

Developing an Ecosystem Approach to Fisheries

Background Information for 'Managing Our Nation's Fisheries II'

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Ecosystem-based fishery management is the popular topic in fishery management today. It represents a new paradigm of management that builds on existing processes and emerging technology and research; however, the ecosystem approach to fisheries is still very much in the developmental stages.

The U.S. Commission on Ocean Policy (USCOP) defined the principle of ecosystem-based management as follows:

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 this principle will require defining relevant geographic management areas based on ecosystem, rather than political, boundaries (USCOP 2004).

With respect to marine fisheries, the concept has gradually evolved from an understanding that single-species management, that is, managing individually for the sustainability of target species without explicit consideration of the interactions of predators and prey or the interactions of fisheries with other species, is not holistic. Research has shown that fishing can have considerable impacts on the marine environment by altering benthic habitat, food webs, and the diversity of living organisms.

An ecosystem approach to fisheries considers interactions between physical, biological, and human components of the ecosystem, while ensuring the overall health of each component, including the sustainability of managed species. Table 1 is a schematic comparison of traditional fishery management and an ecosystem approach to fisheries. The eight regional Fishery Management Councils and the National Marine Fisheries Service (also referred to as NOAA Fisheries) are increasingly moving towards explicit consideration of ecosystem interactions in fishery management.

The Sustainable Fisheries Act of 1996 required regional Fishery Management Councils and NOAA Fisheries to account for bycatch, habitat protection, and improved monitoring and research. Also established by the Sustainable Fisheries Act was the Ecosystems Principles Advisory Panel. The Panel was charged to review the extent to which ecosystem principles are incorporated in fishery management and research, and recommend management and research activities that would integrate ecosystem principles (EPAP 1999). In addition to proposing comprehensive principles, goals, and policies for fishery management, the Panel recommended the development of Fishery Ecosystem Plans and research to support them.

NOAA Fisheries and many of the regional Fishery Management Councils responded by redeveloping fishery management plans to account for the effects of fishing on ecosystem components. For example, the Western Pacific Fishery Management Council have developed the first-ever federal ecosystem-based fishery management plan, resulting in the Coral Reef Ecosystem that encompasses over 6,000 square miles of coral reef habitat around U.S. Pacific Island areas. Other examples in the North Pacific, Chesapeake Bay, and South Atlantic were presented at the 2003 Managing Our Nation's Fisheries conference (Mitsuyasu and Fluharty 2004).

An ecosystem approach to fishery management is not incompatible with single species management (EPAP 1999, FAO 2003). National development of an ecosystem approach should appropriately occur in incremental stages: the process should be ‘evolutionary, not revolutionary’. National guidelines, whether issued by a national ocean council, by NOAA Fisheries, or codified in amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSA), should be sufficiently flexible to account for regional variability and growing scientific understanding.

Discussion topics

The Advisory Panel will develop recommendations on the appropriate next steps for applying an ecosystem approach to fisheries. Specifically, the Advisory Panel may wish to make recommendations regarding:

- Technical requirements for an ecosystem approach to fisheries
- Science limitations
- Regional ecosystem planning and the role of regional ocean or ecosystem councils
- Type of ecosystem planning document: Fishery Ecosystem Plans, or other?
- Process for developing ecosystem-based goals and objectives
- Development of national guidelines for an ecosystem approach to fisheries
- Elements of an ecosystem approach to fisheries that should be codified in the MSA

Technical requirements for an ecosystem approach to fisheries

The first and primary requirement for an ecosystem approach to fisheries is an understanding of the ecosystem in which fishing is occurring. This need is reflected both in the recommendations of the Pew Oceans Commission and the U.S. Commission on Ocean Policy. A robust research and science program is recommended by both commissions (USCOP 2004, POC 2003), and has been echoed in the Ocean Action Plan, the Bush Administration’s response to the U.S. Commission on Ocean Policy report, as well as in proposed legislation before Congress (Table 2). Under one proposal for amendment to the MSA (Table 3), regional Fishery Management Councils, through their Scientific and Statistical Committees, would be involved in developing research plans.

