



National Council for Science and the Environment

Improving the scientific basis for environmental decisionmaking

RECOMMENDATIONS – Prepared by breakout groups and subject to review. These recommendations are the result of group processes and do not necessarily represent the positions of NCSE, affiliated institutions, and conference participants. NCSE served as the enabler of the process that generated the recommendations. The breakout sessions are organized around themes.

January 20, 2011

Oceans and Carbon

Breakout Session 01. Sea Level Rise, Uncertainty and Policy

Task 1. Incorporate climate change and sea level rise considerations in macroeconomic policymaking, prioritizing climate stability in relation to GDP growth in order to ensure long term ecological and economic security.

Task 2. The U.S. should phase out subsidies for coastal flood insurance over the course of a decade and announce a policy to not reimburse people to rebuild in flood zones.

Task 3. The U.S. government should put an economy-wide price on carbon now that starts low and increases gradually.

Task 4. Congress should establish a fund for acquisition of coastal land for the national wildlife refuge system with the goal of “no net loss” of coastal wetlands and coastal ecosystem services.

Task 5. Satellite observations of sea level change should be continued as a priority.

Task 6. Congress should fund more research into sea level change, including adaptation strategies and current impacts on human population, ecosystems, and economies.

Task 7. The government should invest in geoengineering research to learn whether such options can be utilized.

Task 8. The National Governors’ Association and the National League of Cities should create a catalogue of state and local infrastructure costs that have already occurred due to sea level rise since 1970.

Task 9. The U.S. government should provide an annual projection of sea level rise for policymakers and the public.

Task 10. In long term coastal planning, decision makers should take into account sea level rise of up to two meters.

Breakout Session 02. Ocean and Coastal Hypoxia and Climate Change

Task 1. U.S.DA, Army Corps of Engineers and other federal entities should alter their subsidy systems away from practices that worsen water quality.

Task 2. Local and regional planners should facilitate storm water management and develop better knowledge on how activities within watersheds affect receiving waters.

Task 3. Federal, state, NGOs, and foundations should encourage environmental literacy.

Task 4. The Army Corps of Engineers, states, and other entities should restore and mitigate wetlands and floodplains, including through public-private partnerships.

Task 5. Federal agencies should enhance and increase water quality monitoring.

Task 6. Congress should develop long-term energy policies that include environmental and economic costs of degraded water quality.

Breakout Session: 03. Blue Carbon: Carbon Sequestration in the Marine Environment

Task 1. In climate change discussions, governments and intergovernmental bodies (e.g. IPCC, Climate Convention of Parties) should recognize the importance of coastal and ocean carbon sequestration.

Task 2. Cabinet level leadership should establish research priorities and policy regarding coastal and ocean carbon sequestration (e.g. establish an SOST working group, include in White House Council of Environmental Quality guidelines, and include in the National Ocean Policy).

Task 3. To encourage coordinated U.S. federal research and policy regarding coastal and ocean carbon sequestration, the president should identify who's in charge at the agency level and their roles (e.g., DOE, DOI, NSF, NASA, NOAA, U.S.GS, EPA etc.)

Task 4. The government should develop comprehensive ocean carbon science programs that examine the fate of carbon from watersheds to the open ocean and Congress should fund these programs.

Task 5. The government should take immediate action to conserve ecosystems that are already known to sequester carbon, while supporting research on coastal and ocean carbon sequestration.

Coastal Ocean Change and Potential for Adaptation

Breakout Session: 04. Avoiding “Maladaptation” of the Coast

Task 1. The administration should mainstream coastal adaptation and provide incentives for adaptation planning and activities across all federal programs, funding and regulatory approvals.

Task 2. Federal and state governments should adopt policies that support implementation of large-scale ecosystem-based adaptation and green infrastructure into coastal adaptation and planning.

Task 3. The federal government should provide funding and incentives to plan and implement multidisciplinary coastal adaptation projects that include social, economic, and natural sciences.

Task 4. The federal government should develop an interagency online clearinghouse and community of practice for coastal adaptation information, databases, and models.

Task 5. The federal government should develop a federal interagency communication and education strategy addressed to decision makers and the public.

Task 6. The federal government should require the inclusion of coastal adaptation planning into pre-disaster response and recovery plans.

Task 7. The federal government should restrict National Flood Insurance Program (NFIP) coverage for (re)building in high hazard and environmentally sensitive areas.

Breakout Session: 05. Ocean Acidification Threats to Fisheries and Aquaculture

Task 1. Scientists should increase monitoring of chemical, biological, and physical data within hatcheries, coastal waters, essential fish habitat, and open ocean (food web effects)

Task 2. Scientists should develop predictive models and identify tipping points.

Task 3. Policymakers should monetize the impacts of ocean acidification.

Task 4. Scientists should determine the biological responses of economically important species and their food sources.

Task 5. Scientists should sustain monitoring of west coast oyster populations and expand monitoring to other productive marine environments.

