

Minutes for:

**The Adaptation for Climate-Sensitive Ecosystems and Resources
Advisory Committee Meeting**

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Bethesda, Maryland**

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NOTICE

This document was prepared by Versar, Inc., an EPA contractor (Contract No. EP-C-07-025, Task Order No. 07), as a summary of the discussion held at the *Adaptation for Climate-Sensitive Ecosystems and Resources Advisory Committee Meeting* (October 22-23, 2007). This report captures the main points and highlights of the meeting. It is not a complete record of all detailed discussion, nor does it embellish, interpret, or enlarge upon matters that were incomplete or unclear. Statements represent the individual views of each participant.

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PREFACE

The U. S. Environmental Protection Agency's (EPA) Global Change Research Program (GCRP) is an assessment-oriented program within the Office of Research and Development that focuses on analyzing how potential climate change and other global environmental changes may affect water quality, air quality, aquatic ecosystems, and human health in the United States.

The GCRP is a member of the U.S. Climate Change Science Program (CCSP) and is therefore responsible for helping to implement their *Strategic Plan* and to fulfill the requirements of the Global Change Research Act of 1990 to conduct periodic assessments of climate change and variability. Hence, the GCRP is conducting an assessment for the CCSP draft report entitled *Synthesis and Assessment Product (SAP) 4.4: Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources*. A Federal Advisory Committee, Adaptation for Climate Sensitive Ecosystems and Resources Advisory Committee (ACSERAC), was established to conduct an external peer review of the draft SAP 4.4.

1. INTRODUCTION

DAY 1

1.1 Workshop Background and Purpose

The Adaptation for Climate Sensitive Ecosystems and Resources Advisory Committee meeting, hosted by the US EPA, was held on October 22 – 23, 2007 in Bethesda, MD. The meeting was held to conduct an external peer review of EPA’s Draft Report: *Synthesis and Assessment Product (SAP) 4.4: Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources*. The meeting format was guided by discussion of charge questions developed by the EPA specifically for this effort. The charge questions had also been forwarded to the Federal Advisory Committee members to obtain written comments and suggestions prior to attending the meeting.

The U. S. Environmental Protection Agency’s (EPA) Global Change Research Program (GCRP) is an assessment-oriented program within the Office of Research and Development that focuses on analyzing how potential climate change and other global environmental changes may affect water quality, air quality, aquatic ecosystems, and human health in the United States.

The GCRP is a member of the U.S. Climate Change Science Program (CCSP) and is therefore responsible for helping to implement their *Strategic Plan* and to fulfill the requirements of the Global Change Research Act of 1990 to conduct periodic assessments of climate change and variability. Hence, the GCRP is conducting an assessment for the CCSP draft SAP 4.4. A Federal Advisory Committee was established to conduct an external peer review of the draft assessment.

The purpose of the meeting was first and foremost to discuss the charge questions provided to the committee members in advance of the workshop. This report of the meeting minutes is framed around the charge questions and brings in related discussion on a number of other points that surfaced during the workshop. The main body of the report summarizes in-workshop discussions while the appendices provide the pre-meeting comments which contain more detailed responses and citations.

1.2 Meeting Participants/Attendees

The meeting was attended by individuals from EPA, academia, other Federal agencies, industry, and State government. The list of attendees and the Member Roster are presented in Appendix A.

1.3 Charge to the Panel

The charge questions to the Panelists were as follows (Appendix B):

1. Does the Committee agree with the focus on six management systems from across federally owned and managed lands and waters as an effective way to review adaptation options for climate-sensitive ecosystems and resources?
2. Does the Committee agree that the report provides useful information for managers on the state of knowledge regarding ecosystem management decisions sensitive to climate change, the types of adaptation options available, and approaches for implementing adaptation options? If the usefulness of the report could be improved, what specific improvements does the Committee recommend?
3. Does the Committee agree that the case studies are effective at demonstrating adaptation approaches and specific issues related to implementation? If the case studies could be improved to better demonstrate adaptation approaches, what specific improvements does the Committee recommend?
4. Does the Committee agree that the major conclusions and synthetic themes of the Synthesis chapter are supported by, and representative of the underlying chapters?
5. Does the Committee agree that the key findings and recommendations presented in the Executive Summary are the most important and appropriate to bring forward to executive level managers and Congress?
6. Does the Committee agree that EPA effectively followed the CCSP Guidance on characterizing confidence levels for the proposed adaptation approaches presented in the Executive Summary and Synthesis?
7. Does the Committee agree with the decision to use information from a series of stakeholder workshops in addition to the published literature to identify and assess adaptation options and implementation issues for climate-sensitive ecosystems?

1.4 Agenda

The meeting agenda is presented in Appendix C. The meeting began with the welcome and opening remarks. This was followed by a series of presentations by the convening author and the chapter authors.

1.5 Meeting Summary

Section 2 summarizes all presentations made at the meeting. Each presentation is followed by questions and discussion text, which summarize both facts and opinions presented by the meeting participants in response to those presentations. Section 3 provides a summary of the panel discussions for the specific charge questions. Facts, opinions, and concerns brought up by the participants have been recorded. Section 4 provides the panel discussions by chapter and Section 5 provides the meeting conclusion remarks from the Chair.

The Appendices A thru E provide the following: attendees, agenda, charge, presentation overhangs, and pre-meeting comments by Charge question and committee member, respectively.

2. SUMMARY OF OPENING REMARKS/PRESENTATIONS

2.1 Welcome and Introductions

Dr. Janet Gamble, the Designated Federal Official (DFO) opened the meeting by welcoming the panel. She then read aloud both a Federal Advisory Committee Act (FACA) statement and the responsibilities of the Designated Federal Officer. She introduced and thanked the Committee Chair, Dr. Paul Risser, University of Oklahoma Research Cabinet and Vice-Chair, Dr. Reed Noss, University of Central Florida, for their participation. She reminded the Committee that their role was to provide advice for this SAP document. Dr. Gamble also announced that there would be time for expression of public comments later in the day.

2.2 The Importance of SAP 4.4

Dr. Peter Preuss, Director of the National Center for Environmental Assessment, thanked Drs. Risser and Noss for agreeing to chair the committee, and thanked the panel for their time commitment. He reminded them of the importance of peer review at EPA, and explained that this report is part of a process, mandated by EPA's National Center for Environmental Assessment (NCEA), that calls for 21 such products to be created. In particular, this report looks at things from the point of view of the resource manager, focuses on specific ecosystem management goals, discusses a number of representative systems, and attempts to demonstrate approaches that can have broader implications. The report is important for resources managers within and outside the Federal government, with potential applicability for a broad spectrum of society. Dr. Preuss introduced Lead Report Authors, Susan Julius and Dr. Jordan West. He stated that EPA will take the committee's comments very seriously and revise the report accordingly. The committee members then introduced themselves to the group.

2.3 Purpose and Goal of SAP 4.4

Susan Julius discussed the purpose and goal of the report. She noted that the National Center for Environmental Assessment (NCEA) strategic plan calls for 21 Synthesis and Assessment Products, with guidelines given to the government agencies that were to author these reports. The reports were to deal with uncertainty explicitly, undergo expert review, and include an executive summary no longer than eight pages.

Two methods were provided by NCEA for assessing uncertainty. The first is likelihoods based on the underlying data or the level of confidence in the science, a qualitative estimate, based on the amount of evidence that exists. The second method, characterizing the underlying confidence in the science and expert opinion, was employed by this report. Uncertainty statements were included for all conclusions made about adaptation. Specifically, the authors grouped adaptations by approach type and did confidence estimates on the approaches ability to increase resilience.

The authors wanted this report to be useful for resources managers in preparing their ecosystem for climate change. They used the manager's perspective in order to move

from a more general discussion of adaptation options for climate change into something more specific. They looked at constraints faced, adaptation options, and effectiveness of these responses within the management system's context and goals.

The approach to take was laid out in the prospectus, including a series of questions that lead to the structure of the report and the incorporation of case studies. The drafting process began in September 2006, followed by workshops for small groups of academics in adaptation science and resource management. The comments from today's committee will be incorporated into the third revision of the document due out in late December 2007.

There were no questions from the committee following this presentation.

2.4 Presentations by Chapter Lead Authors

2.4.1 Executive Summary

Dr. Jordan West explained that the executive summary structure mirrors the structure of the report, with each system being given 1.5 pages to cover the following four points: 1) a brief background and current status of management, 2) top adaptations to implement now and adaptations for the longer term, 3) barriers to implementation and opportunities as learned from the case studies, and 4) conclusions highlighting insights that emerged.

In general, public comments on the report were concerned with it going beyond the scope of the Prospectus in terms of being policy prescriptive. *Dr. West* explained that the authors intended the report to be policy relevant, not policy prescriptive. She added that many other public comments were editorial in nature and easy to deal with, and that technical corrections were minor. Overall, the most substantive comments came in under the synthesis section, noting that the organization based on management systems was a somewhat limiting approach that the synthesis themes should be based on common lessons/issues across chapter, and that much greater detail and explanation is desirable. According to *Dr. West*, considerations for the authors in responding to these comments are report length, the tension between brevity and adding sufficient context and detail, and the handling of key insights for the executive audience, such as focusing on conclusive adaptation type things or problems, gaps, and barriers.

Dr. West stated that there are two approaches possible for changing the executive summary: 1) leave it in its current structure and lengthen the synthesis section or 2) to look at a different structure that would find a way to summarize across the systems and present the necessary points.

2.4.2 Synthesis Chapter

Dr. Peter Kareiva presented the Synthesis Chapter. In describing the intent of the Synthesis Chapter, he stated that the chapter is not intended to be a summary of the other chapters and thus is not strictly conceptual in nature. In the synthesis, the authors noonly

looked at the conclusions of the ecosystem-specific chapters, but also at other general and theoretical papers concerning climate change, and even added their own experience to the mix. Dr. Kareiva believes that the idea of adaptation makes sense only if it is phrased for particular management objectives. He gave the example of Puget Sound, and how adaptation strategies would differ depending on what institution was representing them, such as The Nature Conservancy versus fisherman, tourists or the shipping industry. Adaptation strategies in a particular ecosystem hinge on the goals of the stakeholder.

Dr. Kareiva stated that resource managers are reluctant to do anything with the high amount of uncertainty associated with climate change. He emphasized that these managers need to get comfortable dealing with this uncertainty, and need to start thinking about how they will respond to the positive and negative impacts of climate change. Managers need to be wary of scientific papers that treat scenario building as if it were climate forecast. Managers need to incorporate baseline monitoring for a basic understanding of their systems.

Dr. Kareiva defines the basic principles of adaptation:

resistance	=	intensive management
resilience	=	good system design
response	=	assisted migration
realign	=	alter objectives
triage	=	abandon certain goals

Dr. Kareiva discussed the specific adaptation approaches for managers presented in Table 9.4, including the protection of key ecosystems features, reducing other stresses, representation and replication of biodiversity, restoration of a particular ecological state, and refugia and relocation of particular species. He stated that options for adaptation will increase if managers work outside their normal constraints, operate at a large scale and learn quickly from others. In particular, it is important that they represent a boarder way of thinking than is often the case. He also presented the wide range of obstacles, such as 1) the shortage of legislation, incentives and expertise, 2) a lack of baseline measurements, 3) poor decision tools, and 4) the rarity of risk-taking.

Dr. Kareiva emphasized the need to manage in terms of one large system, otherwise response agencies could be running counter to each other. This will require agency cooperation and public education. He feels that climate change is an opportunity as well as a stress – an opportunity to implement adaptive management. He added that the public comments to this chapter of the report were good and most should be incorporated.

Dr. Robert Van Woesik questioned the omission of the paleo context. Dr. Kareiva responded that it was included in the baseline information.

2.4.3 National Forests

Dr. Linda Joyce began her presentation with highlights of Figure 3.12 ‘Timeline of the National Forest System Formation and Legislative Influences on the Mission of the National Forests’. She delineated the land that the Forest Service manages, and then listed the organizations six goals. Dr. Joyce reported on where the Forest Service is today with respect to climate change, including several case studies and recent workshops.

Dr. Joyce summarized the public comments on this chapter of the report either as missing concepts, programs/policies questions or technical in nature. Specifically, the public requested more emphasis on management options, shrublands and grasslands, monitoring, timber management, mitigation management, and the perception of fire and fire restoration. Dr. Joyce added that, overall, the goal of this chapter was heavily targeted throughout these comments, and thus appropriate revisions will be made.

Following the presentation, Dr. David Patton asked why only three forests were selected for this evaluation. Dr. Joyce responded that this was enough information given where these systems are right now.

Dr. Patton acknowledged that trying to provide managers with information that they can use on the ground is difficult, but added that the chapter does not include enough information that can be useful at the district level, where management decisions are made. He also stressed the inclusion of other agencies (besides EPA and the Forest Service) across ecoregions, because climate change affects an ecoregion, not an individual administrative unit.

Dr. Patton reminded everyone that nothing happens on the ground until there is a policy change from the top. Dr. Joyce added that in the 1970s the science of resource management moved to ecosystem management and the Agency made substantial changes to move away from clear-cutting by what was essentially a legislative order. Today similar things are being done with adaptation and mitigation, thus there is a good start to policy changes taking place.

Dr. Risser asked what is driving the attention to climate change in the Forest Service and what does this mean for local managers. Dr. Joyce replied that many movies and policy appearances have changed the countries openness to discuss climate change. Staff directors and region staff have come to really want to include it, and the specific workshops held following the SAP workshop provided to be really informative and spurred further meetings.

2.4.4 National Parks

Dr. Jill Baron stated that the National Park Service (NPS) Organic Act of 1916, which created a national park system and national park service, is both still relevant and still ambiguous today. She explained the 3-tiered structure of the NPS organization – a

national office for service-wide policy, seven regional offices for administration services, oversight, and conduits for information, and the individual parks is where individualized resource agendas are created using the management polices as guidelines. Dr. Baron states that this is an increasingly science-based system of ecosystem management, with current resources, processes, systems and values being based on physical/biological resources and processes.

The public comments received regarding this chapter indicated a list of subjects that needed more consideration in the report, including coastal parks and ocean habitats, Karst parks, groundwater and soil moisture, managing visitor behavior, hard trade-off decisions and how to increase resilience. These comments will be addressed by changing text in the chapter, but other suggestions such as using carbon accounting and carbon management to maximize carbon storage in national parks were found to be outside the realm of NPS goals.

Dr. Baron discussed how scenario-based planning could be used to create contingency plans based on alternative but plausible futures, and how it forces consideration of low probability but high risk scenarios. She considered the value of social capital, indicating that resource management only advances by incremental learning and gradual achievement.

Dr. Patton asked if Native Americans were included in this assessment (in particular, Grand Canyon National Park is surrounded by reservations). Dr. Baron stated that there was no tribal representation, and that those invited to the workshops were almost exclusively park resource managers, with a few academics and NGO participants. There were no tribal representatives or general public representatives.

Dr. Noss stated that the historical range of variability is a problematic concept that should not be dismissed too quickly. There are long evolutionary scales of many of the organisms we are talking about, thus they have already seen radical changes. The chapters make clear that there is more or less a range of variability and these organisms/ecosystems will tend to be more resilient because they have retained more of their functional groups, thus is still may be a valuable concept. Dr. Baron agreed partially, stating that it should be considered with caveats, and that there have been so many human manipulations that it may need to be abandoned completely.

Dr. Joseph Arvai asked why the chapter did not address the attributes of parks from which people who visit them derive things. Dr. Baron responded that the reason that they took an ecological approach is because of the title of the chapter. Dr. Arvai added that this is unique for this report because if you ask people what their objectives are for national parks you would get a very different list from visitors than from ecologists and that it would be interesting to hear from visitor groups and to see from an ecological perspective to what extent these align. Dr Baron stated that in their workshops there were a number of participants that do visitor management.

Dr. Scott asked to what extent a historical baseline was appropriate for a historical agency. Dr. Noss was interested in a context for consideration of the paleo information and the ways that organisms have adapted in the past to ecological change because considering the historic range of variability as a broad concept would help make decisions for the future.

Dr. George Hornberger suggested the addition of specific scenario planning examples to facilitate the reader's understanding of the problem of climate change in the NPS. Dr. Baron agreed that some of these types of scenarios should be added.

Dr. Carl Hershner stated that the case studies throughout the report are distracting because they are too big, and suggested that the authors be asked to identify up front what point they are trying to make with the case study so that some of the background material can be eliminated.

Dr. Risser asked why they authors did not want to be prescriptive. Dr. Baron replied that in the case of climate change, prescriptive was wrong because over time the prescription would have to change also. The other reason is that each park almost has its own culture and set of resource management issues, and the report did not want to be specific, thus potentially neglecting important issues. Dr. Risser added that prescriptions could be dynamic or static.

2.4.5 National Wildlife Refuges

Dr. Brad Griffith stated that the focus for this chapter was very large scale, intending to set the stage at the local level, and regional refuge biologists have praised its usefulness in dealing with climate change.

He stated that the refuge system was created at the beginning of the current rapid warming period and thus all management actions have been taking place in a changing climate. Because of this, he believes that it is valuable for refuges to mine their datasets for climate change. He emphasized that refuges are insufficient to accommodate climate change and that many of the species they accommodate are migratory, and will be moving on accordance with climate changes. He stressed that there needs to be acceptance of some degree of failure by the manager of these systems, due to the unpredictability of the problem and the fact that there is inadequate information available to make the response perfect.

Dr. Griffith summarized the public comments. Comments concerning omitted areas or groups may have been attributed to those invited but unable to attend the stakeholder workshops. Comments concerning missing topics or concepts often focused on gaps that require legislation to be included in this area of coverage. They also included comments asking for more emphasis on staff training and education. Comments also came in concerning the scope and structure of the reports, as well as with regards to specific programs and policies. Technical comments characterized models as inaccurate or not

validated. Editorial comments criticized wording such as ‘threaten,’ ‘confidence’ and ‘natural.’

Dr. Griffith believed that the Alaska case study focused on the issue of heterogeneity in warming, however comments came in indicating otherwise. He stated that climate change is a forcing factor that underlies the operation of all other stressors, which makes the picture more complicated because it can also change depending on these stressors.

Dr. Patton noted the particular problem of size for the National Wildlife Refuges and asked how all of the small units that they are dealing with could be designed to get the attention that they deserved. Dr. Griffith stated that educating the public is an important part of this process, as is the idea of directionality, such as targeting where these species will be in the future.

Dr. Patton asked if legislation could be revisited to become more ecosystem oriented rather than species specific. Dr. Griffith responded that he is not familiar with the legal aspects of this issue, but that the entire concept of the organization would likely need to be changed. The refuges are an ecosystem type because they are at low elevations, centered around wetlands, and very productive. Dr. Noss added that there is some inertia in the Agency with regards to this new policy, slow evolution in the refuges, and climate change can offer an opportunity for the refuges to really start thinking about the new mandate under the Wildlife Refuge Improvement Act.

Dr. Scott stated that a new vision of the refuge system in response to climate change has failed to evolve and it will be important to integrate with other agencies. Dr. Griffith believes that the desire to do something about climate change exists within the agency.

Dr. Patton asked if there were partnerships among small refuges. Dr. Griffith stated that there are unique relationships at the local level. For example, in Alaska, native groups often partner with land managers from other agencies. However, these relationships can be very heterogeneous and require increased communication amongst refuges to be successful. Managers need to be aware that the performance on their particular refuge is a function of many outside forces and communicate accordingly, such as when a migration or stopover causes the incorrect perception of population numbers changing. No refuge is an island.

2.4.6 Wild and Scenic Rivers

Dr. Margaret Palmer emphasized the differences between rivers and the ecosystems covered in the assessment. Specifically, the rivers encountered problems of mixed land use and large impacts due to urbanization (water withdrawals), thus climate change is not the only risk factor to consider. Additionally, most watersheds face management difficulties associated with mixed ownership. She indicated that, since the passage of the Wild & Scenic Rivers (WSR) Act of 1968, greater than 11,000 stream miles have been designated as WSRs. Management is administered by one four federal agencies with appropriate state and local partnerships.

Dr. Palmer summarized the comments on this chapter. Reviewers requested a description of the method for inviting stakeholders to the workshops and more validation to certain data that was presented, along with other more technical comments. Comments also indicated the need for more specifics in this chapter, such as the scaling down of precipitation, temperature, and run off predictions to smaller regions.

Dr. Palmer stated that the authors of this chapter did not just address climate change, but also stated that it will have synergistic interactions with other stressors on the rivers. They covered hydrologic, geomorphic and ecological impacts and how these might be responded to by management. She indicated that, since the rivers are not all in protected watersheds, reactive approaches to climate change impacts may be the more important. A proactive approach needs to take into account a larger area around the river. She indicated that, historically, rivers adapt rather well to changes in climate, unless they are impacted by other stressors.

Dr. Palmer believes that managing for uncertainty in the case of wild and scenic rivers makes sense, such as setting aside more land so that the river will have more of an opportunity to react to whatever change occurs. Also, change is needed in the amount of calibration between local and regional groups.

Dr. Palmer suggested that the concept of refugia is also important to this chapter, and that some attempt was made to include it.

Dr. Eric Gilman suggested site-based monitoring of changes in species distribution. Dr. Palmer agreed that this was a good idea, and added that continuous monitoring in the watersheds could help distinguish land use impacts from climate change impacts.

Dr. Hornberger suggested the inclusion of nitrogen deposition changes, because it too is a result of climate change. Dr. Palmer decides to include this also.

Dr. Hornberger stated that management options tailored to ameliorate the major stressors other than climate change could be good for potential climate change anyways. He does not see a need to stress attribution, only the fact that something is causing stress and change. Dr. Palmer agreed and admitted that the attribution issue was hidden in the chapter because she was overly concerned with speaking to climate change, even though urbanization and land use change could give the same impacts. Dr. Hershner agreed with this recommendation, and believes it is applicable to the other chapters as well. He also suggested that Dr. Palmer strengthen her proactive strategies for climate change adaptation. Dr. Palmer will edit accordingly.

