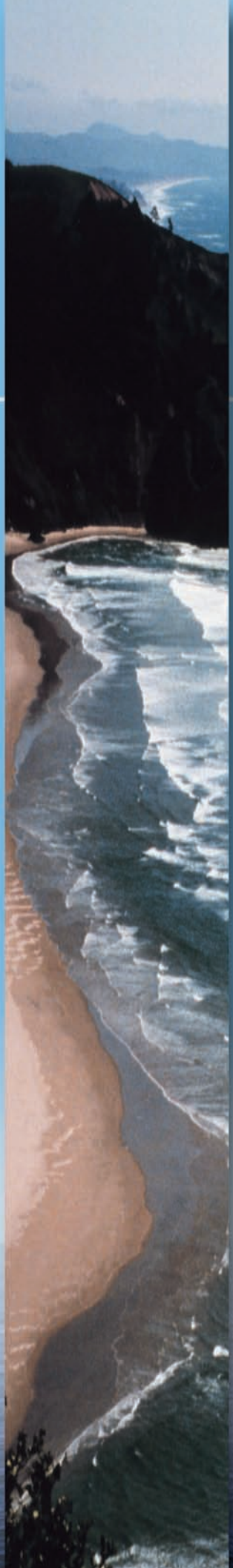

NATIONAL CENTERS FOR COASTAL OCEAN SCIENCE

HUMAN DIMENSIONS STRATEGIC PLAN

FY 2009 - 2014

National Oceanic and Atmospheric Administration
National Ocean Service
National Centers for Coastal Ocean Science

Suggested Citation

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Front Cover Photos

Robert H. Richmond, Ph.D., Kewalo Marine Laboratory, University of Hawaii at Manoa (top, left); Terry McTigue, Ph.D., National Centers for Coastal Ocean Science, Center for Coastal Monitoring and Assessment (top, right); Fridays Films (bottom, right).

For more information, to provide feedback, or to request a copy, please contact:

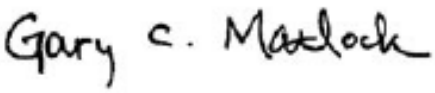
Marybeth Bauer, Ph.D.
Human Dimensions Research Coordinator
National Oceanic and Atmospheric Administration
National Ocean Service
National Centers for Coastal Ocean Science
1305 East-West Highway, Room 8110, Silver Spring, MD 20910
Phone: (301) 713-3020, Fax: (301) 713-4353
Email: nccos.hd@noaa.gov
Internet: http://coastalscience.noaa.gov

Message from the Director

The mission of the National Oceanic and Atmospheric Administration's (NOAA) National Centers for Coastal Ocean Science (NCCOS) is to provide coastal resource managers, other decisionmakers, and stakeholders with scientific information and tools needed to balance society's environmental, social, and economic goals. Humans are integral to ecosystems, and the human dimensions of ecosystems are an integral focus of the science needed to achieve this mission.

This document establishes goals and objectives for fostering improved support of coastal decision-making by expanding NCCOS' science program to include an integral focus on human causes, consequences, and responses to ecosystem stress. It provides the basis for subsequent development of an NCCOS Human Dimensions Research Implementation Plan specifying strategies, partnerships, fiscal and human resources needs, and expected outcomes. The goals and objectives established in this document build on NCCOS' Strategic Plan for FY 2005 – FY 2009 and respond to numerous statutory authorities and other drivers summarized in Appendix 1.

This document was developed through an internal NCCOS process including content analysis of significant coastal and ocean science and management documents, vetted throughout NOAA, and revised in response to public review and comment through a Federal Register Notice. It is intended not only as a strategic guide for NCCOS, but also as an educational resource for the broader coastal and ocean science and management community. As with all of its products, NCCOS is interested in determining the value of this document, especially for coastal and ocean science and decisionmaking. We encourage you to provide feedback via email or telephone, and assure you that we will appreciate and consider all comments in directing our future efforts.



Gary C. Matlock, Ph.D.
Director, NOAA National Centers for Coastal Ocean Science

Acronyms

CRRC	Coastal Response Research Center
ECSC	Environmental Cooperative Science Center
GIS	Geographic information system
HAB	Harmful algal bloom
HABHRCA	Harmful Algal Bloom and Hypoxia Amendments Act of 2004
HARRNESS	Harmful Algal Research and Response: A National Environmental Science Strategy
IHDP	International Human Dimensions Programme on Global Environmental Change
ISDR	United Nations International Strategy for Disaster Reduction
JSOST	Joint Subcommittee on Ocean Science and Technology
LEK	Local ecological knowledge
MPA	Marine protected area
MPAC	National Marine Protected Area Center
NCCOS	National Centers for Coastal Ocean Science
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NRC	National Research Council
NSTC	National Science and Technology Council
PPBES	Planning, Programming, Budgeting, and Execution System
SIA	Social impact assessment
SIMOR	Subcommittee on Integrated Management of Ocean Resources
TEK	Traditional ecological knowledge
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific, and Cultural Organization
USCOP	United States Commission on Ocean Policy

Table of Contents

1. Summary

The mission of the National Centers for Coastal Ocean Science (NCCOS) within the National Oceanic and Atmospheric Administration (NOAA) is to "provide coastal managers and other decisionmakers with scientific information and tools needed to balance society's environmental, social, and economic goals" (NOAA NCCOS, 2004, p. 5) in mitigating and adapting to ecosystem stressors such as climate change, extreme natural events, pollution, invasive species, and resource use.

Humans are integral to ecosystems, and the human dimensions of ecosystems are an integral focus of the science needed to achieve this mission. Understanding the impact of humans on the ocean, the impact of the ocean on humans, and the human aspects of ocean governance provides the scientific basis for ensuring ocean health and quality of life for this and future generations (Joint Subcommittee on Ocean Science and Technology, 2007).

Marine science and policy institutions in the United States and worldwide recognize that a deeper understanding of the human dimensions of ecosystems – human causes, consequences, and responses to ecosystem stress – is needed to foster improved support for coastal and ocean decisionmaking. Examples include statements by the Joint Subcommittee on Ocean Science and Technology (JSOST) (2007), Subcommittee on Integrated Management of Ocean Resources (SIMOR) (2006), United States Commission on Ocean Policy (USCOP) (2004), Pew Oceans Commission (2003), International Human Dimensions Programme on Global Environmental Change (IHDP) (e.g., 2005), and NOAA's External Ecosystem Task Team (2006) (*see* Appendix 1, Human Dimensions Research Drivers).

This plan establishes goals and objectives to foster improved support of coastal and ocean decisionmaking by expanding NCCOS' science program to include an integral focus on human dimensions. It provides the basis for subsequent development of an implementation plan specifying programmatic elements such as strategies, partnerships, fiscal and human resources needs, and expected outcomes. The following list summarizes the human dimensions research goals and objectives established in this plan:

Goal 1

Provide Human Dimensions Understanding

Critical to Support an Ecosystem Approach to Management

Coastal Decisionmaking

Objective 1.1: Develop and apply existing tools to foster effective local, regional, and national coastal decisionmaking processes that integrate scientific analysis and stakeholder deliberation.

Human Causes and Socioeconomic Drivers of Ecosystem Stress

Objective 1.2: Assess the status and trends in human behavioral patterns contributing to coastal ecosystem stress and their complex socioeconomic drivers. Help coastal decisionmakers identify and facilitate strategies for changing human behavior when desirable to achieve environmental, social, and economic goals.

Societal Consequences of Policy and Management

Objective 1.3: Help resource managers and other coastal decisionmakers anticipate the social, cultural, economic, and public health consequences of alternative actions and evaluate the consequences of actions taken.

Traditional and Local Ecological Knowledge

Objective 1.4: Conduct community-based research documenting traditional and local ecological knowledge, facilitate its application to enhance coastal and ocean science and management, and equitably share benefits with local communities.

Institutional Strategies

Objective 1.5: Analyze existing institutional approaches, and evaluate and facilitate prospects for (re)designing institutions, to enhance coastal and ocean science and management.

Evaluation of Products and Services

Objective 1.6: Determine the effectiveness of NCCOS' products and services in promoting social, economic, and human health objectives.

Socially Responsible Science

Objective 1.7: Consult appropriate human dimensions specialists to address societal and ethical questions that arise in the conduct and use of NCCOS science.

Goal 2

Provide Integrative Ecosystem Understanding

Critical to Support an Ecosystem Approach to Management

Integrative Ecosystem Models and Decision Support Tools

Objective 2.1: Provide decisionmakers with integrative ecosystem models and other decision support tools linking changes in ecosystem services to human causes, consequences, and responses.

Integrated Ecosystem Assessments

Objective 2.2: Provide leadership among scientific, management, and other stakeholder partners to define, produce, and facilitate the use of Integrated Ecosystem Assessments incorporating critical human dimensions information.

Goal 3

Promote Ecosystem Resilience

Risk and Vulnerability Assessment

Objective 3.1: Assess the risk and vulnerability of coastal communities to ecosystem stress, responding to the needs of decisionmakers and stakeholders to support mitigation planning.

Risk Communication

Objective 3.2: Reduce the vulnerability of coastal systems and human communities to ecosystem stress by applying research-based strategies to communicate scientific information in ways that foster public understanding, trust, and risk-reducing behavior.

Goal 4

Provide Critical Support for Human Dimensions Research

Organizational Capabilities

Objective 4.1: Build organizational capabilities needed to foster improved support for coastal decisionmaking by expanding NCCOS' science program to include an integral focus on human dimensions.

Communications, Outreach, and Education

Objective 4.2: Identify and implement communications, outreach, and education strategies needed to foster improved support for coastal decisionmaking by expanding NCCOS' science program to include an integral focus on human dimensions.

2. Introduction

A. Purpose

The mission of NCCOS is to "provide coastal managers and other decisionmakers with scientific information and tools needed to balance society's environmental, social, and economic goals" (NOAA NCCOS, 2004, p. 5). NCCOS' science program currently focuses on changes in the structure and function of environmental systems influenced by stressors such as climate change, extreme natural events, pollution, invasive species, and resource use. This plan establishes goals and objectives for expanding NCCOS' science program to include an integral focus on the human dimensions of coastal ecosystems and decisionmaking. It summarizes broad human dimensions research needs that cut across multiple stressors and ecosystems, and are critical to achieve NCCOS' mission.

Expanding human dimensions research will enhance NCCOS' ecosystem science and foster improved support for coastal and ocean decisionmaking. As early as 1935, ecologists cautioned that limiting analysis to environmental systems is neither scientifically sound nor practically useful (Tansley, 1935). As with any system, understanding an ecosystem requires understanding complex interactions among system components. An ecosystem is defined by interactions between human and environmental systems (elaborated below). Recognizing these interactions, ecology is increasingly adopting a systems approach focusing on coupled social-ecological systems (also called human-environmental systems) (e.g., Collins et al., 2007; Colding et al., 2000; Berkes et al., 1998). Expanding NCCOS' scientific focus from interactions within environmental systems to interactions between coupled social and ecological systems will foster holistic ecosystem understanding.

From a practical perspective, human dimensions understanding enhances coastal decisionmaking and its scientific support. This plan provides many examples. It begins by highlighting the effectiveness of coastal decisionmaking that integrates ecosystem understanding with meaningful stakeholder engagement. Social science offers techniques and approaches, based on an understanding of human and organizational behavior, that help decisionmakers work with diverse stakeholders to define and achieve management priorities in the face of challenges such as conflicting and changing societal values, multiagency authorities, and scientific uncertainty. The plan further highlights the integral role of human dimensions understanding in the ecosystem science supporting decision processes. For example, protecting and restoring coastal and ocean systems - a NOAA strategic goal - generally requires accommodating or changing human behavioral patterns associated with coastal development, agricultural practices, and resource uses. Developing effective intervention strategies in turn requires understanding these behavioral patterns and their complex socioeconomic drivers.

B. Future Directions

Providing human dimensions understanding critical to support coastal decisionmaking will require retooling of many NCCOS activities. The NCCOS research agenda must be established through customer-informed strategies that identify complementary human dimensions and environmental research priorities. Innovative approaches are needed to link the concepts, methods, and results of environmental and human dimensions research. Organizationally, critical needs include greater capacity in human dimensions disciplines; workforce training in mission-critical human dimensions research; environmental science training for human dimensions staff; leadership with interdisciplinary team-building skills; practices that identify, encourage, and reward mission-critical human dimensions research; integrated environmental and human dimensions research planning; and adequate funding for human dimensions research.

This plan provides the basis for subsequent development of an NCCOS Human Dimensions Research Implementation Plan. The implementation plan will specify needed program- and project-level actions, fiscal and human resources needs, potential partnerships, expected outcomes, and

other programmatic elements to develop an integral human dimensions research focus in NCCOS – including its component research centers, laboratories, and partnerships with cooperating institutions such as NCCOS' coral reef research institutes. It will be collaboratively developed by the NCCOS centers through a process facilitated by the NCCOS Human Dimensions Research Coordinator.

The effective dates of this plan (FY 2009 - FY 2014) coincide with NCCOS' next strategic plan, which will integrate human dimensions research objectives.

C. Human Dimensions Research Drivers

The National Research Council (NRC) recognizes that "coupling the social and natural sciences is an increasingly important element of emerging research and development programs in the federal agencies" (NRC, 2005, p. 21). NCCOS' initiative to expand its human dimensions focus is responsive to numerous legal authorities and scientific reports, including guidance from the JSOST (2007), SIMOR (2006), USCOP (2004), and Pew Oceans Commission (2003) (*see* Appendix 1, Human Dimensions Research Drivers).

A significant driver is NOAA's Strategic Plan, *New Priorities for the 21st Century FY 2006 – FY 2011*. In this plan, NOAA recognizes that "humans are an integral part of an ecosystem" and that the environment includes "social conditions that surround organisms." It also defines an ecosystem approach to management as one that "strives to balance diverse societal objectives" (NOAA, 2005, p. 3) (*see* Appendix 2, Excerpts from NCCOS and NOAA Strategic Plans).

Another significant driver is a finding by the external Social Science Review Panel to NOAA's Science Advisory Board (2003, pp. 1-2) that "the capacity of NOAA to meet its mandates and mission is diminished by the under-representation and under-utilization of social science." Yet developing adequate capacity is challenged by "a lack of formal understanding of what social science is and what its contributions can be, leading to an organizational culture that is not conducive to social science research." Among its recommendations, the Panel advised integrating social science goals, plans, and outcomes into strategic plans; developing initiatives in mission critical social science; developing social science capabilities, including senior-level social science representation; and increasing social science literacy throughout NOAA.

The Social Science Review Panel recommendations prompted NCCOS to develop a "societal stressors" goal in its Strategic Plan for FY 2005 - FY 2009. This goal directs NCCOS to provide scientific information and tools critical to help coastal managers and other decisionmakers reduce human causes of ecosystem stress (NOAA NCCOS, 2004) (*see* Appendix 2, Excerpts from NCCOS and NOAA Strategic Plans). This *Human Dimensions Strategic Plan* expands NCCOS' focus on societal stressors to develop more comprehensive guidance in providing mission critical human dimensions research. It also represents the development of NCCOS' human dimensions vision since its contribution to the 2005 NOAA National Ocean Service (NOS) Social Science Plan.

Finally, a review of NOAA's ecosystem science enterprise by an External Ecosystem Task Team (2006) titled *Evolving an Ecosystem Approach to Science and Management throughout NOAA and its Partners* echoes the Social Science Review Panel's recommendations. The Task Team's final report to NOAA's Science Advisory Board affirms that "both natural and social science, including communication of science, are critical elements at whatever scale and for whatever purpose ecosystem approaches are being developed" (p. 26). It also emphasizes that "transitioning from the current set of [NOAA] programs and mandates to an integrated ecosystem science enterprise [requires] understanding how humans take benefits from marine ecosystems and their components, and how those uses alter the ecosystems" (p. 8).