Task 6. Scientists and managers should select and develop stock resistant to ocean acidification.

Task 7. Scientists should create a U.S. map of ocean acidification hotspots and use that information to guide research and marine spatial planning.

Task 8. Scientific societies should send a delegation to the White House to discuss ocean acidification.

Task 9. The federal government should strengthen ocean resiliency (e.g. Marine Protected Areas (MPAs)).

Task 10. Congress should fully fund federal programs (stakeholder education and outreach) and existing acts such as the Federal Ocean Acidification Research and Monitoring (FOARAM) Act.

Breakout Session: 06. An Effective Law and Policy Framework for Coastal Adaptation

Task 1. Congress should reauthorize the Coastal Zone Management Act (CZMA) and strengthen provisions for states to include adaptation to sea level rise and climate management plans into their own state coastal management plans, including enforcement requirements.

- a. Funding for states should be conditioned on enforcement.
- b. NOAA should update the CZMA regulations to require effective and strong enforcement of state and local coastal management plans and recertification of local plans.

Task 2. Congress should reauthorize the National Flood Insurance Plan and limit the federal insurance cap per parcel by stopping increases or ramping it down.

Task 3. The U.S. Army Corps of Engineers and states should require rolling easements in exchange for shoreline protection projects.

Task 4. Congress should authorize the creation of the NOAA Climate Service to provide a single authoritative source of climate information (e.g., sea level rise) (using physical, social and natural sciences) for multiple scales of decision-making. Regional and localized data for specific timeframes are needed too.

Task 5. State plans should delineate which properties and lands should be protected and which will be allowed to submerge or retreat, subject to constitutional parameters.

Task 6. Congress should authorize the Federal Emergency Management Agency (FEMA) to update flood maps to account for sea level rise and erosion projections using regional experts knowledgeable in physical processes.

Task 7. The U.S. Army Corps of Engineers' cost/benefit analysis should include ecosystem services and elevate the importance of services considered to be a primary concern.

Task 8. Congress should reauthorize the Upton-Jones amendment that modifies the Federal Flood Insurance program by providing relocation and acquisition coverage for structures in imminent danger from an encroaching shoreline. The amendment should be reauthorized to examine improvements to encourage retreat, allowing property owners to choose retreat and include protection for local governments. Alternatively, Congress should authorize the “hazard erosion insurance rate” developed by the Heinz Center on Science, Economics, and the Environment.

Oceans and Living Marine Ecosystems

Session: 07. What is the Baseline? Developing Research and Monitoring Efforts in Near-Pristine Marine Ecosystems to Measure Global Change

Task 1. As part of implementing the National Ocean Policy, the Department of Interior (DOI) should develop an Oceans and Climate Change Initiative to coordinate agency activities to collectively and collaboratively manage the 1.76 billion acres of marine area under DOI jurisdiction.

Task 2. Federal agencies that fund formal and informal science education should emphasize programs that utilize existing protected areas to offer field experience, hands-on data collection, opportunities to gain interdisciplinary perspectives, and that contribute to time-series observations of global change.

Task 3. The DOI, as part of implementation of the National Ocean Policy, should emphasize greater public awareness of the importance of the remaining, intact marine ecosystems, through expanded management, outreach and education programs.

Task 4. All federal agencies should use existing authorities to enhance and expand public-private partnerships in support of education, research, monitoring and management, of protected areas.

Task 5. All federal agencies should use existing authorities to prioritize and maximize law enforcement of protected areas, with an emphasis on improving use of innovative technologies for remote regions.

Task 6. Federal agencies should use existing authorities to identify and expand additional regions for enhanced conservation to increase the representation of ecosystems under protection.

Task 7. Federal agencies should receive sufficient funding resources to carry out their legal mandates. This includes increased support for infrastructure, monitoring, management, applied science, restoration, and education.

Breakout Session: 08. Ecosystem-based Marine Spatial Planning in U.S. Waters: Managing the Ocean Mosaic

Task 1. Planners should capitalize on work already done in the U.S. territorial waters.

Task 2. Those involved in ecosystem-based Marine Spatial Planning (MSP) should develop a set of maps to recognize and identify resource sensitivity.

Task 3. The U.S. should require those who use the ocean resources to collect more inclusive data and make them available for public and private planners to make decisions.

Task 4. The federal government should encourage data aggregation in useful formats as a repository of information for planning.

Task 5. Create a centralized storehouse of information relevant to MSP.

Task 6. The national ocean planning process should result in at least 10 percent of U.S. waters being designated as “no take” zones.

Task 7. The National Ocean Council should ensure active cooperation among regional managers regarding different species and ecosystem types.

Task 8. Regional planning bodies (RPBs) should develop a data management plan that updates and re-evaluates the data base for regional planning.

Task 9. The Council on Environmental Quality (CEQ) should ensure interface between the National Environmental Policy Act (NEPA) process and information that goes into Coastal and Marine Spatial Planning (CMSP).

Task 10. Congress and the Administration should support effective implementation of marine spatial planning.