The scientific literature and recent ocean reports make clear, however, that an incomplete understanding of the ecosystem is no excuse for inaction. Fishery managers must account for ecosystem interactions to the best of their ability. To do so, the regional Fishery Management Councils and NOAA Fisheries must develop strategies for assessing risk in fishery management actions. Risk is present when the direct, indirect, or cumulative effects of fishing activities on ecosystem components is unknown or unclear. Uncertainty can be balanced at many levels of fishery management, from conservative harvest quotas to precautionary time and area closures. An ecosystem approach requires fishery managers to assess the risks of fishery management actions, and devise an appropriate response.

Other technical requirements involve participation by and collaboration with a broader cross-section of managers and stakeholders. An ecosystem approach requires consideration of the linkages between fishing and other ongoing activities in the ecosystem area, which in turn requires coordinating with other managers. The increased scope correlates to broader stakeholder and public interest. However, collaboration can also increase the understanding of ecosystem functions as knowledge is shared.

Monitoring and evaluation is a critical element of an ecosystem approach. Ecosystem health and the impacts of fishing need to be reviewed over time, as the effect of management measures is assessed.

Many tools are in place for monitoring, and are frequently used in combination, such as harvester and processor reporting, observers, and independent surveys.

Discussion items:

- *What technical requirements of an ecosystem approach to fisheries are beyond fishery management councils/NOAA Fisheries' control to effect? How do they need to be addressed (e.g., Congressional funding for marine ecosystem research)?*
- *What requirements of an ecosystem approach are already being utilized by some regional Fishery Management Councils and NOAA Fisheries, and should these 'best practices' be standardized across regions?*
- *What new tools are required for risk assessment, monitoring, and evaluation in an ecosystem context?*

Science limitations

A new tool that is available to assist fishery managers in developing an ecosystem approach to management is the array of multispecies and ecosystem models that are currently being developed. The models serve many different purposes, to address bycatch and fishery interactions, the indirect effects of fishing, uncertainty, biological and physical interactions, or contribute ecological information for single-species stock assessments. Multispecies and ecosystem models can help fishery managers to predict the downstream effects of management actions on ecosystem components, and expand impact consideration beyond a single-species focus.

Congress recently funded ecosystem management pilot programs for the four east coast fishery management regions. A central element of these programs is to develop quantitative decision support tools, such as models and GIS tools (Waugh et al. 2004). However, data collection is critical for models and GIS tools to be effective. Until there is sufficient data to generate a sophisticated understanding of ecosystem interactions, it will be difficult for fishery managers to successfully consider ecosystem impacts.

Scientific limitations are not restricted to the physical and biological data. Economic and socioeconomic data are also required for effective and realistic modeling. Although needs differ by region, improved data collection is critical to the development of reliable multispecies and ecosystem models to assist fishery managers assess the effect of alternative management actions on directly and indirectly connected components of the ecosystem.

Discussion items:

- *Recognizing that, in data poor situations, an ecosystem approach will have to be implemented incrementally, what steps toward ecosystem-based management can be taken while scientific research and data collection proceeds?*
- *How should improved data collection and modeling be encouraged?*

Regional ecosystem planning and the role of ocean or ecosystem councils

Both the Pew Oceans Commission and the U.S. Commission on Ocean Policy have recommended the creation of regional ocean or ecosystem councils. The primary function of a regional ecosystem council appears to be the development of a regional ecosystem assessment, based on which, goals and objectives are devised to protect, restore, and maintain, as necessary, the health of the marine ecosystem. NOAA has affirmed the use of regional ecosystem councils in its strategic plan for FY2005-FY2010 (NOAA 2004,

p.5), as a means to collaborate and coordinate with partners to achieve regional ecosystem objectives. Of the oceans legislation currently proposed, only HR 4900 introduced in the 108th Congress, the ‘Oceans 21’ bill, proposes to establish regional councils (Table 2).