D. Human Dimensions of Ecosystems

NCCOS has adopted a conceptual model developed by the NRC (1992) that describes the human dimensions of ecosystems in terms of human

causes, consequences, and responses to ecosystem stress. As illustrated in Figure 1 and elaborated below, changes in the structure and function of environmental systems influence the quantity, quality, and sustainability of benefits that humans derive from them (ecosystem services).

Ecosystem services are commonly categorized as supporting (e.g., nutrient cycling and soil formation), provisioning (e.g., timber and food), regulating (e.g., water purification and flood control), and cultural (e.g., spiritual opportunities and aesthetic experiences) (Millennium Ecosystem Assessment, 2005). Changes in ecosystem services influence the achievability and sustainability of societal values such as security from natural disasters, health, good social relations, and freedom to pursue personal and cultural interests (Millennium Ecosystem Assessment, 2005). Ecosystem stress is defined as change in the quantity, quality, and sustainability of ecosystem services that has undesirable consequences for human health and other societal values. Humans respond to ecosystem stress through mitigative and adaptive measures. In addition to modifying social systems, these responses feed back to influence the structure and function of environmental systems.

Stakeholders' values influence their attitudes, intentions, management preferences, satisfaction levels, and norms for behavior. Values differ among individuals, but can be studied at the group level. For example, groups engaging in similar activities at similar locations and rates of participation, and using similar equipment can be expected to share values. Stakeholder values is an important topic of human dimensions research, enabling understanding of: (1) how coastal resource conditions and management decisions are likely to be perceived by different groups; (2) how differing value systems interact to influence coastal resource management planning and effectiveness; and (3) interactions among changing value systems, management decision processes and outcomes, and resource conditions (e.g., Dietz et al., 2005).

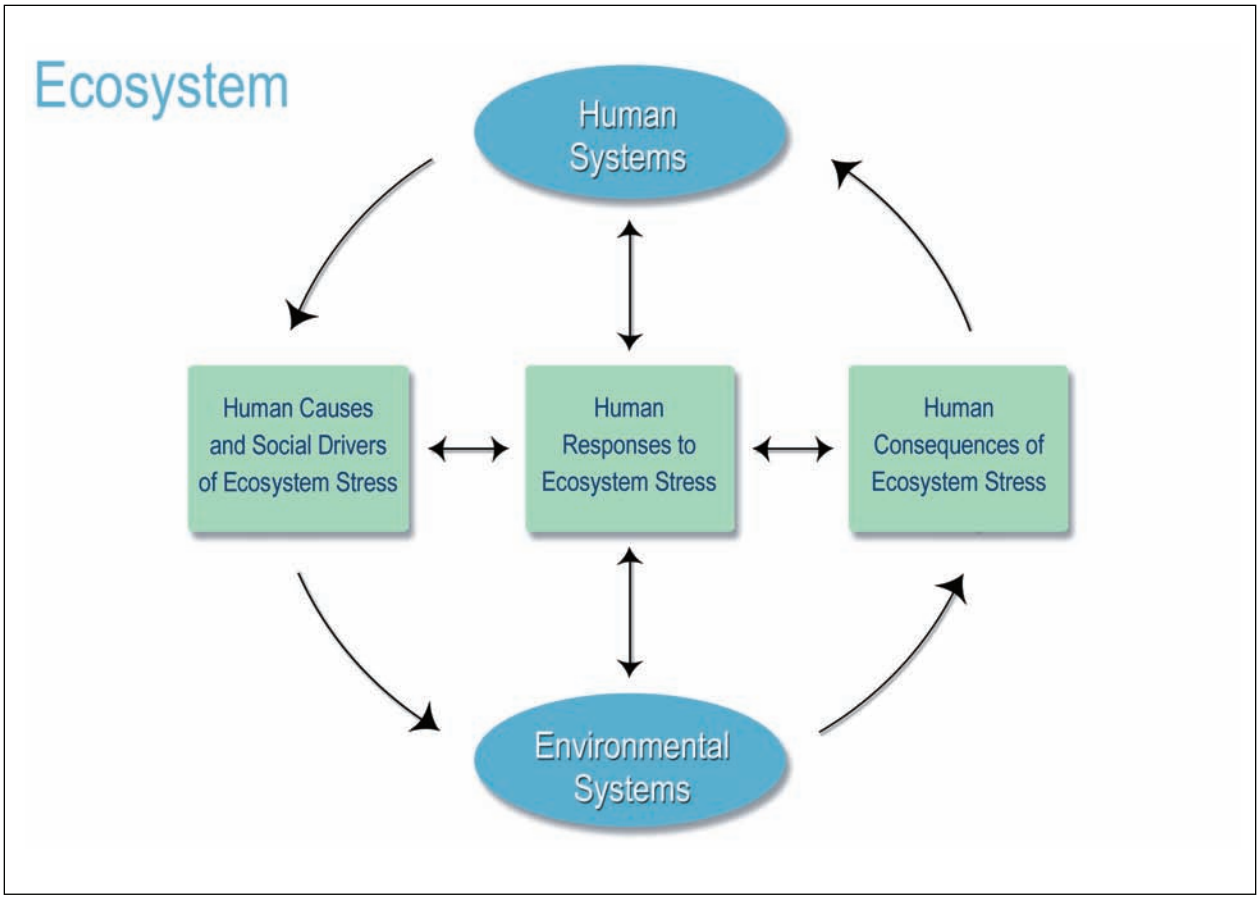


Figure 1. Human-environment interactions integral to ecosystems (Adapted from NRC, 1992).

Human Causes

Human activities have globally transformed the land and sea, altered major biogeochemical cycles, and added and removed species from ecosystems (Lubchenco, 1998). Natural and human-caused factors that directly or indirectly change the structure or function of ecosystems are called drivers. A *direct* driver unequivocally influences ecological processes. An *indirect* driver influences one or more direct drivers (Millennium Ecosystem Assessment, 2005). Indirect drivers include environmental and socioeconomic factors (e.g., demographic, economic, sociopolitical, cultural, religious, scientific, and technological) (Nelson et al., 2006).

For example, our nation's coral reefs are threatened by direct drivers such as destructive fishing practices and overexploitation of reef resources. Overexploitation is influenced by indirect socioeconomic drivers associated with the way a society organizes resource access, extraction, and commerce (Ostrom, 1990). A striking example is the community of Andra Island off the coast of Papua New Guinea, where coral mining for lime production is a predominant livelihood. Individual- and clan-based ownership of reef areas creates incentives for sustainable harvesting to sustain ecosystem services. Yet the community's regional monopoly over lime production for the traditional practice of betel nut chewing creates a stronger incentive to overharvest. A lapse in lime production could enable other areas to gain a market share, threatening the community's predominant livelihood (Cinner et al., 2005). By providing an incentive to overharvest, the regional monopoly over lime production functions as an indirect driver of coral reef degradation.

Human Consequences

Changes in the quantity, quality, and sustainability of ecosystem services can promote or threaten societal values. To continue with the example above, coral reef disease and mortality result in a decline in the quantity and diversity of available reef products such as fish, seaweed, crabs, sea cucumbers, and lime (i.e., provisioning services). Reduced flow of these valued ecological components can threaten the food security and livelihood stability of reef-dependent communities and increase conflict among reef stakeholders (Whittingham et al., 2003).

Human Responses

Ecosystem stress is addressed by human intervention striving to restore declining benefits. Mitigation measures aim to "prevent, limit, delay, or slow the rate of undesired impacts by acting directly or indirectly on environmental systems" (NRC, 1992). Such measures include directly modifying environmental systems (e.g., installing artificial coral reefs to provide essential fish habitat); reducing human causes of ecosystem stress (e.g., regulating a fishery to prevent depletion of stocks); and intervening with social drivers (e.g., providing education and financial assistance to promote agricultural practices that reduce nitrogen inputs). Adaptive responses aim to reduce or eliminate deleterious consequences of environmental degradation for human well-being. These include blocking impacts of environmental degradation on human values (e.g., improving diagnosis and treatment of illness caused by harmful algal blooms, or HABs); adjusting to experienced impacts (e.g., evacuating a flooded area); and modifying human systems to reduce anticipated impacts (e.g., establishing early warning systems for hazards) (NRC, 1992). This document describes research critical to improve several dimensions of human response such as decisionmaking, institutional strategies, and communication.

In a recent discussion paper informed by a broad spectrum of the coastal management community, NOAA and the Coastal States Organization (2006) discuss "articulating a vision" as one of five "big picture" challenges to coastal decision-making. The challenge stems from the need to integrate deliberation of societal values with a traditional decision focus on analysis of scientific information. For planning purposes, a management vision must specify means-end outcomes (objectives) identifying ecosystem services required to sustain societal values. For example, clean water is an ecosystem service that promotes human health. Objectives must be further trans-

lated into measurable indicators, such as incidence of disease, suitable for evaluating alternative actions and tracking progress.

The crux of the challenge is balancing competing objectives. To maximize benefits in the face of conflict, resource managers seek win-win solutions. When win-win solutions are elusive, articulating a vision requires making tradeoffs – compromising one of two desired outcomes, to some extent, in favor of the other. Different tradeoffs entail different arrangements of risks, costs, and benefits for stakeholders over space (e.g., local, regional, and national scales); time (e.g., current and future generations); and social groups (e.g., sectors and user groups). For example, managing "a forest for tree production (a provisioning service) may affect water quality downstream (a regulating service) or decrease the value of the land for recreation (a cultural service)" (Rodriguez et al., 2006). Subsistence users may be particularly vulnerable to declining water quality.

Evaluating tradeoffs is fundamental to coastal management, and is essentially an enterprise in making an ethical choice among alternative futures.

D. Human Dimensions Research

Human dimensions research describes, explains, and predicts the roles of humans in ecosystems to support resource decisionmaking. Diverse quantitative and qualitative methods cut across interrelated disciplines in the social and behavioral sciences, humanities, communication sciences, and interdisciplinary fields (Figure 2). The distinction between the terms "human dimensions" and "social science" often generates confusion. "Human dimensions" refers conceptually to the roles of humans in ecosystems and resource management, whereas the term "social science" denotes a subset of the disciplines useful for describing, explaining, and predicting these roles.

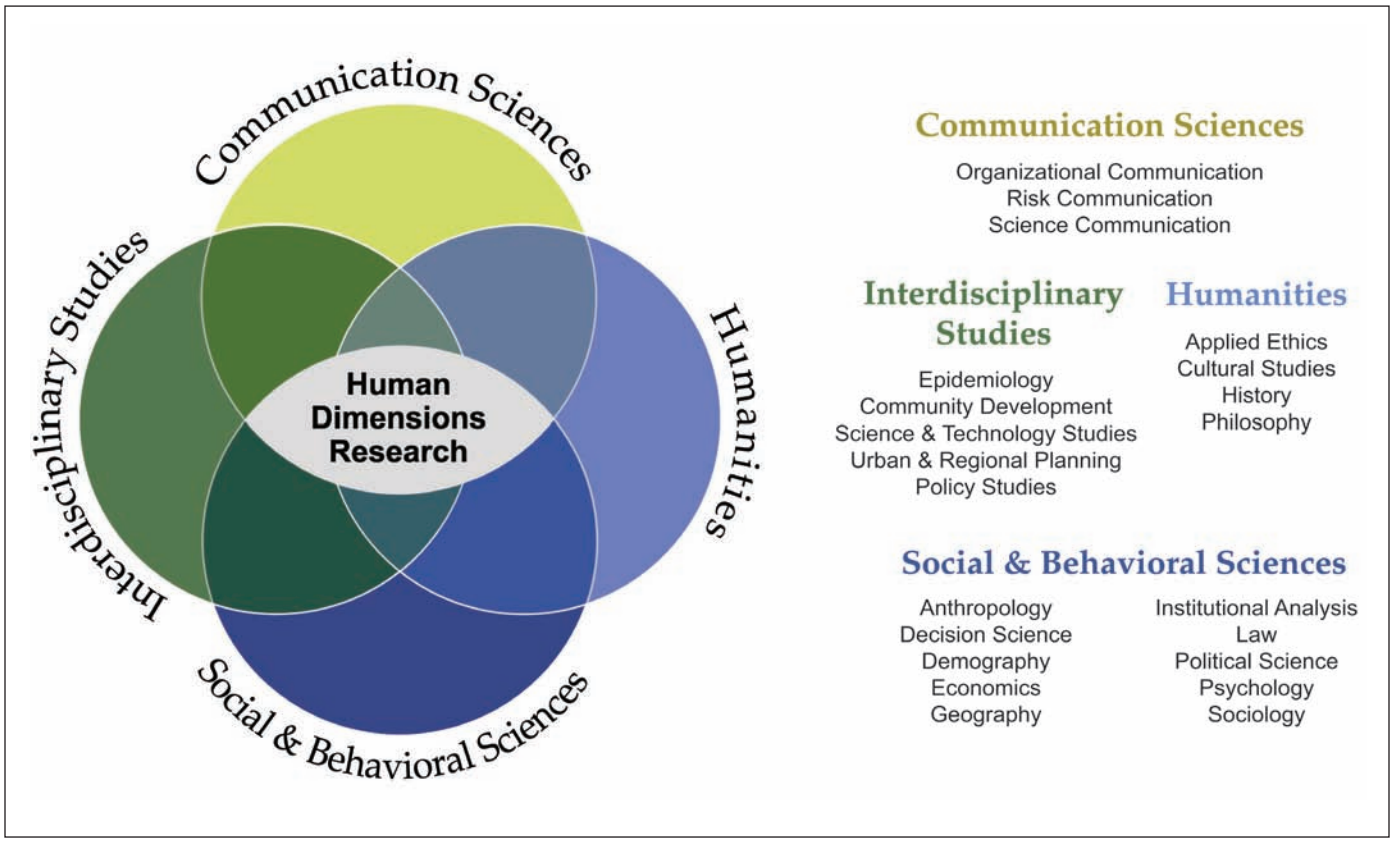


Figure 2. Diverse disciplines integral to human dimensions research.

3. National Centers for Coastal Ocean Science

NOAA created NCCOS in 1999 to strengthen and integrate its coastal science programs in ways that encourage strong external partnerships, increase and protect their integrity, and ensure that they focus on NOAA's coastal ocean missions. NCCOS is the focal point of ecosystem science in NOAA's NOS and Ecosystem Goal Team. The Ecosystem Goal Team coordinates efforts across NOAA's line offices, including NOS, to achieve NOAA's Ecosystems Mission Goal. As defined in NOAA's Strategic Plan (2005), NOAA's Ecosystems Mission Goal is to "protect, restore, and manage the use of coastal and ocean resources through an ecosystem approach to management" (p. 2). NOAA defines an ecosystem approach to management as "management that is adaptive, specified geographically, takes into account ecosystem knowledge and uncertainties, considers multiple influences, and strives to balance diverse societal objectives" (p. 3).

NCCOS is comprised of science centers and laboratories that cooperatively identify and implement ecosystem science needed to achieve NOAA's Ecosystems Mission Goal (Figure 3).

A. Ecosystem Science Focus

NCCOS' ecosystem science program focuses on the individual and interactive significance of five categories of stressors affecting ecosystems of concern to NOAA (Figure 4).

B. Integrative Role

NCCOS' primary role in the coastal and ocean science and management community is to synthesize ecosystem understanding critical to support coastal and ocean decisionmaking. This integrative function has three components.