Breakout Session: 09. The Role of Coastal Marine Spatial Planning in Stabilizing Food Security

Task 1. To develop a national advertising blitz informing the public about CMSP and food security with industries, conservation organizations, and governments should work together.

Task 2. NOAA should develop and participate in a centralized data collection and management system. They should involve land use planning agencies in collecting coastal and watershed data, in developing understanding, and in connecting the system to the local level.

Task 3. Government agencies should collect data on social and economic impact from stakeholders.

Task 4. FDA and U.S.DA should fund education and research about food security and ocean interactions.

Task 5. Regional Fisheries Management Councils (RFMCs) and state regulatory agencies should use discretionary funding to collectively provide input on long- term food security and Coastal and Marine Spatial Planning (CMSP).

Task 6. Regional Ocean Councils (ROCs) and nongovernmental organizations should help to improve literacy and begin conversations about the importance of healthy coastal oceans for food security.

Task 7. NOAA should require recommendations about Essential Fish Habitat (EFH) conservation from the National Marine Fisheries Service (NMFS) and RFMCs to be addressed in permitting of non-fishing projects.

Task 8. Policymakers should use existing tools, such as Total Maximum Daily Loads (TMDLs) in decisions about CMSP and food security.

Task 9. Industry beneficiaries of food security should engage with and fund CMSP.

Breakout Session: 10. Marine Bioinvasions

The coastal areas of the United States possess some of the world's most diverse and fragile ecosystems and support numerous species that depend on these habitats for survival. Unfortunately, global climate change, human development, and the continuous degradation of coastal ecosystems have rendered these once pristine areas vulnerable to the introduction of opportunistic invasive species. Invasive species have a profound effect on aquatic ecosystems resulting in the displacement of native species, reduced biodiversity, and the alteration of community structure and food webs. As a result, biological invasion is a significant contributor to marine species endangerment, habitat degradation and global biodiversity loss.

In addition to the severe and permanent damage to the habitats they invade, invasive species also adversely affect individuals by hindering economic development. Through damage to human enterprises, invasive species inflict an enormous economic cost; the cost to manage both aquatic and terrestrial species is estimated at \$137 billion per year to the U.S. economy alone. This is more than the combined total of all other natural disasters, suggesting that invasive species are a bigger threat than other environmental crises, including global climate change. It is estimated that a marine species will invade a new environment somewhere in the world on a weekly to daily basis. This rate will continue to increase with global trade and development and is likely to be further augmented by continuing global change, especially climate change. The following recommendations are made to prevent, detect, respond to, and control invasive species in a cost-effective and environmentally sound manner.

Task 1. **Reauthorize the National Invasive Species Act.** The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA) was intended to identify and implement ways to

prevent the unintentional introduction and spread of invasive species into waters of the United States, to work toward minimizing economic and ecological impacts of established nonindigenous species, and to establish a program to assist states in the management and removal of such species. NANPCA was last reauthorized and amended in 1996 by the National Invasive Species Act (NISA); since this time a great deal has been learned about invasive species in regards to their introduction, management, and impact to the environment, economy, and human health. We recommend a reauthorization of NISA to include these additional findings. The Act should also be modified to include authorization of funding for a number of programs including a national monitoring program to document the spread of invasive species, an emergency fund for the rapid response of newly detected invasions, and to perform a comprehensive risk assessment on the vectors of non-native species.

Task 2. Coordinate Vector Management. New invasions need to be prevented through coordinated vector management. Further, management goals need to be clearly articulated. Working with other agencies, NOAA should continuously review the science for evaluating marine bioinvasions vectors. An invasive species “czar” should be established to coordinate this issue, and others related to invasive species, with other agencies. All marine vectors need to be evaluated (e.g., magnitude and volume of biota that is moved by different transfer mechanisms). Management schemes for addressing flux and reducing the propagule pressure should also be addressed.

Task 3. Control and Management of Invasive Species. In the short-term, plans should be developed for the necessary actions needed to respond quickly to newly detected non-native species that may cause ecosystem, public health and/or socioeconomic impacts. Risk assessments are needed to prioritize species that warrant a rapid response plan. Further, an emergency fund for such efforts should also be established. In the long-term, Federal agencies should develop and implement effective strategies for control and management of invasive species. As an example, environmentally-sound options should be reviewed for establishing markets for invasive species.

Task 4. National strategy for monitoring. When a new species is introduced, the best strategy is early detection and rapid response. This includes monitoring habitats to discover new species soon after introduction, reporting sightings of previously unknown species in an area, and working quickly to keep the species from becoming established and spreading. Extensive monitoring across environments is needed to document the distribution of native species, identify range shifts, and detect invasions. Further, new innovations for early detection should be explored to determine the most efficient, cost-effective means of eradicating new biological invasions.