2.4.7 National Estuaries

Dr. Charles Peterson thanked the contributing authors for their help in developing the chapter. Dr. Peterson provided some background information on the National Estuaries Program (NEP). He noted that the NEP operates as local programs. These programs lack

regulatory authority and instead rely on voluntary cooperation. They may use Federal or local authorities as a means of implementing the targets and goals. Dr. Peterson noted that areas of concern in National Estuaries include water quality, fisheries/wildlife, habitat, human values, freshwater quantity, introduced species and biodiversity. Historically, the focus has been on management of anthropogenic impacts.

Dr. Peterson discussed relevant legislative and regulatory governance structure for implementing NEP management goals. There are five management goals that are common to all NEPs; these are: water quality, fisheries and wildlife, habitat, human values and welfare and water quantity.

Dr. Peterson noted that there were a number of people involved in workshops related to NEP. These participants were not stakeholders in the sense of having home builders, fishermen, or realtors. Instead, stakeholders were defined as practitioners and scientists that were aware of the management structure and how natural and social sciences would feed into the management structure.

Dr. Peterson discussed the effects of existing stressors on estuarine management goals. Estuaries are the catchments point of all that happens terrestrially, atmospherically and locally. Dr. Peterson presented a list of current stressors, stated as either positive or negative, across the five management goals. He noted that there are also new stressors that need to be addressed. A big issue is the conflict of values when we list the management goals up against each other. Specifically, he noted that humans have come to occupy the coastlines. Therefore, as climate warms and sea level rises, there is a desire to protect that private property investment. However, current measures to protect property investment is in conflict with the fact that the marshes and shallow habitats need to have room to transgress upslope to keep up with sea level rise. It is an interesting conflict that requires a community-based stakeholder group. The fact that the NEPs are stakeholder-driven actually creates an opportunity where it is most needed.

Regarding management adaptations, the chapter discusses various options for protection of water quality, sustainability of fisheries and wildlife populations, preservation of habitat extent and functionality, preservation of human values, and water quantity.

There were not many public comments on the chapter. Some commenters noted omitted areas or groups. A new report related to the potential re-authorization of the Coastal Zone Management Act is available; information from this report will be included in the chapter. Information on the National Estuarine Reserve System (NOAA NERRS) was also omitted in the report. Other missing topics included the role of water quality standards beyond NPDES, the role of aquaculture in management and adaptation, focus on sea level rise and storm intensity to the exclusion of other climate factors such as temperature and precipitation and the effect of climate change on recent investments in restoration. The public also commented on the scope and structure of the chapter noting that the conclusions are beyond the scope of SAP 4.4 and are policy prescriptive. It was also noted that references to existing sea level rise policies and regulations may be outdated. There were some other minor technical and editorial comments

Dr. Hershner noted that the chapter is well written. However, the chapter is another example of where a good job was done in synthesizing background information but the effort felt short when it came to the final recommendations. When specific recommendations were identified (i.e., need for monitoring) they were worded in a unique way. Cumulatively, the recommendations lack a conviction for movement. Recommendations should be concisely worded. Dr. Peterson noted that the list of recommendations does not follow a specific order; in a narrative sense it goes in order but they should be prioritized.

Dr. Hershner believes that the case study is well written but does not seem to inform the chapter. The points that the authors want to make with the case study should be clearly stated. Dr. Peterson noted that the case study was meant to point out the following: 1) the existence of coastal protection habitat process, 2) the fact that 73% of the acreage in North Carolina is on the Pamlico estuary, which is one of the 3 hotspots in the world where sea level rise will have an impact, and 3) the outer banks will not be there in the end, making the inundation model non-sense.

Dr. Peterson noted that the growing eagerness, planning participation and investment is one of the biggest changes seen with federal funding and local match. By identifying those need it will serve to guide the program so it is more than atmospheric and physical science. A lot of these aquatic systems have a problem identifying the organisms.

2.4.8 National Marine Sanctuaries

Dr. Brian Keller noted that a stakeholders' workshop was held in January to discuss the content and applicability of the report. Representatives from various agencies and academia participated in the workshop.

Dr. Keller provided some background information on the Marine Protected Areas chapter. He noted that there are only 13 national marine sanctuaries; some were designed around cultural resources instead of natural resources. The sanctuaries are quite different from each other. National marine sanctuaries are nationally significant places for protection and management and are internationally recognized.

Dr. Keller indicated that the chapter focuses on coral reef ecosystems because of the extensive research that has been done already. The chapter also discusses the key ecosystem characteristics in which management goals depend. These include biodiversity, key species, habitat complexity, trophic linkages, connectivity, nutrient fluxes and larval dispersal and recruitment.

Dr. Keller noted that direct climate change stressors highlighted in the chapter include ocean warming, ocean acidification, rising sea level, climatic variability and ocean circulation, storm intensity and freshwater influx. Climate change interactions with traditional stressors are also discussed in the report. The authors chose to highlight

pollution through shoreline influxes of freshwater, commercial fishing and aquaculture, nonindigenous/invasive species and diseases (i.e., coral bleaching).

In terms of management approaches, Dr. Keller discussed the MPA networks and “beyond boundaries” management strategies. He noted that there is a 5-yr cycle after which management plans are supposed to be reviewed. Climate change has not come up in those discussions yet. Performance measures are being developed to help us be more quantitative.

Regarding adaptations to climate change, Dr. Keller noted that the chapter emphasized the following topics: spreading the risk, critical areas (refugia), connectivity, effective management, monitoring, restoration, building partnerships, tools and social resilience. Three case studies are included in the chapter. The three coral reef managed areas discussed in the case studies cover a range of protection from low to very high. Dr. Keller noted that there is a comprehensive plan to address climate change issues for the Great Barrier Reef. This is a good example from which to draw lessons.

Dr. Keller noted that the conclusions chapter has been revised to discuss research priorities. The management considerations are, to a large extent, exercising best management practices.

Dr. Keller indicated that the chapter did not get many public comments. There was a concern that the chapter was too oceanic. There was also a comment about the lack of information on land-coastal zone linkages. The chapter points out that these linkages exist but does not provide details on how their management realms affect their adaptation options.

Dr. Hershner noted that this is another example of where best management practices are probably the best that can be done. This needs to be universally worded so the point is consistent across chapters. It is very likely that climate change will eliminate the need for marine sanctuaries where they currently exist because changes will be so dramatic. Thus, the adaptive strategy is to give up.

Dr. Keller added that marginal reef systems come and go over time. The physical structure will take some time to erode. It can be argued that even if the reef disappears it is not time to give up on the ecosystem.

Dr. Van Woesik noted that the chapter does not list management adaptation options. There is a disparity between theoretical connectivity and networks and what we actually have in our sanctuaries.

Dr. Keller noted that the issue of large marine protected areas vs. multiple small ones comes up all the time. When trying to impose “no-take” protection in the Florida Keys, the social and political opposition was so great it took years to take the Keys to 6% level of protection. One could argue that seeking consensus is a luxury we no longer have. At the moment marine protected areas cover such a small proportion of the economic zone,

it could be argued that they are insignificant. On the other hand, this could be basis for public outreach and education. With years of protection we have seen pretty fast responses. The presumption is that a more diverse ecosystem will be more resistant to climate change.

3. PANEL DELIBERATION OF CHARGE QUESTIONS

Susan Julius noted that this report can be policy relevant but not policy prescriptive. The report is a scientific document and is not meant to be programmatic or policy prescriptive. The panel needs to be aware of the fact that some adaptation options are programmatic-prescriptive by nature. She noted that this report does not address mitigation since the Climate Change Science Program does not deal with mitigation issues.

Dr. Risser asked panel members for general comments or thoughts prior to addressing the charge questions.

Dr. Noss asked Susan Julius how much restructuring of the overall report is possible at this stage. He noted that panel members may need to keep a level of realism when making comments. Susan Julius indicated that there is a commitment to get the report out by December. This gives the authors about two weeks to make changes to the report in response to comments. She noted that, in spite of the time constraints, the authors need to know what panel members think should be done to make the report better.

Dr. Gilman asked why a committee has been convened so late in the process, since the report is almost complete. Susan Julius noted that this is consistent with EPA's internal regulations. Reports are never drafted using FACA committees; instead FACA committees are used to review the reports.

Dr. Van Woesik noted that in meetings of this nature, it is common to have differing opinions about terminology. For example, the term adaptation may mean something different for different people. Dr. West noted that in the climate change science community the definition of the term adaptation is different from that used by ecologists. In this report, the discussion on adaptation of human social systems is with regards to management. It is a difficult terminology problem and it is important to be careful about using this term. In the introduction, it is stated that adaptation in the context of this report means management. However, it is not clear if this is done consistently throughout the report.

Dr. Arvai noted that the concept of adaptive management is used differently within a chapter and within the report as a whole. Adaptive management needs to be addressed in the report, but (a) the authors should better acquaint themselves with the concept and (b) it should not be treated as a panacea as a grand solution to all problems. Dr. Risser agreed that this is a significant issue that should be communicated to the authors of the report. Dr. Julius noted that this issue will be captured in the minutes and the group can choose to talk more about it later during the meeting.

Charge Question 1 : Does the Committee agree with the focus on six management systems from across federally owned and managed lands and waters as an effective way to review adaptation options for climate-sensitive ecosystems and resources?

Dr. Hershner asked if, given the state of the report, there is an option to say anything other than it is okay. He noted that the report provides a reasonable overview of the subject.

Dr. Hornberger stated that the onus is on the writers of the synthesis chapter and the executive summary to try to overcome the limitations of this particular approach. He noted that the executive summary needs to be spruced up.

Dr. Patton noted that the BLM has concerns that have not been discussed yet. The six systems discussed in the report do not cover the largest land manager in the country. By selecting only six groups, the report is omitting a lot of stressors there have not been identified. He suggested that some text be added to the report to indicate that other agencies are also important. Dr. Noss agreed with Dr. Patton's comments and added that DOD has some of the best representation of federal land management agencies. At this point, however, all that can be done is for the authors to acknowledge up front that other agencies need to be considered.

Dr. Gilman stated that one solution for addressing the need to have a better synthesis is to add a chapter or text that concisely describes the state of knowledge regarding ecosystem response to climate change. This could be done concisely in the executive summary.

Dr. Risser noted that there are a lot of crosscut issues as well when dealing with management issues. It makes sense to acknowledge these commonalities and discuss them in the executive summary and in the synthesis chapter.

Dr. Arvai indicated that there is not a lot of background information in the introduction and the executive summary. There needs to be more information on what this report is meant to be and how it came together. The report should include several pages of expository materials about what is included in the report (and what is not included) and why it is included and why other information was excluded.

Dr. Malone noted that the ecosystem to ecosystem approach is a novel approach to doing a report that has a lot of merit. This approach addresses institutional issues and points out things that can be controlled. Many of the chapters allow to the readers to see how important partnerships are. Some of the chapters are better at that than others. It would be useful to provide the rationale for the approach used up front so that people understand why the report was written in this way.

Dr. Hornberger suggested that the executive summary be short and to the point. He noted that Congress and upper level management are not going to read the entire report so it is important to include in the executive summary things that are of interest to them. Dr. Arvai noted that, given the different audiences for this report, it might make sense to have different reports. A smaller report (i.e., a briefing memo) that spells out the issues more succinctly for congressional representatives and upper level management could be prepared.

Dr. Malone indicated that the summaries of the individual chapters are very good and suggested that they be moved to the chapters themselves as executive summaries. Dr. Van Woesik agreed with this suggestion. He added that the executive summary should be about two pages. The chapter summaries can be moved to the chapters and new text should be developed for the executive summary.

Dr. Tufford noted that the discussion of how legislative mandates affect management is uneven. He is particularly concerned with situations in which the Endangered Species Act is in conflict with climate adaptation response. More discussion on this issue is needed.

Charge Question 2: Does the Committee agree that the report provides useful information for managers on the state of knowledge regarding ecosystem management decisions sensitive to climate change, the types of adaptation options available, and approaches for implementing adaptation options? If the usefulness of the report could be improved, what specific improvements does the Committee recommend?

Dr. Hershner suggested that the re-write of the chapters be informed by the synthesis chapter. In this way, there is consistent use of terminology and themes re-occur throughout the chapters. In addition, there will be a cumulative argument for certain recommendations.

Dr. Noss noted that people has suggested that the synthesis chapter be moved to the front.

Dr. Arvai noted that his idea of creating 2 separate reports involve having the synthesis chapter or a variant of it as one of the stand alone documents, with the other being the longer, full report..

Dr. Malone agreed that the synthesis chapter could be revised first. Changes made to the synthesis chapter would then percolate to the other chapters. She noted that having parallel conclusions would strengthen the report.

Dr. Hornberger suggested that instead of re-writing the chapters, they could be moved to the back of the report as appendices. The report itself would be a reasonable summary of the appendices. This will address the unevenness that is evident in the report, particularly in the executive summary. Susan Julius stated that making the chapters appendices is not something that should be done. She agreed that the chapters should be made more concise. She noted that it is clear that the authors need to do a better job in terms of summarizing the technical information and addressing our congressional audience.

Dr. Patton noted that the authors did an exceptional job of synthesizing the literature. The bibliography by itself is a good management tool. This is a good source of information for managers, but it needs to be presented in way that can be accessible to people on the ground.

Dr. Hershner noted that the target audience is Congress or policy makers. An executive summary for this audience needs to be in the form of talking points. An abstract is not helpful; it is better to have a few bulleted points along with a statement of why those are important. Susan Julius asked whether a summary of the synthesis should be done. Dr. Hershner noted that it would help tie things together if every one of the chapters responds to the seven adaptation approaches listed in Table 9.4. Dr. Hornberger noted that members of Congress will ask staffers to summarize the executive summary. It is preferable that they summarize a 5-page executive summary instead of the full report.

Dr. Arvai stated that the report sets priorities in the absence of clearly identified goals or objectives. He noted that some stakeholders, for example might want to minimize the costs of implementing a management option. Yet is not clear how the priorities that the focus of the report addresses this objective, or others. It is not clear how to make the report address this issue better, but it would go a long way to improving its relevance and usefulness to local managers. A suggestion is to make the report process prescriptive. This involves laying out the considerations and the order in which they can be addressed, figuring out first what the problem and the goals are and thinking about how to measure the achievement of those objectives. Following this, data can be collected about the different options under consideration. Dr. Noss noted that these issues could be addressed in the synthesis chapter.

Dr. Hornberger stated that there is good background information. However, there are no specifics regarding the goals of management. Then there is the conclusion that “adaptive management will work.” In general, the chapters are good but all of them fall down on the specifics. Dr. Risser noted that the “courage coefficient” is quite different among chapters when it comes to making specific recommendations.

Dr. Gilman noted that there are cross cutting issues that would apply no matter what kind of management decisions. In looking at management options there is a question of what to do about invasive species. This should be brought up as a priority. Site-based causes should be addressed.

Dr. Risser asked whether Table 9.4 is specific enough to be helpful. Dr. Hershner noted that the table is general enough to be a useful organizational tool but that the chapters go to specifics that should fit under the various categories; however, what is important is to find a common language. Dr. Risser noted that this needs to be cast as being a framework for more specificity.

Dr. Hershner noted that the concept of ecosystem-based management is mentioned a lot in the chapters. However, there is no documented evidence that it works. This concept needs to be carefully considered before it gets too much play in this document. In addition, the report appears to say that the best way to deal with climate change is to resist it. There is still a lot of debate about this. Discussion of resilience should be balanced by discussion of what to do if we can't resist forever. Dr. Arvai noted that adaptive management and ecosystem management are buzzword paradigms because they

sound good, but mean different things to different people. It is important to make sure that these and other concepts are being used correctly in the report.

Dr. Risser noted that the 6-system approach used in the document brings out the differences in the way agencies work. Dr. Hershner noted that the authors did a good job laying out the background.

Dr. Van Woesik noted that Table 9.4 is a simplified matrix. Marine protected areas and restoration are multiple-level matrices. There needs to be reasoning behind the responses.

Dr. Hornberger noted that there is little that can be done to manage what comes into an estuary. One of the messages might be that climate change will change how you do business.

Charge Question 3: Does the Committee agree that the case studies are effective at demonstrating adaptation approaches and specific issues related to implementation? If the case studies could be improved to better demonstrate adaptation approaches, what specific improvements does the Committee recommend?

Dr. Hershner suggested that all case studies be reduced to boxes. In addition, the purpose of the case studies should be highlighted.

Dr. Van Woesik noted that it should also be clearly stated whether the case study worked or not. He suggested that the report include case studies that have addressed other stresses and how management strategies have adapted to these stresses.

Dr. Malone noted that most case studies are mixed; there are good things and bad things about the case studies. The text should note the purpose of the case study, why it was chosen and the lessons to be drawn. The things learned about adaptation from the case study should be noted. In addition, references could be made to other management system areas that are doing things differently.

Dr. Patton noted that case studies are good if there is a resolution to the problem and there is an outcome.

Dr. Arvai stated that case studies should be evaluated based on the objectives that guide adaptation decisions and not on the outcomes of those decisions.

Dr. West noted that initially case studies were envisioned to be no more than 4 pages. The authors also intended to explicitly state the reasons for choosing the cases studies. It was obvious from the beginning that there may not be a lot of actual examples where climate change policy has been implemented. It was difficult to find good case studies for use in the report. The case studies ended up longer than the authors expected. The question now is what useful information can be distilled from the case studies. Dr. Julius stated that case studies are generally retrospective. In this report, case studies are

prospective. It is difficult to carry the discussion any further about things that have not happened yet.

Dr. Noss stated that case studies should be reduced to boxes or eliminated. In the current state, the case studies do not add much to the report.

Dr. Hershner suggested that the authors extract the critical information and place it in a text box. The text currently in the case study can be moved to an appendix.

Dr. Risser noted that the case studies provide a level of realism to the report. Case studies demonstrate that these approaches can apply to lots of different systems. They should not be moved to the appendix, but a box might be a good compromise.

Charge Question 4: Does the Committee agree that the major conclusions and synthetic themes of the Synthesis chapter are supported by, and representative of the underlying chapters?

Dr. Malone indicated that the overemphasis on resilience in the synthesis chapter should be corrected.

Dr. Hershner noted that there are things in the synthesis chapter that are not included in the other chapters.

Dr. Hornberger noted that it would be a good idea to bring the authors together to revise the report.

Dr. West noted that the only time the authors were together was at the stakeholders meeting. She indicated that one option is to have the authors go through the synthesis chapter and determine if the contents of their chapters are appropriately presented in the synthesis. Another idea could be to do annotations and referencing where specific information can be found in the chapters.

Dr. Hershner noted that it would be better if the authors go back to the chapters and make sure consistent use of terminology.

Susan Julius stated that there are examples of terminology in each of the chapters.

Dr. Malone noted that, regarding the idealized decision making process discussed by Dr. Arvai, it is not clear what kind of recommendations are going to be made. She noted that outlining a decision making process is not going to be a sufficiently good advise to a manager. Dr. Arvai responded that the shelf life of any report dealing with specific options for adaptation to climate change would be relatively short. This, passing on an opportunity to educate managers about possible decisions processes may not be in the best interest of the Agency.

Dr. Arvai indicated that the synthesis chapter does not necessarily need to pull together all the parts where there is agreement. In regards to decision making, it is more important to make the point that a lot of entities responsible for managing do not have the capacity to see that process through instead of saying “here is a process that you can apply to all situations.” Capacity needs to be built within the responsible agency. The Synthesis Chapter can lay that out, e.g., common judgmental traps, poorly specified objectives, the tendency for managers to avoid of tradeoffs, etc. The report is not meant to provide all the answers but to highlight important points.

Dr. Malone agreed that the report is not meant to provide solutions; however, she noted that just saying that there are things lacking is not good enough either. In order to be helpful to decision makers, the report should do more than just stating that there isn’t a good process for making decisions. This might be one example of good use of case studies.

Dr. Arvai suggested that the synthesis chapter be the place to talk about the challenges faced when making decisions under uncertainty. The report is a good start, but it is contaminated by a real closed-mindedness about uncertainty. This report can go a step further by taking a broader look at the challenges in decision making faced by managers.

Dr. Malone noted that there is a CCSP report on uncertainty. This may be a way of getting out of doing a lot of writing for this report.

Dr. Risser asked about next steps. Susan Julius stated that the notes from contractor will be ready 10 days after this meeting. The panel members will look at the summary notes and edit as needed. The individual reports are going to be more useful for the authors than the raw notes.

Charge Question 5: Does the Committee agree that the key findings and recommendations presented in the Executive Summary are the most important and appropriate to bring forward to executive level managers and Congress?

Dr. Hershner suggested that the chapter summaries be moved from the executive summary to the individual chapters.

Dr. Hornberger noted that it is not clear that there were recommendations made in the executive summary. If there are recommendations they are buried in the text. This is not a useful way to have the final executive summary.

Dr. Malone stated that she did not think about this as a recommendation-type report. It is more like a conclusion-type report. Susan Julius agreed that the report was meant to provide conclusions not instructions to the Programs on how they should operate.

Dr. Gilman indicated that the executive summary should focus on identifying main conclusions on ecosystem adaptation. There should be a concise statement of what we learned.

Dr. Arvai stated that the Agency needs to think about what parts of the report are going to different audiences. Dr. Julius noted that the executive summary is meant for high level managers. This is the reason the information is presented by system. In the synthesis chapter there are themes addressed to different audiences. The first part is meant for managers on the ground. Information is included on what to do if management goals cannot be achieved. This is followed by information on capacity to adapt. Thus, there are two different audiences.

Dr. West noted that the high-level executive audience may be split into different levels. Some people will be more interested in detail than others.