Research Collaboration: NCCOS coordinates research across diverse partners within NOAA and in other Federal and state agencies, tribes, communities, and universities.

Interdisciplinary Scientific Synthesis: NCCOS is developing an integrative ecosystem research approach focusing on coupled social and ecological systems.

Science Supporting Decisionmaking: NCCOS provides scientific information and tools that are informed by and support coastal and ocean decisionmakers.

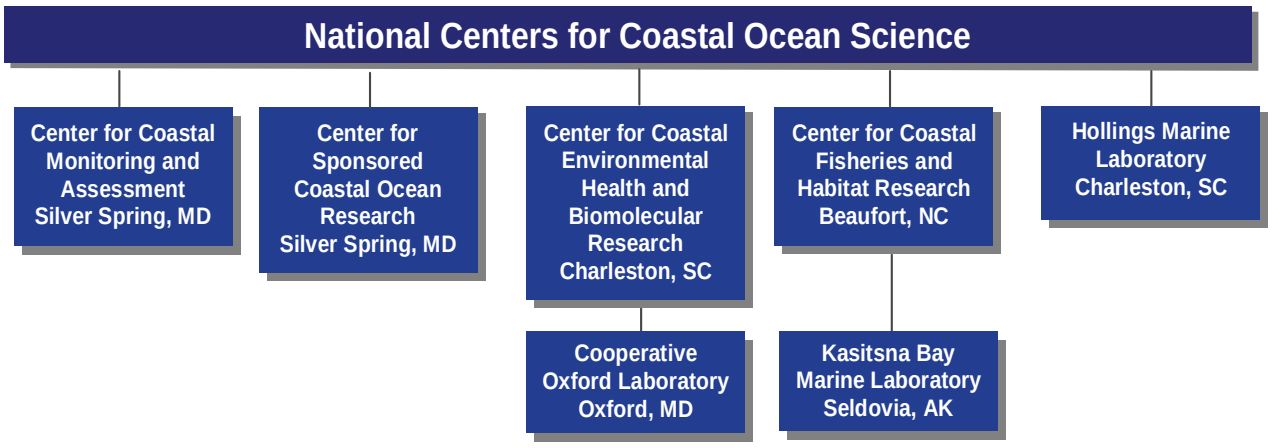


Figure 3. NCCOS centers and laboratories.

National Marine Sanctuaries	Climate Change
Coral Reefs	Extreme Natural Events
Coastal Oceans	Pollution
Estuaries (Including National Estuarine Research Reserves)	Invasive Species
	Land and Resource Use

Figure 4. NCCOS' ecosystem science focal areas and stressors.

C. Integrated Assessments

NCCOS' fundamental strategy is the integrated assessment (Figure 5). Integrated assessments synthesize available environmental and human dimensions information to forecast the status, sustainability, and tradeoffs among societal objectives under alternative management scenarios. This information provides a focus for collaborative decisionmaking across sectors, agencies, and stakeholder groups (e.g., Committee on Environment and Natural Resources, 2000).

D. Customers

NCCOS informs coastal and ocean decisionmaking across spatial scales extending from the local to the global and social scales extending from individuals to intergovernmental, intersectoral networks. Customers include state and local coastal resource managers; the greater coastal and ocean science community; tribes; local, state, and Federal governmental agencies; nongovernmental organizations; private industry; resource user groups; and other stakeholders who influence and are influenced by coastal and ocean systems and their societal linkages.

E. Ecosystem Regions

The USCOP (2004, p. 87) recommends a regional approach to coastal and ocean research and management to enable "decisionmakers at all levels to coordinate their activities, reduce duplication of efforts, minimize conflicts, and maximize limited resources." Following this recommendation and its endorsement in the President's *United States Ocean Action Plan* (Executive Office of the President, Council on Environmental Quality, 2004), NOAA delineated eight regional ecosystems as a focus for internal and external coordination, ecosystem observation, ecosystem modeling, and stewardship and management. These regional delineations are based on Large Marine Ecosystem boundaries adopted by the World Bank and Global Environment Facility. NCCOS supports NOAA's regional foci: the Northeast Shelf, Southeast Shelf, Caribbean, Great Lakes, Gulf of Mexico, California Current, Alaskan Ecosystem Complex, and Pacific Island Ecosystem Complex (Figure 6).

F. NCCOS Human Dimensions Research

Capabilities

NCCOS has developed significant capabilities to further its human dimensions research initiative. These include a Human Dimensions Research Coordinator and a memorandum of agreement with two premiere human dimensions-related academic departments. NCCOS is also funding graduate assistantships in human dimensions research. In addition, NCCOS serves as the technical representative for the Environmental Cooperative Science Center (ECSC), a research and training center sponsored by NOAA and Florida A&M University (http://www.ecsc.famu.edu/). The ECSC's research themes include conceptual modeling of coupled social-ecological systems (*see* Reiter et al., 2006; Reiter, 2004), social and economic analysis, and environmental justice. Through capabilities such as these, NCCOS is already providing human dimensions and integrated ecosystem information critical to support coastal and ocean decisionmaking. The following

highlighted publications and projects provide analytical guidance in identifying and implementing human dimensions research critical to inform coastal management. Additional relevant publications can be found by searching the web-based NCCOS Project Explorer (http://coastalscience.noaa.gov/research/welcome.html).

Publications

Effects of Nutrient Enrichment in the Nation's Estuaries: A Decade of Change (Bricker et al., 2007) assesses the status and trends in nutrient-related water quality conditions, causes, and outlook for national estuaries and other water bodies, including evaluation of impairments to human use.

Harmful Algal Research and Response: A Human Dimensions Strategy (Bauer, 2006) provides a multiagency strategy for human dimensions research critical to reduce impacts of HABs. Research priorities and example projects inform implementation of the Harmful Algal Bloom and Hypoxia Amendments Act of 2004 (HABHRCA), National Plan for Algal Toxins and Harmful Algal Blooms (*Harmful Algal Research and Response: A National Environmental Science Strategy*, HARRNESS), and Oceans and Human Health Act.

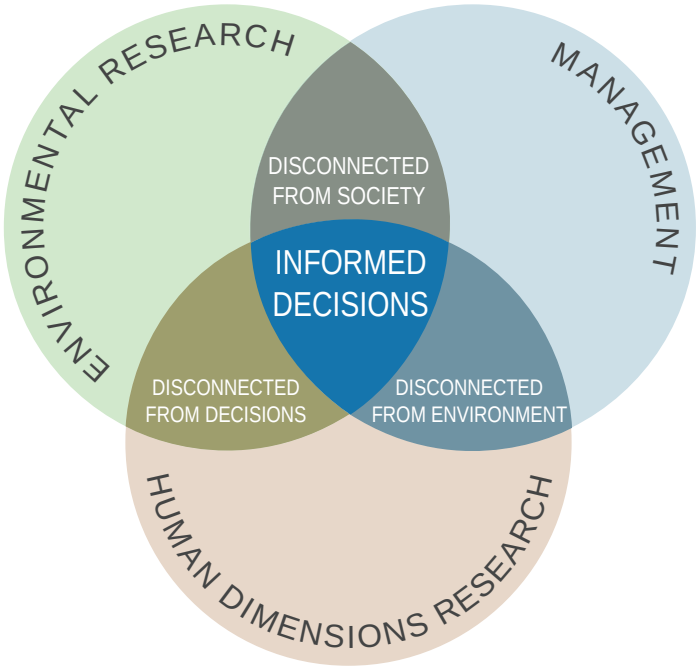


Figure 5. Schematic reflecting synthesis of information in integrated assessments (Adapted from Michigan Sea Grant, 2005).

Improving Methods and Indicators for Evaluating Coastal Water Eutrophication (Bricker et al., 2006) uses an assessment of Gulf of Maine and Mid-Atlantic estuaries to improve nutrient-related eutrophication assessment methods, including development of an indicator to evaluate human and socioeconomic costs of nutrient-related degradation.

Human Dimensions of Coastal Restoration (Salz and Loomis, 2005) provides technical assistance for developing and implementing sound scientific monitoring of coastal restoration, including selection of indicators for assessing the benefits of coastal restoration projects to human communities and economies.

Visual Impact Assessment of Small Docks and Piers: Theory and Practice (Bliven and Kelty, 2005) summarizes legal bases for developing visual impact standards and analysis techniques, local and state capabilities to implement visual impact standards, and mitigation projects.

Evaluation of the Economic Costs and Benefits of Methods for Reducing Nutrient Loads to the Gulf of Mexico (Doering et al., 1999) evaluates the social and economic costs and benefits of alternative methods for reducing nutrient loads to the Gulf of Mexico. The report is part of a hypoxia science assessment documenting the state of knowledge of the extent, characteristics, causes, and effects (ecological and economic) of hypoxia in the northern Gulf of Mexico.

Integrating Biology and Economics in Seagrass Restoration: How Much is Enough and Why? (Fonseca et al., 2000) discusses a technique for integrating field data and economic methods (Habitat Equivalency Analysis) to determine the amount of habitat that must be restored to compensate for the loss of public services resulting from environmental damage.

Socioeconomic Causes and Consequences of Coastal Ecosystem Change (Huppert et al., 1998) describes methods to understand the linkages among human causes, consequences, and responses to ecosystem change.

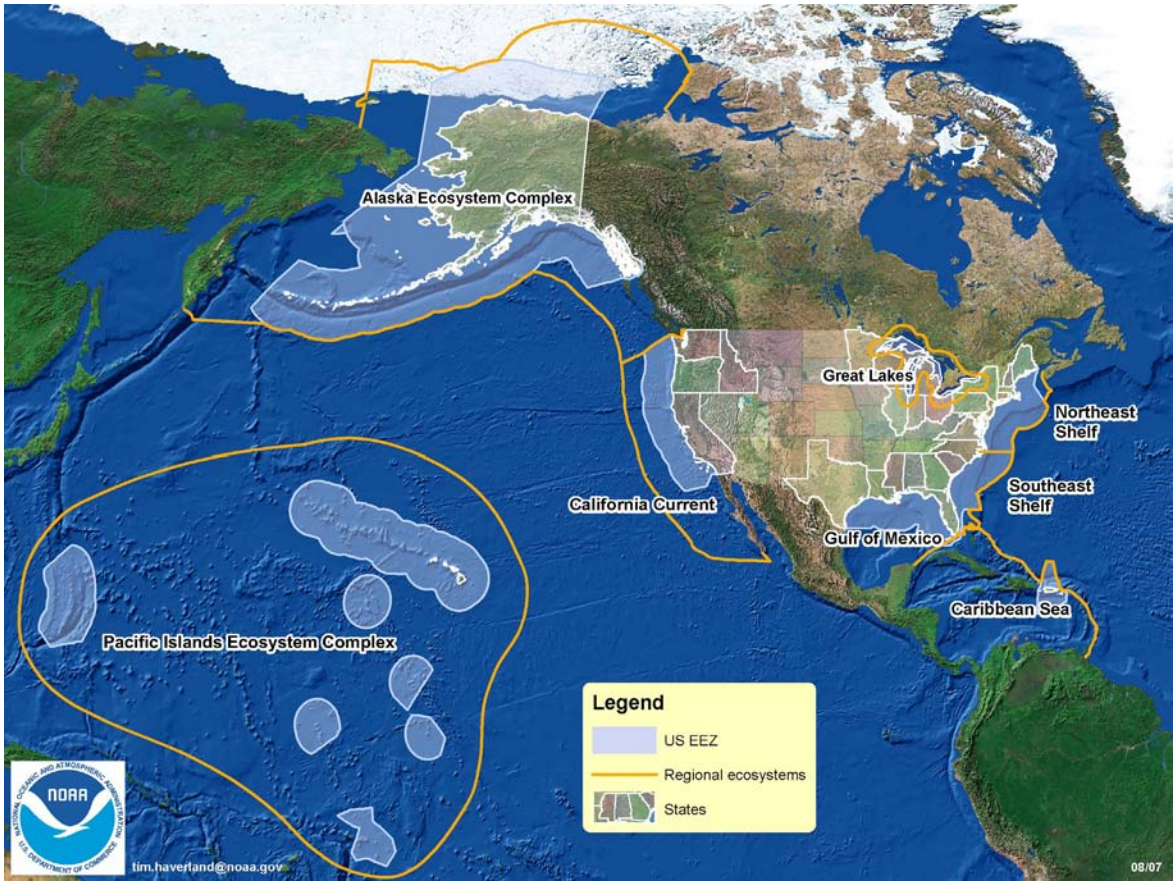


Figure 6. United States regional ecosystems delineated by NOAA.

The Effects of Urbanization on Human and Ecosystem Health (Vernberg et al., 1996) discusses the impact of environmental change on water quality and human health.

Economic Valuation of Natural Resources: A Handbook for Coastal Resource Policymakers (Lipton et al., 1995) explains basic economic concepts and tools used in environmental decisionmaking such as willingness-to-pay, cost effectiveness analysis, economic impact analysis, and sustainable development.

Ongoing Projects

- Assessing the biogeographic and socioeconomic effects of a no-take area established in 2001 in the Tortugas Ecological Reserve in the Florida Keys National Marine Sanctuary (http://www8.nos.noaa.gov/nccos/npe/projectdetail.aspx?id=28&fy=2002).

- Assessing community vulnerability to tidal creek flooding and the effects of water quality on property values and other aspects of quality of life in the Mid-Atlantic and Gulf Coast states (http://www8.nos.noaa.gov/nccos/npe/projectdetail.aspx?id=215&fy=2007).

- Documenting and incorporating traditional ecological knowledge (TEK) and local ecological knowledge (LEK) into resource management programs in Alaska (http://www8.nos.noaa.gov/nccos/npe/projectdetail.aspx?id=517&fy=2007).

- Collecting and analyzing socioeconomic information supporting the Southeast Florida Coral Reef Initiative, Florida Reef Resiliency Program, and Florida Keys National Marine Sanctuary.

Other Highlights

The NCCOS-sponsored project *Coral Reef Ecosystems Study: Integrating Science and Management in the Caribbean* documented LEK and TEK

and perceptions of marine resource use, management systems, and coral reef health to inform the establishment and co-management of marine protected areas (MPAs) in Puerto Rico (http://www8.nos.noaa.gov/nccos/npe/projectdetail.aspx?id=42&fy=2007).

As part of the NCCOS-sponsored project *Coral Reef Ecosystems Study: Integrating Science and Management in the Tropical Pacific Islands*, the Palau International Coral Reef Center used the results of community surveys to focus outreach efforts informing Palauan traditional leaders and communities about the impacts of erosion on coral reefs. These outreach efforts led to community engagement and a moratorium on mangrove clearing, ultimately facilitating conservation of the reefs and sustainability of the vital services they provide to Palauan communities (http://www8.nos.noaa.gov/nccos/npe/projectdetail.aspx?id=468&fy=2007).

A chapter of the *National Coastal Condition Report II*, "Health of Galveston Bay for Human Use" assesses the health of Galveston Bay relative to its capacity to provide for human uses such as marine transportation; commercial and recreational fishing; receiving waters for industrial, municipal, and thermal wastes; recreational activities; oil and gas production sites; and residential housing. This assessment complements other chapters focusing on environmental impacts of human activities (Environmental Protection Agency, 2004).

4. Goals and Objectives

Goal 1

Provide Human Dimensions Understanding Critical to Support an Ecosystem Approach to Management

Coastal Decisionmaking

Objective 1.1: Develop and apply existing tools to foster effective local, regional, and national coastal decisionmaking processes that integrate scientific analysis and stakeholder deliberation.