Task 5. Expand Educational and Outreach Programs. It is imperative that the public has an understanding of the problems and impacts associated with invasive species so that they can be partners in solving the problem. More importantly, people need to know what they can do to help prevent the introduction and spread of invasive species. Increased funding should be given to support national invasive species campaigns (e.g. Habitattitude™ and Stop Aquatic Hitchhikers!), that are designed to increase awareness about invasive species and promote actions that empower audiences to become part of the solution in preventing future invasions.

Increased efforts should be incorporated into these campaigns to translate the combined risks from climate change and biological invasion to the public through real-world examples. Additionally, citizen-science needs to be incorporated into invasives species monitoring and management.

Task 6. Fund Research Programs. Dedicated research programs across a diversity of regions (e.g., high, mid and low latitude sites) must be developed and adequately funded to detect species movements and likely interspecies interactions, in order to predict, and possibly prevent, the impact of invasion resulting from global climate change. These goals will best be accomplished via focused, mechanistic studies of invasive species to inform and predict how global climate change factors may impact native species, invasive species and interact with local stressors to affect invasion success.

Task 7. Increased Coordination. Partnerships should be built among international, Federal, state and local agencies, academic institutions, and others to enhance capacity for detecting, responding to, and managing invasive species. Interagency groups (e.g., Coral Reef Task Force) need to build partnerships that broadly implement the other recommendations. The dispersal of invasive species is a global problem; therefore international coordination and cooperation is an important part of the solution. Invasive species are moved around the globe as a result of trade, transport, and travel, thus it is important to develop an international agreement for the management of pathways and to disseminate information on the risks and impacts from invasive species.

Oceans and Human Health

Breakout Session: 11. Human Health Effects of the Impact of Climate Change on Our Oceans

Task 1: The National Council on Science and the Environment should foster creation of a network of organizations committed to advancing the understanding of the human health effects of the impacts of climate change on the ocean. This network should include government agencies, scientists, educators, NGOs, and private entities. The Consortium for Ocean Leadership would be pleased to help with this effort and should include the American Public Health Association as a key partner.

The network should engage in three core activities:

- 1) Organize an effort to use the National Contingency Plan as a model to educate the public and their representatives about the significance of the health and ocean nexus and the resources needed to promote public health in the long-term.
- 2) Establish multisector, multidisciplinary teams to consider both science and infrastructure funding needs.
- 3) Establish a “Community of Practice” in the interdisciplinary field of Oceans and Human Health including expertise, best practices, education, and networking.

Task 2: The National Ocean Council (NOC) should make protecting and improving human health, including its integration with coastal and marine spatial planning, a central objective in its implementation of the national ocean policy.

Task 3: Using the National Contingency Plan as a model, Congress should require funding agencies for oceans, environment and public health to establish interagency, multidisciplinary teams that would consider funding for both science and infrastructure proposals.

Task 4: Agencies should involve land-use planners and the business community both as stakeholders and as sources of business and other economic data for assessment of potential impacts of climate and ocean-health threats.

Task 5: Decision-making agencies should collect and integrate economic data from the private sector in research and development of policy dealing with ocean-related health benefits and risks.

Task 6: Management and public health agencies should employ social media and emerging communication and data technologies to provide greater effectiveness of risk communication for health warnings, beach closures, and other events that require quick action by recipients.

Task 7: Federal agencies should collect, evaluate, integrate, and share ocean monitoring and surveillance data that are relevant to human health, and that can be used to inform modeling and risk and economic assessments.

Breakout Session: 12. Public Engagement and Education

Task 1: Federal oceans agencies should determine the top 10 threats to oceans and humans and widely publicize what can be done to curtail them.

Task 2: The federal government should direct 10% of each relevant federal grant (related to aquatic sciences) for K-12 formal and informal education and outreach.

Task 3: Create partnerships among environmental education groups and scientific societies (particularly by organizations represented by participants) to work with existing Oceans and Health centers and with affiliates for oceans and human health outcomes. Expand the Aldo Leopold Fellowship Program and the Udall Scholarship Program.

Task 4: Include ocean concepts and issues in K-12 school textbooks, supplemental textbooks, and curriculum, perhaps working with National Geographic, National Academy of Sciences, and the National Marine Educators Association and focusing on CA, TX, NY, which are the largest markets for textbooks.

Task 5: Conduct research to identify potential corporate partners from a variety of economic sectors for issues of common interest in relation to oceans and human health, work on a social marketing campaign.

Task 6: Implement the “[Thank You Ocean](#)” campaign nationwide.

Task 7: Establish an Oceans and Human Health “teach the teachers” (K – 12) program, using the “AMBIENT” program (Created by Dr. Lisa Pitman, U of Miami Ed. Specialist) as a model.

Task 8: Require communications training for science degree programs. Increase the number of formal “science communication” degree programs. Create a “science communication” certificate program.

Breakout Session: 13. Monitoring for and Forecasting Health Threats from the Oceans

Task 1: The White House Office of Science and Technology Policy (OSTP) should direct NOAA to lead a collaborative interagency effort to support research, development, evaluation, and deployment of biological sensors for multiple applications, including health of humans and marine animals. The effort should include agencies working on chemical and biological weapons detection of leverage expertise and resources to overcome common technical challenges.