Dr. Arvai noted that the Executive Summary may need to cover some of the points present in the Synthesis Chapter.

Dr. Risser suggested that the executive summary be drafted for the agency heads. A good EPA PR person can then write a summary for Congress. Dr. West asked how long the executive summary should be if it is to be directed to agency heads. Various suggestions were provided by panel members including having the Executive Summary to be between two and five pages long. Dr. Hornberger noted that it is more important to have a concisely written summary. He noted that not a lot of people will read it if it only rehashes things that do not belong there. It is okay if the report does not have recommendations. However, the report should include recommendation-like statements.

Dr. Arvai noted that sometimes these reports are seen as being the culmination of work on a particular topic. However, climate change, and adaptation to it, is a concept that the Agency, and indeed the scientific community, will be talking about for years-perhaps decades-to come. As a result, five years from now, this report may be looked upon quite differently than it is now. He, therefore, asked whether there are any plans for addressing or responding to future changes with future EPA working groups so as to provide some Agency continuity on this topic. Dr. Julius stated that there are workshops planned to decide when the next national assessment will be done. There is a commitment to continue working on these issues. However, the nature of that continuance is in question.

In response, Dr. Arvai also noted that one of the synthetic themes in the report should be to emphasize the need for an ongoing effort by EPA as it relates to adaptation to climate change. Failing to send the signal to EPA and to the audience(s) for this report, would be an opportunity lost. Dr. West agreed and noted that the term “preliminary review” is an important phrase. Some of the conclusions are that, right now, we can only take the thinking so far. Dr. Julius noted that one question in prospectus that could not be addressed is how to measure progress. Dr. Arvai indicated that it is important to highlight this issue beyond simply using the relatively cryptic language of “preliminary review” in the title.

DAY 2

Side Discussion: Use of Non Peer-Reviewed Literature

Dr. Risser noted that CCSP needs to approve cited literature that is not peer reviewed, and that the agency needs to have copies of the literature available for the public. There are a number of citations in the report that should be checked in light of this, particularly in Section 4.4.

Dr. Joyce gave a few examples of cited literature that was not peer reviewed: the 2006 mitigation report, the Mahal and Bettenport article, and the National Acid Precipitation Assessment Program.

Susan Julius noted that a database had been created of cited articles, copies of which were available.

Dr. Noss suggested that it would be sufficient to state clearly the status of these articles' availability in the report. He also noted that, since new science is continually being published, it is important to stay current by using more than just peer-reviewed literature.

Dr. Malone agreed and gave as an example workshop reports that might contain useful information, even though they are not peer-reviewed literature. However, Dr. Hornberger cautioned that it would be incorrect to cite a workshop report as a definitive citation.

Dr. Risser, summarizing the thoughts of the group, stated that peer-reviewed information should be used whenever possible, but that, when peer-reviewed literature was not being used, the authors should clearly mark that information as not being peer-reviewed. Non-published peer reviewed literature should be available to readers on request.

The expert panel reviewed the general comments submitted during the public comment period. Susan Julius stated that the authors need to address each comment and state whether or not they agree with each one. The authors had chosen particular issues for the expert panel's consideration.

Dr. Patton noted that after looking at the pre-meeting comments on National Forests, Dr. Joyce covered most of the material (missing items) during her presentation.

Dr. Risser noted that, as Dr. Patton said, 1 or 2 agencies dominate the reviews, but in general, it's done well.

Charge Question 6: Does the Committee agree that EPA effectively followed the CCSP Guidance on characterizing confidence levels for the proposed adaptation approaches presented in the Executive Summary and Synthesis?

Dr. Hornberger believes that there is a link missing between Table 9.4 and the chapter text. Also, the text box in the synthesis section forms the basis of Table 1.1, which is the assessment of confidence level. There also needs to be a link between those two parts. This can be fixed by having explicit explanations in each chapter about how adaptation options were considered. He believed that such explanatory text is necessary as per CCSP guidance.

Dr. Gilman stated his concern about making uncertain projections of climate change, thinking about a range of responses that also have uncertainty associated with them, and finally developing confidence intervals for adaptation options. This train of projections requires a great deal of compounded uncertainty.

Dr. Jordan clarified the intent of the report. The confidence statements in the report are not meant to be about the probability of the impacts or the probability of a specific climate change impact occurring. Rather, they were meant to answer the question “will implementing these strategies render the system more resilient?” The authors tried to answer this subjective question without consideration of how realistic the strategies would be to implement.

Dr. Gilman suggested that, to clarify the intent, the report should preface the confidence statements in this way: assuming that the projected impacts are going to occur, what is the level of confidence that Option X will work?

Charge Question 7: Does the Committee agree with the decision to use information from a series of stakeholder workshops in addition to the published literature to identify and assess adaptation options and implementation issues for climate-sensitive ecosystems?

Dr. Arvai noted that the report may be criticized as an example of insufficient (at best) or poor (at worst) stakeholder involvement. By admission of the authors, “stakeholder involvement” for this report consisted mostly of expert input, as scientists, rather than stakeholders responses. Calling these expert consultations “stakeholder involvement” risk upsetting and disenfranchising other legitimate stakeholders groups. Dr. Arvai also stated that there is debate in literature about whether or not expert advisors can be considered stakeholders. The book “The Fifth Branch” by Shelia Jasanoff contains a useful discussion of the matter. In the end, Dr. Arvai, recommended that the report be honest about what its stakeholder involvement process entailed: this includes a rationale for why things were done as they were and what may be lost by not having a more comprehensive stakeholder involvement process. This is not a minor point.

Dr. Patton noted that focus groups had been successfully used during his time on the Indian forest assessment team.

Dr. Malone suggested that the experts who provided input could be considered stakeholders; however, it needs to be clear who those people were and what the purpose was in inviting those people to provide input.

Susan Julius suggested stating in the report what the goals of the stakeholder meetings were, as doing so would help explain who was invited.

Dr. Malone suggested that the process used for this report constitutes one type of stakeholder involvement, and that this fact should be noted in the report.

Dr. Noss noted that there was a list of attendees to the stakeholder meetings but not a list of invitees. It might be useful to provide the latter list.

4. CHAPTER BY CHAPTER DISCUSSION

Dr. Risser led the panel in discussion of each of the eight chapters. Prior to the meeting, eight panel members had been assigned particular chapters for which they were to record comments elicited by the panel. During this chapter-by-chapter discussion, each of the chapter leads was invited to summarize their recorded comments. Dr. Risser asked that points directly related to the charge questions not be included in these summaries, as they would be addressed separately.

4.1 Executive Summary

Dr. Gilman summarized the panel's comments about the Executive Summary as follows:

- *The report's main conclusions were not adequately expressed.*
- *Key policy areas and key areas in need of attention should to be clearly identified. However, actual policy prescriptions should not be made.*

Dr. Hornberger questioned whether the executive summary should be recommending that all of the nation's lands and waters be managed by a single entity. The authors should not be making direct recommendations; moreover, the suggestion may be infeasible. Dr. Hershner suggested that, rather than recommend the creation of a single managing entity, two important conclusions should be highlighted:

1. Managers should be conscious of opportunities for interagency cooperation.
2. There will be a need to expand authority in certain agencies in order to deal with climate change.

Dr. Hershner believes that these two statements suggest the same "single entity" idea but in a more realistic way. Dr. Gilman suggested adding a sentence that says "existing authorities may be inadequate to deal with implementation methods." Dr. Van Woesik suggested adding a sentence that says that "agencies can benefit from cross-agency communication."

- *The action items (i.e., what decision makers should consider when making decisions) need to be clearly stated.*
- *The executive summary should be relatively succinct.*

Dr. Arvai noted that the proper length for the executive summary will depend on where the synthesis chapter is ultimately placed. Dr. Malone noted that the format of the executive summary should take into account the fact that there are two executive audiences: congressional staffers and agency heads. The latter will be interested in the executive summary, the Synthesis Chapter, and their own management system chapter. Congress would probably prefer a shorter executive summary. Dr. Noss noted that, if the panel were to recommend that the synthesis should be moved up front, then they can also note the roles they see the executive summary and synthesis chapters as fulfilling. Dr. Noss suggested that the panel recommend an executive summary length of 2-5 pages.

Drs. Hornberger, Risser, and Gilman suggested that a “succinct and short” executive summary be recommended, without reference to a particular length.

- ***There needs to be a better summary of the main lessons learned from the case studies.***

Dr. Hershner suggested that case studies can be used not only to showcase a particular lesson learned, but also to illustrate a concept described in theoretical terms in a chapter. Drs. Hershner and Van Woesik suggested moving the case studies out of the executive summary and leaving them only in the chapters. Dr. Hornberger suggested that a summary statement of the case studies would suffice, rather than a long list of all the case studies. However, if there are any particularly useful examples, those could be highlighted.

- ***Put the chapter summaries currently in the executive summary into the actual chapters.***

Dr. Hornberger suggested that, if the decision is made to not put the chapter summaries into the actual chapters, the summaries should be rewritten to make them consistent in content and style.

- ***Clarify that a plan is needed even if the United States decides to take action against greenhouse gas emissions.***

Dr. Hershner suggested that this point should be carefully managed so that it does not come across as a prescriptive statement. Dr. Van Woesik noted that, although the issue was important, the authors are not supposed to describe mitigation processes in the report. Dr. Malone suggested the sentence “even if greenhouse gas emissions stopped tomorrow, concentrations would still continue to rise.”

Dr. Gilman suggested that the phrase “uncontrollable climate stresses” be changed.

4.2 Synthesis Chapter

Dr. Arvai summarized the panel’s comments about the Synthesis Chapter as follows:

The structure of the document should be changed. Dr. Arvai noted that the panel should suggest to the authors how the document should be restructured. If the executive summary is written so that it provides a brief summary of the entire report, then there is no need for expository material. However, if the Executive Summary does not provide a brief summary, then the Synthesis Chapter should. Also, the panel should recommend where the Synthesis Chapter should be placed.

Dr. Van Woesik asked if the Synthesis Chapter should start at Section 9.3, where adaptation approaches are discussed, and if the synthesis themes could be placed in the back of the chapter.

Dr. Arvai suggested that the material in Section 9.2 be reduced and that the overarching themes in Section 9.3 be emphasized.

Dr. Van Woesik suggested that the biodiversity issues be brought to the end of the chapter.

Dr. Noss suggested the creation of a first chapter that would serve the purpose of both an introduction and a synthesis. Dr. Hornberger agreed.

Dr. Arvai suggested that the introductory material in Chapter 2 be presented prior to or following after the synthesis chapter.

Dr. Hershner suggested that Chapter 2 be split, leaving in those portions that will go well with the synthesis chapter. The Synthesis Chapter could then be appended to the abbreviated Chapter 2 to create an “introduction and synthesis” chapter. The remainder of Chapter 2 could be used to create a Chapter 3 entitled “Background”.

Dr. Hornberger suggested that the Executive Summary be removed from the chapter numbering system (i.e., not be called Chapter 1).

- ***The Synthesis Chapter can be used as a guide for subsequent revisions in other chapters.***

Dr. Arvai clarified that the Synthesis Chapter should be edited first and that individual authors could address the themes brought up in the revised synthesis chapter. The Synthesis Chapter should provide expository background information, i.e., a description of the systems chosen for the analysis, why they were chosen, and what was left out and why. This might help orient the reader.

- ***Key themes didn't receive the detailed attention that they deserved (e.g., state of knowledge regarding decision making for ecosystem management, buzzword paradigms without a clear discussion of how the authors see adaptive management as a synthetic theme).***

Dr. Arvai added that some of the themes discussed weren't addressed as forcefully as the supporting text in the main chapters would suggest would be appropriate.

- ***This report should be treated as one step in a series of steps, and language should be included to indicate this.***

Dr. Gilman noted that, in the previous day's discussion, it was suggested that text or a matrix describing individual ecosystem responses might be useful. The information could go into the background chapter.

Dr. Malone noted that the panel had discussed the need of the synthesis include more discussion about the confidence table and to provide rationale for the grades assigned.

Dr. Malone expressed concern about the extent of changes being recommended by the panel and the degree of difficulty for the authors to implement them. She suggested softening the panel's recommendations.

4.3 National Forests

Dr. Patton summarized the panel's comments on the National Forest Chapter. He noted that the forest service presentation in the previous day had highlighted the key issues. He summarized the panel's comments as follows:

- Timber management as a stressor was not discussed.
- Information from other federal agencies was not included in the case studies.
- There are a number of missing concepts, including genetics, wildlife fire.
- The report should be formatted to cover 2 levels of management: executive and decision-making.
- In general, the report is a reflection of what is in the scientific literature.
- There is a lack of site-specific examples that could be used by land managers.
- Issues such as adaptive management and the need for better definitions have not been specifically addressed in the national forests section.
- Case study summaries need to be reformatted, perhaps as text boxes.
- The panel agreed that the separation of the report into administrative units rather than ecological units was a good way to give credit to stakeholders/agencies, but that it didn't lessen the validity of ecosystems.

Dr. Hornberger noted that there may be management options that have been implemented for reasons other than climate change that would be useful in the climate change context. He believes that these options should be pointed out. Dr. Hershel added that a good adaptive response option to climate change is doing better those activities that are already being done.

Dr. Patton stated that some organizations have started growing seedlings to give to private land owners in an attempt to grow ponderosa pine ceilings. There are other activities such as this that are relevant to the situation but not well known. He will add such ideas to his list of recommendations to the authors.

Dr. Noss stated that some options, such as thinning out forests, may be considered by some as overzealous management.

4.4 National Parks

Dr. Malone believed that the National Park Chapter was excellent overall. The chapter has a good emphasis on the way managers think and length is also good. She summarized the panel's comments about the chapter as follows:

- There should be a brief discussion of other agencies and entities who can affect the management of national parks.
- Tribal considerations, as they affect the management of national parks, should be considered.
- Paleozoological data might need to be considered.

- The chapter should reflect visitor perspectives to the park. Also, what thought has been given to planning for adaptation in light of visitor impact?
- Case studies should be improved by adding a clear description of purpose of each case study.
- More site-specific examples should be added, as the chapter is very theoretical.

Dr. Hornberger wondered how recommendations could be made for the effect of climate change on the frequency of extreme events. He noted that, from a management perspective, it's not clear how this change in frequency should be handled.

Dr. Noss suggested that anticipatory actions could be taken by agencies, but that these actions would depend on site-specific aspects.

Dr. Patton noted that, in southern California, citizens are warned not to build homes in fire-prone areas, but continue to do so, even after having their houses burned down.

Dr. Malone read text that she developed as a possible solution, and the panel agreed that the text would be good to include into the report.

4.5 National Wildlife Refuges

Dr. Tufford summarized the panel's comments on the National Wildlife Refuges Chapter as follows:

- The chapter should be conceptually consistent with the Synthesis Chapter.
- Terms such as "adaptive capacity", "adaptive management", and "anticipatory management" should be used appropriately.
- There needs to be a clear focus on the audience that is to be addressed by the chapter. The focus should be on the national and regional levels, since that is where policy is being made. However, this recommendation by the panel may be in conflict with the suggestion that more detail be provided about some of the local issues that might be related to climate change.
- The one case study provided in the chapter was perhaps too large, and there was some concern about whether it covered all the issues (in particular, coastal issues). The case study may be better if reduced to a text box.
- The national wildlife system appears to be the main focus of the report, and the panel encourages more discussion on that topic.

Dr. Jordan suggested that, instead of directly suggesting the development of a new interagency council to deal with climate change, the report could recommend better coordination through the subcommittee within Office of Science and Technology Policy that handles ecosystems coordination. Then it would be up to the policy maker to read the report and determine if the subcommittee would be capable of such action.

Dr. Noss stated that the comments noted by the chapter leads that apply report-wide would be combined into a "general comments" section of the recommendations.

4.6 Wild and Scenic Rivers

Dr. Hornberger believed that the Wild and Scenic Rivers Chapter was well written. He summarized two major points about how improvements could be made to the chapter:

- Linking management options to potential climate change issues, and
- Using case studies to emphasize this link.

He noted, for example, that in policy context section, six steps are listed for developing effective management strategies. These points would be useful to carry forward to what is feasible under the current structure. As another example, the adaptation section notes in paragraphs 6-24 that managers should develop reservoir operating plants. But in the previous table, it's shown that such development is not possible, since the managers are upstream. He suggested that text be added that says "these are current options, but if they're not sufficient, here are potential barriers and potential solutions."

Dr. Hornberger noted that the case studies, though interesting, lacked focus, and that the conclusions were not explicitly stated. In addition, some concluding statements, like the need for modeling, were not specific to the Wild and Scenic Rivers Chapter. Also, the conclusion did not state that stressors other than climate change will continue to have deleterious effects if no correction management actions are taken, or that some of those actions may be useful for climate change as well.

Dr. Hornberger also noted that the description of how WSRs are designated or how management authority is assigned is not clear.

Dr. Hershner suggested that the "no regrets" synthetic theme, along with the other 4 themes should be addressed in all of the main chapters.

4.7 Estuaries

Dr. Hershner summarized the panel's comments on the estuary chapter as follows:

- The conclusions need to be focused and prioritized.
- The first two sections of the report are well written.
- The Coastal Zone Management Act needs to be addressed.
- "Adaptive management" and "ecosystem based management should not be considered strategy options, as they are not simple options to implement, nor are they necessarily effective.
- The correlation between resilience and biodiversity is still suspect and debatable.
- The case study provided is long and could use a description of the purpose, as described in the previous day's meeting.
- A summary of the chapter should be provided at the beginning.

Dr. Noss noted his personal view that there is a correlation between resilience and biodiversity; however, he acknowledged that it's unclear if the correlation will hold true in a time of rapid change of environment.

Dr. Hershner clarified that he didn't want the discussion removed from the report; rather, he simply worries that the conclusion that biodiversity will provide resilience to climate change is too strong.

Dr. Noss noted that Kareiva et al. was cited in the Synthesis Chapter as evidence that resilience is a short- to medium- term strategy. He believes this is a reasonable statement, and the other chapters could be consistent and make a similar statement if necessary.

Dr. Hornberger agreed and suggested that a statement about the uncertainty about the longer-term outlook be included in the report.

Susan Julius suggested that the definitions of terms such as "adaptive management" and "ecosystem based management" be treated carefully in one place, rather than in each chapter.

Dr. Hershner suggested that it was too late to have chapter authors rewrite sections to adhere to common definitions of these terms.

Dr. Van Woesik suggested that the synthesis authors lay out a general definition, from which the individual chapters could expand on the definition as necessary.

Dr. Hershner stated that ideas like "adaptive management" and "ecosystem based management" require thinking about the entire system, and that, though good in principle, they would be extremely difficult to implement, and are not realistic solutions.

Susan Julius suggested characterizing these management strategies not as solutions, but as goals to be striving towards.

Dr. Hornberger read text that he developed as a possible solution, and the panel agreed that the text would be a good inclusion.

4.8 Marine Protected Areas

Dr. Van Woesik summarized the panel's comments for the marine sanctuary section.

- A link should be made between management options and climate change.
- Text should be added regarding factors that contribute to bleaching other than temperature, such as turbidity.
- The report talks about the concept of invasive species. Additional text should be added to describe the concept of geographic range expansion. If, as a result of climate change, species permanently shift their geographic range, that is a different issue from exotic species coming from different continents.

- It should be noted that monitoring and forecasting do not necessarily facilitate management for climate change.
- Case studies that describe non-climate related stresses might be useful if they help show a management strategy that could be useful in a climate change situation. Case studies that illustrate the adaptive management strategy could also be useful.

Dr. Hornberger agreed strongly with the importance of the geographic range expansion idea and noted that there may be utility in letting species shift to areas where they can live more readily.

Dr. Noss added that the term “invasive species” may not apply when a species is shifting locations within a continent. Managers would be off-base in being concerned about taxon native to North America shifting their habitat. Such shifting is desirable during a change in the environment.

Dr. Van Woesik noted that geographic range shift is much more likely to happen in the ocean, where the boundaries between water bodies aren't clear.

5.0 MEETING CONCLUSION

The panel reviewed their individual writing assignments and the timetable. Susan Julius will send a distribution list to the group. Chapter Leads were asked to provide a one page summary of chapter comments. No template was deemed necessary. Dr. Risser suggested that the Chapter Leads feel free to stress the positive aspects of the chapters as well. Dr. Risser suggested that they schedule the conference call for sometime in the future to resolve conflicts. Dr. Risser noted that panel members could share comments with authors immediately if desired, as long as it is made clear that the comments are preliminary notes. The major comments from the panel will be included in the memo being prepared.

Dr. Gamble noted that, though the work for the panel was described as having a lifespan of two years, there is no anticipated work for the panel to do in the future after these last tasks are completed. Susan Julius stated that possibly issues could arise in the future for which the panel would be asked to reconvene.

Dr. Risser ended the meeting by expressing thanks to the authors and the contractors.