NOAA Fisheries has drafted a strategy that would establish ten regional marine ecosystem councils, with regions based on Large Marine Ecosystem delineations (Holliday 2004, Lent 2004b). The regional marine ecosystem councils would comprise federal, state, local, and tribal decisionmakers, regional Fishery Management Councils, industry and resource users, community and non-governmental organization interest groups, academia, and the public. The ecosystem councils would be responsible for developing a regional marine ecosystem strategy that provides operational goals and objectives for the ecosystem, information on the ecosystem region, and performance metrics for assessing progress. Fishery Management Councils would modify their fishery management plans as necessary, to accord with the overarching guidance of the appropriate regional marine ecosystem strategy.

The NOAA Fisheries strategy does not necessarily comport with the U.S. Commission on Ocean Policy report, which did not promote a ‘one size fits all’ approach to regional ecosystem councils. Rather, the report recommends voluntary regional councils that build on existing partnerships and regional cooperative agreements (USCOP 2004, pp. 59-60). The regional Fishery Management Councils have argued that the existing fishery management council process could effectively be used as a basis for establishing further collaboration with other agencies. As highlighted by the U.S. Commission on Ocean Policy, many of the key elements of a regional process are already embodied in the fishery management councils: regional councils based loosely on ecosystem boundaries, incorporation of science in management plans, and an emphasis on local public participation (USCOP 2004, p. 242). Also, the Councils already include federal and state representatives from many agencies.

As recommended, the regional ecosystem councils are not intended to displace existing authorities (USCOP 2004, p. 58; Lent 2004b, slide 10). Instead, they would optimally provide an opportunity for managers to coordinate regional information and consider the cumulative impacts of all ongoing activities on ecosystem components. However, the development of an ecosystem policy (consisting of goals and objectives for maintaining ecosystem health) inevitably involves reconciling competing objectives. Vesting such authority in a regional ecosystem council would constrain the regional Fishery Management Councils’ and NOAA Fisheries’ management.

Discussion items:

- *How should existing processes be reconciled with regional ocean or ecosystem councils?*
- *If the existing fishery management process is retained as the mechanism for developing regional ecosystem assessments and policies, how does it need to be modified to incorporate an ecosystem approach? How are non-fishery activities to be considered and accommodated within the fishery management council process?*
- *If regional ecosystem councils are created outside of the fishery management council process, what should their role be, beyond developing an initial ecosystem plan? Who should participate? How would they coordinate with the existing fishery management structure?*

Types of ecosystem planning documents: Fishery Ecosystem Plans or other?

Both the U.S. Commission on Ocean Policy and the Pew Oceans Commission recommended that comprehensive management plans need to be developed that consider impacts on the ecosystem as a whole (Table 3). Yet ecosystem plans can be targeted to different activity scales.

The Ecosystem Principles Advisory Panel recommended the development of Fishery Ecosystem Plans for each ecosystem under regional Fishery Management Council jurisdiction (EPAP 1999). The Fishery Ecosystem Plan would not supplant existing fishery management plans (FMPs), but would provide an overarching ecosystem context to all FMPs overlapping with the geographically delineated ecosystem. The Fishery Ecosystem Plan would describe the ecological system in which fishing takes place, discuss the role of fishing in cumulatively impacting ecosystem components, and include a plan for monitoring and evaluation. The Fishery Ecosystem Plan would guide the development of FMP management options.

NOAA Fisheries' proposed regional marine ecosystem strategy is an example of a broad-scale plan. Rather than focusing specifically on fishing activities, the ecosystem strategy would set goals and objectives for ecosystem health that would apply to all activities in the marine ecosystem, be it fishing, mineral extraction, or eco-tourism. This requires collaboration and consensus amongst a potentially wide-reaching group of managers and stakeholders. Based on the overall strategy, lead agencies would develop individual implementation plans to operationalize ecosystem objectives (Holliday 2004). Regional Fishery Management Councils would need to ensure that FMPs are consistent with both the overarching ecosystem strategy and NOAA Fisheries' implementation plan.