Task 2: NOAA should lead an interagency effort to coordinate marine sensors into a comprehensive system of surveillance of pollution and ecosystem monitoring that includes humans, marine animals, and terrestrial animals in order to detect trends, changes, and health risks. These efforts should include the U.S. Global Change Research Program (U.S.GCRP) Climate Change and Human Health Group and the Interagency Working Group on Harmful Algal Blooms, Hypoxia, and Human Health.

Task 3: Ocean Observing Systems should integrate marine sensors into a comprehensive surveillance system for monitoring and forecasting health risks.

Task 4: Congress should support sensor development by reauthorizing and funding the Oceans and Human Health Act at levels recommended in previous legislation and external reports.

Task 5: Congress should provide incentives for private sector engagement for prototyping and commercialization of marine sensors for human and animal health. Examples could include tax incentives, support of interagency efforts and programs, market support for high risk product development, and support through fees associated with pollutant discharge and resource extraction.

Task 6: NOAA and the interagency effort should define system requirements and facilitate development of real-world performance in order to support translation research and operations of marine sensors for human and animal health.

Task 7: Agencies should support analysis of existing data from marine sensors, including sentinel species, to determine baselines and to inform risks to human health.

Task 8: Knowledge derived from marine sensors should be utilized to educate policy and decision makers about the connections between ocean health and human health.

Oceans Affect Everyone

Breakout Session: 14. Kilowatt Hours and Ocean Breezes: Making Decisions about Offshore Wind Projects

Task 1. BOEMRE should collaborate with other federal agencies to increase support for education on renewable energies at all levels and to promote communication between involved groups.

Task 2. The revenue stream from offshore leases for wind power shall be shared with local communities.

Task 3. The manufacturing jobs associated with offshore wind should support US jobs with union wages.

Task 4. BOEMRE shall take the lead in interagency collaboration to standardize the siting and permitting processes to the degree possible and to make the overall process easier and faster.

Task 5. BOEMRE shall systematically study and apply the environmental, economic and regulatory history of wind energy development in Europe and make this information readily available to the US public.

Task 6. BOEMRE should be the lead agency and, in concert with other federal agencies, NGOs, private industry and pertinent state agencies, should coordinate efforts to further educate the public about the strengths and weaknesses of offshore wind as an energy source.

Task 7. Congress should establish long-term investment and production tax credit incentives for renewable energy.

Task 8. Congress should strengthen funding for marine spatial planning efforts including support for regional ocean partnerships, long-term data collection, and data repositories.

Task 9. Congress should develop an appropriate pricing mechanism for carbon that accurately addresses the externalities of energy generation and use, including health and environmental impacts.

Task 10. Congress should enact an organic act for BOEMRE and a national policy on renewable energy.

Breakout Session: 15. Security and the Ocean

Task 1. Ratify UNCLOS (United Nations Convention on the Law of the Sea) as an important aspect of dealing with an ice-free Arctic, migratory fish, and other marine environmental issues that impinge on security.

Task 2. Policymakers should emphasize the importance of regional approaches (such as Port Authorities in the U.S.A) to climate change adaptation solutions both within and outside the U.S..

Task 3. Scientists and decision makers should put possible outcomes regarding Climate change security in the form of a matrix to assess multiple dimensions (risk, reward, impacts, probability)

Task 4. Advocates should reemphasize the call for more robust climate observing and modeling system to provide strategic planners at the Department of Defense (DoD) with actionable intelligence that can influence future planning and budgeting decisions.

Task 5. The administration should endorse interagency funding and implementation of an ocean observing system.

Task 6. The NCSE conference in 2012 should define both the terms “security” and “environment” to emphasize the global dimensions of the security issue.

Task 7. Stakeholders should strengthen the role of the Arctic Council to contribute to regional cooperation and science based policy making.

Task 8. The federal government and the public should recognize that the lack of understanding of climate science and the role of the ocean in climate is a national security issue and that this issue is inadequately understood by the public and by decision makers. There should be an effort to **communicate** (to the general public, user-communities, administrators, and legislators) the ocean’s role in weather, climate, transportation/commerce, recreation and fishing.

Breakout Session: 16. Cities, Economics, and Oceans

Task 1. The federal government should increase financial resources and research for estimating the value of natural assets including the ecological and recreational resources of waterfronts and shorelines (including beaches and wetlands) and for tracking the role of the oceans and Great Lakes in the national, state, and local economies.

Task 2. Climate risk and other specific risks associated with our coastlines should be integrated into the decision making process for economic development and planning in these regions.

Task 3. NOAA should work to ensure that the public understands the importance of our oceans and coasts to their well being, particularly in urban areas where they are most vulnerable and where coastal states represent 83% of the nation’s GDP.