Rationale

Articulating a vision for resource management and other coastal decisions requires deliberation of conflicting societal objectives. Stakeholder participation in deliberation fosters a broadly acceptable vision and effective strategies to achieve it. The USCOP (2004) calls for changes in governance to foster stakeholder participation. This call echoes an influential NRC study (1996) recommending decisionmaking that integrates scientific analysis and broad-based stakeholder participation in deliberation. Leadership guided by decisionmaking tools is needed to structure effective analytic-deliberative processes in local, regional, and national coastal decisionmaking.

Discussion

Stakeholder participation in decisionmaking is an opportunity to elicit diverse societal values, establish clear objectives linking values to resource outcomes, develop measurable indicators, and examine tradeoffs through broad-based deliberation. Participatory decisionmaking not only honors the democratic right of citizens to participate meaningfully in public decisions, but also fosters a broadly acceptable vision and effective strategies to achieve it (e.g., Mascia, 2003; NRC, 1996). Recognizing this opportunity, the USCOP (2004, p. 66) calls for governance changes fostering broad stakeholder participation to help decisionmakers balance "multiple desirable but competing objectives." In addition, in a 2006 survey of coastal managers sponsored by NOAA's Coastal Services Center, almost half of the respondents rated stakeholder engagement processes as highly useful and another 23 percent gave a rating of medium usefulness (NOAA Coastal Services Center, 2006). These examples echo an influential 1996 NRC study recommending approaches integrating scientific analysis and broad stakeholder participation in deliberation (an analytic-deliberative approach) (NRC, 1996).

In addition to conflicting (and changing) values, coastal decisionmaking is often challenged by the complexity of coupled social-ecological systems, scientific uncertainty, multi-scale management, multi-agency authority, multiple stakeholders, time pressure, and scarce funds (NRC, 2005). Leadership is needed to foster an analytic-deliberative approach to addressing these challenges in local, regional, and national resource management and other coastal decisionmaking processes. This leadership must be guided by an understanding of human judgment and organizational behavior, as well as tools and techniques for structuring analysis and deliberation (e.g., Gregory et al., 2001; Gregory and Wellman, 2001; Brown et al., 2001).

There is no standard procedure for structuring an analytic-deliberative approach to decisionmaking. Needs and effective tools will depend on the decision context, including stressors and risks addressed, legal mandates, and governance structure (NRC, 1996). The field of decision science has developed tools and techniques for purposes such as clarifying participants' values and preferences for specific action alternatives; addressing uncertainty and disagreement about the implications of action alternatives; and arriving at a social choice despite conflicting individual understandings and values (NRC, 2005). Such techniques can be applied in the context of innovative approaches to participatory decisionmaking such as co-management of protected areas (Ender-Wada et al., 1998). In addition to decision science, fields such as psychology, organizational studies, applied ethics, professional facilitation, and economics offer important perspectives. The 2005 NRC study, *Decision Making for the Environment: Social and Behavioral Science Research Priorities*, reviews decision support tools and recommends research to improve environmental decisionmaking.

The social science method of stakeholder analysis provides a starting point for structuring decision-making processes by identifying and describing key stakeholders. Methods such as focus groups, interviews, and surveys provide information on stakeholders' values, desired uses, and other characteristics that inform the evaluation of tradeoffs. Description of other stakeholder characteristics can help decisionmakers anticipate the effectiveness of alternative actions and design effective communications to facilitate stakeholder support. These include stakeholder interrelations (e.g., conflicts), attitudes, motivations, beliefs, intentions, satisfaction with management, perceptions of risk and resource quality, and preferences for management actions.

Human Causes and Socioeconomic Drivers of Ecosystem Stress

Objective 1.2: Assess the status and trends in human behavioral patterns contributing to coastal ecosystem stress and their complex socioeconomic drivers. Help coastal decisionmakers identify and facilitate strategies for changing human behavior when desirable to achieve environmental, social, and economic goals.

Rationale

Reducing stress on coastal systems generally requires accommodating or encouraging change in human behavioral patterns such as exurban development, agricultural practices, and resource use. Developing effective intervention strategies requires understanding behavioral patterns requiring remediation and their complex natural and socioeconomic drivers.

Discussion

Coastal resource management requires accommodating or encouraging change in human behavioral patterns such as resource uses to reduce the threat they pose to ecosystem goods and services. Understanding and monitoring environmentally significant behavioral patterns and the socioeconomic factors driving them is critical to help resource managers identify effective and efficient strategies (Sutinen et al., 2005; Endter-Wada et al., 1998). Socioeconomic drivers of environmentally significant human behavior include demographic (e.g., population growth and migration); economic (e.g., income growth and distribution); sociopolitical (e.g., resource use conflict); psychological (e.g., values, attitudes, and beliefs influencing human decisions); and scientific and technological factors (e.g., new technologies for resource harvest) (Nelson et al., 2006).

For example, nutrient pollution fueling hypoxic conditions and some harmful algal species is caused by sewage and wastewater treatment effluent, agricultural and other fertilizer runoff, waste from animal feed operations, aquaculture discharge, and atmospheric deposition from fossil fuel combustion (Anderson et al., 2002). Understanding how economic factors influence the use of fertilizers and fossil fuels (such as government programs supporting fertilizer intensive crops) provides insight into the effectiveness of alternative pollution abatement approaches (Segerson and Walker, 2002). From a cultural perspective, an anthropological study by Urban (2005, p. 177) concluded that farming decisions are also influenced by farmers' ideals of "what it means to be a progressive or successful farmer." Efforts to change farming decisions may be enhanced by framing scientific and other guidance to resonate with these ideals.

Societal Consequences of Policy and Management

Objective 1.3: Help resource managers and other coastal decisionmakers anticipate the social, cultural, economic, and public health consequences of alternative actions and evaluate the consequences of actions taken.

Rationale

Coastal decisionmaking requires anticipating and weighing the costs and benefits of alternative actions (including policies, programs, plans, and projects) across environmental, social, cultural, economic, and public health dimensions. Methods of social, economic, and health impact assessment complement environmental impact assessment to provide decisionmakers with a full understanding of potential intended and unintended consequences. Such an understanding helps decisionmakers identify alternatives that promote benefits (and equitable distribution of benefits) and avoid unacceptable costs. This pri-

ority echoes an objective in the NCCOS Strategic Plan (FY 2005 – FY 2009) to assess the social and economic costs and benefits of alternative development scenarios for navigation and aquaculture (NOAA NCCOS, 2004) (*see* Appendix 2, Excerpts from NCCOS and NOAA Strategic Plans).

Discussion

Social Impact Assessment. Social impact assessment (SIA) grew out of the impact assessment provisions of the National Environmental Policy Act (NEPA) (42 U.S.C. § 4332). The NEPA-implementing regulations require Federal agencies to assess "aesthetic, historic, cultural, economic, social, or health" effects of major actions "whether direct, indirect, or cumulative" (40 C.F.R. §§ 1500-1508). In addition to NEPA, the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. § 1801 et seq.) and Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, require Federal agencies to analyze and consider social and economic consequences in decisionmaking. Although these are Federal regulations, the value of SIA to coastal decisionmaking extends beyond Federal agencies to inform a diverse array of coastal decisionmakers.

A statement of SIA principles endorsed by the International Association for Impact Assessment defines SIA as a collection of methods for "analyzing, monitoring, and managing the intended and unintended social consequences, both positive and negative" of alternative actions (Vanclay, 2003, p. 6; *see also* Interorganizational Committee on Principles and Guidelines for Social Impact Assessment, 2003). The statement characterizes the wide range of social factors considered in SIAs, including:

- Way of life – how people live, work, play, and interact with one another;
- Culture – people's shared beliefs, customs, values, and language or dialect;
- Community – its cohesion, stability, character, services, and facilities;
- Political systems – the extent to which people are able to participate in decisions affecting their lives, and the resources provided for this purpose;
- Environment – the quality of the air and water people use; the availability and quality of the food they eat; the level of hazard or risk, dust, and noise to which they are exposed; the adequacy of sanitation; their physical safety; and their access to and control over resources;
- Health – a state of complete physical, mental, social, and spiritual well-being and not merely the absence of disease or infirmity;
- Personal and property rights – particularly whether people are economically affected, or experience personal disadvantage which may include a violation of their civil liberties; and
- Fears and aspirations – people's perceptions about their safety, their fears about the future of their community, and their aspirations for their future and the future of their children (modified from Vanclay, 2003, p. 8).

Economic Impact Analysis. Economic impact analysis is a method for determining how an action will affect economic activities such as revenues, expenditures, and employment (Lipton et al., 1995). Methods for putting a dollar figure on the costs and benefits of alternative management actions are contested and require improvement (e.g., accounting for the true costs and benefits of alternative actions for non-market values). Non-market values are outcomes (such as the preservation of cultural heritage) that are valued, but not traded directly in markets. Moreover, it is important to point out that conducting an economic impact analysis does not eliminate the need for assessing the social impacts of alternative actions, as these methods reveal different kinds of consequences. For example, "an economic analysis of a proposed fishery allocation might suggest an increase in jobs, local trade, and tax bases. The same data subjected to a social impact assessment might indicate community changes and losses due to a shift from year-round to seasonal employment … [as well as] decreased opportunities for crew members to become vessel owner/oper-

ators, loss of cultural values, and a rise in cultural costs to families and communities as they deal with the social effects of under employment" (NOAA National Marine Fisheries Service, 1997, App. 2g, Section 1).

Health Impact Assessment. Health impact assessment is commonly defined as "a combination of procedures, methods, and tools by which a policy, program, or project may be assessed and judged for its potential effects on the health of the population and the distribution of these impacts within the population" (European Centre for Health Policy, 1999; *see also* World Health Organization: http://www.who.int/hia/en/ and Centers for Disease Control: http://www.cdc.gov/healthyplaces/hia.htm).

Traditional and Local Ecological Knowledge

Objective 1.4: Conduct community-based research documenting traditional and local ecological knowledge, facilitate its application to enhance coastal and ocean science and management, and equitably share benefits with local communities.

Rationale

Community-based documentation of TEK and LEK enhances coastal science and management, and benefits communities.

Discussion

Community-based documentation of TEK and LEK can enhance coastal and ocean science and management by supporting or augmenting scientific observations, suggesting testable hypotheses, contributing explanatory and predictive models, and expressing novel ways of understanding the relation of humans to the rest of nature (Drew, 2005; Huntington, 2000). TEK is "a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment" (Berkes et al., 2000, p. 1252). "Traditional knowledge systems are based on the shared experiences, customs, values, traditions, subsistence lifestyles, social interactions, ideological orientations, and spiritual beliefs unique to aboriginal communities" (Stevenson, 1996, p. 281).

Like TEK, LEK "is tied to place (e.g., specific hunting or fishing grounds) and is acquired through experience and observation. LEK differs from TEK in that it does not require an ancient or even multigenerational accumulation of knowledge, it does not require that the population be indigenous, and it does not require embedding in a broader shared culture" (NOAA National Marine Fisheries Service Local Fisheries Knowledge Project, http://www.st.nmfs.gov/lfkproject/02_c.definitions.htm).

TEK and LEK encompass taxonomic, population, and ecosystem levels (Drew, 2005) including human dimensions such as resource use patterns, community attitudes, and management practices. For example:

- Practices found both in conventional resource management and in some local and traditional societies (e.g., monitoring resource abundance, protection of vulnerable life history stages, protection of habitats, temporal restrictions of harvest, and species protection);

- Practices largely abandoned by conventional resource management but still found in some local and traditional societies (e.g., multiple species management, resource rotation, and succession management); and

- Practices related to the dynamics of complex systems, seldom found in conventional resource management but found in some traditional societies (e.g., management of landscape patches, watershed-based management, managing ecological processes at multiple scales, and responding to and managing pulses and surprises) (Berkes et al., 2000; Folke et al., 1998).

TEK and LEK have not been widely integrated into coastal and ocean science or resource management in part due to the unfamiliarity of environmental scientists and managers with social science methods required for documentation (Huntington, 2000). The purpose of this objective

is to build on NCCOS' success documenting and using TEK and LEK to enhance coastal and ocean science, including incorporating these forms of knowledge into Integrated Ecosystem Assessments (*see* Objective 2.2, Integrated Ecosystem Assessments) and other tools supporting coastal decisionmaking. Following international law and policy regarding the rights of indigenous peoples (United Nations Environment Programme Convention on Biological Diversity, http://www.biodiv.org/doc/legal/cbd-un-en.pdf; Mauro and Hardison, 2000), research should incorporate community participation at all stages and demonstrate respect for community self-determination and cultural heritage – for example, by equitably sharing any benefits arising from documentation.

Institutional Strategies

Objective 1.5: Analyze existing institutional approaches, and evaluate and facilitate prospects for (re)designing institutions, to enhance coastal and ocean science and management.

Rationale

Analysis and development of institutional approaches is critical to foster formal and informal interactions across multiple scales, regions, stakeholders, and sectors that facilitate an ecosystem approach to coastal and ocean resource management.

Discussion

For purposes here, institutions are defined as the patterns of interaction among scientists, resource managers, stakeholders, and others integral to coastal decisionmaking and its scientific support. Some interactions are shaped by formal laws and policies. For example, the Magnuson Fishery Conservation and Management Act of 1976 created eight regional fishery management councils to manage the living marine resources within the United States Exclusive Economic Zone. The Act also created a formal structure governing councils by specifying their membership, functions, and operating procedures, and the required and discretionary contents of fishery management plans. Other interactions are structured by informal norms such as communication and leadership styles that vary across disciplines, organizations, and individuals (for a more nuanced definition of institutions, *see* IHDP, 2005).

An ecosystem approach to management is fundamentally an endeavor in designing, managing, and maintaining institutions. The social scientific discipline of Institutional Analysis focuses on the role that institutions play in resource management, including strategies for generating understanding of social and environmental systems, stakeholder participation, handling scientific uncertainty in decisionmaking, resolving conflicts, promoting compliance with rules of resource use, and translating scientific information into policy change (e.g., Dietz et al., 2003; Juda, 1999; Hanna, 1998; Ostrom, 1990). In addition, the institutionalization of social science data collection, storage, management, and mining is a fundamental problem for incorporating human dimensions consideration into coastal decisionmaking (Collins et al., 2007).

The United Nations Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (2001, p. 97) recognizes that "Institutional Analysis provides a systematic way of obtaining an understanding of the nature, strengths, and weaknesses of institutions within the context in which they are operating or in which it is proposed they may operate in the future. It is, therefore, a key element in moving away from sectoral-based management of natural resources to an holistic [ecosystem] approach that is likely to require modifications in the roles of different institutions" (*see also* Imperial, 1999a and 1999b). Leschine and Chadsey (in prep.) provide an example. They applied an institutional framework to analyze Washington State's management of recreational shellfish harvests using scientific information related to domoic acid contamination. Recommendations for institutional analysis aiding HAB research and response are provided by Bauer (2006).

The SIMOR (2006, pp. 1-2) echoes this objective by identifying several institutional research needs as priority focal areas, including the need to: (1) "identify opportunities for improvements in the application of science in collaborative ef-

forts;" (2) "analyze ways to improve efficiency and effectiveness of interagency ocean, coastal, and Great Lakes resource management activities;" and (3) "identify next steps to enhance interagency coordination on use and conservation of marine resources (e.g., energy, fisheries, recreation, and transportation)."

Evaluation of Products and Services

Objective 1.6: Determine the effectiveness of NCCOS' products and services in promoting social, economic, and human health objectives.

Rationale

Social science methods are critical to link program outputs to intended social, economic, and human health objectives. Evaluation of program outputs demonstrates measurable success, enhancing public accountability and informing future program development.

