whose daily decisions impact ocean resources and research into the proper delivery methods for these audiences are essential.

#### **National Estuarine Research Reserve Association**

Page 44-45: This chapter is good, but is lacking mention of important issues such as the transfer of information or education to coastal decision makers and land managers, and adaptive management (integrating more closely science and management). Further, these ideas, while important enough to warrant their own section, also need to be integrated more fully into the entire document. Education and management should not be treated as separate entities from good science, but need to be recognized as a part of a unified way of dealing with science.

Page 44-45: This chapter should provide additional emphasis in the “delivery mechanism” of research information and products. As it is, it lacks a discussion on how research information will be used in coastal management decisions and what types of products will be produced to assist in coastal management decisions.

Research must focus equal attention on the delivery mechanism and how it relates to the intended audience. Research focused on the barriers to science translation and application to resource management is necessary. To achieve the vision of this plan, education directed at individuals whose daily decisions impact ocean resources and research into the proper delivery methods for these audiences are essential.

#### **NOAA-NOS-Estuarine Reserves Division**

\*Page 44 - The public needs access to honest, truthful science. The science we get nowadays is politically skewed by lobbyists appointed by the administration. Why trust dishonest science politically skewed and biased. Where are the honest scientists?

**Sachau, private citizen**

Page 44, Line 1 to Page 45 Line 37: On the whole, the education section reads very poorly. While the overall content is not far off base, it is not presented in a compelling way.

Education must be an integral part of all facets of an Ocean Research Priorities Plan. It is imperative that we build and sustain broad support for the ocean research enterprise. The foundation of this support is public appreciation of ocean science and the relevance of the ocean to their lives. We need to build capacity for national scale efforts in both ocean science education and communication.

Recommended actions:

- Formulate a national ocean education and communication strategy that focuses on generating a knowledgeable, ocean literate public and a well-prepared ocean workforce. The strategy should address ocean sciences education at every level (elementary through graduate) and communication via a wide variety of mechanisms including television, radio, newspapers, popular press, science centers, internet, etc. Central to the strategy should be the involvement of ocean researchers in providing up-to-date and accurate content, insight into the process of science, and a window into the exciting world of ocean science exploration and discovery.
- Work to integrate ocean sciences education into the national quest for public scientific literacy and continued U.S. leadership in science, technology, engineering and mathematics (STEM). We cannot separate ourselves from the national efforts aimed at maintaining and increasing US competitiveness in STEM disciplines and in the global economy
- Foster a graduate education system that allows for individuals to pursue advanced degrees in ocean science while simultaneously training to become leaders in government, communications, media, education, policy, industry etc. We need people with a firm grounding in ocean science in positions of national leadership and influence. I feel that this can in part be accomplished by providing a broader range of degree opportunities within ocean research institutions associated with large universities. Individuals educated in this way and employed outside of the traditional research arena can advocate for and support ocean science research.
- Fund the actions above at an appropriate level.

The report includes a section on Educational Assessments. I agree that assessment of the efficacy of any given effort is essential, and a gap analysis can provide the basis for formulating a robust ocean education and communication strategy.

**Scripps Institution of Oceanography**

Page 44: Suggest changing this chapter title to *Ocean Literacy*; two somewhat distinct paths include outreach and education—both seek to promote public awareness and understanding of the oceans, and develop the nation’s next generation of scientists and managers (together, ocean literacy); again, chapter should be rewritten with parallel structure with other themes-- **Vision Statement, Rationale, Challenges, Research Needs, and Expected Results**. Suggest COSEE program consider review and rewrite at May 2006 meeting.

**Shepard, University of North Carolina at Wilmington**

### **Cross-cutting Theme: Ocean Education**

#### **To what extent are the gaps FSTT identified in this theme from Draft 0 still present in the Planning Document?**

In its initial report, the Task Team noted that the new focus of ocean research must include a significant understanding of the “human dimension,” of which education is a key component. Education was not identified as a cross-cut in the early JSOST work.