Task 4. University presidents should break down silos in higher education to encourage interdisciplinary approaches to knowledge so that schools of science include relevant social sciences and practical applications so that business schools and social science departments include natural sciences, especially ecological systems and environmental changes, in their curricula.

Task 5. Educators should increase accessibility of ocean and coastal information through the uses of media and social networking, (e.g. Facebook, Google Earth, and radio).

Task 6. The administration should develop new strategies to connect federal programs and legislation to local communities' need for scientific and practical knowledge to apply to planning and management of shoreline changes including natural, social and economic shifts.

Task 7. Evaluate flood and storm depth of the U.S. coastline for the next 100 years in an affordable and realistic way. (e.g. 1m, 1.4 m, and 2 m representing years 2050 and 2100).

Task 8: Researchers should carry out an affordable study to evaluate the socioeconomic consequences of sea level rise.

Task 9: Public and private insurers provide key signals about the risks of development in hazardous coastal regions, and they should work together to make sure that development fully accounts for those risks, including the options of not developing in exposed areas.

Task 10: Coastal developers should build flexible infrastructure that can be moved or rebuilt after natural disasters but can also withstand natural forces in case of storm surge risk or sea level rise.

Tipping Points

Breakout Session: 17. Lessons from Two Potential Tipping Points: Arctic Summer Sea Ice and Acidification

Task 1. Scientists, advocates, and students should use more easily understood terminology to provide clarity on what they mean by tipping points and thresholds. The term, 'tipping points,' should be used only for changes that are likely to shift climate in ways that are irreversible. This would differentiate them from changes that cross thresholds that have major ecosystem effects but that are reversible in ecological time.

Task 2. Communication about the nature of changes described as 'tipping points' is very important. Equally important is identification of the degree of certainty associated with the forcing of the change and of the 'tipping point' response.

Task 3. Communicators should put the issue of tipping points in the context of the impact on the audience (e.g. health, economic, etc.) and should focus on "what is the impact" and "where is the impact".

Task 4. Scientists should communicate the time frame of the impact in the perspective of 50 years; they should use linear trends to explain the likely impact in 2050.

Task 5. Science communicators should use words and imagery that can be understood and related to by non-scientists.

Task 6. Science communicators should provide hope that societal action can have a significant impact ameliorating the problem.

White Arctic/Blue Arctic

Breakout Session: 18. Balancing Multiple Uses of Natural Resources in the Arctic (these are not recommendations, other than task 4)

Task 1. The health of the ecosystem is measured by the health of the community. The two are interchangeable.

Task 2. A thriving subsistence culture does not have to be at odds with sustainable development but it requires effective local engagement.

Task 3. Alaska's North Slope communities and the state of Alaska will continue to depend on oil revenue for health and human services.

Task 4. To honor traditional views and effectively manage natural resources, federal and state governments should more actively use traditional ecological knowledge.

Task 5. There should be increased public and private partnerships to improve scientific understanding will be critical in this fiscal climate.

Task 6. Arctic communities should advance technologically without losing cultural ties or destroying the environment.

Task 7. Some federal management tools, like the Endangered Species Act, have a disproportionate impact on local communities.

Breakout Session: 19. Governance of a Rapidly Changing Arctic

Task 1. Utilize strength of the U.S. Norway & Russia to encourage firm responses on governance.

Task 2. Strengthen the Arctic Council.

Task 3. Decision makers regarding the Arctic should collectively commit to marine spatial planning and develop integrative and holistic plans and agreements for ecosystem management.

Task 4. Decision makers should encourage national and international cooperation when considering the lack of regional resources.

Task 5. Decision makers should fund and plan well for future arctic actions and create an agenda to use the arctic as a microcosm for similar regions or countries.

Task 6. Decision makers should encourage strategic assessments of transboundary impacts of climate change on arctic people and resources.

Task 7. Decision makers should pinpoint issues in order to make concrete decisions and provide direction on implementation.

Task 8. Arctic Council members should resolve which additional countries can become observers to the Arctic Council.

Observing and Measuring Ocean Changes for Improved Stewardship

Breakout Session: 20. Attaining an Operational Marine Biodiversity Observing Network: Transforming Recommendations into Action

Task 1. Given marine biodiversity's central role in ocean health and ecosystem services, the National Ocean Council (NOC) should establish a national committee on marine biodiversity to set national goals and objectives.

Task 2. The National Ocean Council (NOC) should endorse and implement a national marine biodiversity observing network (BON) to support the national ocean priorities (see *Attaining an Operational Marine Biodiversity Observation Network Synthesis Report*, available at www.nopp.org).

Task 3. Federal agencies should support demonstration projects for a national marine BON, through an interagency mechanism such as the National Oceanographic Partnership Program (NOPP).

Task 4. Entities overseeing ocean observing systems such as the Integrated Ocean Observing System (IOOS) should incorporate observations of biodiversity.