Discussion

The Government Performance and Results Act of 1993 requires Federal agencies to provide the President and Congress an annual report evaluating the effectiveness of program activities in achieving strategic performance goals. Among other purposes, this requirement is intended to: (1) "improve Federal program effectiveness and public accountability," (2) "help Federal managers improve service delivery by requiring that they plan for meeting program objectives and by providing them with information about program results and service quality," and (3) "improve congressional decisionmaking by providing more objective information on achieving statutory objectives, and on the relative effectiveness and efficiency of Federal programs and spending" (31 U.S.C. §§ 1101 et seq.). In addition, pursuant to Executive Order 12862, *Setting Customer Service Standards* (1993), measurement of customer satisfaction is required to evaluate program outputs.

Program evaluation is a distinct discipline with theories and methods related to diverse subjects and settings. The social, behavioral, and health sciences provide methods for gathering data that link program outputs to intended outcomes such as social, economic, and public health benefits. For example, a "value of information" approach estimates the economic value of market and non-market benefits resulting from improved decisionmaking enabled by information such as synthesized data and forecast products (e.g., Kite-Powell et al., 2004). Risk communication specialists use a variety of social science methods to retrospectively evaluate the efficacy of communications for program goals such as audience understanding of messages, targeted changes in attitudes or behavior that reduce impacts, and facilitation of successful stakeholder participation (Bostrom et al., 1994).

Socially Responsible Science

Objective 1.7: Consult appropriate human dimensions specialists to address societal and ethical questions that arise in the conduct and use of NCCOS science.

Rationale

Socially responsible science requires anticipating and critically addressing societal and ethical questions related to issues such as stakeholder participation in research prioritization, public perceptions and societal implications of emerging science and technology, personal and professional decisionmaking, and defining success in restoration.

Discussion

The following examples illustrate the kinds of ethical questions that arise in the conduct and use of NCCOS science.

Stakeholder Involvement in Research Prioritization. The rationale for broad stakeholder participation in governmental decisionmaking is democratic, substantive, and instrumental. From a democratic standpoint, stakeholder participation upholds citizens' right to meaningfully participate in governmental decisionmaking. From a substantive perspective, stakeholders can contribute important insights, questions, concerns, and observations that may otherwise remain unaddressed. Instrumentally, public participation can facilitate public acceptance of and trust in decisions (NRC, 1996). NCCOS will consult appropriate human dimensions specialists to design research prioritization processes effective for facilitating these democratic, substantive, and instrumental out-

comes – both in developing the NCCOS research agenda and in facilitating regional and other research planning initiatives.

Public Deliberation of Emerging Coastal Science and Technology. Responsible development of emerging coastal science and technology requires analyzing and managing anticipated risks. Risk governance incorporates technical assessment of environmental, health, and safety risks as well as ethical, legal, and other societal issues. It further integrates technical assessment with understanding of public perceptions, attitudes, and concerns about the risks and benefits of emerging science and technology. Both of these components are critical to effectively engage all sectors of society in scientific (evidence-based) and societal (value-based) deliberation about scientific and technological development (International Risk Governance Council, 2006).

For example, clay flocculation has emerged as a promising method for reducing the significant public health, socioeconomic, and ecosystem impacts of HABs by directly controlling their causative organisms (e.g., Sengco and Anderson, 2004). At a recent public forum on HABs held in Southwest Florida, coastal residents, environmental activists, and others expressed attitudes toward clay flocculation and other methods of HAB control that ranged from reasonably doubtful to strongly negative. Concerns included the ethical unacceptability of interfering in natural processes (appeals to the ideal of nature) and the possibility of unforeseen environmental and public health impacts of control mechanisms that may be worse than the blooms themselves (fear that the treatment will be worse than the disease). Democratic decisionmaking about the course of HAB control experimentation requires engaging stakeholders in weighing risks and opportunities. Engaging stakeholders in such deliberation requires not only correcting misconceptions about risk by providing information on technical risk assessment, but also understanding and addressing such concerns.

Personal and Professional Responsibility. The conduct and use of coastal and ocean science raises controversial ethical questions where legal guidance leaves off and personal-professional decisionmaking is required. When such questions arise, there is a need to bring ethicists, scientists, and resource managers together in collaborative problem-solving (Minteer and Collins, 2005). For example, participants in a recent human dimensions workshop sponsored by NOAA's Coastal Research and Response Center (CRRC) highlighted numerous ethical quandaries with which they have grappled in the context of spill response and restoration: Does it make sense to spend thousands of public dollars to rehabilitate an individual bird that has a low likelihood of surviving and is ecologically insignificant? Would euthanasia be a more appropriate option? Are the expected benefits of response actions associated with protecting a resource, cleaning a shoreline, or salvaging a leaky tanker worth the risk of worker injury or fatality? Are the benefits of response actions such as burning oil worth the risk of damage to otherwise uncontaminated resources? Is it morally permissible to harvest or intentionally dose healthy animals to study contaminants? Under what criteria is in-situ burning an appropriate containment and cleanup method – considering the risk of harm to proximate human populations, air quality degradation, and injury to response personnel?

Defining Success in Restoration. Participants at the CRRC workshop also raised the question of how to define success in the context of oil spill restoration. On the one hand, this is a legal question. Natural Resource Damage Assessment regulations promulgated under the Oil Pollution Act of 1990 establish "baseline conditions" as the legal standard of success. Baseline refers to the "condition of natural resources and services that would have existed had the incident not occurred" (NOAA, 1997). However, this legal standard invokes ethical questions with serious practical import. Do spill responders, regulators, and other parties integral to restoration have a responsibility to restore public health, sociocultural, and economic conditions degraded by an incident, including natural resource services not traded in markets? Such a responsibility would necessitate broadening restoration practice to conduct injury assessment and restoration planning explicitly

with respect to social values related to culture, family, and community.

On the other hand, even if the legal standard is understood to encompass social values, the acceptability of "baseline" as the legal endpoint for restoration is itself questionable. On what grounds should *historical* conditions (i.e., those characterizing a community and its natural environment at the time of an oil spill) receive favored status? Is there good reason to think that the standard for restoration ought to demand engagement, coordination, and enhancement of community capacities to *improve* sociocultural, public health, economic, and environmental conditions from baseline in so far as practicable? An affirmative answer to this question would demand a standard of community engagement and development rather than restoration of the status quo.

Goal 2

Provide Integrative Ecosystem Understanding Critical to Support an Ecosystem Approach to Management

Integrative Ecosystem Models and Decision Support Tools

Objective 2.1: Provide decisionmakers with integrative ecosystem models and other decision support tools linking changes in ecosystem services to human causes, consequences, and responses.

Rationale

Coastal decisionmaking to sustain societal values requires scientific monitoring, analysis, and forecasting that links changes in ecosystem services to human causes, consequences, and responses.

Discussion

An ecosystem approach to management requires an ecosystem approach to science supporting management. For example, understanding the implications of ecosystem stress for societal benefits requires understanding changes in ecosystem services. Understanding changes in ecosystem services requires understanding the interactive, cumulative effects of human activities and their complex socioeconomic drivers. Protecting and restoring societal benefits in response to such changes requires anticipating the environmental and societal consequences of policy and management options.

Recommendations of an External Ecosystem Task Team to NOAA's Science Advisory Board (2006) urge the development of social science capabilities needed to understand human causes, consequences, and responses. Approaches to linking human dimensions and environmental information may include, but should not be limited to geographic information systems (GIS); analytic approaches such as Integrated Ecosystem Assessments (*see* Objective 2.2, Integrated Ecosystem Assessments); and ecosystem forecasts and conceptual models. Four component models link human activities as drivers of environmental change, mechanisms of environmental change, effects of environmental change on valued ecosystem components, and resulting alterations of flows of goods and services valued by humans (Reiter, 2004; Reiter et al., 2006). Integrative approaches will require active, persistent, and adaptive interdisciplinary learning and collaboration throughout the process of research design, implementation, application, and evaluation.

Integrated Ecosystem Assessments

Objective 2.2: Provide leadership among scientific, management, and other stakeholder partners to define, produce, and facilitate the use of Integrated Ecosystem Assessments incorporating critical human dimensions information.

Rationale

Integrated Ecosystem Assessments are a priority for NCCOS in supporting regional ecosystem-based approaches to coastal decisionmaking. NCCOS is uniquely positioned to provide leadership among scientific, management, and other stakeholder partners in incorporating critical human dimensions components into Integrated Ecosystem Assessments.

Discussion

The Pew Oceans Commission (2003) and USCOP (2004) call for regional ecosystem-based approaches to coastal decisionmaking. NOAA's External Ecosystem Task Team (2006) and NCCOS have identified the development of Integrated Ecosystem Assessments as a priority to provide scientific support for regional ecosystem-based approaches. Integrated Ecosystem Assessments synthesize available scientific information to assess the status and trajectory of regional ecosystems, and anticipate costs and benefits of alternative resource management actions. They provide a scientific foundation for regional resource managers and stakeholders to work together to clarify objectives and develop indicators; evaluate tradeoffs; and select, implement, and evaluate strategies. Integrated Ecosystem Assessments are iteratively developed and revisited. Subsequent assessments evaluate past success in predicting the consequences of alternative management strategies as well as implementing previously identified research needs.

Human dimensions considerations are fundamental to both the science and the purpose of Integrated Ecosystem Assessments. First, the assessment component is intended to describe the capability of ecosystem services to support diverse societal objectives. Stakeholder assessment and participation in decisionmaking (e.g., through community visioning excercises) are required to clarify societal values, link values to supporting ecosystem services, and develop a broadly acceptable set of measurable indicators as criteria for assessment. Second, assessment focuses on ecosystem-level interactions, including human drivers and consequences of ecosystem stress (as discussed in Objective 1.2, Human Causes and Socioeconomic Drivers of Ecosystem Stress). Third, the predictive component of Integrated Ecosystem Assessments must anticipate consequences of alternative resource management actions for social, cultural, economic, and human health dimensions in addition to the state of the environment (as discussed in Objective 1.3, Societal Consequences of Policy and Management). This information is critical to evaluate tradeoffs and select approaches that maximize benefits while avoiding unacceptable costs.

NCCOS' emerging focus on integrative ecosystem science (coupled social-ecological systems) puts it in a unique position to provide leadership among scientific, management, and stakeholder partners in developing Integrated Ecosystem Assessments that include the following critical human dimensions components:

1. *Ecosystem Assessment Criteria*: As illustrated by the Millennium Ecosystem Assessment (2005), ecosystem assessments link changes in ecosystem services to measurable indicators of societal values. Development of indicators for regional ecosystem assessments should be informed by understanding of stakeholder values and ecosystem services required to support them. Understanding of stakeholder values is provided by the social science method of stakeholder analysis and stakeholder participation in decisionmaking. The adequacy of social science information to develop criteria for ecosystem assessment will vary by region. When sufficiently descriptive or broadly representative information is lacking, decision processes guided by social science tools must be developed and implemented to establish a regional management vision and indicators (stakeholder analysis and participatory decision processes are described in Objective 1.1, Coastal Decisionmaking).

2. *Causes of Ecosystem Stress*: Integrated Ecosystem Assessments should synthesize existing information on the status and trends in human and natural causes of ecosystem stress, and underlying socioeconomic drivers. Such information is critical to complement understanding of the status and trends in biogeographic characteristics and ecological mechanisms of ecosystem stress.

3. *Human and Societal Consequences of Ecosystem Stress*: Integrated Ecosystem Assessments should synthesize existing information on status and trends in ecosystem services and consequences for social, cultural, economic, and human health dimensions.

4. *Predicted Consequences of Management Options*: Integrated Ecosystem Assessments should help resource managers and other coastal

decisionmakers evaluate tradeoffs by anticipating and weighing the costs and benefits of alternative actions. Toward this end, they should predict the likely consequences of alternatives (including no action) across environmental, social, cultural, economic, and public health dimensions.

5. *Research Needs*: Integrated Ecosystem Assessments should identify gaps in critical human dimensions understanding, and provide recommendations for needed research. Gaps in human dimensions information are likely to be significant and require the development of NCCOS and NOAA social science capabilities.

Goal 3
Promote Ecosystem Resilience

Promoting ecosytem resilience is a national and international priority (e.g., NRC, 2006; United Nations International Strategy for Disaster Reduction, 2005; Disaster Mitigation Act of 2000). As defined by the United Nations International Strategy for Disaster Reduction (ISDR) (2005, p. 4), resilience is the capacity of a "system, community, or society potentially exposed to hazards to adapt, by resisting or changing, in order to reach an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures." A hazard is "an act or phenomenon that has the potential to produce harm or other undesirable consequences to humans or what they value" (NRC, 1996, p. 215). Hazards encompass human-caused and natural, and chronic and episodic phenomena – including the ecosystem stressors that serve as focal areas for NCCOS science (i.e., climate change, extreme natural events, pollution, invasive species, and resource use).

Conversely, vulnerability refers to an erosion of resilience – i.e., the susceptibility of coastal systems, coastal communities, and specific human populations (e.g., subsistence users) to impacts from hazards. Vulnerability is influenced by characteristics of and linkages among the natural, built, and sociocultural environments (Heinz Center, 2000). For example, global coastal vulnerability is increasing due to the interplay of changing demographic, technological, and socioeconomic conditions; unplanned urbanization; development within high-risk zones; environmental degradation; climate variability and change; geological hazards; competition for scarce resources; and the impact of health epidemics (ISDR, 2005). The vulnerability of small island communities is heightened by factors such as the infeasibility of migrating out of danger zones and extreme land values.

Resilience and vulnerability are properties of coupled social-ecological systems. "Importantly, the social and biophysical responses or coping mechanisms influence and feed back to affect each other, so that a response in the human subsystem could make the biophysical subsystem more or less able to cope, and vise versa" (Turner et al., 2003, p. 8077). For example, "environmental degradation such as land clearing, coastal erosion, over fishing, and coral mining has reduced the potential for economic recovery from the [2004] Asian tsunami because of the loss of traditional income sources related to coastal ecosystems rich in biodiversity and ecosystem functions" (Adger et al., 2005, p. 1038).

Risk and Vulnerability Assessment

Objective 3.1: Assess the risk and vulnerability of coastal communities to ecosystem stress, responding to the needs of decisionmakers and stakeholders to support mitigation planning.

Rationale

Risk and vulnerability assessments are critical to inform hazard mitigation planning.

Discussion

Risk and vulnerability assessments provide a basis for collaboration across sectors, agencies, and communities-at-risk to evaluate existing responses to ecosystem stress, and focus on critical needs and opportunities for enhancing resilience. The NRC (2006, p. 2) expresses this research imperative in the context of disaster preparedness and response, stating that "disaster research, which

has focused historically on emergency response and recovery, is incomplete without the simultaneous study of the societal hazards and risks of disasters, which includes data on the vulnerability of people living in hazard-prone areas." "The starting point for reducing disaster risk and for promoting a culture of disaster resilience lies in the knowledge of the hazards and the physical, social, economic, and environmental vulnerabilities to disasters that most societies face, and of the ways in which hazards and vulnerabilities are changing in the short and long term" (ISDR, 2005, p. 7). Coastal managers have also expressed a need for risk and vulnerability assessments. In a 2006 survey of coastal managers sponsored by NOAA's Coastal Services Center, 70 percent of respondents agreed with the statement that "I need to know about risk and vulnerability assessment for my job" (NOAA Coastal Services Center, 2006).