At a much smaller scale, ecosystem-based FMPs could simply incorporate ecosystem objectives and considerations directly into the FMP. For different fisheries that occur in the same geographical area, the ecosystem assessment and objectives would be duplicated in each FMP.

Despite differences of scale, there are common elements of all ecosystem plans. The first is a description of the ecosystem boundary. Although the extents of ecosystems are not sharply defined, for management purposes, a geographic delineation is important. NOAA Fisheries has adopted the Large Marine Ecosystem concept, which identifies ten ecosystems in the U.S. (Lent 2004b). In some instances, sub-regions may be more appropriate for planning, however, the U.S. Commission on Ocean Policy cautions that geographic scale and scope of ecosystem plans "will need to be broad to enable them to realize their potential," (USCOP 2004, p.58).

The plan should also contain goals and objectives for the ecosystem area, which can be translated to specific objectives for activity management. An information base to assess the condition of the ecosystem can be used to measure the performance of activities against goals and objectives. Also, the plan should include timelines for accomplishing the objectives and reevaluating the plan.

Proposed legislation for reauthorizing the MSA has included pilot Fishery Ecosystem Plan or ecosystem-based FMPs (see Table 3). Congress has also provided funding for four ecosystem management pilot projects, in the New England, Mid-Atlantic, South Atlantic, and Gulf of Mexico regions. With the exception of the South Atlantic, the funding is being used to identify and develop ecosystem-based management objectives, threats, and alternatives through the regional Fishery Management Councils; to facilitate workshops between managers and scientists to determine technical needs for ecosystem-based management; and to develop quantitative models and mapping tools to evaluate management options at the ecosystem level. The South Atlantic Fishery Management Council is further advanced in the process, and a comprehensive Fishery Ecosystem Plan is scheduled for implementation in 2005.

Discussion items:

- *What kind of plan works best? Fishery Ecosystem Plan, regional ecosystem plan, ecosystem-based FMP?*
- *How should ecosystem boundaries be defined? Can they comprise different scales, based on regional differences? How small is too small?*
- *How should lessons from the pilot projects be developed into a national strategy?*

Process for developing ecosystem-based goals and objectives

The process of developing goals and objectives for an ecosystem plan begins with an understanding of the national and regional context, statutory mandates, regional activity management and protection plans, and generic principles of ecosystem-based management. There is currently no national ocean policy, yet this was recommended by both the Pew Oceans Commission and U.S. Commission on Ocean Policy, and the idea has been taken up in proposed legislation (see Table 2).

The Food and Agriculture Organization of the United Nations has proposed a process for developing goals and objectives (FAO 2003). The first step, high level policy goals (social, economic, and ecological), could flow directly from a national-level ocean policy. The ecosystem plan would then develop broad objectives, under which issues are identified and prioritized. NOAA Fisheries has suggested that objectives should include both outcomes (e.g., avoid overfishing, protect dependent and associated species); and process (e.g., maintain inter-generational equity and options, use of precaution in decision making) (Lent 2004a). Then operational objectives can be developed with associated indicators, targets, and performance measures. Finally, management measures to be triggered by the performance measures are identified.

The Ecosystems Principles Advisory Panel (1999) recommended that the desired state of the ecosystem, on which goals and objectives for ecosystem management should be based, is a state of ecosystem health. A healthy ecosystem is resilient and generally has a high buffering capacity to adapt to stress. A healthy ecosystem is not necessarily a pristine ecosystem, but supports human activities, including resource extraction, as part of the natural balance. Defining quantitative measures of a healthy ecosystem is difficult, although research is progressing, but the lack of clarity results in differing viewpoints among managers and the public. A first step in developing goals and objectives should be to develop consensus as to the desired state of the ecosystem to be managed.