APPENDIX A
LIST OF ATTENDEES

**Adaptation for Climate-Sensitive Ecosystems and Resources Advisory Committee
(ACSERAC)
Member Roster**

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Adaptation for Climate-Sensitive Ecosystems and Resources Advisory Committee

October 22, 2007

Hyatt Regency at Bethesda

Attending Government Officials, Committee Members, and Report Authors:

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Adaptation for Climate-Sensitive Ecosystems and Resources Advisory Committee

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APPENDIX B

CHARGE

Charge Questions for the Adaptation for Climate-Sensitive Ecosystems and Resources Advisory Committee (ACSERAC) Review of Draft Synthesis and Assessment Product (SAP) 4.4: Preliminary Review of Climate-Sensitive Ecosystems and Resources

October 22-23, 2007

EPA requests that the ACSERAC review the draft report entitled Synthesis and Assessment Product (SAP) 4.4: Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources. EPA respectfully submits the following general charge questions:

8. Does the Committee agree with the focus on six management systems from across federally owned and managed lands and waters as an effective way to review adaptation options for climate-sensitive ecosystems and resources?
9. Does the Committee agree that the report provides useful information for managers on the state of knowledge regarding ecosystem management decisions sensitive to climate change, the types of adaptation options available, and approaches for implementing adaptation options? If the usefulness of the report could be improved, what specific improvements does the Committee recommend?
10. Does the Committee agree that the case studies are effective at demonstrating adaptation approaches and specific issues related to implementation? If the case studies could be improved to better demonstrate adaptation approaches, what specific improvements does the Committee recommend?
11. Does the Committee agree that the major conclusions and synthetic themes of the Synthesis chapter are supported by, and representative of the underlying chapters?
12. Does the Committee agree that the key findings and recommendations presented in the Executive Summary are the most important and appropriate to bring forward to executive level managers and Congress?
13. Does the Committee agree that EPA effectively followed the CCSP Guidance on characterizing confidence levels for the proposed adaptation approaches presented in the Executive Summary and Synthesis?
14. Does the Committee agree with the decision to use information from a series of stakeholder workshops in addition to the published literature to identify and assess adaptation options and implementation issues for climate-sensitive ecosystems?

APPENDIX C

AGENDA

**U.S. Environmental Protection Agency
National Center for Environmental Assessment – Global Change Research Program
Adaptation for Climate Sensitive Ecosystems and Resources Advisory Committee (ACSERAC)**

Monday, October 22, 2007 – 9:00 a.m. to 5:30 p.m. Eastern Time

Tuesday, October 23, 2007 – 9:00 a.m. to 3:00 p.m. Eastern Time

Hyatt Regency at Bethesda, One Bethesda Metro Center, Bethesda, MD 20814

**Purpose: Conduct a Peer Review of EPA’s Draft Report: Synthesis and Assessment Product 4.4:
Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources**

Monday, October 22, 2007

8:00 am - Registration
9:00 am

9:00 am Introductions and Administration

Janet Gamble,
*Designated Federal
Official, EPA*

9:05 am Welcome and Opening Remarks from EPA

Peter Preuss,
*Director, National
Center for
Environmental
Assessment*

9:10 am Purpose of Meeting and Overview of Meeting Agenda

Paul Risser, *Chair,*
ACSERAC
Reed Noss, *Vice-
Chair, ACSERAC*

9:15 am Presentation on Purpose and Goal of SAP 4.4 Report

Susan Julius, *Lead
Author, EPA*

9:25 am Presentation on Executive Summary

Jordan West, *Lead
Author, EPA*

9:35 am Presentations by Lead Authors (*20 minutes, with 10 minutes for
discussion*)
Synthesis
National Forests
National Parks

Peter Kareiva, *TNC*
Linda Joyce, *USFS*
Jill Baron, *USGS*

11:05 am Break

11:20 am	Presentations by Lead Authors National Wildlife Refuges Wild and Scenic Rivers	Brad Griffith, <i>USGS</i> Margaret Palmer, <i>UMD</i>
12:20 pm	Lunch	
12:40 pm	Presentation by Lead Authors National Estuaries National Marine Sanctuaries	Pete Peterson, <i>UNC</i> Brian Keller, <i>NOAA</i>
1:40 pm	Panel deliberation of charge questions Charge Q1. Does the Committee agree with the focus on six management systems from across federally owned and managed lands and waters as an effective way to review adaptation options for climate-sensitive ecosystems and resources? Charge Q2. Does the Committee agree that the report provides useful information for managers on the state of knowledge regarding ecosystem management decisions sensitive to climate change, the types of adaptation options available, and approaches for implementing adaptation options? If the usefulness of the report could be improved, what specific improvements does the Committee recommend? Charge Q3. Does the Committee agree that the case studies are effective at demonstrating adaptation approaches and specific issues related to implementation? If the case studies could be improved to better demonstrate adaptation approaches, what specific improvements does the Committee recommend?	Paul Risser, <i>Chair, ACSERAC</i> Reed Noss, <i>Vice-Chair, ACSERAC</i>
4:55 pm	Formal public comment period (<i>for members of the public who are present at the FACA meeting</i>)	Janet Gamble, <i>Designated Federal Official, EPA</i>
5:00 pm	Adjourn	

Tuesday, October 23, 2007

- 9:00 am Panel discussion of public comments (*received during 45 day public comment period*) Paul Risser, *Chair, ACSERAC*
Reed Noss, *Vice-Chair, ACSERAC*
- 10:00 am Panel deliberation of charge questions Paul Risser, *Chair, ACSERAC*
Charge Q4. Does the Committee agree that the major conclusions and synthetic themes of the Synthesis chapter are supported by, and representative of the underlying chapters? Reed Noss, *Vice-Chair, ACSERAC*
- 11:15 Break
- 11:30 am Panel deliberation of charge questions Paul Risser, *Chair, ACSERAC*
Charge Q5. Does the Committee agree that the key findings and recommendations presented in the Executive Summary are the most important and appropriate to bring forward to executive level managers and Congress? Reed Noss, *Vice-Chair, ACSERAC*
- 12:15 pm Lunch
- 12:45 pm Panel deliberation of charge questions Paul Risser, *Chair, ACSERAC*
Charge Q6. Does the Committee agree that EPA effectively followed the CCSP Guidance on characterizing confidence levels for the proposed adaptation approaches presented in the Executive Summary and Synthesis? Reed Noss, *Vice-Chair, ACSERAC*
Charge Q7. Does the Committee agree with the decision to use information from a series of stakeholder workshops in addition to the published literature to identify and assess adaptation options and implementation issues for climate-sensitive ecosystems?
- 2:45 pm Wrap-up and next steps Paul Risser, *Chair, ACSERAC*
Reed Noss, *Vice-Chair, ACSERAC*
- 3:00 pm Adjourn

APPENDIX D
PRESENTATION OVERHEADS



Background on SAP 4.4: Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources

Presentation to ACSERAC on October 22, 2007



Office of Research and Development
Global Change Research Program, National Center for Environmental Assessment



SAP 4.4: CCSP Guidance

- Requirements
 - IQA compliant
 - Highly influential science assessment
 - Uncertainty
 - Review process:
 - Expert review
 - Independent external review (with public review)
 - CCSP and NSTC clearance
- Strongly recommended
 - Executive summary ≤ 8 pages
 - Stakeholder workshops



SAP 4.4: Scope and Focus

- Examine context for applying adaptation: management goals
- Focus on federally managed lands and waters
- Generate broadly applicable insights

2



SAP 4.4: Prospectus

- Identify:
 - Climate sensitive management goals
 - Options for adapting to climate change
 - Characteristics of human and ecological systems that enhance or inhibit implementation
- Communicate this information to stakeholders:
 - Resource and ecosystem managers at federal, state and local levels
 - Tribes, non-governmental organizations and others involved in protected area management decisions
 - Scientists, engineers and technical specialists

3



SAP 4.4: Report Structure

- Executive Summary
- Introduction
- System Chapters
 - Enabling legislation
 - Interpretation of goals
 - Current status of management systems
 - Adapting to climate change
 - Case study/ies
- Synthesis

4



SAP 4.4: Lead Authors

Dr. Linda Joyce (USFWS)	National Forests
Dr. Jill Baron (USGS)	National Parks
Dr. Michael Scott (USGS)	National Wildlife Refuges
Dr. Margaret Palmer (U. of Md.)	Wild and Scenic Rivers
Dr. Charles "Pete" Peterson (U. of S.C.)	National Estuaries
Dr. Brian Keller (NOAA)	Marine Protected Areas
Dr. Peter Kareiva (TNC)	Synthesis and Conclusions

5



SAP 4.4: Process

- Invited Lead Authors (Sept 06)
- Held stakeholder workshops (Dec 06 – Jan 07)
- First draft report internally peer reviewed (May – Jun 07)
- Response to comments and second draft report (Jul – Aug 07)
- Public review (Sept – early Oct 07)
- FACA review (late Oct 07)
- Response to comments and third draft report (Nov – Dec 07)
- FACA review of responses (late Dec 07)
- Submit for CCSP and NSTC clearance (late Dec 07)

6



SAP 4.4: Stakeholder Workshops

Goal: Obtain feedback on the content and the management applicability of concepts under development for SAP 4.4.

Stakeholders helped shape the substance of the report. Invitees were small groups of leaders in adaptation science and resource management.

Workshops held in Annapolis, Maryland

National Forests: Dec 4-6	National Estuaries: Jan 17-19
National Parks: Dec 13-15	Wild and Scenic Rivers: Jan 22-24
National Wildlife Refuges: Jan 10-12	Marine Protected Areas: Jan 24-26

7



Executive Summary

Presentation to ACSERAC



Office of Research and Development
Full Name of Lab, Center, Office, Division or Staff goes here. <Go to View, Master, Title Master to change>

November 12, 2007



Executive Summary Structure

- Introduction
- System Chapters
 - Forests
 - Parks
 - Refuges
 - Rivers
 - Estuaries
 - MPAs
- Synthesis





System Chapter Summaries

1. Background and current status of management

- Brief intro to management system & vulnerable ecosystems
- Top 3 climate-sensitive management goals/actions

2. Adapting to climate change

- Top 3 adaptation options to implement now
- Top 3 adaptation options to develop over the long-term

3. Insights from case studies

- Status of adaptation planning/implementation
- Top 3 barriers & top 3 opportunities for implementation

4. Conclusions

- Top 3 insights emerging from the chapter

2



Public Comments

- Report goes beyond the scope of the Prospectus
- Many comments editorial
- Technical corrections minor
- Substantive comments mostly on “Synthesis” section
 - Organization based on management systems is limiting
 - Synthetic themes do not follow obviously from preceding chapter summaries
 - Themes should be based on common lessons/issues across chapters rather than synthesized adaptation approaches
 - Much greater detail/explanation requested in several areas

3



Considerations

- Length
- Tension between brevity and sufficient context/detail
- Key insights for “Executive” audience
- Presentation of themes
- Organization/structure of Executive Summary

**“synthesis” not a summary or
recapitulation**

**“synthesis” treated each chapter as
data input, added broader
conceptual literature and
experience to extract key insights**

the whole idea of adaptation makes
sense only in context of management
objectives

one could take exactly the same
ecosystem, but depending on goals end
up with totally different adaptation
responses (consider Puget Sound and
biodiversity NGO, fisherman, tourist
business, shipping industry)

**everything begins with impacts
(but impacts you focus on depends
on objectives)**

always keep in mind response

**there are a lot of tools, but none
work without basic understanding
and baseline information**

**managers and decision-makers
need help with the uncertainty
conundrum**

**technical: run all models and
highlight agreements**

scenario building

Given even the crudest impact assessments and uncertainty analyses, there are basic principles of adaptation:

- resistance (intensive management)
- resilience (MPA deployment)
- response (assisted migration)
- realign (alter objectives)
- triage

Table 9.4 Adaptation response

- protect key ecosystem features
- reduce other stresses
- representation
- replication
- restoration
- refugia
- relocation

Options for adaptation will increase if:

work outside normal constraints and
enlist all the help you can get

operate at a large spatial scale, and
consider lands outside normal agency
control

learn quickly and from others

There are a wide range of obstacles:

legislative

incentives

expertise

lack of baselines

poor decision support tools

risk taking not common

Some general changes needed

do not fragment response by agency
or land parcel -take whole system
approach

spatial scale of thinking: "manage as
one large system"

agency cooperation and public
education

There is the possibility of failure to
adapt because:

institutions fail
the ecological change is too great

Need a triage approach -think through
where the most good can be done and
where resources can be invested with
greatest return

Is climate change an "opportunity" as well as a stress ?

climate change is one of many stresses that impact ecosystems

but it is so pervasive, it may be the stress that prompts land and water managers to learn to be more agile and adaptive

Climate change is altering the rules of the management game

It cannot be business as usual

There are numerous very practical and concrete steps that can be taken -but Still do not really have a national plan for response

Public comments?

generally excellent—feel most
should be responded to

technical corrections
make clearer it was derived from
other chapters (a lot of that
was in tables)
more specific (can elaborate)

National Forests chapter SAP 4.4

FACA Meeting
October 22, 2007

SAP 4.4. Adaptation Options for Climate-Sensitive Ecosystems and Resources: National Forests

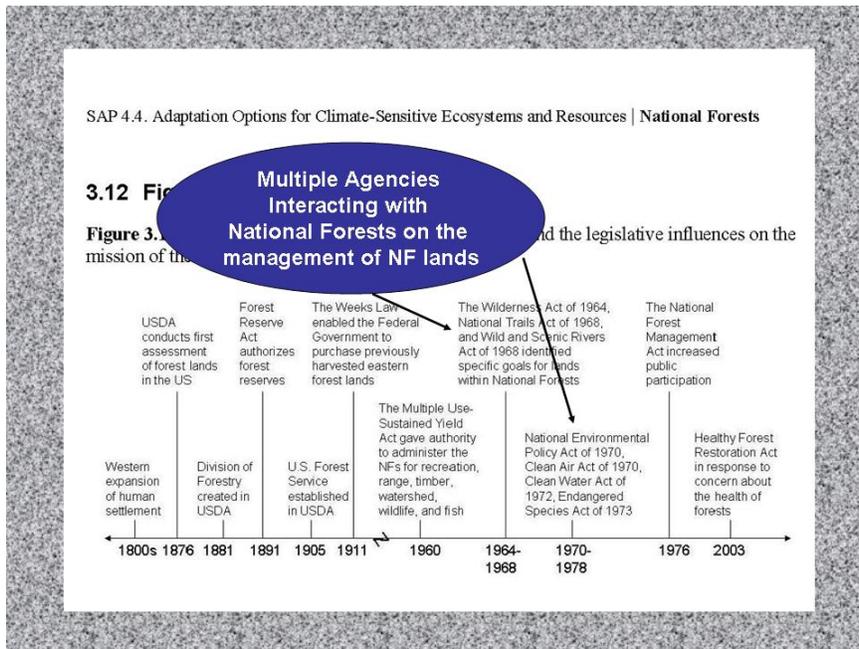
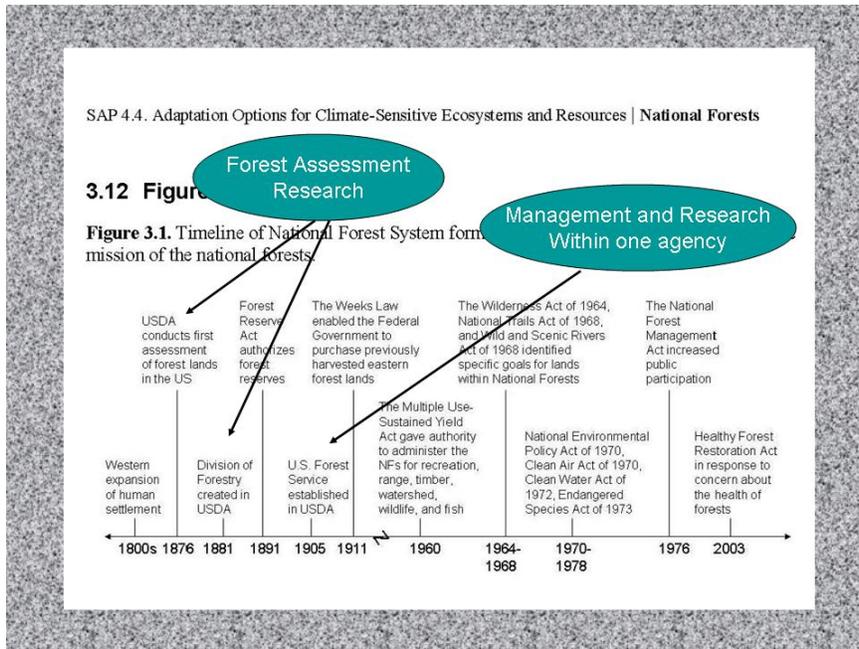
Water and Timber

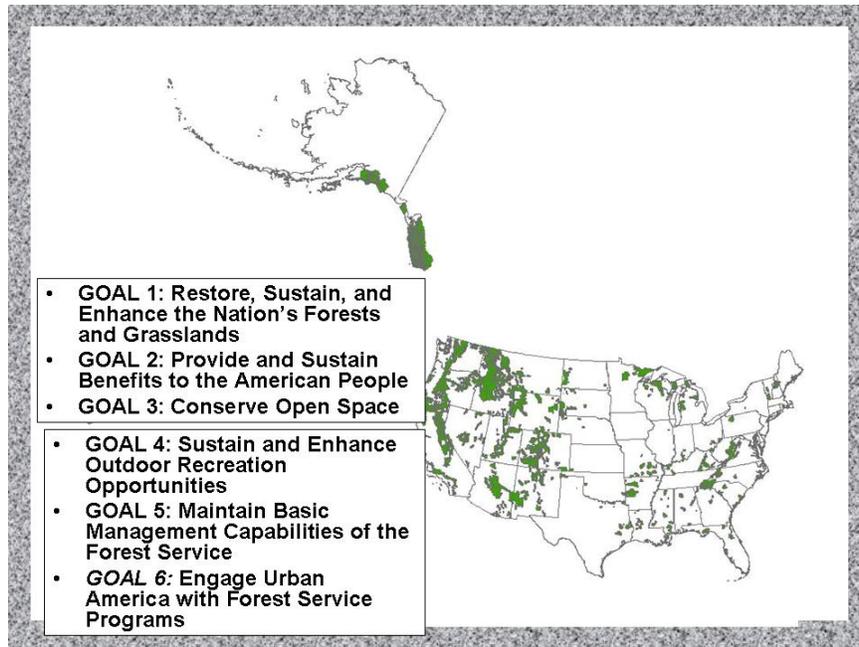
Water, timber, range, watershed,
wildlife, fish, recreation

3.12 Figures

Figure 3.1. Timeline of National Forest System formation and the legislative influences on the mission of the national forests.







Where is the FS/NFS today with respect to climate change

- SAP 4.4 Workshop, Annapolis, MD, December, 2006
- SAP 4.4 Olympic NF, Workshop, Winter, 2006
- SAP 4.4 Tahoe NF, Workshop, January 2007
- NFS IREMCG (Deputy Regional Foresters), Wash DC, Jan. 2007
- NFS Region 4 Integrated Resource Training, Ogden, UT, Feb 2007
- NFS Region 6 Vegetation Mgrs, March 2007
- FS National Leadership Team meeting, March, 2007
- NFS Region 6 Regional Leadership Team, Workshop, March 2007
- NFS Regional Vegetation/Fire Aviation managers, San Antonio, March 2007
- NFS Regional Planners meeting, Milwaukee, WI, April 2007
- NFS Region 3 Regional Leadership Team mtg, Albuquerque, April 2007
- NFS Regional Directors, Wildlife, Fish, Air, Rare Plants, Breckenridge, CO, June 2007
- NFS Region 2 Regional Leadership team meeting, June 2007, Rapid City
- NFS IREMCG, October 2007, SAP case study presented

Missing Concepts

- **Expand and emphasize management options**
 - Consider genetics in silvicultural treatments
 - Managing natural regeneration and genetics
 - Genetics and shelterwood
 - Management experiments with new species
 - Wildland fire use – option as well as challenge
 - Post-fire restoration practices in PSW
 - Connected landscapes – obliterating roads

Missing Concepts

- **Remember shrublands and grasslands**
 - Chapter focuses on all ecosystems in National Forests
- **Monitoring not stressed enough**
 - Key component in adaptation
- **Effective mechanisms missing**
 - Specifically for connected landscapes, checkerboard ownerships, small management units
 - No suggestions offered; chapter does identified collaborations as key.

Missing Concepts - Questions

- **Timber Management as a Stressor was not stressed**
 - Current stressor section focused on un-managed stresses for which no strategies were in place
 - Timber management is described under Current Management.
 - Option:
 - Under Stressors, add a legacy section to describe the impacts of previous management – timber, grazing, mining
 - Role of forest management as a current stressor.
- **Pros and Cons of Mitigation Management**
 - Focus is on adaptation, with mention of mitigation
 - Option:
 - Mitigation not in the SAP Prospectus, so no expansion of text
 - Consideration of adaptation and mitigation together could result in a different set of strategies than when each is considered alone.

Missing Concepts - Questions

- **Fire: perception of judgment**
 - Chapter attempts to avoid judgments on fire – catastrophic, unprecedented unless substantiated.
 - Option:
- **Fire: restoration of natural fire regimes**
 - Identifying what natural fire regimes to manage for; current or future.
 - Option:
- **Reviewer's specific management recommendations**
 - Purchase inholdings, Use public education to discourage remote developments
 - Option:

Programs and Policies

- **Specific Recommendations for Management**
 - **Substantial change needed in planning**
 - New rule making in process
 - Option: Chapter addresses adaptation and NF planning
 - **Environmental review of anticipated actions**
 - Chapter focuses on the possibility that current management could restrict future options, e.g. wildland fire use.
 - Option: recommended change emphasizes retaining analysis whereas the chapter intent was to be proactive, plan ahead.
 - **Direction to reduce wall between research and mgt**
 - Option: Chapter emphasizes collaborative efforts
 - **FS has separated monitoring from planning**
 - Option: Adaptive management is discussed in the chapter

Technical

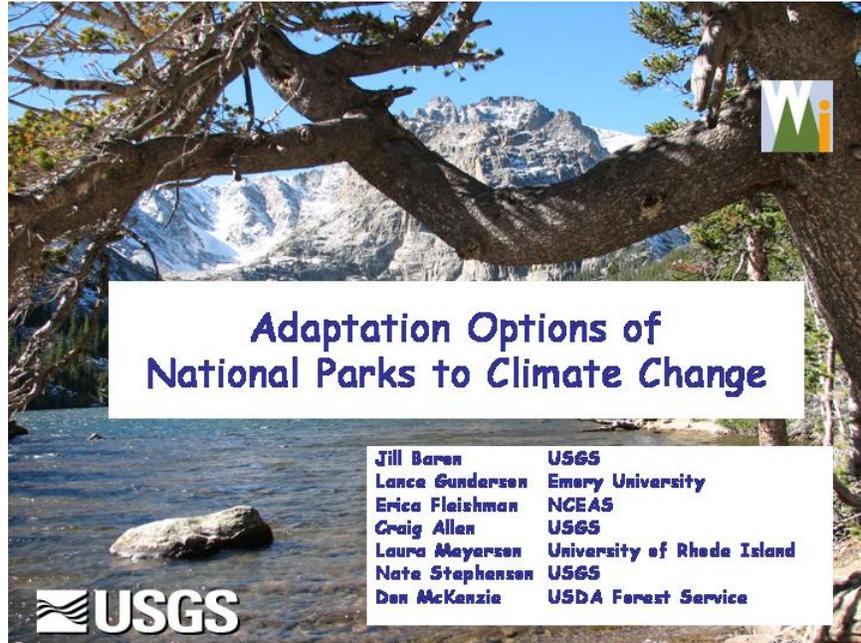
- **Salvage logging, appeals, etc**
 - Text was from the Tahoe workshop and reflects the managers comments; reviewers interpreted this text as the authors.
 - Option:
- **2005 rule comments**
 - Rule making is in process.
 - Option: Address planning in general, rather than details from the 2005 rule.