Risk and vulnerability assessments are a "systematic approach to organizing and analyzing scientific information" about risk and vulnerability to inform hazard planning, response, and recovery (NRC, 1996, p. 4). NCCOS vulnerability assessments will determine the likelihood of adverse impacts of key hazards to the natural, built, business, and social environments of coastal communities (*see* Heinz Center, 2000). Risk and vulnerability assessments include the following components:

1. *Hazard Identification*: Identification of one or more hazards to which ecosystems - both social and ecological systems - may be exposed;

2. *Risk Assessment*: Estimation of the likelihood that potential hazards will occur;

3. *Vulnerability Assessment*: Assessment of the susceptibility of coastal systems, coastal communities, and specific human populations to potential impacts of hazards; and

4. *Characterization of Risks and Vulnerabilities*: A synthesis of results that responds to the needs and concerns of decisionmakers and stakeholders, and addresses uncertainties (*see* Heinz Center, 2000; NRC, 1996).

Risk Communication

Objective 3.2: Reduce the vulnerability of coastal systems and human communities to ecosystem stress by applying research-based strategies to communicate scientific information in ways that foster public understanding, trust, and risk-reducing behavior.

Rationale

Reducing vulnerability to hazards requires communication of scientific information that fosters public understanding of risks, trust in the communicating agency, and risk-reducing behavior. The multi-disciplinary field of risk communication can help NCCOS develop and test products, and facilitate their use in decisionmaking, to achieve these outcomes.

Discussion

Translating scientific information and products into desirable societal outcomes is in large part a challenge of communication. In a report titled *Grand Challenges for Disaster Reduction*, the National Science and Technology Council (NSTC) explains that, to be effective, communication of hazard information must foster public understanding and trust. At-risk populations must then respond appropriately to mitigate and adapt to undesirable environmental, sociocultural, and economic consequences. The NSTC concludes that this communication challenge "can only be met by effectively leveraging the findings from social science research" (NSTC, 2005, p. 11).

Many NCCOS products communicate hazard information. These include ecological forecasts of sea level rise, HABs, and hypoxia; monitoring of chemical contaminants; and assessments of invasive species abundance and distribution. The purpose of such products is to help decisionmakers and at-risk populations understand the nature of coastal hazards and their potential impacts on the environment and society. Ultimately, such understanding is essential to reduce vulnerability to impacts; it enables decisionmakers to develop effective mitigation strategies and at-risk populations to choose risk-reducing behaviors. As suggested by the NSTC, achieving these outcomes requires social science input into the production and delivery of scientific understanding and

tools. Among other disciplines, the multi-disciplinary field of risk communication can help NCCOS scientists work with coastal managers and other customers to develop and test products, and facilitate their use in decisionmaking, to address the following needs:

1. *Identify Audiences*: NCCOS' scientific products should reach beyond traditional audiences such as resource managers to other groups integral to mitigating ecosystem stress. Depending on the stressor, these may include at-risk populations, emergency responders, land use planners, public health professionals, and sectors such as agriculture and tourism.

2. *Understand Audiences*: Characteristics of audiences can influence product effectiveness by influencing access, interpretation, and response to hazard information. These include audience concerns, perceptions of risks, attitudes, knowledge, level of credence and trust in authorities, cultural attributes, and primary information sources. A "mental models" approach to designing hazard communications compares an "expert" to a "layperson" understanding of risks, impacts, and mitigation strategies. Comparison reveals audience misconceptions and gaps in knowledge that must be addressed in product development to promote understanding of hazard information and ultimately risk-reducing behaviors (Atman et al., 1994).

3. *Build Organizational Trust*: The extent to which an audience believes risk information is closely related to its degree of trust and confidence in the communicating agency (Kasperson, 1986). Trust and credibility are influenced by factors such as perceptions of communicators' knowledge, openness, honesty, and concern (Peters et al., 1997).

4. *Develop Effective Messages and Strategies*: The content and delivery of hazard information influences an audience's interpretation and behavioral response. For example, the way in which hazard information is presented can significantly influence an audience's understanding, perception of the sending agency, and decision to seek additional supporting or contradicting information (Scherer et al., 1999). Communication messages and strategies must be based on audience analysis to be effective. They must also take into consideration changes to the risk communication process as result of modern technology such as cell phones and the internet. NCCOS will enlist the help of risk communication specialists to develop, test, and deliver scientific products incorporating messages effective for promoting risk-reducing behaviors.

Goal 4

Provide Critical Support for NCCOS Human Dimensions Research

Organizational Capabilities

Objective 4.1: Build organizational capabilities needed to foster improved support for coastal decisionmaking by expanding NCCOS' science program to include an integral focus on human dimensions.

Rationale

Significant development of NCCOS organizational capabilities is required to provide human dimensions understanding critical to support coastal decisionmaking.

Discussion

As stated in the Introduction, providing human dimensions understanding critical to support coastal decisionmaking will require retooling of many activities across NCCOS' component research centers, laboratories, and partnerships with cooperating institutions such as NCCOS' coral reef research institutes. The NCCOS research agenda must be established through customer- and stakeholder-informed strategies targeted to identify complementary human dimensions and environmental research priorities. Innovative approaches are needed to link the concepts, methods, and results of environmental and human dimensions research. Organizationally, critical needs include greater capacity in hu-

man dimensions disciplines; workforce training in mission critical human dimensions research; environmental science training for human dimensions staff; leadership with interdisciplinary team-building skills; practices that identify, encourage, and reward mission-critical human dimensions research; integrated environmental and human dimensions research planning; and adequate funding for human dimensions research.

As part of a follow-up implementation plan, NCCOS will develop a strategy to build critical organizational capabilities, including:

1. *Human Resources*: Develop an exceptional, competitively hired human dimensions team with an organizational structure that fosters cooperation in identifying and implementing human dimensions research objectives across NCCOS centers, laboratories, and cooperating institutions;

2. *Human Dimensions Literate Workforce*: Foster a workforce that understands, appreciates, and furthers mission critical human dimensions research;

3. *Financial Resources*: Obtain adequate funding to develop and execute a follow-up NCCOS Human Dimensions Research Implementation Plan;

4. *Integrated Research Prioritization and Planning*: Conduct integrated environmental and human dimensions research prioritization and planning in NCCOS; NOAA's Planning, Programming, Budgeting, and Execution System (PPBES); and other planning processes; and

5. *Partnerships*: Identify and collaborate with NOAA and external partners to implement human dimensions research objectives.

Communications, Outreach, and Education

Objective 4.2: Identify and implement communications, outreach, and education strategies needed to foster improved support for coastal decisionmaking by expanding NCCOS' science program to include an integral focus on human dimensions.

Rationale

Providing human dimensions understanding critical to support coastal decisionmaking requires communications, outreach, and education strategies. Critical outcomes include promoting ecosystem literacy, promoting human dimensions research objectives, providing visibility to NCCOS human dimensions research, and developing a human dimensions workforce.

Discussion

The purpose of this objective is to ensure that NCCOS communications, outreach, and education efforts assist the development and execution of a follow-up implementation plan using this document as a basis. Critical outcomes include reaching out to diverse audiences (e.g., NCCOS employees, partners, Congress, the public, students, coastal managers, and other decisionmakers) to:

1. *Promote Ecosystem Literacy*: NOAA has adopted a strategic objective to promote environmental literacy defined as "understanding of our planet's dynamic air and water systems and the effect those systems have on all aspects of people's lives" (NOAA, 2005, p. 16; *see also* NOAA Office of Education and Sustainable Development, 2004). NCCOS recognizes that environmental literacy is necessary, but not sufficient to support NOAA's vision of "a better world through environmental and ecological knowledge and stewardship" (NOAA, 2005). Ecosystem literacy – defined as integrated understanding of interactions across all ecosystem components (including human causes, consequences, and responses to ecosystem stress) – is critical to inform decisionmaking by individuals, businesses, government agencies, the NOAA workforce, and others. NCCOS will pro-

mote ecosystem literacy within and beyond NOAA by integrating human dimensions information to reflect a comprehensive ecosystem approach in all internal and external communications, outreach, and educational activities.

2. *Promote Human Dimensions Research Objectives*: NCCOS will promote human dimensions research objectives through leadership in NOAA's Ecosystem Research Program, Ecosystem Goal Team, PPBES, strategic and research planning, outreach exhibits and communications, and other venues.

3. *Provide Visibility to NCCOS Human Dimensions Research*: Communications, outreach, and education venues provide opportunities to promote the visibility of NCCOS human dimensions research activities and products, which can serve to enhance national recognition, foster partnerships, and increase the trust and assistance of constituents.

4. *Develop a Diverse Human Dimensions Workforce*: A strategic goal of *An Education Plan for NOAA* is to increase the number of people, particularly in underrepresented groups, who choose education and careers supporting NOAA's mission (NOAA Office of Education and Sustainable Development, 2004). NOAA's Educational Partnership Program accomplishes this by providing financial assistance through competitive processes to minority serving institutions. Consistent with the findings of the Social Science Review Panel to NOAA's Science Advisory Board (2003), NCCOS recognizes the need to develop and attract employees with critical human dimensions expertise and the requisite skills and dispositions for interdisciplinary collaboration.

Appendix 1.

Human Dimensions Research Drivers

The following is a non-exhaustive list of mandatory authorities, authorizations, statutes of general applicability, and significant reports that require or substantially inform NCCOS human dimensions research. Drivers are categorized as cross-cutting or applicable to specific stressors, regions, or managed areas.

Cross Cutting

International

Agenda 21 – Chapter 17: Oceans and Coasts *United Nations Environment Programme (UNEP), 1992*

Provides the international basis for the protection and sustainable use of coastal and marine resources, including human dimensions research needs such as: (1) identifying existing and projected uses of coastal areas and their interactions; (2) developing and applying methods, such as national resource and environmental accounting, that reflect changes in value resulting from uses of coastal and marine areas; (3) developing socioeconomic and environmental indicators; (4) developing economic incentives to avoid degradation of the marine environment; and (5) considering traditional knowledge and interests of local communities, small-scale artisanal fisheries, and indigenous people in development and management programs. (http://www.un.org/esa/sustdev/documents/agenda21/english/agenda21toc.htm)

Convention on Biological Diversity *UNEP, 1992*

Provides the international basis for the conservation, sustainable use, and equitable sharing of benefits arising from biodiversity. Commitments include: (1) respecting, preserving and maintaining traditional knowledge of the sustainable use of biological diversity with the involvement of indigenous peoples and local communities; (2) adopting social and economic incentives for biodiversity conservation and sustainable use; and (3) ensuring fair and equitable access to results and benefits of biotechnologies. (http://www.biodiv.org/doc/legal/cbd-un-en.pdf)

Convention on Biological Diversity Strategic Plan *UNEP, 2002*

Guides implementation of the Convention of Biological Diversity at the national, regional, and global levels. Discusses socioeconomic obstacles to implementation such as poverty, population pressure, unsustainable consumption and production patterns, and lack of local capacities. (http://www.biodiv.org/sp/default.shtml)

Global Program of Action for the Protection of the Marine Environment from Land-Based Activities *UNEP, 1995*

Provides guidance in preventing, reducing, controlling, and/or eliminating marine degradation from land-based activities. Affirms that action priorities should, among other human dimensions considerations: (1) reflect the relative importance of impacts upon food security, public health, coastal and marine resources, ecosystem health, and socioeconomic benefits, including cultural values; (2) reflect the costs, benefits, and feasibility of options for action, including the long-term cost of no action; and (3) involve stakeholders. (http://www.gpa.unep.org/documents/full_text_of_the_english.pdf)

IHDP Science Plans *IHDP, 2006*

Promotes, catalyzes, and coordinates research on the human dimensions of global environmental change. IHDP currently has seven core projects with science plans and implementation strategies: Global Environmental Change and Human Security, Institutional Dimensions of Global Environmental Change, Industrial Transformation, Land-Use and Land-Cover Change, Land-Ocean Interactions in the Coastal Zone, Urbanization and Global Environmental Change, and Global Land Project. (http://www.ihdp.uni-bonn.de/)

Ecosystems and Human Well-being: Synthesis *Millennium Ecosystem Assessment, 2005*

"Focuses on ecosystem services (the benefits people obtain from ecosystems), how changes in ecosystem services have affected human well-being, how ecosystem changes may affect people in future decades, and response options that might be adopted at local, national, or global scales to improve ecosystem management and thereby contribute to human well-being and poverty alleviation. Synthesizes information from the scientific literature, datasets, and scientific models, and includes knowledge held by the private sector, practitioners, local communities and indigenous peoples" (*from* About the Millennium Assessment, http://ma.caudillweb.com/en/about.overview.aspx). (http://www.maweb.org/documents/document.356.aspx.pdf)

Rio Declaration on Environment and Development *UNEP, 1992*

Establishes principles guiding national conduct for sustainable development, including the need to reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies (Principle 8), the importance of public participation (Principle 10), the use of the precautionary approach in the face of scientific uncertainty (Principle 15), the need for economic instruments to internalize environmental costs (Principle 16), and the vital role of indigenous and local communities in environmental decisionmaking (Principle 22). (http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm)

National

America's Living Oceans: Charting a Course for Sea Change *Pew Oceans Commission, 2003*

Recommends reform in national policies and practices to combat major threats to oceans. Calls for increased national social science research capacity, including "monitoring of both human and natural systems" (p. 90) and documentation of traditional ecological knowledge. Affirms that "we need to know as much about people and economics as we do about the biology and ecology of living marine resources and ecosystems. Complex interactions between human and environmental systems must be better understood. Cooperative research involving the fishing industry and native communities, that offer valuable experiential and traditional knowledge, should be a central element of a number of these new scientific programs" (p. 89). (http://www.pewtrusts.org/pdf/env_pew_oceans_final_report.pdf)

Charting a Course for Ocean Science in the United States: Research Priorities for the Next Decade *JSOST, 2007*

Outlines national ocean research priorities for the next 10 years. Identifies human dimensions research priorities such as understanding human use patterns that influence resource stability and sustainability, understanding and predicting the impact of anthropogenic processes on ecosystems, developing socioeconomic assessments and models to evaluate the impact of multiple human uses on ecosystems, understanding human health risks associated with the ocean and the potential benefits of ocean resources to human health, and understanding how human use and valuation of ocean resources can be affected by ocean-borne human health threats and how human activities can influence these threats. (http://ocean.ceq.gov/about/docs/orppfinal.pdf)

Coastal Zone Management Act and Amendments *16 U.S.C. §§ 1451 et seq.*

Provides Federal grants to states for the development and implementation of coastal zone management programs to "achieve wise use of the land and water resources of the coastal zone, giving full consideration to ecological, cultural, historic, and esthetic values as well as the needs for compatible economic development" (§ 303 (2)).

Coral Reef Conservation Act and Amendments *16 U.S.C. §§ 6401 et seq.*

Authorizes NOAA to issue matching grants for coral reef conservation activities. The 2006 reau-

thorization specifies criteria for project approval, including "promoting and assisting entities to work with local communities, and all appropriate governmental and nongovernmental organizations, to support community-based planning and management initiatives for the protection of coral reef systems" (§ 2(b)(11)).

Executive Order 12866 – Regulatory Planning and Review

Requires regulatory agencies to assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and benefits include both quantifiable measures and qualitative measures that are difficult to quantify, but nevertheless essential to consider.