Determining participation in the development process is a key decision point. The ecosystem management pilot programs in the four east coast fishery management regions have devoted half their funding to enhancing participatory processes between the regional Fishery Management Councils, stakeholders, and the general public, to identify and prioritize ecosystem-related issues (Waugh et al. 2004, Lent 2004b). Regional ecosystem plans, as described in the Pew and U.S. Commission on Ocean Policy reports, also require coordination and participation by all governmental authorities, federal, state, local, and tribal, with jurisdiction within the ecosystem under consideration. To the extent that the goals and objectives for the ecosystem impact other agencies, either because fishing impacts other managed resources, or other activities impact fishery resources, partnership and coordination may be critical.

Identifying a lead agency may increase the efficacy of the process. The lead may not necessarily be a fisheries agency (i.e., not NOAA Fisheries or a regional Fishery Management Council), in which case fishery managers and stakeholders will need to remain closely involved.

Discussion items:

- *How should the national regulatory and scientific context be accounted for in regional ecosystem goals and objectives?*
- *What is the desired state of the ecosystem? What is the endpoint towards which an ecosystem approach is tending?*
- *Who should be involved in determining goals and objectives?*

Development of national guidelines for an ecosystem approach to fisheries

Implementation of an ecosystem approach to fishery management will be a long-term venture. As more funding is devoted to ecosystem research, and our knowledge base increases, fishery management will change accordingly. Additionally, ecosystems and the combination of activities that occur in them vary greatly from region to region. NOAA Fisheries should be cautious of instituting national guidelines for ecosystem-based management that are overly specific and end up constraining the ability of regional Fishery Management Councils and regions to make the best use of new information and research as it becomes available. Critics point to the essential fish habitat guidelines as an example of binding national guidelines that have changed the fishery management focus from habitat protection to the avoidance of legal challenge (Madsen 2004).

At the same time, there is a need for all regions to improve their consideration of ecosystem components in fishery management, and national guidelines and standards can effectively accomplish across-the-board compliance. Also, recent ocean reports have criticized some regional Fishery Management Councils for purportedly prioritizing short-term economic concerns over the sustainability of target species and their ecosystems. Raising the standards nationally could help to ameliorate this perception.

Discussion item:

- *How should national guidelines be developed to maintain long-term and regional flexibility, while at the same time requiring regional Fishery Management Councils and NOAA Fisheries to advance ecosystem considerations in fishery management?*

Elements of an ecosystem approach to fisheries that should be codified in MSA

The Magnuson-Stevens Fishery Conservation and Management Act was originally written as a vehicle for single species fishery management. Revisions to the MSA, in the Sustainable Fisheries Act of 1996, incorporated a wide variety of ecologically friendly amendments, including bycatch, habitat, and multi-species considerations, and increased focus on the human component of ecosystems through the explicit mitigation of fishing community impacts. The focus of the MSA, however, remains essentially on commercially-important species, to ensure the sustainability of the fishery. For example, the essential fish habitat provision requires conservation of habitat important to managed species, but does not address habitat necessary to other components of the food web that may still be critical to maintaining a productive ecosystem. An ecosystem approach to fisheries could explicitly promote conservation and management measures for the protection and maintenance of a healthy ecosystem as well as the sustainability of managed species. Changing the focus of management could lead to many different types of amendment to the MSA. Some examples of amendments that could be recommended are given below.

Discussion items:

- *A mandate to protect, restore, and promote the long-term health and stability of the marine ecosystem as well as the fishery*
- *A national standard for the ecosystem*
- *An ecosystem assessment in the fishery management plan, which would include a requirement to assess the effects of the fishery on non-target species and marine habitat*
- *Consideration of the habitat needs of non-managed species*
- *A requirement for Fishery Ecosystem Plans, or for consistency of the FMPs with broader regional ecosystem plans*
- *Refinement of the focus of management from optimum yield to maintaining a healthy ecosystem*

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Table 1. Schematic comparison of fisheries and ecosystem management. *From Garcia, S.M, Zerbi, A., Aliaume, C., Do Chi, T., Lasserre, G. 2003. The ecosystem approach to fisheries. Issues, terminology, principles, institutional foundations, implementation and outlook. FAO Fisheries Technical Paper. No. 443. Rome, FAO. 2003. p.4.*