Additional Considerations New FS Strategic Plan – Revised Management Goals

- **GOAL 1: Restore, Sustain, and Enhance the Nation's Forests and Grasslands**
 - Objective 1.1 Reduce the risk to communities and natural resources from wildfire
 - Objective 1.2 Suppress wildfires efficiently and effectively
 - Objective 1.3 Build community capacity to suppress and reduce losses from wildfires
 - Objective 1.4 Reduce adverse impacts from invasive and native species, pests, and diseases
 - Objective 1.5 Restore and maintain healthy watersheds and diverse habitats
- **GOAL 2: Provide and Sustain Benefits to the American People**
 - Objective 2.1: NF provide a reliable supply of forest products over time that: 1) is consistent with achieving desired conditions on NFS lands and 2) helps maintain or create processing capacity and infrastructure in local communities
 - Objective 2.2 The National Forests and Grasslands provide a reliable supply of rangeland products over time that ...
 - Objective 2.3 Help meet energy resource needs
 - Objective 2.4 Promote market-based conservation and stewardship of ecosystem services
- **GOAL 3: Conserve Open Space**

Additional Considerations

- **GOAL 4: Sustain and Enhance Outdoor Recreation Opportunities [USDA Objective 6.3]**
 - **Objective 4.1** Improve the quality and availability of outdoor recreation experiences
 - **Objective 4.2** Secure legal entry to national forest lands and waters
 - **Objective 4.3** Improve the management of off-highway vehicle use
- **GOAL 5: Maintain Basic Management Capabilities of the Forest Service**
 - **Objective 5.1** Improve accountability through effective strategic and land management planning and efficient use of data and technology in resource management
 - **Objective 5.2** Improve the administration of National Forest lands and facilities in support of the agency's mission
- **GOAL 6: Engage Urban America with Forest Service Programs**
 - **Objective 6.1** Promote conservation education to increase environmental literacy through partnerships with groups that benefit and educate urban populations
 - **Objective 6.2** Improve management of urban and community forests to provide a wide range of public benefits



**Adaptation Options of
National Parks to Climate Change**

Jill Baren	USGS
Lance Gunderson	Emory University
Erica Flaishman	NCEAS
Craig Allen	USGS
Laura Meyerson	University of Rhode Island
Nate Stephenson	USGS
Don McKenzie	USDA Forest Service



NPS Organic Act of 1916

"to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

The intent of Congress

"preserve unimpaired"

minimize human-caused disturbances

restore and maintain the ecological integrity of the National Parks



NPS Organization

- **National Office**
 - Service-wide policy
 - Information, guidance, management expertise, especially for the Natural Resource Challenge programs
- **Regional Offices (7)**
 - Administrative services/oversight
 - Conduits for information
- **Individual parks**
 - Set own resource management agendas
 - Use management plans as guidelines

Management philosophy has changed substantially and more than once since 1916

•NPS has broad discretion in management and regulation to meet its goals.

•Increasingly science-based ecosystem management



Wheeler Geologic Area





Current Resources, Processes, Systems and Values Managed by NPS

- Physical resources
 - (water, air, soils, topographic features)
- Physical processes
 - (weather, erosion, wildland fire)
- Biological resources
 - (native plants, animals, communities)
- Biological processes
 - (photosynthesis, succession, and evolution)
- Ecosystems
- Highly valued associated characteristics such as scenic views, soundscapes.

 USGS NPS 2006

Authors' philosophy for adaptation:

The onset and continuance of climate change over the next century requires NPS managers to **think** differently about park ecosystems than they have in the past.

Preparing for and adapting to climate change is as much a cultural and intellectual challenge as it is an ecological one.

p. 4-6

Adapting to Climate Change



- **Come to Terms With Uncertainty**
- **Incorporate Climate Change considerations**
 - into park operations
 - into natural resource management



Adaptations of Parks/Park Service to Climate Change

- **Identify resources and processes at risk from climate change**
- **Develop monitoring and assessment programs for resources and processes at risk from climate change**
- **Define baselines or reference conditions for protection or restoration**



Adaptations of Parks/Park Service to Climate Change

•Develop and implement management strategies for adaptation

- Diversify portfolio of management approaches
- Accelerate capacity for learning
- Assess, plan, and manage at multiple scales
 - Let the issues define appropriate scales of time and space
 - Form partnerships with other resource management entities
- Reduce other human-caused stress to park ecosystems
- Nurture and cultivate human and natural capital



Review Comments

- Not enough attention paid to:
 - Coastal parks, ocean habitats
 - Karst parks
 - Groundwater, soil moisture
 - Rest of the National Park System
 - Management of visitor behavior to ameliorate CC/other stress interactions
 - Tradeoffs between hard decisions/evils (burning policies vs air quality)

We can and will add some text for some of these, but emphasize the APPROACH we propose can be applied to a diversity of sites and resources

Review Comments

- Examples needed for how to increase resilience
- More explanation desired for what constitutes invasive

Will add some text, but these are issues best addressed by individual parks in regional context.

Review Comments

- Remove the paragraph addressing past de-authorization of 27 parks

The paragraph illustrates historic flexibility in NPS management/policy. It represents important out-of-the-box thinking. We want to keep it.

Review Comments

- List of suggestions from a resource manager include bringing ecosystems back to within range of natural variability

This may be a bad idea: systems change as a result of management, and demonstrate hysteresis

Humpback
Chub



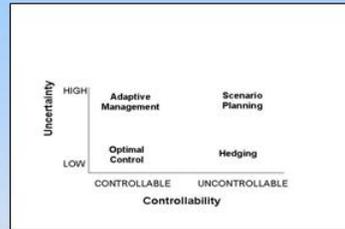
Review Comments

- Carbon accounting/manage to maximize C storage

This does not address NPS management goals, and may run counter to some. Proportion of US C stocks in national parks is likely small.

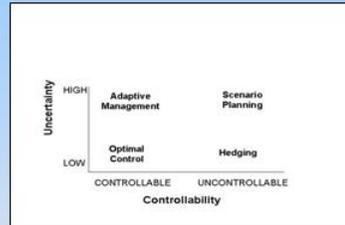
Scenario-Based Planning

- **Brainstorming alternative, but plausible, futures**
 - Incorporates ideas of complexity
 - Assigns probabilities of occurrence
 - Forces consideration of low probability but high risk scenarios
- **Informed by data and experts**
- **Can be used to develop contingency plans**



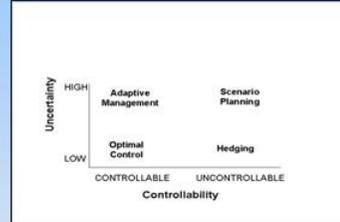
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Scenario-Based Planning

- **Brainstorming alternative, but plausible, futures**
 - Incorporates ideas of complexity
 - Assigns probabilities of occurrence
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- **Can be used to develop contingency plans**



Value Social Capital

- Resource management advances by incremental learning and gradual achievement of goals
- Some failure must be tolerated and even expected
- There are gradients between success and failure, with learning along the way
- As climate changes, even the most well-reasoned actions have some potential to go awry
- Protect and reward the wisdom and experience of front line managers ("**safe to fail**" philosophy)



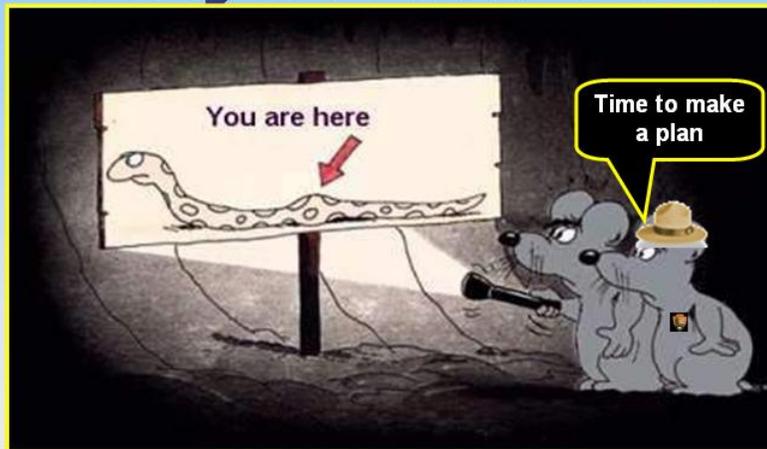
NPS has tried many ways to eradicate feral hogs, and failed often.



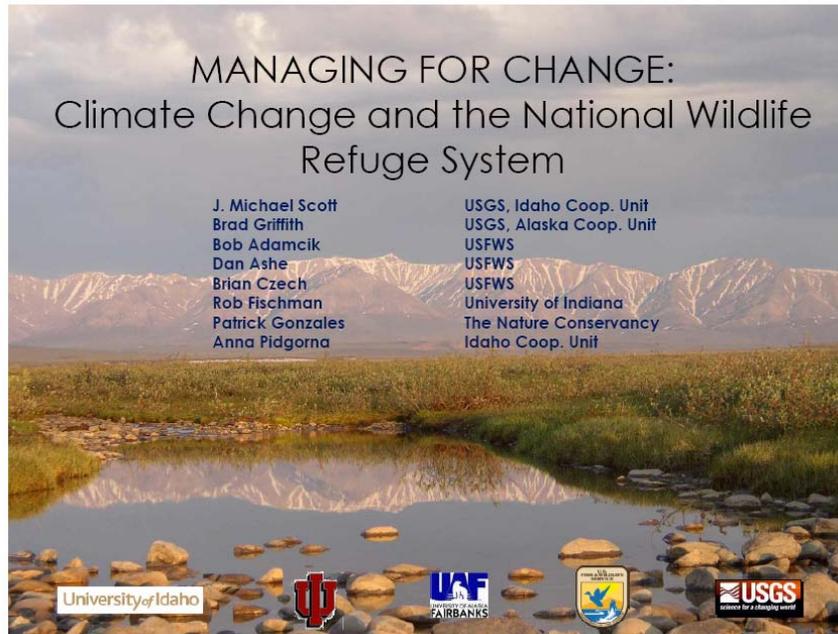
Reviewer Comments

- Rocky Mountain Case Study doesn't illustrate broad range of issues NPS managers will have to address
 - The case study illustrates ways of thinking about climate change effects
 - A full list of issues would be exhaustive, prescriptive, and still incomplete (due to surprise)
 - As with entire chapter, emphasis is strategic, rather than operational

Climate Change: Coming to a Park Near You!



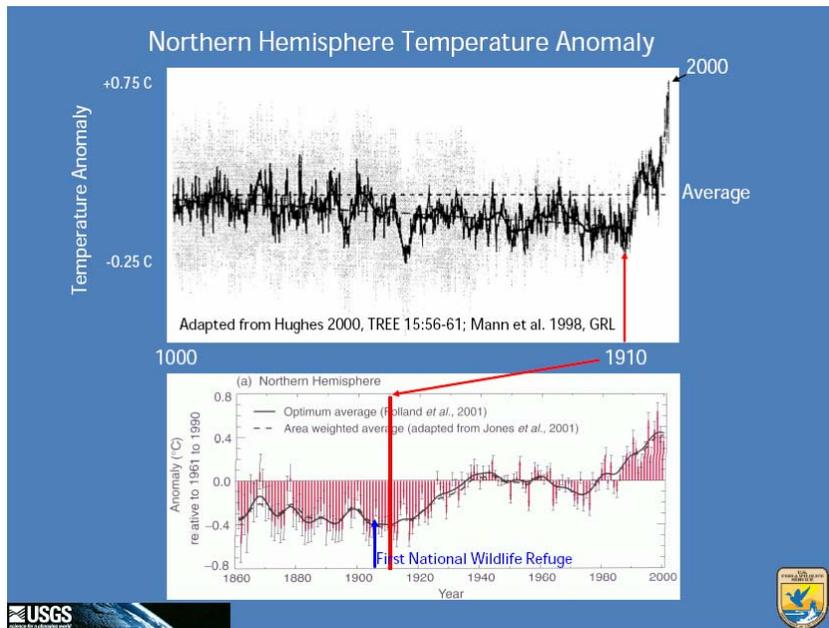
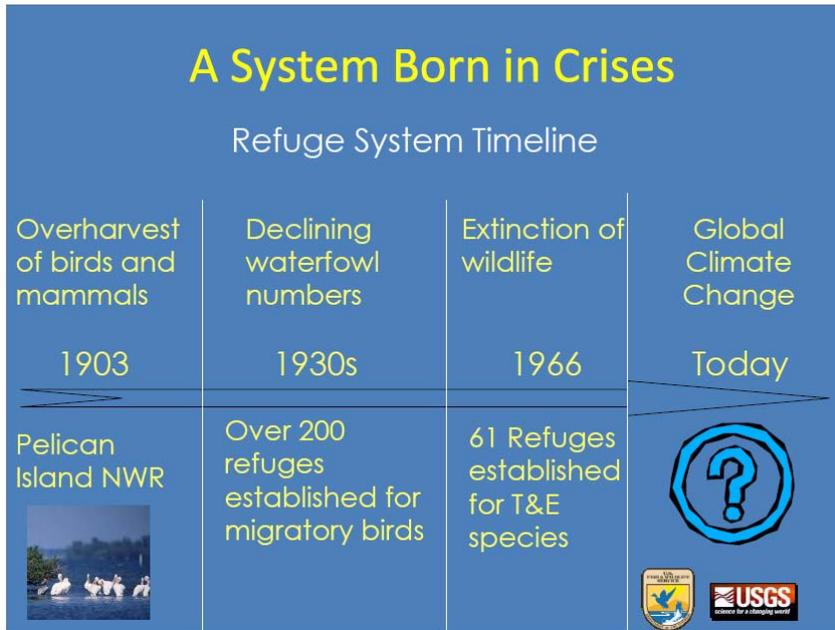
 USGS



Philosophy

- Focus on the National Wildlife Refuge SYSTEM
 - Summarize potential effects of climate change
 - Identify vulnerable types of refuges
 - Identify research needs
 - Identify information needs
 - Identify adaptation
 - Strategies
 - Tools
- Motivate multiple management levels





Refuges are Insufficient to Accommodate Global Climate Change

- Too small;
- Too fragmented;
- Embedded in an inhospitable matrix;
 - Anthropogenic, competing land uses
- Expected community shifts
 - e.g. tundra to northern boreal forest



New tools, new ideas and new relationships are needed

- Non-traditional partnerships.
- Thinking and acting
 - across boundaries and scales
 - across disciplines
- A reintegration of conservation areas into the American landscape (Rosenzweig, 2003).



Take Away Messages - I

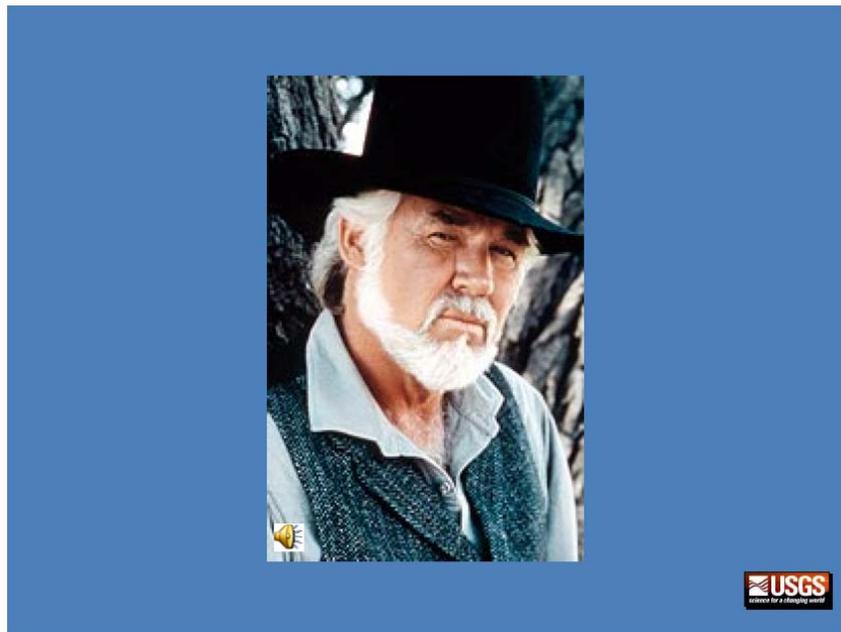
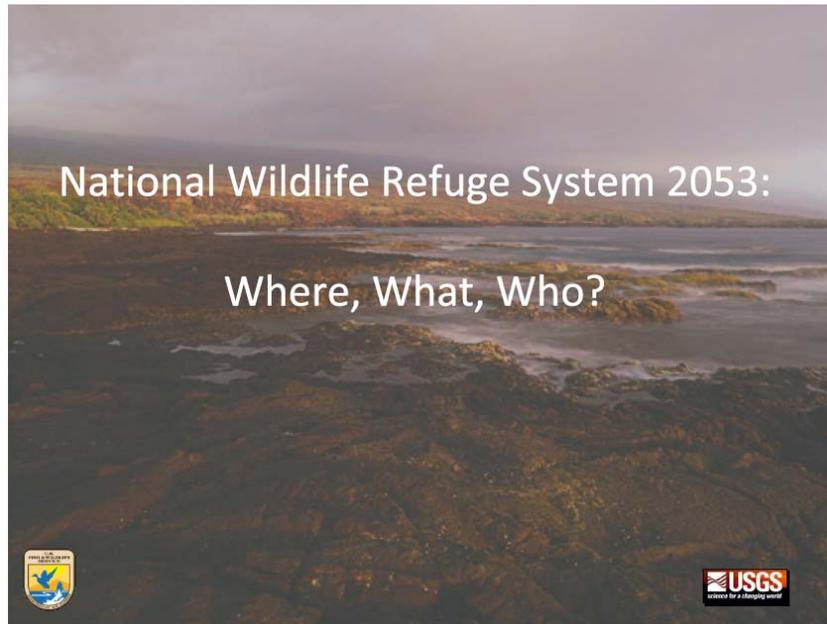
- Establish two bodies:
 - National Interagency Climate Change Council
 - National Climate Change Information Networkto advise and oversee the management of ecosystems and resources.
- Identify Conservation targets
- Ensure that conservation targets provide a
 - representative,
 - resilient, and
 - redundant sample of trust species and communities.



Take Away Messages - II

- Strategically grow the NWRS
- Manage lands as dynamic systems.
- Use refuges as models of energy efficiency
- Use refuges as educational centers
- Enhance management-research partnerships





Public Comments

Omitted Areas/Groups

- ** Too narrow a range of stakeholders
 - Many invited, few responded

Missing Topics/concepts

- NWR System Contribution to Ecosystem and Landscape perspective
- Public Awareness campaign
- Deserts
- Permafrost melting re: oil development
- Leadership re: funding and planning
- Need for modeling of habitat changes
- How deficiencies in information and resources will stall progress
- Definition of native/non-native species (human cause vs. else)
- ** Divestiture of lands – seems NWRS focused
- Strategic land acquisition
- Warming effects on biomass production (CO2 and water use efficiency)
- More emphasis on staff training and education
- ** Failure to emphasize potential extinctions
- ** Insufficient emphasis on Adaptive Management

Scope/Structure

- FWS needs to advocate for resources and support necessary to respond to climate change

Programs/Policies

- Need a call to create performance goals for biological diversity and environmental health, particularly in regard to healthy populations

Technical

- ** Models are inadequate to guide policy
- ** Models need to be validated
- ** Paleoclimate record not emphasized as model for historical/future possibilities
- Potential warming influence on productivity, again

Editorial

- Not obvious how extreme events “threaten”
- Projections vs. Predictions
- ** Water use efficiency re: plants, again
- Frequency of extreme events – warming vs. “natural” causation
- Heterogeneity in warming
- Too much “confidence” in models
- Magnitude of climate change vs. other stressors
- ** Excessive “enthusiasm” re the 4th Crisis

Resolution

- Achievable:
 - More emphasis on critical concepts
 - Expanded contextual and explanatory information
 - Particularly re: modeling issues
 - Addressing comments will clarify issues

Climate Change and Adaptation Options for Wild and Scenic Rivers

Purpose & Major Findings
Summary of Public Comments

Margaret Palmer, University of Maryland

Dennis Lettenmaier, University of Washington
N. LeRoy Poff, Colorado State University
Sandra Postel, Global Water Policy Project
Brian Richter, The Nature Conservancy
Richard "Omar" Warner, Kinni Consulting

FACA meeting, Bethesda, MD October 22, 2007

Wild & Scenic Rivers Represent > 11,000 stream miles

1968: Wild & Scenic Rivers Act is passed. First 8 rivers are designated as wild and scenic.