- The Task Team comments on Draft 0 noted that each of the JSOST themes included a brief section on education, but appeared to be included as an afterthought. We noted additional specifics about education were needed and suggested moving the shorter subsections to the cross-cut section on education, first included in Draft 0 of the JSOST report. **The Planning Document addressed these comments and concerns with the inclusion of a more robust cross-cut section on Ocean Education. This section provides a good description of gaps for ocean literacy in K-12 education and workforce competencies. There remains a need to further articulate specifics for the “educational efforts” that will be used to address these gaps.**
- The Task Team also pointed out the need for an improved exchange of information between management and research communities. In particular, we stressed, if the results of science are to be useful to the management community, the identification of communication mechanisms between the two communities must be identified as a priority. Science-to-management concepts should be considered as an additional cross-cut issue. **There is a remaining need to further clarify the means by which there will be effective translation of science to management.**

#### **How well are the workshop recommendations for this theme aligned with both the FSTT Report on research priorities and the FSTT comments on Draft 0?**

- Workshop recommendations under this theme go even farther and provide more specific guidance as to how Ocean Education should be carried out.
- The Task Team acknowledges and concurs with challenges for this theme outlined by workshop participants, particularly:
  - Bridge, address, and capitalize cultural, geographic, languages, values, and practices to reach diverse audiences
  - Improve knowledge of conveyers of ocean information and create an educational continuum that promotes a knowledgeable and ocean-literate literate public (Task Team suggests using the term “lifelong learning”)

- Understand the needs and priorities of end users

**SIMOR FSTT**

\*Page 44: This section is good, but is lacking mention of important issues such as education of coastal decision makers and land managers, and adaptive management (integrating more closely science and management). Further, these ideas, while important enough to warrant their own section, also need to be integrated more fully into the entire document - education and management should not be treated as separate entities from good science, but need to be recognized as a part of a unified way of dealing with science.

**Talley, SF Bay NERR/ SFSU**

\*Page 44, Line 1 to Page 45, Line 36: We strongly support ocean education and have made this a critical part of our Council's ongoing fishery management efforts.

**Waugh, SAFMC**

\*Page 44: This section provides opportunities for educational experiences by younger generations but does not plan for educating the current older generations that have the greatest, immediate impact on today's ocean and its resources. This section does not plan to provide the communities and the public in general, a way to access the information in terms that are understandable and can be easily comprehended. Annual reports on the research, in a easy to understand format, should be published to update the citizens of the United States on what is happening and what their tax dollars are going towards.

**Western Pacific Regional Fishery Management Council**

## **OCEAN EDUCATION-PAGE/LINE SPECIFIC**

\*Page 44, Line 1-36: This section on ocean education doesn't give an optimistic sense of the kind of K-gray integration that is being pursued by COSEE. For that matter it does not mention COSEE directly. Is there a reason for this omission?

**Jumars, University of Maine**

\*Page 44, Line 1: New Cross-cutting theme

Summary:

RATIONALE: The ocean is a cold, dark, high pressure, and corrosive environment, hard on humans and their machines. As such, it remains the least explored and most under-sampled environment on Earth. None of the ocean challenges listed can be effectively addressed without sustained access to the tools and techniques provided by advanced and available technology. Likewise, continued progress in ocean research and discovery is dependent on a nationally sustained marine technology and development effort.

Add subtopic, OCEAN INFRASTRUCTURE: Access to the means to study, explore, and observe the ocean is key to addressing each of the ocean research priorities. In order for these means to be available, affordable, and sustainable, a coordinated, cooperative approach to providing the nation's ocean infrastructure needs and determining priorities is necessary. This approach must consider the full suite of ocean infrastructure including ships, laboratories, manned submersibles, unmanned autonomous and remotely operated vehicles, sensors, ocean observation equipment and techniques, and manned diving techniques. (Develop additional language.)

Add subtopic, NEW TOOLS: Add p. 40, lines 21-26 (Also develop additional language)

**Kohanowich, NOAA's Undersea Research Program**

\*Page 44, Line 4: I would change it to the more fundamental: "The role and value of the ocean..."

**Jumars, University of Maine**

\*Page 44, Lines 4-13: This sub-section is especially weak because it has no references. It also assumes a society that understands the value of the ocean in the Earth system will result in governance that reflects this value. What is the evidence for this statement (provide references)? If the goal is stewardship at the expense of science, engineering, and mathematics education, ocean education will be a paper tiger. Stewardship of our Planet and its ocean is an appropriate goal for all citizens. However, it needs to be accompanied by development of a skilled science and technology workforce capable of both innovation and creating and sustaining new knowledge industries if our Nation is to be an economic leader in the 21st Century. Stewardship that is based on an emotional connection to the resource (i.e., the ocean) without a strong intellectual understanding of the science associated with the resource is hollow. For Stewardship to be authentic, citizens must be informed and motivated enough to make personal, business, and public policy decisions based on that knowledge today and in the future. This section would be much stronger if it considered lifelong learning to create and sustain a society of

informed citizens, ocean/Earth stewards, and a globally competitive science and technology workforce via a focus on the oceans.

**Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

Page 44. Line 14. Insert the following challenges:

- Communicate the value of ocean resources and science effectively;
- Ensure a diverse and qualified workforce;
- Bridge, address, and capitalize cultural, geographic, languages, values, and practices to reach diverse audiences;
- Improve knowledge of conveyers of ocean information and create an educational continuum that promotes a knowledgeable and ocean-literate public;
- Understand the needs and priorities of end users; and
- Promote the recognition and acceptance of ocean education and its impact on economic/global competitiveness by the scientific/technology research community and decision-makers.

This nation must enhance educational achievement in natural and social sciences and increase ocean awareness, including promotion of programs that transcend the traditional mission boundaries of individual agencies. CORE recommends that each paragraph in this cross-cut theme have clear action items. We offer the following recommendations [NOTE-recommendations are listed by line below].

**CORE**

Pages 44-45, lines 15-16: Make the connection between the two sections "Formal and Informal Education" and "Workforce Development." The former is essential to inspiring the next generation to enter the workforce. Workforce development needs to include training scientists to be effective at formal and informal education.

Page 44, line 15. Citizen science can be both an educational opportunity and an important contribution to research.

**COFS graduate students, University of Washington**

\*Page 44, Lines 15-16: This statement is backwards. It lacks vision. It should focus on how ocean science research serves as a means to address deficiencies in education system. Shall we continue to ignore the extensive research that demonstrates the value of science and technical research engagement in science education.

**Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

Page 44, Line 16-31: Will there be an area within the Education section that addresses electronic outreach or online education? I think these areas offer a lot of opportunity for implementing a strategy and hope they'll be considered.

**Eskins, Ocean Web Portal Project, Smithsonian National Museum of Natural History**

Page 45, line 17, Educational assessments need to go beyond a baseline to research into what educational practices are the most effective.

**COFS graduate students, University of Washington**

\*Page 44, Lines 17-36: This section might be more persuasive if it began by linking back to the Earth system theme of the first sentence in this section of the draft ORPP. A focus on the ocean's role in the Earth system and the modernization of earth science in the NSES and in state curricula to be consistent with modern Earth system science.

Where are the place-based education organizations (e.g., parks, sanctuaries, reserves, seashores, aquaria – the natural and cultural history sites) and the youth and community group programs? These are tangible and authentic, and it's easiest for most citizens to commit to tangible, authentic resources. Integrating ocean science and technology research into these learning environments is an important approach – especially in light of the fact that there are more than 70 million visitors to these facilities every year.

### **Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

Page 44. Line 26. Insert the following at the end of the paragraph: The nation must begin by developing a medium-term (five-year) national ocean education plan for ocean-related K–12 and informal education. The development of such national ocean education plan/strategy will require the convening of ocean science communicators to design an implement a plan that includes:

- assessment, inventory, and gap analysis of existing ocean-based curricula and coordination of the development and adoption of ocean-related materials;
- coordination and integration of all federal ocean-related education activities and investments;
- establishment of a cooperative system of dedicated, sustained, multi-agency funding for formal and informal ocean education as well as a grant program for development and implementation of core science curricula that incorporates ocean research and opportunities for virtual and hands-on field, laboratory, and at-sea experiences;
- integration of ocean science into formal education, including the development of cross-curricular material that engenders an appreciation of the oceans;
- inclusion of ocean science principles and concepts in national science standards; and
- development of a framework for evaluating the effectiveness of ocean related education programs.