Implementing the Work Priorities of the SIMOR *SIMOR, 2006*

Identifies priority areas and related action items to improve coastal and ocean resource use and conservation. Proposes initiatives addressing human dimensions, including: (1) conducting community workshops to "demonstrate new and innovative ways to integrate coastal and watershed management programs, funding sources, policies, and other tools" (p. 7); and (2) expanding Ocean and Coastal Economics Data and Analysis to "support the needs of federal agencies and state and local governments for comprehensive economic data to address specific management problems such as ocean and coastal transportation and infrastructure issues, minerals management, and understanding of tourism and recreation at the state and local level" (p. 8). (http://ocean.ceq.gov/about/docs/SIMOR_WorkPlan_Final.pdf)

Interorganizational Committee on Principles and Guidelines for Social Impact Assessment *Impact Assessment and Project Appraisal, 2003 21(3): 231-250*

Provides guidance for the conduct of SIA in the context of the National Environmental Policy Act. Six principles focus on understanding of local and regional settings, dealing with the key elements of the human environment, using appropriate methods and assumptions, providing quality information for decisionmaking, addressing environmental justice issues, and establishing mechanisms for monitoring and mitigation. (http://www.nmfs.noaa.gov/sfa/reg_svcs/social%20guidandpri.pdf)

National Action Plan to Conserve Coral Reefs *United States Coral Reef Task Force, 2000*

Provides a detailed, long-term strategy for implementing Executive Order 13089, *Coral Reef Protection*, which charges the United States Coral Reef Task Force, along with the scientific community, with developing and implementing research aimed at identifying the major causes and consequences of coral reef degradation. Adopts a core principle to "incorporate the human dimension into coral reef conservation strategies by ensuring that management measures reflect, and are sensitive to the local socioeconomic, political and cultural environment, and that they build an informed public engaged in choosing alternatives to activities that harm coral reefs" (p. vi). Specifies four components of understanding coral reef ecosystems and their long-term conservation, including "socioeconomic studies of the human dimension of successful coral reef conservation" (p. 10). (http://www.coralreef.gov/taskforce/pdf/CRTFAxnPlan9.pdf)

NEPA *42 U.S.C. §§ 4321 et seq.*

Requires Federal agencies to: (1) utilize a systematic, interdisciplinary approach integrating the natural and social sciences, and the environmental design arts, in planning and in decisionmaking which may have an impact on the environment; (2) consider presently unquantified environmental amenities and values in decisionmaking; and (3) prepare an Environmental Impact Statement prior to approval of any major Federal action significantly affecting the quality of the human environment.

NEPA Regulations for Implementing Procedural Provisions *40 C.F.R. 1508.14*

Requires Federal agencies to interpret "human environment" comprehensively to "include the natural and physical environment and the re-

lationship of people with that environment. … When an environmental impact statement is prepared and economic or social and natural or physical environmental effects are interrelated, then the environmental impact statement will discuss all of these effects on the human environment" (§ 1508.14).

Ocean Blueprint for the 21st Century *USCOP, 2004*

Develops recommendations for a coordinated and comprehensive national ocean policy, as mandated by the Oceans Act of 2000, including consideration of human dimensions. For example, Recommendation 25-3 urges that a new "National Ocean Council research strategy should include a national program for social science and economic research" that includes an operational socioeconomic research and assessment function within NOAA; and an interagency steering group, chaired by NOAA … to coordinate ocean-related socioeconomic research" (p. 384). (http://www.oceancommission.gov/documents/full_color_rpt/000_ocean_full_report.pdf)

Oceans and Human Health Act *33 U.S.C. §§ 3101-3104*

Establishes a national research program to improve understanding of the role of the oceans in human health.

NOAA

Evolving an Ecosystem Approach to Science and Management Throughout NOAA and its Partners *External Ecosystem Task Team Report to NOAA Science Advisory Board, 2006*

Identifies three guiding considerations that cut across recommendations for improving NOAA's ecosystem science enterprise over the next decades. Two of these address human dimensions: (1) "NOAA science and management need to take account of how human activities affect the ecosystem properties for which NOAA is steward – and how those ecosystem properties affect the wellbeing of citizens socially, economically, and culturally; and (2) NOAA science support for decision-making must be integrated across ecosystem components and across its management of different human activities" (p. 27). Recognizes social science as integral to core capabilities in monitoring, analysis, and integration needed in each region to develop Integrated Ecosystem Assessments as key components of NOAA's ecosystem science enterprise. Affirms that "both natural and social sciences, including communication of science, are critical elements at whatever scale and for whatever purpose ecosystem approaches are being developed" (p. 26). (http://www.sab.noaa.gov/Reports/eETT_Final_1006.pdf)

NOAA NOS Social Science Plan *NOAA, 2003*

Summarizes social science capacity in NOAA's NOS and establishes goals for social science as a basis for coordination to further NOAA's mission. (http://marineeconomics.noaa.gov/SSP/Plan_pub.html)

NCCOS Strategic Plan FY 2005 – FY 2009 *NOAA, 2004*

NCCOS' second strategic goal regarding societal stressors "focuses on the human activities that affect coastal ecosystems. Successfully managing those activities to reduce the stress they impose on ecosystems requires a sound scientific basis. It also requires a good understanding of what society desires of the services provided by the management of coastal ecosystems. By combining the social expectations, economic costs and benefits, and the natural sciences, NCCOS will be able to make predictions (with specified certainty) of the social and economic costs and benefits of alternative management actions that could be taken to achieve ecosystem conservation goals" (p. 16). (http://coastalscience.noaa.gov/documents/strategicplan.pdf)

New Priorities for the 21st Century – NOAA's Strategic Plan: Updated for FY 2006-FY 2011 *NOAA, 2005*

Recognizes that "humans are an integral part of an ecosystem" (p. 3). Adopts an ecosystem approach to managing coastal and ocean resources that strives to balance diverse societal objectives.

Aims to improve resource management by "advancing our understanding of ecosystems by gathering information consistent with established social and economic indicators to support monitoring, assessing, and predicting national and regional ecosystem health" (p. 5). Affirms the need for "a strong economic and social science capability" to ensure state of the art research by analyzing and understanding "evolving user requirements, priorities, and benefits of our information, services, and products" (p. 16). (http://www.ppi.noaa.gov/pdfs/STRATEGIC%20PLAN/Strategic_Plan_2006_FINAL_04282005.pdf)

NOAA Sea Grant Strategic Plan for FY2003-2008 and Beyond *NOAA, 2004*

Establishes goals and strategies addressing 10 national priority research themes, including a focus on coastal communities aiming "to design and implement comprehensive research and outreach programs promoting sustainable communities that achieve a complementary integration of economic, environmental, and social values" (p. 9). (http://www.masgc.org/gmrp/plans/NSG.pdf)

Social Science Research Within NOAA: Review and Recommendations *Final Report to the NOAA Science Advisory Board by the Social Science Review Panel, 2003*

Finds that "the capacity of NOAA to meet its mandates and mission is diminished by the under-representation and under-utilization of social science" (p. 1), yet developing adequate capacity is challenged by "a lack of formal understanding of what social science is and what its contributions can be, leading to an organizational culture that is not conducive to social science research" (p. 2). Among other recommendations, the Panel advises integrating social science goals, plans, and outcomes into strategic plans; new initiatives in mission-critical social science; development of social science capacity, including senior-level social science representation; and specific strategies for increasing social science literacy throughout NOAA. Also identifies social science research needs for each of NOAA's line offices. (http://www.sab.noaa.gov/Reports/NOAA_SocialSciencePanelFinalReport.pdf)

Stressors

Climate Change

Climate Change Science: An Analysis of Some Key Questions *NRC, 2001*

Concludes that "in order to address the consequences of climate change and better serve the Nation's decisionmakers, the research enterprise dealing with environmental change and environment-society interactions must be enhanced" (p. 24). Specific needs include "(a) support of interdisciplinary research that couples physical, chemical, biological, and human systems, (b) an improved capability of integrating scientific knowledge, including its uncertainty, into effective decision support systems, and (c) an ability to conduct research at the regional or sectoral level that promotes analysis of the response of human and natural systems to multiple stresses" (p. 5).

Global Environmental Change: Research Pathways for the Next Decade *NRC, 1999*

Outlines a research framework across multiple areas related to global environmental change, including human dimensions. Defines human dimensions research as addressing "human activities that alter the Earth's environment, the driving forces of those activities, the consequences of environmental change for societies and economies, and human responses to the experience or expectation of global change. Such research is essential both to understand global change and to inform public policy" (p. 293).

Making Climate Forecasts Matter *NRC, 1999*

Proposes a program of research to understand and increase the value of seasonal-to-interannual climate forecasts. Programmatic questions "fall into three broad categories: research on the potential benefits of climate forecast information, improved dissemination of forecast information, and estimating the consequences of climatic variations and of climate forecasts" (p. 129).

United States Climate Change Science Program Strategic Plan *United States Climate Change Science Program, 2003*

Describes critical research on human contributions and responses to climate variability and change, including "the potential effects of climate variability and change on human health and welfare; human influences on the climate system, land use, and other global environmental changes; analysis of societal vulnerability and resilience to global environmental change; decisionmaking under conditions of significant complexity and uncertainty; and integrated assessment methods" (p. 6). (http://www.climatescience.gov/Library/stratplan2003/vision/ccsp-vision.pdf)

Harmful Algal Blooms

HABHRCA *16 U.S.C. §§ 1451 note*

Requires local and regional assessments, a report on prediction and response capacity, and plans for a "comprehensive and coordinated national research program to develop and demonstrate prevention, control, and mitigation methods to reduce the impacts of HABs on coastal ecosystems (including the Great Lakes), public health, and the economy (§ 104(i)).

Harmful Algal Research and Response: A Human Dimensions Strategy *United States HAB Office, 2006*

Provides a detailed implementation plan for human dimensions research critical to reduce public health, sociocultural, and economic impacts of HABs. Research needs fall into six areas: socioeconomic impacts, public health impacts, recreational and drinking water impacts, risk communication, coordination in research and response, and education and outreach. The research strategy informs implementation of HARRNESS and HABHRCA. (http://coastalscience.noaa.gov/stressors/extremeevents/hab/HDstrategy.pdf)

HARRNESS *Ramsdell, J.S., et al. (Eds.), 2005*

Reflects the views of the United States research and management community about "the current state of the HAB problem, needs and priorities, and approaches available to address these problems" (p. 1). Priorities and needs fall into four foci: bloom ecology and dynamics, toxins and their effects, food webs and fisheries, and public health and socioeconomic impacts. (http://esa.org/HARRNESS/harrnessReport10032005.pdf)

Coastal Hazards

Facing Hazards and Disasters: Understanding Human Dimensions *NRC, 2006*

Assesses the current state of social science research related to hazards and disasters, and recommends social science research and interdisciplinary collaboration to improve disaster preparedness and response.

Grand Challenges for Disaster Reduction *NSTC, 2005*

Establishes a framework for sustained Federal investment in science and technology, including social science research, to enhance the disaster resilience of communities. (http://www.sdr.gov/SDRGrandChallengesforDisasterReduction.pdf)

Hidden Costs of Coastal Hazards: Implications for Risk Assessment and Mitigation *Heinz Center, 2000*

Develops a risk and cost assessment framework for hazard preparedness and mitigation planning that takes into account a broad range of economic, business, social, and environmental costs associated with hazards.

Human Links to Coastal Disasters *Heinz Center, 2002*

Examines human factors influencing vulnerability to coastal hazards, including policies and practices that drive coastal development. Explores human impacts of hazards, including changes related to physical health, mental well-being, and social institutions. (http://www.heinzctr.org/NEW_WEB/PDF/Full_report_human_links.pdf)

Oil Pollution Act *33 U.S.C. §§ 2701 et seq.*

Authorizes NOAA, as the primary Federal trustee for coastal resources, to recover natural resource damages resulting from oil spills and defines natural resource damages to include the cost of restoring, rehabilitating, replacing, or acquiring the equivalent of the damaged resources; the reasonable cost of assessing those damages; and the diminution in values of those natural resources pending restoration. Damages encompass injury to and economic losses from destruction of real or personal property, loss of subsistence use, loss of profits and earning capacity, and costs associated with increased public services.

Invasive Species

Executive Order 13112 - Invasive Species

Aims to "minimize the economic, ecological, and human health impacts that invasive species cause." Defines "invasive species" as a species that causes economic harm or harm to human health.

Non-indigenous Aquatic Nuisance Prevention and Control Act *33 U.S.C. §§ 1251 et seq.*

Aims to "understand and minimize economic impacts of nonindigenous aquatic nuisance species." Establishes an Aquatic Nuisance Species Task Force required to "develop and implement a program for waters of the United States to prevent introduction and dispersal of aquatic nuisance species; to monitor, control and study such species; and to disseminate related information" (§ 1002(b)(4)). The program is to include research on the "economic risks and impacts associated with the introduction of aquatic nuisance species into the waters of the United States; possible methods for the prevention, monitoring and control of aquatic nuisance species; and the assessment of the effectiveness of prevention, monitoring and control methods" (§ 1202(f)(1)(a)).

Ocean Blueprint for the 21st Century – Chapter 17: Preventing the Spread of Invasive Species
USCOP, 2004

Recommends research focusing on "understanding the human dimensions behind species introductions, including human behavior, decision making, and economics" (p. 262). (http://www.oceancommission.gov/documents/full_color_rpt/000_ocean_full_report.pdf)

Pollution

Chesapeake 2000
Chesapeake Bay Program, 2000

Aims to "identify specific actions to address the challenges of communities where historically poor water quality and environmental conditions have contributed to disproportional health, economic or social impacts" by 2005. (http://www.chesapeakebay.net/agreement.htm)

HABHRCA *16 U.S.C. §§ 1451 note*
See entry under "Harmful Algal Blooms."

Marine Protection, Research, and Sanctuaries Act *16 U.S.C. §§ 1431 et seq.*

Creates a comprehensive and continuing program of research with respect to the possible long-range effects of pollution, overfishing, and human-induced changes of ocean ecosystems. Such research shall address "economic considerations involved in both the protection and the use of the oceans, possible alternatives to existing programs, and ways in which the health of the oceans may best be preserved for the benefit of succeeding generations of mankind" (§ 202(a)(1)). Also requires Federal agencies to "assess the feasibility in coastal areas of regional management plans for the disposal of waste materials" addressing, among other things, "the environmental, economic, social, and human health factors (and the methods used to assess these factors) associated with disposal alternatives" (§ 203(c)).

Resource Use

Coastal Sprawl: The Effects of Urban Design on Aquatic Ecosystems in the United States
Pew Oceans Commission, 2002

Reviews trends in coastal population growth and urban expansion in the United States, describes the state of science related to effects of impervious surfaces on aquatic ecosystems, and discusses strategies and implementation measures for watershed planning. (http://www.pewtrusts.com/pdf/env_pew_oceans_sprawl.pdf)

Social and Cultural Impact Assessment of the Highly Migratory Species Management Plan
Prepared for the Highly Migratory Species Office, National Marine Fisheries Service, NOAA, 1998

Assesses the social and cultural impacts of the Fisheries Management Plan for Highly Migratory Species and the amendment to the plan for Atlantic billfish. Explains what is meant by social and cultural impacts, reviews the methods used, and discusses major impacts and possible mitigating measures across affected communities. (http://www.st.nmfs.gov/st1/econ/cia/hms.pdf)

Socioeconomic Perspectives on Marine Fisheries in the United States
Pew Oceans Commission, 2003

Describes the social and economic status and health of United States marine fisheries. (http://www.pewtrusts.org/pdf/environment_pew_oceans_socioeconomic_perspectives.pdf)

Sustainable Fisheries Act
16 U.S.C. §§ 1801 et seq.

Includes National Standard 8, which requires that conservation and management measures "take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities" (§ 106(b)(8)(A)).