1980: 25 WSRs are established in Alaska as a result of the Alaska National Interests Land Conservation Act

1982. DOA sets classification criteria, the evaluation process and context, and reporting requirements for potential WSRs. It also sets management guidelines for designated WSRs

1995: Interagency WSR Coordinating Council Charter addresses the administration of WSRs.

2007: As of January, 165 Rivers are Designated As WSR



Why suitable for SAP 4.4?

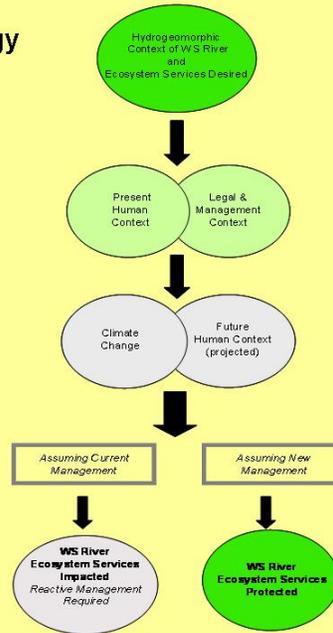
Highly valued resources
Potential for management options

Why problematic?

Most in watersheds with mixed ownership
mixed land use
many with dams

...so climate change is not the only risk they face

Chapter strategy

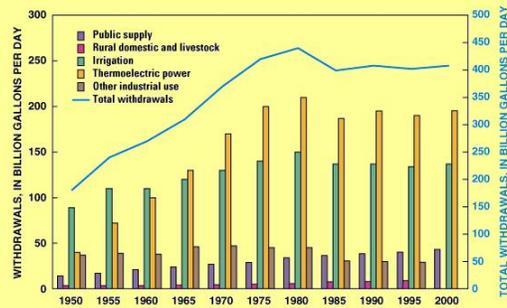


Ecosystem Goods & Services of Wild Rivers

- Water purification
- Water supply
- Flood control
- Carbon sequestration (1 and 2 production)
- Nitrogen sequestration
- Food Production
- Biodiversity
- Temperature regulation
- Erosion & sediment control
- Recreation & tourism

...but present human context has compromised many

for example:



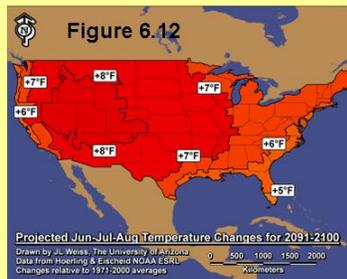
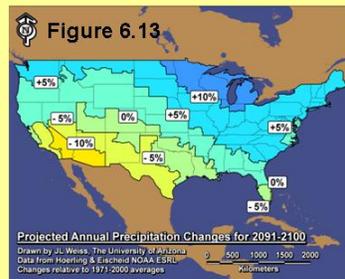
Water withdrawal, dams (flow regulation), land use, pollution, etc.

Management of W & S Rivers

- Each river added by congress is to be administered by a federal agency (BLM, NPS, USFWS, USFS) with appropriate partnership from state and local authorities
- A **comprehensive management plan** is required for each designated river to provide a framework for protecting and enhancing the river's values.
 - plan has the potential to take into account climate change science
 - robust plans include detailed description of rivers' values when designated (baseline conditions) and a monitoring scheme

Overview of impacts of climate change on rivers

- Temperature increases likely in most regions
- Rainfall changes less certain: extreme events like storms/droughts will be more common in some areas and less so in others
- Snowmelt earlier in some regions



Maps represent averaged projections of changes for 2091-2100 calculated from 18 climate model simulations completed for the IPCC 4th Assessment Report under the A2, or "business as usual". Projected changes for 2091-2100 are relative to temperature and precipitation averages during 1971-2000, and are interpolated to U.S. NOAA climate divisions by M. Hoerling and J. Eischeid at NOAA Earth System Research Laboratory (ESRL).

.... % change in run-off

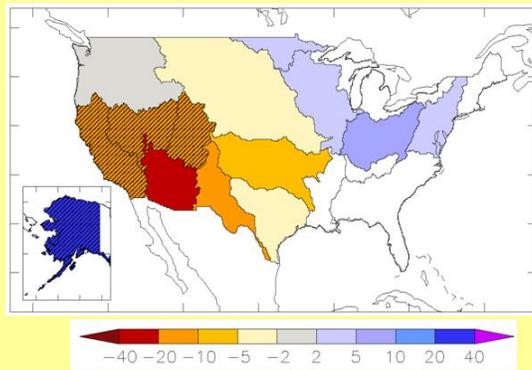
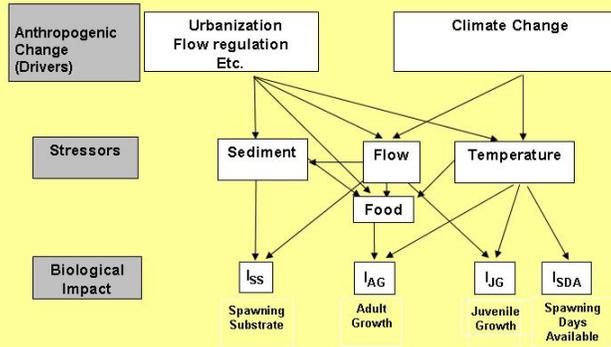


Figure 6.14. Median, over 12 climate models, of the percent changes in runoff from United States water resources regions for 2041–2060 relative to 1901–1970. More than 66% of models agree on the sign of change for areas shown in color; diagonal hatching indicates greater than 90% agreement. Recomputed from data of Milly, Dunne, and Vecchia (2005) by Dr. P.C.D. Milly, USGS.

Theme: interactive effect of multiple drivers

Temperature, hydrologic, geomorphic → ecological processes & species



Recommendations: proactive vs. reactive

- designate more rivers as W&S
- purchase more water rights or establish environmental flows programs
- amend Comprehensive Management Plans to take climate change into account
- modify reservoir release options
- develop forecasts for water management at appropriate scales
- enhance monitoring
- enhance technical capacity

Public Comments

- explanation of technical aspects of W&SR Act need attention (e.g., discussion of free-flowing status & WSR Act; depending on which federal agency assists management, standards for controlling 'impacts' from water resource projects vary; no authors on nonfederal lands within river corridor)
- describe method for stakeholder invitation to meeting
- discuss validation of data in Figs 6.12 & 6.13 (temperature & precipitation)
- not necessarily more severe weather events...varies spatially
- take care in using exact quotes from IPCC 2007
- do not select only one scenario for reporting temperature changes (we reported full range)
- editorial comments

Output from climate change models indicate that **global** temperature will increase, with the direction and magnitude varying regionally. Projections of changes in precipitation are less certain but include change in the amount or timing of rainfall as well as the frequency and magnitude of extreme rainfall events. The latest IPCC (2007a) assessment report states: [We are] “**virtually certain** to experience **warmer and fewer cold days over most land areas** as well as **warmer and more frequent hot days**; we are **very likely** to experience **heat waves and heavy rainfall events more frequently**; and we are **likely** to experience **more drought in some regions**.” Thus, in general, much of the **world** can expect warmer conditions with more severe weather events.

**Table SPM-1.
IPCC 2007**

Phenomenon ^a and direction of trend	Likelihood that trend occurred in late 20th century (typically post 1960)	Likelihood of a human contribution to observed trend ^b	Likelihood of future trends based on projections for 21st century using SRES scenarios
Warmer and fewer cold days and nights over most land areas	Very likely ^a	Likely ^a	Virtually certain ^a
Warmer and more frequent hot days and nights over most land areas	Very likely ^a	Likely (nights) ^a	Virtually certain ^a
Warm spells / heat waves. Frequency increases over most land areas	Likely	More likely than not ^f	Very likely
Heavy precipitation events. Frequency (or proportion of total rainfall from heavy falls) increases over most areas	Likely	More likely than not ^f	Very likely
Area affected by droughts increases	Likely in many regions since 1970s	More likely than not	Likely

Public Comments

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- editorial comments



Estuaries Chapter Overview

Presentation to ACSERAC
October 22, 2007

Charles H. Peterson, Ph.D.
Lead Author
University of North Carolina

Contributing Authors

Richard Barber, *Duke University*
Kathryn Cottingham, *Dartmouth College*
Heike Lotze, *Dalhousie University*
Charles A. Simenstad, *University of Washington*
Robert R. Christian, *East Carolina University*
Michael Piehler, *University of North Carolina*
John Wilson, *Office of Water, EPA*

Background

- The NEP provides funding and guidance to 28 estuaries:
 - National estuaries operate as local programs
 - Management is watershed-based and stakeholder-oriented
 - Programs lack regulatory authority and rely on voluntary cooperation
 - Commonly set targets, goals, benchmarks as incentives
 - May use existing federal, state, tribal, and local legislation and regulation
- Areas of concern in National Estuaries are:

Water quality	Fisheries
Habitat extent & function	Wildlife
Introduced species	Biodiversity
Human values	Freshwater quantity
- Historically, focus has been on management of anthropogenic impacts

Effects of Existing Stressors on Estuarine Management Goals

Stressor	Water Quality	Fisheries & Wildlife	Habitat	Human Value & Welfare	Water Quantity
Excess Nutrient Loading	negative	positive then negative	positive then negative	Positive then negative	
Sedimentation	negative	positive or negative	positive or negative	negative	
Pathogens	negative	negative		negative	
Oyster Loss & Habitat Destruction	negative	negative	negative	negative	
Benthic Habitat Disturbance	negative	positive or negative	positive or negative	negative	
Wetland Habitat Loss from Development	negative	negative	negative	positive or negative	positive or negative
Toxics	negative	negative	negative	negative	
Invasive Species	positive or negative	positive or negative	positive or negative	positive or negative	
Thermal Pollution	positive then negative	positive then negative	positive then negative	positive then Negative	
Overfishing	Negative or positive	negative	negative	positive then negative	

Effects of Emerging or Enhanced Stressors on Estuaries Arising from Climate Change

Stressor	Water Quality	Fisheries & Wildlife	Habitat	Human Value & Welfare	Water Quantity
Sea Level Rise (shoreline armoring prevents transgression of habitats)	positive then negative	positive then negative	positive then negative	negative	negative
Increased Intensive Storms (shoreline erosion; pulsed floods and runoff)	negative	negative	negative	negative	
Temperature Increases (new species mix; disease and parasitism increase; phenology mismatch)	positive then negative	positive then negative	positive then Negative	positive then negative	
Increased CO ₂ and Acidification (CaCO ₃ deposition inhibited)	negative	negative	negative	negative	
Precipitation Change (stratification changes)	negative	positive or negative	positive or negative	positive or negative	positive or negative
Species Introduction (facilitated by disturbance)	unpredictable	positive or negative	positive or negative	positive or negative	

Relevant Legislative and Regulatory Governance Structures for Implementing NEP Management Goals

Water Quality	Fisheries & Wildlife	Habitat	Human Value & Welfare	Water Quantity
Clean Water Act - NPDES, TMDLs - Balanced Indigenous Populations (BIPs) - NEP - State Water Pollution Control Revolving Funds	Magnuson-Stevens Fishery Conservation & Management Act - EFH - FMPs ESA MMPA Oil Pollution Act (OPA) - compensatory restoration	Estuary Restoration Act CZMA Clean Water Act - 404 provision OPA - compensatory restoration	National Flood Insurance Program (included in FEMA) Native American Treaty Rights - fish management - subsistence rights Coastal Barriers Resources Act (CBRA)	State Agency Water Allocations Establish State Use Containment Areas - groundwater allocation and conservation
State Basinwide Management of Water Quality	CERCLA - compensatory restoration	CERCLA - compensatory restoration	CZMA - local land-use plans	State Agency Water Reuse Rules
NEPA	NEPA Nonindigenous Aquatic Nuisance Protection and Control Act State Fish & Wildlife Management	NEPA State Wetlands Protective Laws NOAA NERRS Program	Federal Programs for Public Infrastructure - for bridges, water supply, wastewater treatment Local Zoning Ordinances	State Agency Water Conservation Rules

Management Adaptations

- Protect water quality
 - Redraft riverine floodplain maps and flood insurance coverage
 - Preserve/protect/increase extent and functionality of tidal marsh and wetlands/riparian buffer zones
 - Reduce wetland habitat loss and protect water quality by minimizing shoreline armoring
 - Modify permitting process for locating landfills, hazardous waste dumps, mine tailings, and toxic chemical storage facilities
- Sustain fisheries and wildlife populations
 - Make sustainable fisheries management an adaptive process as changes in estuarine carrying capacity and community make-up occur
 - Strengthen rules to prevent introduction of injurious non-native species
 - Remove invasive non-native species and restore native species

Management Adaptations (cont.)

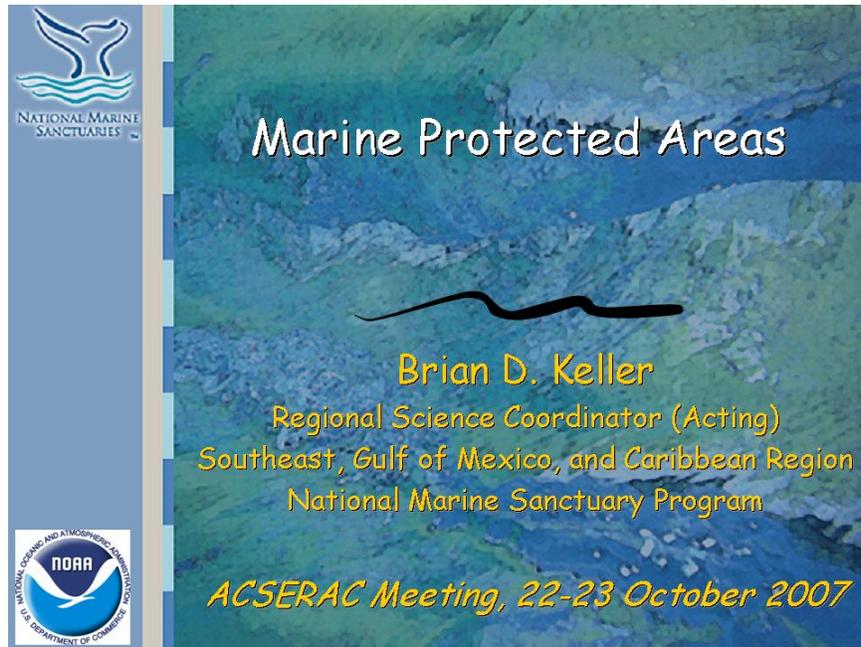
- Preserving Habitat Extent and Functionality
 - Expand land use planning horizon to incorporate the projections of consequences of global change to prevent development in areas at risk from extreme events and to modify maladaptive policies such as beach nourishment
 - State-run wetlands restoration programs could select sites where the restored wetland can move up-slope as sea level rises or purchase upland development rights/property to insure transgression potential
 - For largely undeveloped areas, establish rolling easements
- Preserving Human Values
 - Restructure development along coastal barrier and estuarine shorelines to avoid future loss of life and property, and protect ecosystem services in the interest of the public trust
 - Establish setbacks and buffer widths based on projections of future shoreline position
 - Remove federal flood insurance and infrastructure development subsidies for coastal shorelines

Management Adaptations (cont.)

- Water Quantity
 - Establish/broaden "use containment areas" so that uses are sustainable
 - Modify permitting procedures for affected development to address potential future salt water intrusion and reduced aquifer productivity
 - Increase water re-use and conservation.
 - Project shifts in zones of biogeochemical processes and biotic use in estuaries to allow proactive management of fish and wildlife critical habitats

Summary of Public Review Comments

- Omitted Areas/Groups
 - Coastal Zone Management Act (CZMA) and consistency review process
 - Nat'l Estuarine Research Reserve System (NOAA NERRS)
- Missing topics/concepts
 - Role of WQ standards beyond NPDES (benchmarks and TMDLs)
 - Role/implications of aquaculture for management and adaptation
 - Focus on SLR and storm intensity to the exclusion of climate factors such as temperature, precipitation, acidification (ES)
 - Effect of climate change on recent investments in restoration and how to assure their success (ES)
- Scope/Structure
 - Conclusions are beyond the scope of SAP 4.4 and are policy prescriptive, e.g., reduce greenhouse gas emissions (3) and pursue an Executive Order on climate change (14)
- Programs and policies - Specific references to existing SLR policies and regulations may be outdated based on recent reports
- Technical (minor)
- Editorial (minor)



MPA Chapter Authors

- **Brian D. Keller** (Lead)
- **Satie Airamé** (UC Santa Barbara/Partnership for Interdisciplinary Studies of the Coastal Ocean) - CINMS
- **Billy D. Causey** (NOAA/National Marine Sanctuary Program, Southeast Region) - FKNMS
- **Alan Friedlander** (NOAA/CCMA-Biogeog. Team) - PMNM
- **Daniel F. Gleason** (Georgia Southern U) - Current Status of Management System
- **Rikki Grober-Dunsmore** (NOAA/National Marine Protected Areas Center) - Tables 8.1 and 8.3
- **Johanna Johnson** (Great Barrier Reef Marine Park Authority) - GBRMP
- **Elizabeth McLeod** (The Nature Conservancy) - Adapting to Climate Change
- **Steven L. Miller** (UNC Wilmington) - FKNMS +
- **Robert S. Steneck** (U Maine) - Box 8.2 (new)
- **Christa Woodley** (UC Davis) - Stressors of Concern

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Stakeholder Workshop: January 2007

Discuss content and applicability of the report

1. **Maria Brown** (Gulf of the Farallones NMS)
2. **Deborah Cramer** (Stellwagen Bank NMS Sanctuary Advisory Council [SAC])
3. **Daniel F. Gleason** (Gray's Reef NMS SAC)
4. **Lynne Hale** (The Nature Conservancy)
5. **Lara Hansen** (World Wildlife Fund)
6. **Terrie Klinger** (Olympic Coast NMS SAC)
7. **Irina Kogan** (Gulf of the Farallones NMS)
8. **David Loomis** (U Mass/Florida Reef Resilience Program)
9. **Linda Paul** (Hawaii Audubon Society)
10. **Bruce Popham** (Florida Keys NMS SAC)
11. **Teresa Scott** (Olympic Coast NMS SAC)
12. **Jack Sobel** (The Ocean Conservancy)
13. **Steve Tucker** (Stellwagen Bank NMS SAC)
14. **Lauren Wenzel** (NOAA National Marine Protected Areas Center)
15. **Bob Wilson** (Gulf of the Farallones SAC)

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MPA Chapter

8.1 Background and History

Type of MPA/MMA	Number of Sites	Administration	Mandate
National Marine Sanctuary	13	NOAA/National Marine Sanctuary Program	National Marine Sanctuaries Act
Fishery Management Areas	216	NOAA/National Marine Fisheries Service	Magnuson-Stevens Act, Endangered Species Act, Marine Mammal Protection Act
National Estuarine Research Reserve ¹	27	NOAA/Office of Ocean and Coastal Resource Management	Coastal Zone Management Act
National Park	42	National Park Service	NPS Organic Act
National Monument ²	3	National Park Service ²	NPS Organic Act ²
National Wildlife Refuge	109	U.S. Fish and Wildlife Service	National Wildlife Refuge System Administration Act

²: PAAWA, administered by NOAA, U.S. FWS, and State of Hawaii; Presidential Proclamation

- Many different types of federally managed MPAs
- Highlight national marine sanctuaries
 - Only enabling legislation specifically for MPAs
 - Nationally significant places for protection & management
 - Internationally recognized
- Highlight coral reef ecosystems

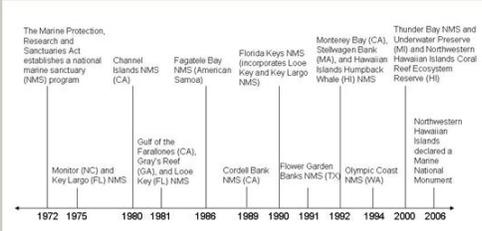
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 **MPA Chapter** 

8.1 Background and History

1972: Congressional Acts for conservation of coastal and ocean resources

- Water Pollution Control Act
- Marine Mammal Protection Act
- Coastal Zone Management Act ... and ...



The Marine Protection, Research and Sanctuaries Act establishes a national marine sanctuary (NMS) program

1972: Monitor (NC) and Key Largo (FL) NMS

1980: Channel Islands NMS (CA)

1981: Gulf of the Farallones (CA), Gray's Reef (GA), and Looe Key (FL) NMS

1986: Fagatele Bay NMS (American Samoa)

1989: Cordell Bank NMS (CA)

1990: Florida Keys NMS (incorporates Looe Key and Key Largo NMS)

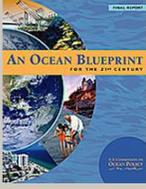
1991: Flower Garden Banks NMS (TX)

1992: Monterey Bay (CA), Stellwagen Bank (MA), and Hawaiian Islands Humpback Whale (HI) NMS

1994: Olympic Coast NMS (WA)

2000: Thunder Bay NMS and Underwater Preserve (MI) and Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve (HI)

2006: Northwestern Hawaiian Islands declared a Marine National Monument



Ecosystem-based management: a hallmark of the NMSP

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 **MPA Chapter** 

8.2 Current Status of Management System

- 8.2.1 Key Ecosystem Characteristics Upon Which Goals Depend
- 8.2.2 Stressors of Concern
- 8.2.3 Management Approaches and Sensitivity to Climate Change

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MPA Chapter

Box 8.1. Draft Goals of the National Marine Sanctuary Program, 2005-2015

- Goal 1.** Identify, designate, and manage sanctuaries to maintain the natural biological communities in sanctuaries and to protect and, where appropriate, restore and enhance natural habitats, populations, and ecological processes, through innovative, coordinated and community-based measures and techniques.
- Goal 2.** Build and strengthen the nation-wide system of marine sanctuaries, maintain and enhance the role of the NASP's system in larger MPA networks and help provide both national and international leadership for MPA management and marine resource stewardship.
- Goal 3.** Enhance nation-wide public awareness, understanding, and appreciation of marine and Great Lakes ecosystems and maritime heritage resources through outreach, education, and interpretation efforts.
- Goal 4.** Investigate and enhance the understanding of ecosystem processes through continued scientific research, monitoring, and characterization to support ecosystem-based management in sanctuaries and throughout U.S. waters.
- Goal 5.** Facilitate human use in sanctuaries to the extent such uses are compatible with the primary mandate of resource protection, through innovative public participation and interagency cooperative arrangements.
- Goal 6.** Work with the international community to strengthen global protection of marine resources, investigate and employ appropriate new management approaches, and disseminate NASP experience and techniques.
- Goal 7.** Build, maintain, and enhance an operational capability and infrastructure that efficiently and effectively support the attainment of the NASP's mission and goals.