### **CORE**

Page 44, Line 30-31: Please consider adding, “The Smithsonian Institution's National Museum of Natural History (NMNH) and the National Oceanic and Atmospheric Administration (NOAA) have partnered to create an Internet-based gateway to high-quality ocean information: the Ocean Web Portal will provide over 30 million visitors a year with a free, world-class ocean education." - <http://ocean.si.edu>

### **Eskins, Ocean Web Portal Project, Smithsonian National Museum of Natural History**

Page 44. Line 37. Add the following new paragraph: We should foster more effective relationships between the research and education communities to expand professional development opportunities for teachers and teacher educators and provide increased

opportunities for graduate students to interact with teachers and students to increase ocean education opportunities. We should provide professional/meaningful rewards to scientists for including education and outreach components within research and/or participating in education and outreach efforts. In developing these national plans we must acknowledge cultural differences and other aspects of human diversity to expose and engage students and teachers from all cultures and backgrounds to ocean issues with the goal of increased participation of traditionally underrepresented and underserved groups in the ocean-related workforce. The Administration and academic institutions should work collaboratively to establish a program with colleges and universities to promote introductory ocean and coastal science and engineering courses to expose a wider cross-section of students, including non-science majors, to these subjects. Finally, in terms of graduate-level education, educational institutions should offer students at the undergraduate, graduate, and postdoctoral level experiential learning opportunities in a range of marine fields through summer internships, fellowships, and traineeships that emphasize interdisciplinary approaches to ocean science and management and real-world experiences outside the university setting.

Page 45. Line 16. Insert the following sentence at the end of the paragraph. Finally, we should create competitive incentives to develop and share training and job placement programs for workforce enhancement.

Finally, CORE concurs with the recommendation from the workshop to designate science translators for each societal theme to make the science education link and to engage in the development of the final plan and implementation strategy.

#### **CORE**

\*Page 45 - The public wants guarantees of truthful, honest science, not the crap alleged "science" given to it today. The chemical companies are buying their science and then feeding it to us. The drug companies buy "science". The U.S. government is skewing "science".

#### **Sachau, private citizen**

\*Page 45: Workforce development does not include the unskilled workforce. This section will create jobs for those that already have the skills. This will not address unemployment, and will not help the education of this sector of the workforce.

#### **Western Pacific Regional Fishery Management Council**

\*Page 45, Lines 2-16: The absence of the technology component of the workforce is a glaring omission in this sub-section. The scientific research carried out in this plan can only proceed with new advances in technology and with adaptation and re-purposing of technology into the marine environment. That workforce will not appear by "spontaneous generation."

Is it a given that workforce development includes graduates with a H.S., Community College, Bachelors, MS and PhD diploma. All are needed for different aspects of the workforce. Workforce development must consider workforce supply too. Workforce development, most especially in all science and technical fields, begins in kindergarten

not at undergraduate education. This section should acknowledge the importance of a quality k-12 science and math education system in supplying and developing the workforce (i.e., the "education pipeline").

The workforce allied with ocean observing systems is likely to be much greater and much more diverse in expertise than solely those who operate it (as implied by the term "operational workforce"). This should be reflected in the text. If we consider weather forecasting as an analog industry--the diversity and extent of this workforce in both industry and government is extensive and extremely diverse (e.g. embedded in the financial, energy, transportation, and agricultural industries to hi-tech, information science, broadcasting, and government). Its size, and sophistication and diversity of expertise could not have been imagined when modern weather forecasting was in its infancy as ocean observing is today. Like weather forecasting, ocean observing/forecasting is likely to require a similar sophistication and diversity of expertise in its workforce and undergo similar unforeseen changes within the 10 years of this ORPP.

**Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

\*Page 45, Line 10: COMMENT: I really like the idea of "professional certification" programs, especially as we need more and more technicians for mass spectrometers, multibeam systems, oceanographic videography, etc. The expertise for these pursuits is commonly developed in a rather haphazard way of manufacturer's training courses, masters or PhD level research, or by accumulating hours with consulting companies.

**Ford, Massachusetts Division of Marine Fisheries**

\*Page 45, Lines 18-29: The topic sentence doesn't seem to be related to the rest of the sub-section. Understanding what makes effective education practices is only one aspect of an assessment. What is missing here is a sentence or two that address the aspects of an assessment and how those various aspects work together to provide information on the quality, effectiveness, and performance (output, outcome and impact) of individual efforts and the entire educational endeavor.

This section is not well connected to the other sections--for example, why would you want to know most effective education practices? There should be a mention of their use or a requirement to use them in the previous two sections. The point of a baseline measurement is to have a "beginning" point against which progress can be measured, as stated. I'd say this before the listing of the assessments.

**Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

\*Page 45, Lines 32-36: This is not well connected to the rest of the OCE Ed chapter.

**Malone, OceanUS Office for Integrated and Sustained Ocean Observations**

Page 46. footnote i: Insert "and marine" after "ocean".

**NOAA Fisheries**

## ATTACHMENTS

### References submitted by Miller et al

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