Criteria	Fisheries management	Ecosystem management
Paradigm	Sector-based. Vertically integrated. Focusing on target resource and people.	Area-based. Holistic. Loosely cross-sectoral. Focusing on habitats and ecosystem integrity.
Governance	Objectives	Not always coherent or transparent. "Optimal" system output. Social peace.
	Scientific input	Formalized (particularly in regional commissions). Variable impact.
	Decision-making	Most often top-down. Strongly influenced by industry lobbying. Growing role of environmental NGOs.
	Role of the media	Historically limited. Growing as fisheries crisis spreads.
	Regional and global institutions	Central role of the Food and Agriculture Organization of the UN and regional fishery bodies.
Geographical basis	A process of overlapping and cascading subdivision of the oceans for allocation of resources and responsibilities.	A progressive consideration of larger-scale ecosystems for more comprehensive management, e.g. from specific areas to entire coastal zones and Large Marine Ecosystems (LME).
Stakeholder and political base	Narrow. Essentially fishery stakeholders. Progressively opening to other interests.	Much broader. Society-wide. Often with support from recreational and small-scale fisheries.
Global instruments	1982 Law of the Sea Convention, UN Fish Stock Agreement and FAO Code of Conduct.	Ramsar Convention, UN Conference on Environment and Development and 1992 Agenda 21, Convention on Biological Diversity and Jakarta Mandate.
Measures	Regulation of human activity inputs (gear, effort, capacity) or output (removals, quotas) and trade.	Protection of specified areas and habitats, including limitation or exclusion of extractive human activities. Total or partial ban of some human activities.

Table 2. National-level Oceans Initiatives Affecting Fisheries

	U.S. Commission on Ocean Policy (USCOP 2004)	PEW Oceans Commission (POC 2003)	Ocean Action Plan	HR 4900 Ocean's Caucus Oceans 21	S 2647 Hollings National Ocean Policy and Leadership Act¹
Ocean policy, national ocean standards	<ul style="list-style-type: none"> National Ocean Policy Framework overarching principles: sustainability, stewardship, ocean-land-atmosphere connections, ecosystem-based management, multiple use management, preservation of marine biodiversity, best available science and information, adaptive management, understandable laws and clear decisions, participatory governance, timeliness, actability, international responsibility 	<ul style="list-style-type: none"> National Ocean Policy Act that requires federal, state, and territorial agencies to protect, maintain, and restore marine and coastal ecosystems should provide clear and measurable goals and standards to govern activities affecting the oceans, establish mechanisms to ensure compliance with the national policy, and establish national and regional institutions capable of carrying it out 	<ul style="list-style-type: none"> cabinet level committee to address ocean policy and interagency coordination 	<ul style="list-style-type: none"> protect, maintain, and restore the health of marine ecosystems in order to fulfill the social, economic, and other requirements of present and future generations of Americans 4 national standards 	<ul style="list-style-type: none"> establish and maintain a coordinated, comprehensive, and long-range national program of ocean and atmospheric research, conservation, management, education, monitoring, and assessment (that will...) ensure long-term and sustainable use of fishery resources and other ocean and coastal resources held in the public trust, using ecosystem-based management and an adaptive approach
Regional ocean/ ecosystem Councils, regional strategy	<ul style="list-style-type: none"> voluntary regional ocean councils – representative of all government levels coordinate regional ecosystem responses, develop goals priorities, develop regional ecosystem assessments 	<ul style="list-style-type: none"> regional ocean ecosystem councils of federal, state, and tribal representatives develop and oversee implementation of enforceable regional ocean governance plans to protect, maintain, and restore ecosystems plans to include performance goals and indicators authority to create marine reserves 		<ul style="list-style-type: none"> 8 councils to develop and implement ecosystem-based management; ½ state, ½ federal advisory committees (science, citizens, inland states) responsible for regional ecosystem plan fisheries must be consistent with regional plan 	
Research/ science plan	<ul style="list-style-type: none"> national strategy and increased support for ocean and coastal research in natural and social sciences 	<ul style="list-style-type: none"> national commitment to improving applied ocean science and research 	<ul style="list-style-type: none"> ocean research priorities plan and implementation strategy 	<ul style="list-style-type: none"> marine ecosystems research program office of ocean exploration 	
Definitions	<ul style="list-style-type: none"> precautionary approach 			<ul style="list-style-type: none"> marine ecosystem health ecologically sustainable ecosystem-based management 	