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8.2.1 Key Ecosystem Characteristics Upon Which Goals Depend

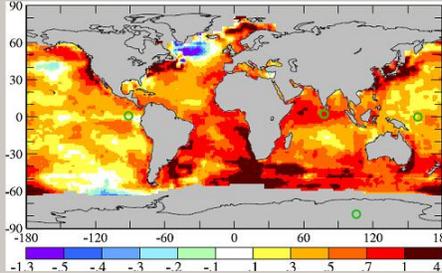
- **Biodiversity** - high, temperate as well as tropical/subtropical, e.g., deep-water
- **Key Species** - resident, migratory - protected (e.g., whales), fisheries (e.g., king mackerel)
- **Habitat Complexity** - biological, geological - strong association with biodiversity
- **Trophic Linkages** - benthic/pelagic - fishing top predators/trophic cascades
- **Connectivity** - open nature of marine systems
- **Nutrient Fluxes** - land/nearshore/offshore
- **Larval Dispersal and Recruitment** - multiple scales - MPA networks

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8.2.2.1 Direct Climate Change Stressors

- Ocean Warming
- Ocean Acidification
- Rising Sea Level
- Climatic Variability and Ocean Circulation
- Storm Intensity
- Freshwater Influx

Sea surface temperature change (°C) 1870-1900 to 2001-2006
Hansen et al. 2006 PNAS



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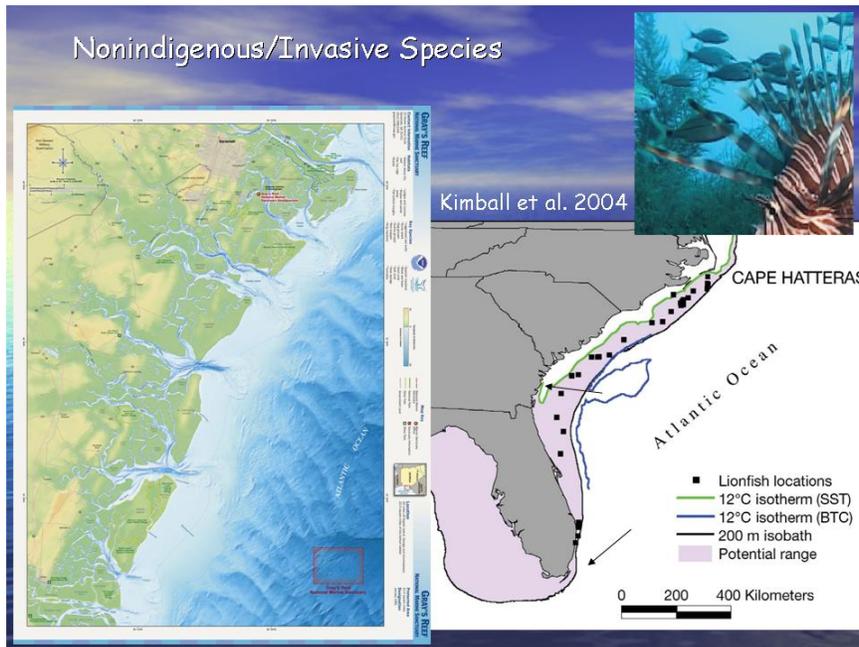
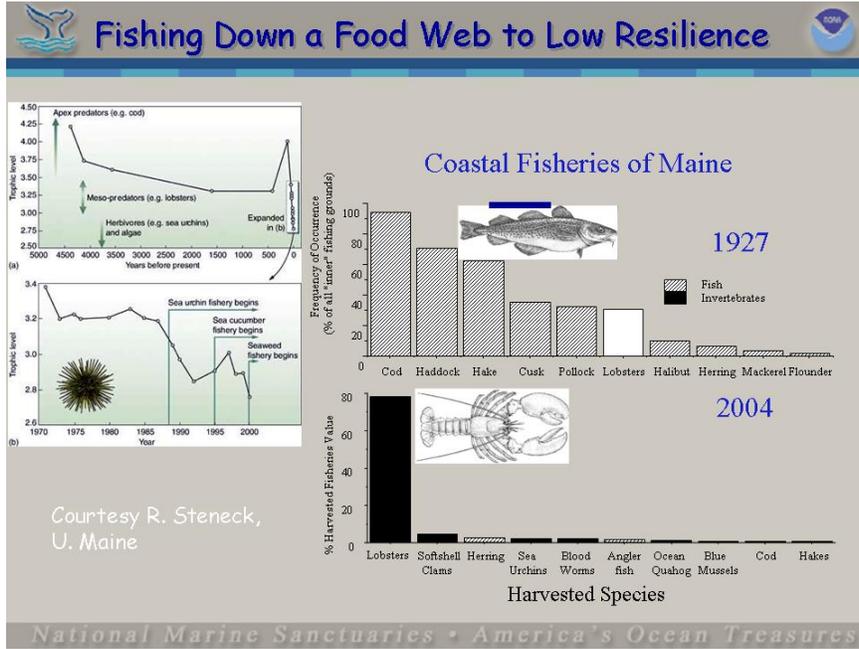
8.2.2.2 Climate Change Interactions with "Traditional" Stressors of Concern

- Pollution
- Commercial Fishing and Aquaculture
- Nonindigenous/Invasive Species
- Diseases



<http://www.ncat.org/nutrients/hypoxia/hypoxia.html>

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SCIENCE'S COMPASS • REVIEW

REVIEW: MARINE ECOLOGY

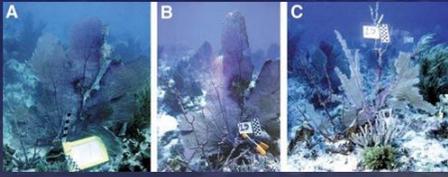
Emerging Marine Diseases—Climate Links and Anthropogenic Factors

C. D. Harvell,^{1*} K. Kim,^{1,2} J. M. Burkholder,² R. R. Colwell,^{4,5} P. R. Epstein,⁶ D. J. Grimes,⁷ E. E. Hofmann,⁸ E. K. Lipp,⁹ A. D. M. E. Osterhaus,¹⁰ R. M. Overstreet,¹¹ J. W. Porter,¹² G. W. Smith,¹³ G. R. Vasta⁴

Mass mortalities due to disease outbreaks have recently affected major taxa in the oceans. For closely monitored groups like corals and marine mammals, reports of the frequency of epidemics and the number of new diseases have increased recently. A dramatic global increase in the severity of coral bleaching in 1997–98 is coincident with high El Niño temperatures. Such climate-mediated, physiological stresses may compromise host resistance and increase frequency of opportunistic diseases. Where documented, new diseases typically have emerged through host or range shifts of known pathogens. Both climate and human activities may have also accelerated global transport of species, bringing together pathogens and previously unexposed host populations.

Science 1999

16 Jun. 1996 8 Aug. 1996 10 Nov. 1997



8.2.3 Management Approaches and Sensitivity of Management Goals to Climate change

- MPA networks + “beyond boundaries” management strategies, e.g., pollution abatement and sustainable fisheries
- National Marine Sanctuary Program goals - NMSA/operations at sites
- NMS management plans - evolution through Sanctuary Advisory Councils and public scoping meetings
- Performance measures to further efforts toward adaptive management

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8.3 Adapting to Climate Change

- Spreading the risk - replication of habitat types in multiple areas
- Critical areas (refugia) - nurseries, spawning aggregations
- Connectivity - larval dispersal, adult movements
- Effective management - enhance resilience
- Monitoring - MPA effectiveness, community engagement and awareness
- Restoration - e.g., transplantation
- Building partnerships - stakeholder involvement
- Tools - guides, early warning systems
- Social resilience - engaging communities

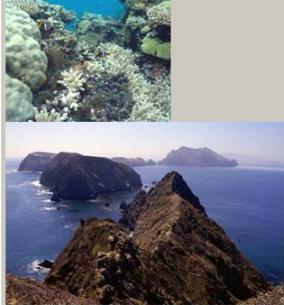


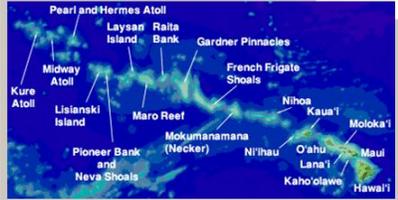
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8.4 Case Studies

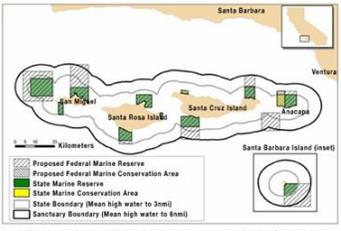


GREAT BARRIER REEF CATCHMENT





Pearl and Hermes Atoll, Laysan Island, Raita Bank, Gardner Pinnacles, Midway Atoll, French Frigate Shoals, Nihoa, Kaula I, Moloka I, Lisianski Island, Maro Reef, Mokumanamana (Necker), Niihau, Oahu, Lana I, Maui, Pioneer Bank and Neva Shoals, Kaho'olawe, Hawai I, Kure Atoll



Santa Barbara Channel

Santa Rosa Island, Santa Cruz Island, Anacapa, Santa Barbara Island (inset)

Proposed Federal Marine Reserve
 Proposed Federal Marine Conservation Area
 State Marine Reserve
 State Marine Conservation Area
 State Boundary (Mean high water to 3nm)
 Sanctuary Boundary (Mean high water to 3nm)

NOAA's preferred alternative for marine zones in the Sanctuary.

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8.5 Conclusions (Revision)

- **Management Considerations**
 - Ameliorate existing stressors in coastal waters
 - Protect apparently resistant and potentially resilient areas
 - Develop networks of MPAs: critical areas, connectivity, replication
 - Incorporate climate change into MPA planning, management, and evaluation
- **Research Priorities - consolidation of topics identified elsewhere in the chapter**

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General Comments

- **Omitted areas/groups**
 - Land-water linkages and impacts to wildlife in this interface
 - National parks
- **Missing topics/concepts**
 - Ecosystem-based management not featured
 - Management by zoning not emphasized
 - The lessons and perspectives of various enabling legislations should be broadened
 - Include examples of NPs, NERRs, NWRs
- **Scope/structure of report**
 - Arctic/sub-arctic poorly represented

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Specific Comments



- Missing topics/concepts
 - Further explore role of amelioration of existing stressors in resilience
 - Expand management to include reducing local sources of warming
 - Discuss strategies for outreach
- Scope/structure of report
 - Need to for management to actively work to reduce carbon emissions

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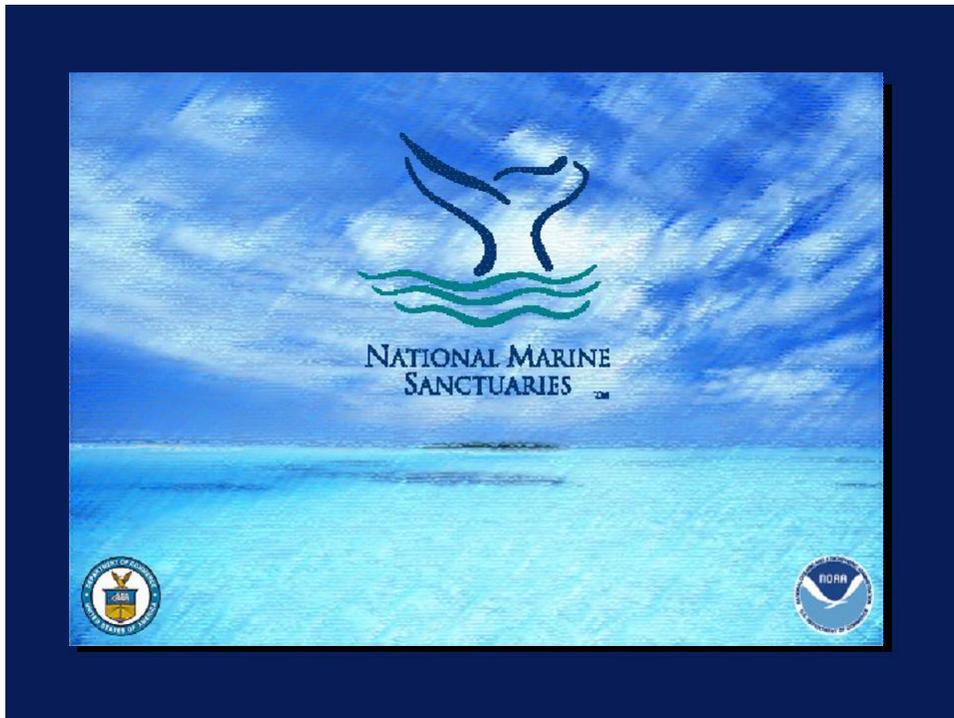


Specific Comments



- Programs and policies
 - U.S. response pitiful compared to Australia
- Technical
 - PMNM case study in part inaccurate and in part incomplete

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APPENDIX E
PRE-MEETING COMMENTS



October 26, 2007

U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, D.C. 20460

Attention: Ms. Joanna Foellmer

Reference: Contract No. EP-C-07-025; Task Order 07

Dear Ms. Foellmer:

Attached is the Peer Review Comments Report of the *Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources Synthesis and Assessment Product (SAP) 4.4: U.S. Climate Change Science Program*. Table 1 includes the responses grouped according to charge questions. Table 2 provides general comments. Table 3 contains Specific Comments grouped according to Chapter and Section. Appendix A contains the Charge Questions. Appendix B through J provides all the comments as summated by the reviewers.

Sincerely,

A handwritten signature in black ink that reads 'Patricia D. Wood'. The signature is written in a cursive style.

Pat Wood

COMMENTS SUMMARY REPORT

PEER REVIEW OF

Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources Synthesis and Assessment Product (SAP) 4.4: U.S. Climate Change Science Program

Prepared for:

**Ms. Joanna Foellmer
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., N.W.
Washington, DC 20460**

Prepared by:

**Versar, Inc.
6850 Versar Center
Springfield, Virginia 22151**

**Contract No. EP-C-07-025
Task Order 07**

Peer Reviewers:

**Joseph Arvai, Ph.D.
Eric Gilman, Ph.D.
George Hornbereger, Ph.D.
Elizabeth Malone, Ph.D.
Reed Noss, PhD.
David Patton, Ph.D.
Paul Risser, Ph.D.
Daniel Tufford, Ph.D.
Robert Van Woesik, Ph.D.**

October 19, 2007

Table 1. Response to Charge

Reviewer	Reviewer Comment	EPA Response to Comment
Preliminary Comments		
<i>Eric Gilman</i>	In preparation for the October 22-23 2007 Federal Advisory Committee meeting, the Committee Chair and Vice Chair have assigned me with the task of providing replies to seven ‘charge questions’ specifically related to the report Executive Summary and section on Marine Protected Areas. As my area of expertise is focused on mangrove and other coastal wetland responses to changes in relative sea-level and other climate change outcomes, I have additionally directed my comments to address the charge questions to the adequacy of the report in addressing options for adaptation to these coastal ecosystems’ responses to climate change.	
<i>Elizabeth L. Malone</i>	My background and expertise are in sociology (institutional, cultural, economic issues) and communications.	
<i>David R. Patton</i>	I am responding to the Charge Questions for ACSERAC and in particular questions 1, 2, 3, 6 and 7 for the National Forests and National Wildlife Refuges. For this preliminary report I will respond with my concerns and not with a “yes or no” to questions until the committee has discussed the issues.	
Question 1. Does the Committee agree with the focus on six management systems from across federally owned and managed lands and waters as an effective way to review adaptation options for climate-sensitive ecosystems and resources?		
<i>Joe Arvai</i>	<p>The focus on six management systems in the Executive Summary seems sensible. Other alternatives seem plausible, however, and it’s unclear why these were not chosen. In lieu of a focus on National Forests, National Parks, National Wildlife Refuges, Wild and Scenic Rivers, National Estuaries, and Marine Protected areas, the report instead could have focused on grasslands, wetlands, savanna, forests (all by sub-type). I’m sure there was a good reason behind why the report focuses on federally managed systems; perhaps it could be stated in the Executive Summary.</p> <p>The Synthesis chapter seems to downplay the six systems types, quite appropriately I think, in favor of more general recommendations about management considerations. However, from the perspective of the decision sciences, many of these recommendations seem to be glossed over. See item 2, below.</p>	
<i>Eric Gilman</i>	<p>(a) The organization of the report by categories of federally owned and managed properties is an ineffective structure to facilitate identifying optimal options for climate change adaptation. The report would be extremely more useful if organized by ecosystem type. Alternative adaptation strategies for an ecosystem type will generally apply regardless of the owner and manager. For instance, the word ‘mangrove’ occurs 57 times scattered in numerous sections throughout the 784 page report. Resource managers wishing to review best practices, for a site-specific context, to adapt to predicted mangrove responses to projected outcomes of climate change, would find the report much more efficient to use if it were organized by ecosystem type.</p> <p>(b) A review of the state of knowledge regarding individual ecosystem responses to climate change should be included in the report, as this scientific understanding is the basis for identifying effective adaptation options. If the current report structure is maintained (organized by federal management system), then a new chapter should be added, with individual sections devoted to a review of responses to climate change for each ecosystem type. Ecosystem responses to changes in individual global warming environmental factors, and combined effects, should be covered, including change in relative sea-level, extreme high water events, storminess, precipitation, temperature, atmospheric CO₂ concentration, health of functionally linked neighboring ecosystems, as well as human responses</p>	

Table 1. Response to Charge

Reviewer	Reviewer Comment	EPA Response to Comment
	<p>to climate change.</p> <p>(c) It is unclear why ‘marine protected areas’ is a separate category from other federally managed properties, as several categories of federally owned and managed property contain coastal and marine waters and are examples of MPAs (i.e. National Sanctuaries, National Estuaries, National Wildlife Refuges, National Parks, Naval Defensive Seas). The concepts identified in the MPA section are applicable to all of the other management systems covered in the report.</p> <p>(d) Naval Defensive Seas should be included as a federally managed, owned and extremely well enforced property and MPA.</p>	
<p><i>George M. Hornberger</i></p>	<p>The focus on six systems is fine. There is unevenness in how the ExecSumm handles the six, however. The sections on Adapting to Climate Change, for example, are all over the place. For National Forests, a total of six options are listed. For NWR,s, the options are not enumerated, but one can see that some are listed (along with a “recommendation” for forming a national interagency climate change council!). For WSRs, options are not presented; rather a general plea for “proactive management” is made. For Estuaries, it is not clear what items are management options and what are wishes for how people will behave in the future. For MPAs, the primary option is expansion and this is followed by a case study and a general plea for stakeholder involvement. Insights from case studies are similarly uneven. In fact, I think that significant rewriting is called for. In NPs, do you really want to say what University curricula should be? In NWRs, Does “The primary opportunities for enhancing implementation of adaptation options include (1) creating n institutional culture where employees are rewarded for being proactive catalysts for adaptation to climate change” carry any meaning? In WSRs, the claim is made that Alaska rivers are “laboratories.” This is presented only in a box, not in the Chapter itself. It is made only as a statement, with no evidence or argument to support the notion. It is hard to see how this is truly an insight from the case studies. For MPAs, I do not see where the last two paragraphs have anything to do with insights from the case studies. Overall, there is precious little specificity attached to the lessons learned.</p>	
<p><i>Elizabeth L. Malone</i></p>	<p>The focus on six management systems, it should be said, is at odds with the title of the SAP. However, such a focus allows this chapter to illuminate factors that are under the control of its managers. The chapter contains a wealth of information about various ecosystems in the national parks, sometimes focusing on one type (especially in “Stressors of Concern”), but several dimensions of adaptation require a richer analysis than an ecosystem-by-ecosystem organization provides. As the chapter itself says, “Preparing for and adapting to climate change is as much a cultural and intellectual challenge as it is an ecological one” (page 4-6, lines 32-33).</p> <p>a. The chapter emphasizes the dependence of various ecosystems on each other. Principal examples of this are animals that spend different phases of their lives in different ecosystems (fish, migratory birds) and the impacts of water withdrawals and pollution upstream from federally managed lands.</p> <p>b. The organization of particular agencies and the multiple enabling legislative acts are important for consideration of how the particular types of systems are and can be managed. The history of the national parks is helpful in understanding how various management arrangements evolved, including planning documents and public input.</p>	