Regions

Alaskan Ecosystem Complex

North Pacific Research Board Science Plan
North Pacific Research Board, 2005

Recognizes the importance of understanding "how societies adapt to changing environments, ecosystems and management systems" (p. 114). Expresses intent to fund human dimensions research needs related to fishery management and policy, baseline assessment, human health, human values and resource protection, and climate variability. (http://doc.nprb.org/sci_plan/science_plan_nov05_low.pdf)

People and the Arctic: A Prospectus for Research on the Human Dimensions of the Arctic System *National Science Foundation, Arctic System Science Program, Human Dimensions of the Arctic System, 1997*

Provides research principles, objectives, questions, and methods for the Human Dimensions of the Arctic System program of the National Science Foundation's Arctic System Science Program. In general, the program "considers human activity, both within and outside the Arctic, as a link and vital driver among the terrestrial, marine, and climatic subsystems. Accordingly, the initiative provides a significant opportunity to integrate ecosystem and climate studies with a broad range of the social sciences" (p.3). (http://www.arcus.org/harc/HARC_Prospectus.pdf)

California Current

California Marine Life Protection Act
California Fish and Game Code, Chapter 10.5, §§2850-2863

Requires that the California Department of Fish and Game develop a master plan to improve the design and management of the state's MPA system. The master plan must take into account socioeconomic and environmental impacts of alternatives.

California's Ocean Economy
National Ocean Economics Program, 2005

Measures the coastal and ocean economy of California, including sectors related to living resources, ocean minerals, marine transportation, marine construction, ship and boat building, and tourism and recreation. (http://resources.ca.gov/press_documents/CA_Ocean_Econ_Report.pdf)

Regional Priorities for Social Science Research on MPAs: Pacific Coast
NOAA National MPA Center, 2005

Identifies regional social science research needs in six priority areas for planning, management, and evaluation of MPAs: governance and institutions; use patterns; attitudes, perceptions, and beliefs; economics; communities; and cultural heritage and resources. (http://www.mpa.gov/pdf/helpful-resources/pacificcoast-ssrs-final.pdf)

Caribbean

Managing Beach Resources in the Smaller Caribbean Islands *University of Puerto Rico Sea Grant College Program and United Nations Educational, Scientific, and Cultural Organization (UNESCO), 1997*

Contains papers presented at a workshop titled "Integrated Framework for the Management of Beach Resources within the Smaller Caribbean Islands" held at the University of Puerto Rico, Mayaguez Campus, 1996. Papers discuss human dimensions topics such as anthropogenic causes of beachfront erosion, traditional and sociocultural beach management issues, community-based approaches to beach management, social issues affecting beaches, and the management of beaches as a tourism resource. (http://www.unesco.org/csi/pub/papers/papers1.htm)

Regional Priorities for Social Science Research on MPAs: Caribbean and South Florida
NOAA MPA Center (MPAC), 2003

Identifies region-specific social science research needs in six priority areas for planning, management, and evaluation of MPAs: governance and institutions; use patterns; attitudes, perceptions, and beliefs; economics; communities; and cultural heritage and resources. (http://www.mpa.gov/pdf/helpful-resources/caribbean.pdf)

Small Islands Voice: Voices in a Changing World *UNESCO, 2004*

Describes the United Nations Educational, Cultural, and Scientific Organization's (UNESCO) Small Islands Voice, an interregional (Caribbean, Indian Ocean, and Pacific) and island-based initiative for visioning and capacity building to promote sustainable development. Based on a representative interview survey, describes and discusses issues that concern residents of small islands: economy, employment, health care, education, infrastructure, environment, tourism, decline in traditional values, increased crime, and governance. Discusses the importance of island heritage. (http://www.unesco.org/csi/pub/papers3/world.pdf)

Great Lakes

Human Dimensions of Great Lakes Fishery Management *Great Lakes Fishery Commission, Fishery Research Program, 2003*

Provides background information, a statement of research focus, and a list of key research questions to define and implement the human dimensions theme of the Great Lakes Fishery Commission's Fishery Research Program. The research focus is organized around "three main lines of inquiry: (1) decisionmaking and the role of human dimensions information, (2) research into organizational structure and behavior (formal and informal), and (3) research into stakeholder participation in management, including communications, collaborative decisionmaking, and processes that foster interaction among fishery managers" (p. 3). (http://www.glfc.org/research/humandimensions.pdf)

Revealing the Economic Value of Protecting the Great Lakes *Northeast-Midwest Institute and NOAA, 2001*

Familiarizes "resource managers and decision-makers for the Great Lakes with the techniques currently available for economic analysis of environmental benefits, including the strengths and limitations of these techniques. Rather than advocate the use of these economic techniques, the guidebook takes an objective look, pointing out caveats and advantages associated with the techniques currently available. This fundamental information is extremely important in the process of building consensus around the use of information these techniques can supply" (p. 5). (http://www.nemw.org/GLEconVal.pdf)

Gulf of Mexico

Assessment of the United States Outer Continental Shelf Environmental Studies Program: III. Social and Economic Studies *NRC, 1992*

Recognizes that the Minerals Management Service and other Federal agencies charged with natural resource management "are increasingly being required by their enabling legislation and by other laws to assess the social, economic, and cultural effects of development and regulation" (p. 2). Evaluates the Minerals Management Service socioeconomic research program.

Deepwater Gulf of Mexico Environmental and Socioeconomic *Data Search and Literature Synthesis, United States Department of Interior, Minerals Management Service, 2000*

Provides "a comprehensive search and integration of environmental and socioeconomic data for the deepwater Gulf of Mexico." Summarizes available information by topic including socioeconomic activities in the area. Incorporates "existing literature, relevant data, and ongoing research pertaining to geological, physical, chemical, and biological processes of the study area, social and economic data and literature, and deepwater technology." (http://www.gomr.mms.gov/homepg/whatsnew/techann/000049.html)

Florida Coastal Environmental Resources: A Guide to Economic Valuation and Impact Analysis *Florida Sea Grant, 2002*

Discusses concepts and methodologies of environmental economics (e.g., tradeoffs, willingness to pay, cost-benefit analysis, and environmental valuation) important for natural resources management. Presents case studies of regional projects that demonstrate the nature and importance of coastal resource valuation and economic impact analysis. (http://nsgl.gso.uri.edu/flsgp/flsgph02002.pdf)

Northeast

New England's Fishing Communities *MIT Sea Grant College Program, 2001*

Identifies fishing communities in the New England region and assesses their fishing dependency to lay the groundwork for measuring the social impacts of specific management regulations, as required by the Sustainable Fisheries Act. (http://web.mit.edu/seagrant/aqua/cmss/marfin/MarfinFinal.pdf)

Overview of the Social and Economic Survey Administered during Round II of the Northeast Multispecies Fishery Disaster Assistance Program *NOAA Technical Memorandum, NMFS-NE-164, 2001*

Characterizes and summarizes responses to selected questions from the Social and Economic Survey administered in spring and summer 2000 to recipients of the second round (Round II) of financial assistance in the Northeast (Gulf of Maine) Multispecies Fishery Disaster Assistance Program" (p. 5). Describes "how these fishermen conduct their livelihood, the beliefs they have about fishing, and the social communities in which they live, and points to further research needs generated by the initial survey results" (p. 5). (http://www.nefsc.noaa.gov/nefsc/publications/tm/tm164/)

Pacific Island Ecosystem Complex

Hawaii Revised Statutes – Designation of Community-Based Subsistence Fishing Area *HRS § 188-22.6*

Authorizes the Hawaii Department of Land and Natural Resources to "designate community based subsistence fishing areas and carry out fishery management strategies for such areas … for the purpose of reaffirming and protecting fishing practices customarily and traditionally exercised for purposes of native Hawaiian subsistence, culture, and religion" (§ 188-22.6(a)).

Regional Priorities for Social Science Research on MPAs: Pacific Islands *MPAC, 2005*

Identifies region-specific social science research needs in six priority areas for planning, management, and evaluation of MPAs: governance and institutions; use patterns; attitudes, perceptions, and beliefs; economics; communities; and cultural heritage and resources. (http://www.mpa.gov/pdf/helpful-resources/pacific_islands.pdf)

Small Islands Voice: Voices in a Changing World *UNESCO, 2004*
See entry under "Caribbean"

Southeast

Florida Statutes – Environmental Regulation Commission *2006 Florida Statutes, Title XXIX, Chapter 403.804*

Requires the Florida Environmental Regulation Commission to "consider scientific and technical validity, economic impacts, and relative risks and benefits to the public and the environment" (§ 403.804(1)(e)). Requires that the Commission study "the economic and environmental impact which sets forth the benefits and costs to the public" of any proposed standard (§ 403.804(2)). (http://www.leg.state.fl.us/statutes/index.cfm?StatuteYear=2006&Tab=statutes&Submenu=1)

Florida Statutes – Saltwater Fisheries *2006 Florida Statutes, Title XXVIII, Chapter 370.025*

Specifies that "conservation and management measures shall be based upon the best information available, including biological, sociological, economic, and other information deemed relevant" (§ 370.025(3)(b)). (http://www.leg.state.fl.us/statutes/index.cfm?StatuteYear=2006&Tab=statutes&Submenu=1)

Regional Priorities for Social Science Research on MPAs: South Atlantic *MPAC, 2003*

Identifies region-specific social science research needs in six priority areas for planning, management, and evaluation of MPAs: governance and institutions; use patterns; attitudes, perceptions, and beliefs; economics; communities; and cultural heritage and resources. (http://www.mpa.gov/pdf/helpful-resources/south_atlantic.pdf)

Managed Areas

Estuaries

Estuary Habitat Restoration Strategy *Estuary Habitat Restoration Council, 2002 (Federal Register, Vol. 67, No. 232)*

Specifies that "successful restoration of estuarine habitat will protect native flora and fauna in estuaries and their watersheds, while providing multiple additional benefits such as improved surface and ground water quality and quantity, nutrient cycling, flood control, outdoor recreation, and other services valued by local stakeholders" (p. 71944). This specification, combined with NOAA's responsibility under the Estuary Restoration Act of 2000 (33 U.S.C. §§ 2901 et seq.) to develop monitoring guidance for coastal restoration practitioners, creates the need for selecting human dimensions goals for restoration projects and developing measurable parameters that can be monitored to assess effectiveness in achieving them (*see* Salz et al., 2005). The Strategy was developed by the Estuary Habitat Restoration Council in accordance with the requirements

of the Estuary Restoration Act. (http://era.noaa.gov/pdfs/120302_finalstrat.pdf)

National Estuarine Research Reserve System Research and Monitoring Plan, 2006-2011
NOAA's National Ocean Service, Office of Ocean and Coastal Resource Management, Estuarine Reserves Division, 2006

Includes "Social Science and Economics" as a research priority aiming to address the following questions: "(1) How are coastal populations' demographics changing and how does this/will this impact natural resource protection and management? (2) What are the economic tradeoffs/effects of increasing development and urbanization in the coastal zone on traditional commercial enterprises such as seafood harvesting, etc.? (3) How do human perceptions of health risks influence coastal decision making and natural resource protection? (4) What are the cumulative impacts of multiple human recreational and economic activities on the coastal environment?" (p. 21). (http://nerrs.noaa.gov/pdf/Research_Monitoring.pdf)

National Strategy to Restore Coastal and Estuarine Habitat
Restore America's Estuaries, 2002

Provides a framework for estuarine restoration that recommends broad public involvement and consideration of social and economic benefits in establishing priority regions, selecting goals, developing projects, and monitoring success. (http://www.estuaries.org/assets/documents/NationalStrategyFull.pdf)

Marine Protected Areas

How is Your MPA Doing? A Guidebook of Natural and Social Indicators
World Conservation Union, 2004

Provides socioeconomic and governance indicators for successful development, management, and performance of MPAs. (http://effectivempa.noaa.gov/guidebook/guidebook.html)

Mapping Human Activity in the Marine Environment: GIS Tools and Participatory Methods *MPAC, 2005*

Develops design criteria for GIS-based participatory methods for collecting spatial data on human resource use patterns to inform local and regional MPA planning. (http://www.mpa.gov/pdf/helpful-resources/hupi-workshopreport-fdraft.pdf)

MPAs Needs Assessment *NOAA Coastal Services Center with the MPAC, 2002*

Emphasizes that social science regarding MPAs is "desperately needed" as a cross-cutting priority and that "there is universal agreement across the MPA community that stakeholder/community involvement is critical to success" (p. 4). Specific needs include incorporating traditional knowledge into marine management, stakeholder assessment, monitoring resources with historical and cultural significance, and evaluating socioeconomic impacts. (http://www.mpa.gov/pdf/helpful-resources/mpanafinal.pdf)

Marine Reserves: A Tool for Ecosystem Management and Conservation *Pew Oceans Commission, 2002*

Argues that marine reserves are a fundamental tool in ecosystem-based management. Emphasizes the need for research to understand the social impacts of reserves. (http://www.pewtrusts.org/pdf/pew_oceans_marine_reserves.pdf)

Social Science Research Strategy for MPAs
MPAC, 2003

Provides "a practical and compelling framework for incorporating social science into the planning, management, and evaluation of the nation's MPAs" (p. 5). Identifies priority social science research areas (governance; use patterns; attitudes, perceptions, and beliefs; economics; communities; and cultural heritage and resources) and specific topics. (http://www.mpa.gov/pdf/publications/ssr_strategy.pdf)

National Marine Sanctuaries

National Marine Sanctuaries Act
16 U.S.C. §§ 1431-1445c-1

Authorizes the Secretary of Commerce to designate and manage marine areas of special national significance as the National Marine Sanctuary System. Requires that proposals for designating a national marine sanctuary include resource assessment documenting "present and potential uses of the area, including commercial and recreational fishing, research and education, minerals and energy development, subsistence uses, and other commercial, governmental, or recreational uses"(§ 303(b)(1)(C)).

Socioeconomic Overviews of National Marine Sanctuaries *NOAA, Coastal and Ocean Resource Economics, Spatial Trends in Coastal Socioeconomics, 2000-2003*

Includes overviews for Channel Islands National Marine Sanctuary, Northern and Central California Sanctuaries, and Gray's Reef National Marine Sanctuary that provide socioeconomic information needed for sanctuary management. (http://marineeconomics.noaa.gov/socioeconomics/assessment/cinms.html)

Appendix 2.

Excerpts from NCCOS and NOAA Strategic Plans

The research priorities put forth in this plan build upon and promote the following NCCOS, NOS, and NOAA strategic elements.

NOAA's Mission

To understand and predict changes in Earth's environment and conserve and manage coastal and marine resources to meet our Nation's economic, social, and environmental needs (NOAA, 2005, p. 1).

NOAA's Definition of an Ecosystem

An ecosystem is a geographically specified system of organisms, the environment, and the processes that control its dynamics. Humans are an integral part of an ecosystem (NOAA, 2005, p. 3).

NOAA's Definition of the Environment

The environment is the biological, chemical, physical, and social conditions that surround organisms (NOAA, 2005, p. 3).

NOAA's Ecosystem Mission Goal

To protect, restore, and manage the use of coastal and ocean resources through an ecosystem approach to management (NOAA, 2005, p. 2).

NOAA's Definition of an Ecosystem Approach to Management

An ecosystem approach to management is adaptive, specified geographically, takes into account ecosystem knowledge and uncertainties, considers multiple external influences, and strives to balance diverse societal objectives (NOAA, 2005, p. 3).

National Ocean Service Mission

To provide products, services, and information that promote safe navigation, support coastal communities, sustain marine ecosystems, and mitigate coastal hazards (NOAA, 2005b, p. iv).

NCCOS' Mission

To provide coastal managers with scientific information and tools needed to balance society's environmental, social, and economic goals (NOAA NCCOS, 2004, p. 5).

Appendix 3.

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