¹ as reported out of the Senate Subcommittee on Commerce, Science, and Transportation

Table 3. Proposed Changes to the Magnuson-Stevens Fishery Conservation and Management Act

	U.S. Commission on Ocean Policy (USCOP 2004)	PEW Oceans Commission (POC 2003)	S 2066 Snowe Fishery Conservation & Mgmt Amds Act of 2004	HR Gilchrest Magnuson- Stevens Act Amendments	HR 4706 Rahall Fisheries Managemt Reform Act
MSA policy	<ul style="list-style-type: none"> ecosystem-based management, based on science, precautionary and adaptive, with explicit consideration of biological diversity require regional fishery management councils to incorporate advice and findings of SSCs into decisionmaking process 	<ul style="list-style-type: none"> principal objective to protect the long-term health and viability of fisheries by protecting, maintaining, and restoring the health, integrity, productive capacity, and resilience of the marine ecosystems upon which they depend socioeconomic objective to conserve and manage fisheries to support diversity, flexibility, resilience, and adaptability within the industry and fishing communities 		<ul style="list-style-type: none"> development of ecosystem-based approaches to fishery conservation and management ecologically sound 	
Authority for conservation and management		<ul style="list-style-type: none"> marine ecosystems the organizing principle for fishery management 		<ul style="list-style-type: none"> discretionary authority for health of ecosystem 	<ul style="list-style-type: none"> forage fish
Fishery Ecosystem Plans, ecosystem-based FMPs	<ul style="list-style-type: none"> need comprehensive mgmt plans that consider the cumulative impacts of fishing and other activities on all components of the ecosystem set harvest quotas based on holistic ecosystem understanding of role of target species in food web re-designate essential fish habitat in ecosystem rather than single-species approach, identify important habitats and optimum size areas develop broad regional bycatch reduction plans targeting all components of the ecosystem, not just commercially important species 	<ul style="list-style-type: none"> require FMPs be developed based on consideration of fishing impacts on entire ecosystem require mgmt of core problems such as bycatch, habitat, and overcapacity as a condition of fishing regulate use of fishing gear that is destructive to marine habitats require bycatch monitoring and monitoring plans as a condition of fishing require access and allocation planning as a condition of fishing (including limited access, IFQs/community quotas, precautionary harvest quotas) 	<ul style="list-style-type: none"> each SSC must identify and report to Secretary of Commerce (SoC) on data needs for ecosystem-based mgmt Councils to identify one pilot fishery for FEP, and submit plan 	<ul style="list-style-type: none"> develop criteria for ecosystem FMPs based on EPAP (report to Congress) SoC pilot ecosystem-based FMPs, one each on east and west coasts, in consultation with Councils identification of ecosystem research plans authority to conduct research to understand the ecosystem needs 	
Contents of FMPs	<ul style="list-style-type: none"> FMPs consider effects of fishing on ecosystem, e.g. availability of prey for other species FMPs also need to consider impacts of environmental phenomena on fish populations human component of ecosystems – need more data to consider impacts of fishery mgmt on fishermen and communities marine protected areas can be used to benefit fisheries 	<ul style="list-style-type: none"> require zoning in FMPs, e.g., spatial/ temporal closures, spawning closures, habitat protection areas, bycatch reduction areas, marine reserves closed areas required in any FMP with substantial uncertainty regarding the status of heavily exploited major fishery stocks redefine overfishing in ecosystem context require cooperative data collection and planning program where data is insufficient to determine whether overexploiting 		<ul style="list-style-type: none"> FMP to define ecosystem and marine ecosystem 	<ul style="list-style-type: none"> require ecosystem assessment in FMP