Task 5. Federal agencies with ocean-related missions should support the principle of data sharing. An early priority in establishing a marine BON is to establish a mechanism to encourage data sharing among agencies and to establish standardized policies about data. Data standards, interoperability and accessibility for physical and chemical data are well established; the same level of standards, interoperability and accessibility should be established for biodiversity observations, enabling their incorporation in analysis and modeling of global climate change.

Task 6. Congress should appropriate funding for the Smithsonian Institution to establish a national headquarters of biodiversity sorting and processing.

Task 7. The State Department should support the establishment of an operational marine biodiversity observing network (BON) and coordinate with similar international efforts, and ensure incorporation in the International Mechanism of Scientific Expertise on Biodiversity (IMoSEB) and Global Earth Observing BON (GEO BON).

Task 8. The National Ocean Council (NOC) should utilize communication and outreach tools such as citizen scientists to increase observations of biodiversity and to elevate public awareness of the importance of marine biodiversity.

Breakout Session: 21. Essential Data for Marine Spatial Planning

Task 1. The National Ocean Council (NOC) should ensure interoperability of existing data systems, for example, IOOS, OBIS, MMC, NAMERA, National Atlas of Ecosystem Services.

Task 2. The NOC and Regional Planning Bodies (RPBs) should acknowledge and act on the fact that Coastal and Marine and Spatial Planning (CMSP) transcends static planning for 2-dimensional areas, and should incorporate the water column, benthos and changes over time.

Task 3. RPBs should improve and evaluate relevant data sets as an integral part of adaptive management of CMSP plans.

Task 4. To ensure interoperability across regions, a web-based community of practice should be established by the CMSP data subgroup that provides best practices, recommended standards, implementation specifications, and a communication forum.

Task 5. The ecosystem Services Partnership and the NOC should show the link between ocean Uses and ecosystem services.

Breakout Session: 22. Measuring What Counts and Valuing Marine Ecosystems

Task 1. The science and practitioner community should synthesize information about ecosystem service values, ecosystem attributes, and human well-being information to inform coastal and marine spatial planning and other decision contexts.

Task 2. The National Oceanic Council (including Regional Planning Bodies) should use pilot studies to test the Usefulness of information about ecosystem service values, ecosystem attributes, and human well-being in coastal and marine spatial planning and restoration strategies.

Task 3. The science and practitioner community should develop guidance describing the conditions, including multiple ecosystem services and multiple objectives, that would change the nature and outcome of decisions.

Task 4. The National Oceanic Council should make explicit the governance principles (e.g., define rights, public trusts) for applying ecosystem services in coastal and marine spatial planning and other decision contexts.

Task 5. The science and practitioner community should conduct quantitative, spatially explicit assessments of ecosystem service values, ecosystem attributes, and human well-being.

Task 6. The National Oceanic Council should identify a science advisory structure to include information about ecosystem service values, ecosystem attributes, and human well-being in coastal and marine spatial planning and other decision contexts.

Task 7. The National Oceanic Council agencies (including Regional Planning Bodies) should use management and policy scenarios including baseline and future conditions for proactive decision-making.

Cross-cutting

Breakout Session: 23. Increasing Diversity in Ocean Leadership

Task 1. Short term (1-5 years) NCSE and educational institutions should create/continue to support mentoring programs and effectively match students to resources that bridge the gap between capability and successful careers in coastal and ocean leadership positions.

Task 1. Long term (5-10 years) NCSE should create an interagency working group which promotes, coordinates and facilitates communication between diversity programs that are spearheaded by educational institutions, nonprofit organizations, corporations, faith-based entities and mainstream environmental groups.

Task 2. Short term (1-5 years) Those within the coastal and ocean management field engaged with students, should emphasize the importance of parental support, faculty mentorship, students further along the pipeline serving as role models, interaction with youth in the communities surrounding their institutions, understanding public interest and awareness, recording and sharing of career/study experiences and participation in conferences.

Task 3. Short term (1-5 years) Educational institutions (from K-graduate) should create access to programs which improve the skills of underrepresented/minority students to successfully write grant proposals.

Task 4. Short term (1-5 years) - Educational institutions should increase professional development programs specific to careers in coastal and ocean science/management for

underrepresented groups while educational institutions, community groups, faith-based entities and private sector groups should increase distribution of information on diversity programs.

Task 5. Short term (1-5 years)- Federal agencies, private sector industry and NGO's should create a public relations campaign (e.g. public service announcements, television advertisements) for the mainstream public that gives insight to the importance of diversity within ocean and coastal science/management.

Task 6. Long term (5-10years) Federal agencies, private sector industry and NGO's should work with educational institutions to create a "Shadow" program with ocean and coastal leaders in high management/administrative or chief/senior scientist positions, where graduating students could gain on the job experiences and training.

Task 7. Long term (5-10 years) Federal agencies should invest more resources into creating co-op opportunities for federal employee's to teach courses at universities or establish academic positions for scientists that can assist in pipeline development for increasing diversity in ocean and coastal science research/workforce.

Task 8.Short term (1-5 years) Federal administrators should focus on the critical importance of bridge (transition from student to career) and community colleges as they contain large proportions of the community which are underrepresented in coastal sciences and management.