Attachment 1. Definition of selected terms

Ecosystem: a geographically specified system of organisms, the environment, and the processes that control its dynamics. Humans are an integral part of an ecosystem. [NOAA's Strategic Plan for FY 2005-FY 2010]

Ecosystem approach to management is management that is: adaptive, specified geographically, takes into account ecosystem knowledge and uncertainties, considers multiple external influences, and strives to balance diverse social objectives. [NOAA's Strategic Plan for FY 2005-FY 2010]

Ecosystem health is the capability of an ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization that has evolved naturally. [Ecosystem-based Fishery Management: A Report to Congress by the Ecosystems Principles Advisory Panel, 1999]

Ecosystem-based fishery management: fishery management actions aimed at conserving the structure and function of marine ecosystems, in addition to conserving the fishery resource. [Ecosystem-based Fishery Management: A Report to Congress by the Ecosystems Principles Advisory Panel, 1999]

Ecosystem-based management: an approach to the management of human activities and natural resources affected by such activities that incorporates the following: (a) long term ecological sustainability; (b) clear, operational goals, with reference to a desired future status of ecosystem processes and components; (c) use of the best available scientific information regarding ecosystems and their functions, including, but not limited to, multiple indicators, including models and other quantitative and qualitative techniques at varying scales; (d) awareness of complexity, interconnectedness, and resiliency; (e) recognition that ecosystems are dynamic; (f) attention to context and scale, as necessary to align decision processes with ecosystem processes that vary across space and time; (g) acknowledgement of humans as ecosystem components who must be engaged to achieve long term management goals; (h) accountability; (i) identification of uncertainties; (j) adaptiveness, including approaches that supplement limited predictive capacities and respond to changes in ecosystems, information, and anthropogenic stressors. [HR 4900 from 108th Congress (2004), Oceans 21 Act]

Environment: the biological, chemical, physical, and social conditions that surround organisms. [NOAA's Strategic Plan for FY 2005-FY 2010]

Essential fish habitat: those waters and substrate necessary for fish to spawn, breed, feed, and grow into maturity. [Sustainable Fisheries Act, 1996]

Healthy Marine Ecosystem: a marine ecosystem with the ability to support and maintain a productive and resilient community of organisms, having a species composition, diversity, and functional organization resulting from the natural habitat of the region, such that it provides a complete range of ecological benefits, including—(a) a complete diversity of native species and habitats wherein each native species is able to maintain an abundance, population structure, and distribution supporting its ecological and evolutionary functions and processes; and (b) a physical, chemical, geological, and microbial environment that is supporting of the requirements of this paragraph. [HR 4900 from 108th Congress (2004), Oceans 21 Act]

Large Marine Ecosystems: Ten large marine ecosystems (LMEs) have been identified for the United States. These LMEs are regions of the ocean starting in coastal areas and extending out to the seaward boundaries of continental shelves and major current systems. They take into account the biological and physical components of the marine environment as well as terrestrial features such as river basins and estuaries that drain into these ocean areas. [U.S. Commission on Ocean Policy report, 2004]

Precautionary approach: To ensure the sustainability of ecosystems for the benefit of future as well as current generations, decision makers should follow a balanced precautionary approach, applying judicious and responsible management practices based on the best available science and on proactive, rather than reactive, policies. Where threats of serious or irreversible damage exist, lack of full scientific certainty shall not be used as a justification for postponing action to prevent environmental degradation. Management plans and actions based on this precautionary approach should include scientific assessments, monitoring, mitigation measures to reduce environmental risk where needed, and periodic reviews of any restrictions and their scientific bases. [U.S. Commission on Ocean Policy report, 2004]