Task 9. Short term (1-5 years) Researchers and funding entities should focus on increasing interdisciplinary and culturally competent research which uses social science/human dimensions research to improve coastal and ocean science/management, as this could be relevant to underrepresented and diverse communities.

Breakout Session: 24. Improving Ocean Governance through Multi-Scale Ocean and Coastal Management

Across breakout sessions

Depending on scale, the majority of the following recommendations can be implemented by nations, agencies, and leaders involved in coastal and ocean governance.

Security and the Ocean (Session 15)

Task 1 – The U.S. government should show leadership to:

- Ensure that the sustainable development of the oceans is a substantive portion of the Rio + 20 convention;
- US Senate ratifies UNCLOS (United Nations Convention on the Law of the Sea) as an important aspect of dealing with an ice-free Arctic, migratory fish, and other marine environmental issues (ref. Session 15);
- Emphasize the importance of regional approaches to climate change adaptation solutions both within and outside the US;

- Contribute to the establishment of an international code of good conduct for ocean users;
- Expand capacity building to the benefit of developing countries that share common waters such as training practitioners in best science and management practices.

Public Engagement and Education (Session 12)

Task 2 – Increase public understanding of ocean governance for the protection of environmental benefits. Adopt federal policies to strengthen environmental education with a focus on oceans. More specifically (ref. Session 12):

- Federal ocean agencies should determine the top 10 threats to oceans and humans;
- The federal government should direct 10% of each relevant deferral grant for K-16 formal and informal education and outreach;
- Create partnerships among environmental education groups and scientific societies to work with existing Oceans and Health centers and with affiliates for oceans and human health outcomes;
- Include ocean concepts and issues in K-12 school textbooks, supplemental textbooks, and curriculum, working with National Geographic, National Academy of Sciences, and the National Marine Educators Association and focusing on CA, TX, NY, which are the largest markets for textbooks;
- Conduct research to identify potential corporate partners for issues of common interest in relation to oceans and human health, work on a social marketing campaign, also including artists and culinary schools;
- Implement the “Thank You Ocean” campaign nationwide;
- Establish an Oceans and Human Health “teach the teachers” (K-12) program, using the “AMBIENT” program as a model.

Ecosystem-based Marine Spatial Planning in U.S. Waters: Managing the Ocean Mosaic (Session 8)

Task 3 – Inventory and assess existing global coastal and ocean management practices in order to inform future practice in the US territorial waters and beyond (ref. Session 8).

Task 4 – Develop mechanisms that support cross-sector and regional networking.

An Effective Law and Policy Framework for Coastal Adaptation (Session 6)

Task 5 – Ensure sustainable native practices and cultural knowledge are incorporated into CMSP/EBM practices and procedures.

Task 6 – Congress should re-authorize the Coastal Zone Management Act (CZMA) and strengthen provisions for states to include adaptation to sea level rise and climate management plans into their own state coastal management plans, including enforcement requirements. More specifically:

- Funding should be conditioned on enforcement;
- NOAA should update the CZMA regulations to require effective and strong enforcement of state and local coastal management plans including CSMP within their boundaries (ref. Session 6 Task 1).

The Role of Coastal Marine Spatial Planning in Stabilizing Food Security (Session 9)

Task 7 – Strengthen ocean governance through the inclusion of all stakeholders and multiple perspectives at all scales.

Task 8 – Regional Fisheries Management Councils (RFMCs), state regulatory agencies should use discretionary funding to collectively provide input on long-term food security and Coastal and Maritime Spatial Planning (CMSP).

Task 9 – Regional Ocean Councils (ROCs) or advocacy organizations should begin conversations to improve literacy about the importance of healthy coastal oceans for food security.

Essential Data for Marine Spatial Planning (Session 21)

Task 10 – Develop long term monitoring ocean observing system, including supporting systems for establishing baselines and trends. More specifically:

- The National Ocean Council (NOC) should ensure interoperability of existing data systems, for example, IOOS, OBIS, MMC, NAMERA, National Atlas of Ecosystem Services;
- The NOC and Regional Planning Bodies (RPBs) should acknowledge and act on the fact that CSMP transcends static planning for 2-dimensional areas, and should incorporate the water column, benthos and changes over time;
- RPBs should improve and evaluate relevant data sets as an integral part of adaptive management of CMSP plans;
- Interoperability should be ensured across regions, a web-based community of practice should be established by the CMSP data subgroup that provides best practices, recommended standards, implementation specs, and communication forum;
- Ecosystem Services Partnership and the NOC should show the link between ocean uses and ecosystem services.

Task 11 – Establish monitoring for the enforcement and efficacy of ocean governance.

Attaining an Operational Marine Biodiversity Observing Network: Transforming Recommendations into Action (Session 20)

Task 12 – Explore the creation of a legal mechanism for the designation, management, and enforcement of high seas MPAs and MPA networks.