Table 1. Response to Charge

Reviewer	Reviewer Comment	EPA Response to Comment
	<p>c. The focus on management systems allows the necessity for partnerships in adaptation approaches and activities to emerge.</p>	
<p><i>Reed F. Noss</i></p>	<p>No. A focus on the six management systems provides helpful examples of how changes in the management of lands and waters, and changes in management and monitoring philosophy, can facilitate adaptation to climate change. Nevertheless, I worry that a restricted focus on six management systems will give the impression that effective adaptation to climate change can be accomplished through management initiatives on these lands and waters alone. This would be a highly fallacious assumption, especially because of (1) the fragmented nature of these management units; and (2) their incomplete representation of ecosystem types and species.</p> <p>Given potentially dramatic range shifts of native species, invasions of non-native species, and other regional to continental-scale phenomena, a broader consideration of landscapes and seascapes is necessary. Looking only at terrestrial ecosystems, adding BLM and DoD lands to the six management systems would provide rather good representation of ecosystems and regional-scale connectivity in the far western U.S. (i.e., from the Rocky Mountains westward). In the remainder of the country, however, the full suite of federal lands still represents a fraction of ecosystem diversity and is highly fragmented. Here, the addition of state, county, and private lands is more critical.</p> <p>I concur with Eric Gilman that the report might be better organized by ecosystem type. However, from that initial organization, it would still be useful to discuss what every federal land-managing agency could do within its particular structure and mandate to address the key issues. The discussion could then move to consideration of adaptation options on state, county, tribal, and private lands, with appropriate examples.</p>	
<p><i>David R. Patton</i></p>	<p>One stated goal is to provide useful information on potential adaptation options for Key representative ecosystems. However the six ecosystems are administrative units that do not include the Bureau of Land Management (BLM) and Indian Reservations (IRs). BLM and IRs are important in the western U.S. because they border other federal lands. Decisions made by BLM and IRs particularly affect National Forest lands. In addition BLM administers 258 million acres in 11 western states compared to 193 million acres in National Forests and 275 Indian Reservations across the U.S. have 56 million acres.</p> <p>BLM will make the case that the agency contributes as much or more biodiversity than the Forest Service. The current six choices for climate-sensitive ecosystems represent a broad spectrum of administration and management situations but the addition of BLM and IRs will strengthen the knowledge of stressors and adaptive opportunities.</p> <p>In the introduction to the National Forest chapter a point was made that the Forest Service has 27 major forest types in the continental U.S., Hawaii and Puerto Rico. These types are the official forest cover types for the U.S. included in the National Atlas (USGS 2000). Ecosystems (ecological systems) are generally identified by a vegetation formation (wetland, forestland, shrubland, etc.), cover or vegetation type (forest cover types or potential natural vegetation), and ecoregions (Bailey’s Forest Service system or Omerick’s EPA system) and not by administrative boundaries. NWRS used the EPA ecoregions to group refuges into a Level I classification. The ecosystem and not the administrative approach would add a measure of scientific creditability to the review process of options for climate-sensitive ecosystems. While it may be too late to organize the current draft along some ecological</p>	

Table 1. Response to Charge

Reviewer	Reviewer Comment	EPA Response to Comment
<p><i>Paul G. Risser</i></p>	<p>designation this approach should be stressed where possible.</p> <p>The report is organized around six federally-managed systems: national forests, national parks, national wildlife refuges wild and scenic rivers, national estuaries and marine protected areas. The general approach is to address three topics in each system: effects of climate and other stressors, existing and possible management options mostly based on case studies and obstacles to implementing management options.</p> <p>Focusing on the six management systems is certainly convenient from an administrative point of view. However, there are two deficiencies with this approach. First, despite the common general framework, the treatment of each section is different, some focusing the need to insist on changes in philosophy (e.g. parks) and others with a focus on planning. As a result, the report never really synthesizes the different emphases and lacks the potential power and richness of laying out and analyzing the different conceptual approaches.</p> <p>Second, obviously many, even most, ecosystem types occur in more than one management system. Under the current focus on six management systems, the user has no easy way of synthesizing information and management techniques by ecosystem type. There is a summary (Box 1.11 in the Executive Summary) of the kinds of adaptation approaches, but these are only helpful at the most general level. A manager trying to meet management goals, for example, for riparian forest would like to benefit from the case studies for riparian forests from multiple management systems.</p> <p>This horizontal deficiency in the report could be solved to some degree by a synthesis across major ecosystem types. Although it would add to an already too long report, the synthesis could refer to specific entries in the existing chapters.</p> <p>Finally, one must ask whether the report would be far more useful if it were entirely electronic with a portal front-end that simply allowed users to link information from various sections based on the users specific interests and needs.</p>	
<p><i>Dan Tufford</i></p>	<p>This focus makes sense as an organizing approach given the substantially different origins and missions of each of the management systems. It is particularly useful because in the absence of a significant change in mission each will be required to use adaptation approaches that may be very different. This comes through very clearly in the various sections. This same aspect makes it difficult to understand whether the combined and integrated set of approaches will result in an effective national response to climate change for natural resource management. I also think the issue of interaction among management systems and other environmental laws may not have gotten effective treatment. For example, if ensuring habitat for an endangered species would force an action that is strongly suspect of being ecologically unsound in the context of climate change, would the requirements of the ESA or sound ecosystem management prevail? This type of question is alluded to several times but not clearly answered. So I am sure the issue was thought about a great deal by the teams and may be addressed to the best extent possible, but it still stood out for me.</p>	

Question 2. Does the Committee agree that the report provides useful information for managers on the state of knowledge regarding ecosystem management decisions sensitive to climate change, the types of adaptation options available, and approaches for implementing adaptation options? If the usefulness of the report could be improved, what specific improvements does the Committee recommend?

Joe Arvai

It is my view that all of the major conclusions point in the correct general direction. However, many of these themes seemed to be glossed over. I am somewhat concerned about this because a report with this heft will likely steer many readers to just the Executive Summary and Synthesis chapters. As a result, I think these two chapters should be clear in terms of providing detailed guidance about the challenges that might be expected in the six system types as well as the management strategies for approaching them.

In terms of an illustrative example, I am concerned by what appears to be, at best, an overly simplistic view of adaptive management (including Figure 9.1). I think this reflects, in part, the short treatment it receives in this chapter. However, I also think that the collective understanding among many scientists and managers of adaptive management is growing weaker. This is a shame for two reasons: First, much of what is positive (and negative) about adaptive management is lost on users. Second, it further contributes to the general level of misunderstanding that surrounds the concept. In the end, I think that drawing attention to the adaptive management framework in the context of climate management is appropriate and I recommend that the discussion of it in this report be bolstered. Moreover, I think that the concept can be more easily applied to climate change than many of the other resource management problems for which it was designed.

Adaptive management proceeds based on “experimentation” by simultaneously implementing varied policy treatments and then comparing their results to test clearly formulated hypotheses about the behavior of complex systems. Experimentation in this sense goes beyond management through trial and error and casual observation; it is structured and theoretically driven, designed to elicit specific responses from systems under study such that new knowledge can be incorporated systematically into future treatments.

While this experimental focus is especially appealing to scientists, adaptive management reaches beyond the goal of simply enhancing traditional scientific understanding of natural systems independent of human systems. The approach also recognizes that managed systems present moving targets influenced largely by human drivers and, therefore, explicitly incorporates these human factors into management experiments. By linking science and policy in this way, the objectives of adaptive management go beyond maximizing utility (from an environmental or human standpoint) relative to a previous baseline under a given management option to also include learning over time about complex and uncertain systems. The added appeal of adaptive management, therefore, lies in its ability to help inform the judgments of policy makers who must address complex problems with high levels of uncertainty.

Implementing adaptive management takes place in two phases: the challenging task of institutionalizing a framework in which intentional, varied, and comparable policies may be implemented, and the relatively easier task of learning over time by monitoring the responses of the system(s) on which the varied experimental policy “probes” have been enacted.

There are at least three reasons to believe *a priori* that adaptive management is a useful way to approach the problem of global climate change. First, any policy approach to global warming must incorporate the interaction of human behavior with the atmosphere, and vice versa. This point is obvious insofar as global warming is

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anthropogenic, but, more importantly, it is also true that mitigation and adaptation strategies themselves will interact with each other and with natural variables, creating a complicated dynamic of cause and effect where most important variables are both exogenous and endogenous. Adaptive management is well suited to incorporating this concern with the human-environment nexus.

Second, adaptive management is appealing because of the sheer complexity of the climate change problem coupled with the need to make management decisions under uncertainty. Even after over a quarter century of intense research, questions linger regarding the magnitude of human disturbance, climate sensitivity, impacts of realized climate change, and what mitigation and adaptation schemes will be most effective. Applying adaptive management to climate policy could provide policymakers with the flexibility needed to proceed and to learn over time, a preferable alternative to the current stalemate in many countries and localities where uncertainty leads to incrementalism or inaction. Adaptive management may be especially valuable since many planners and decision makers—particularly those in North America—have reported little direct experience with climate change and its consequences from which to draw analogies and lessons.

Finally, adaptive management is inclusive and flexible in terms of the precise goals of climate change policy and the means used to achieve them. By definition, the approach seeks to apply a variety of policy treatments to a problem. As such, it could be used to pursue a range of policy goals in the areas of both mitigation (e.g., emissions reductions, farming practices and forestry) and adaptation (e.g., accommodating changes in temperature and precipitation patterns, planting new crops and protecting biodiversity, building seawalls to protect coastal areas from flooding). Likewise, the approach also possesses the flexibility to include policy treatments that address climate indirectly; indeed, it is hard to imagine a policy intervention that *only* achieves goals related to climate change. Conversely, there are many interventions that may be pursued and justified on the basis that they help to achieve other goals and address climate change only via a secondary pathway. An example of one such ‘no regrets’ intervention is the effort to enhance the efficiency of motor vehicles in order to reduce dependence on fossil fuel imports and improve local air quality. In sum, the flexibility and inclusiveness that is inherent to adaptive management is appealing from a political and practical standpoint insofar as it allows different managers—at the international, national, sub-national, and individual levels—to pursue different objectives and options when it comes to climate change policy depending on the values and incentives that are specific to their regions.

It is important to note, however, that implementing an adaptive framework is not without significant challenges (albeit ones that may be overcome). Indeed, all of the barriers discussed in this section apply to both adaptive management and adaptation to climate change. Rather than going into further detail about these here, I would point the authors to the following papers:

Arvai, J. L., G. Bridge, N. Dolsak, R. Franzese, T. Koontz, A. Luginbuhl, P. Robbins, K. Richards, K. Smith Korfmacher, B. Sohngen, J. Tansey, and A. Thompson. 2006. Adaptive management of the global climate problem: Bridging the gap between climate research and climate policy. Climatic Change 78:217-225.

Gregory, R., D. Ohlson, and J. L. Arvai. 2006. Deconstructing adaptive management: Criteria for applications to environmental management. Ecological Applications 16:2411-2425.

It’s also curious that this section does not discuss non-ecological endpoints (as targets for adaptation/management). This is particularly noticeable in the discussion (in this section and elsewhere) of National Parks. Is there a reason

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	<p>why social objectives for adaptation—such as those relating to recreation in National Parks and property protection in the coastal zone—are not discussed?</p> <p>Finally, I think this section would be more comprehensive and accurate if it discussed some of the difficulties associated with establishing attributes and measures for management endpoint (i.e., objectives). This section does discuss establishing important baselines against which changes could be measured but, I think, it goes too far when it suggests that this data will be critical in a decision making context. In my experience, data inputs for decision making have to be specific to the objectives of stakeholders and decision makers.</p> <p>To be maximally informative for resource management, a key consideration is to ensure that measures of environmental health or quality are <i>decision-relevant</i> (as opposed to <i>science-relevant</i>). Many efforts by ecologists and resource managers aimed at identifying measures of environmental quality are little more than long lists of potentially important biological or physical factors (i.e., <i>science-relevant</i>) that are not useful from the standpoint of informing management decisions. To illustrate this point (though not in a climate change context), decades of research conducted in the lower Fraser River and its estuary in southwestern British Columbia yielded lengthy, detailed, and science-relevant data sets for parameters such as sedimentary metal and organic material content, dissolved oxygen levels, and benthic algal biomass. Very little of this information was useful for evaluating the effects of combined sewer overflow (CSO) events from nearby sewage treatment facilities on the ecology of the area and making subsequent decisions related to their management. This data vacuum resulted in a significant time lag (and further environmental degradation) between when a need for decision-relevant data was expressed and when additional research on the temporally- and spatially-dependent energy flow dynamics of certain key species that could be correlated with annual CSO events could be conducted</p>	
<p><i>Eric Gilman</i></p>	<p>Overall, the report identifies key concepts for climate change adaptation, but provides very few site-specific examples of how these concepts can be implemented. As a result, due to the lack of specific guidance for implementing adaptation methods, it is unlikely that resource managers will modify their planning and management actions to better incorporate predicted ecosystem responses to climate change based on the production of this report.</p> <p>(a) Managed retreat as a method for adapting to ecosystem responses to relative sea-level rise should be highlighted in the executive summary and main text. This concept is discussed in the Executive Summary (section 1.7.2) and the chapter on National Estuaries, but is applicable to all six management systems and ecosystem types. “Managed retreat” involves implementing land-use planning mechanisms before the effects of climate change become apparent, which can be planned carefully with sufficient lead time to enable economically viable, socially acceptable, and environmentally sound management measures. As an example, based on the well documented understanding that coastal ecosystem response to rising sea-level relative to the coastal ecosystem’s sediment surface is to migrate landward, removing obstacles to this natural landward migration is a recommended adaptation measure to reduce reductions in area of coastal ecosystems in response to relative sea-level rise.</p> <p>With managed retreat, coastal development could remain in use until the eroding coastline becomes a safety hazard or begins to prevent landward migration of mangroves, at which time the development can be abandoned or moved inland. Adoption of legal tools, such as rolling easements, can help make such eventual coastal abandonment more acceptable to coastal communities. Zoning rules for building setbacks and permissible types of new development can be used to reserve zones behind current mangroves for future mangrove habitat. Managers can determine adequate setbacks by assessing site-specific rates for landward migration of the mangrove landward margin. Construction codes can be instituted to account for relative sea level rise rate projections to allow for the natural inland migration of mangroves based on a desired lifetime for the coastal development. Any new</p>	

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	<p>construction of minor coastal development structures, such as sidewalks and boardwalks, should be required to be expendable with a lifetime based on the assessed sites' erosion rate and selected setback. Otherwise, the structure should be portable. Rules could prohibit landowners of parcels along these coasts from constructing coastal engineering structures to prevent coastal erosion and the natural inland migration of mangroves. This managed coastal retreat will allow mangroves to migrate and retain their natural functional processes, including protecting the coastline from wind and wave energy.</p> <p>(b) Clarify that, in referring to ecological restoration, which can contribute to mitigating anticipated ecosystem degradation in response to climate change, through a specific definition, that this does not include habitat conversion (i.e. converting mudflats into coastal wetlands as a means to offset anticipated reductions in area and health of coastal wetlands as a result of responses to climate change).</p> <p>(c) There is a dearth of research and experiences for climate change adaptation for certain ecosystems, e.g., pelagic marine ecosystems. In these instances it is important to identify research priorities as part of the approach for adaptation.</p> <p>(d) For each ecosystem, the report should use the IPCC's fourth assessment as a baseline and starting point for information on the state of knowledge for internationally accepted options for adaptation to ecosystem responses to climate change.</p>	
<p><i>George M. Hornberger</i></p>	<p>Chapter 6, "Wild and Scenic Rivers"</p> <p>The section on policy context is excellent and lays out clearly the options available (and hints at some of the difficulties of implementation of options). On the other hand, I think that the distinction between "reactive management" and "proactive management" artificially glorifies the latter and denigrates the former. There will always be a need for reactive management; for example, rescuing stranded canoeists can't possibly be otherwise. And there will always be a need to repair damages caused by extreme events – this was true in the past and will be true in the future with or without climate change. I don't disagree with the notion that proactive management measures should be considered carefully under climate change scenarios, but I think the utter dismissal of "reactive" approaches to bolster the claim that this should be done misses the mark.</p> <p>The basic problem with adaptive management is glossed over. The statement is made that many of the management actions needed are in response to risks of changes in the frequency and magnitude of extreme events. But suppose some management action is taken in the expectation that the 100-year flood is now in reality the 50-year flood. How would one assess whether the action was successful? In one case there might not be any observed flood over a couple of decades (even though the hypothesis was true) and in another case, one might have an extreme flood two years in a row. The authors obviously know this, but the way the prose is written does not make it clear what an adaptive strategy is in these cases. Because there are no detailed examples of management actions and options, it is not possible to figure out what the advice is.</p> <p>My main criticism is that an inference that comes to me quite strongly is not even stated explicitly. For many, many systems, other stressors (water withdrawals, nutrient enrichment, etc.) will continue to have a deleterious effect unless proactive management options are undertaken. It turns out that most such actions would also be beneficial for climate change effects. Why not recognize this explicitly and make appropriate recommendations?</p>	
<p><i>Elizabeth L. Malone</i></p>	<p>Chapter 4, "National Parks"</p> <p>The chapter on national parks, like the other chapters on management systems, provides very useful information</p>	

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	<p>about the state of knowledge, including the uncertainties that abound, and adaptation approaches, along with elements of implementation. Although it would be ideal to have a sort of “cookbook” of best practices, the chapter (and, overall, the report) make clear this is impossible, that management actions should be aimed at limiting damages from climate change and experimenting to find ways of easing the ecological transitions to new climate regimes.</p> <p>To be more helpful to managers, the chapter should more clearly distinguish the following:</p> <p>a. What is under the control of park managers, and what actions would require partnerships with others, support from the public and Congress, and continuing monitoring and research. This delineation would also help to clarify what is possible in the short, medium, and long terms.</p> <p>b. The line drawn between “Nature” and people. Some of the stressors on the parks clearly come from human activities, and these should in principle be more controllable than, say, fires ignited by lightning strikes during drought conditions. However, it is also true that people are part of Nature—and are certainly included in park ecosystems. Showing human visitors how to align with the ecosystems around them, for instance, should be a part of what park managers can control and a pathway to reducing stress on the parks.</p> <p>c. Native and nonnative species. Nonnatives seem to be treated by definition as harmful, but climate change is almost sure to cause species movement; will species that move because of climate change be considered invasive and harmful in their new places? The chapter begins a good discussion of this issue on page 4-21 but does not take it far enough to be useful to managers.</p> <p>Section 4.3.3, “Incorporating Climate Change Considerations into Natural Resource Management,” parallels but improves upon the mental model depiction in the synthesis chapter because this chapter’s section speaks in terms of resources “at risk”—that is, incorporating the uncertainty of the whole process.</p>	
<p>Reed F. Noss</p>	<p>I was impressed with the quality of writing and, for the most part, the scientific content of the report. Although there was some unevenness among chapters in this respect, I found the chapter on estuaries, for example, very compelling – this could be published as a review paper on the topic. So, in general I agree that the report adequately summarizes the state of knowledge regarding ecosystem management decisions.</p> <p>Regarding adaptation options available to managers, the report could be improved by providing more specific and concrete suggestions on what to do differently. There are some such suggestions, but in part because the report is of outrageous length, these suggestions tend to be buried in a mass of verbiage. The most specific suggestions can be found in the boxes on “adaptation options” for each management system. These are useful, but are still arguably not specific and direct enough to tell a manager precisely what to do. I acknowledge that detailed directions will be largely case-specific, but perhaps the case studies could have provided this level of detail.</p>	
<p>David R. Patton</p>	<p>There is considerable documentation of information presented in the draft report and this is to the credit of the authors of the chapters. However the level of use will probably be most beneficial to planners at the regional or national level and not on National Forest Districts or Wildlife Refuges. Most but not all of the information is a statement of need or what could be done without providing detail on the “how to do”. However, information at the management or specific ecosystem level may not be available in the literature. Cumulatively, the literature could be a state-of-knowledge publication on climate-sensitive ecosystems.</p>	

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	<p>Climate change has no political or geographical boundary and throughout the draft there is information on stressors that could be the core topic of publication chapters within defined ecosystems. The information is scattered throughout the report but should be consolidated and made available to managers for decision-making, no matter what federal agency is involved. For National Forest and National Wildlife Refuge Systems the tables on Adaptation Options for Resource Managers comes the closest to providing direction and management guidelines. At this early stage in addressing climate change effects on sensitive ecosystems and resources these guidelines may be all that are needed until more research is completed or adaptive change has provided useful examples.</p> <p>One of the tools for the toolbox could be a database with an annotation of all the literature cited and included as a CD in the final report.</p>	
<p>Paul G. Risser</p>	<p>The volume provides a great deal of information and a wealth of literature review throughout the report as a whole and in each section. This relatively complete background is of course helpful as some level, at least to give the manager confidence that information is anchored in the literature. So, the authors are to be commended for their thoroughness.</p> <p>In many cases the information summaries are unnecessarily verbose and repetitive—it is almost as if the authors were afraid of omitting any previous literature citation. In addition, many of the recommendations are so general as to be of limited use, e.g., <i>avoid sources of pollution</i>.</p> <p>I wonder, however, if the chapters are not backward. That is, the first attention should be paid to what is known about each stressor and response. Each chapter might better start with one or several conceptual models detailing the primary stressor/response. Then the subsequent analyses can be directed management strategies that are associated with each stressor/response. The extensive “context” material can be referenced in the models and be included later in the chapters.</p>	
<p>Dan Tufford</p>	<p>Overall I think it does a pretty good job of this. I have a concern with the emphasis on resilience, in particular the frequent references to increasing or enhancing resilience. As an emergent property, resilience may not be responsive to tinkering by humans. At the very least it will be difficult or impossible to know if our actions actually did increase resilience. In most situations we have no quantitative understanding of resilience so talk of increasing it may be misleading in that sense. What we do know is that human activity is a cause of stress on ecosystems so it makes sense to plan to reduce anthropogenic stress so that natural resilience can operate as it evolved to do. Section 9.3.1 in the Synthesis is a very good discussion that includes these points and more.</p> <p>These points are acknowledged at several places in the report and the Synthesis is quite clear that dependence on resilience may have a low utility value for adaptation over the long term. I will have more to say about this in a later section.</p> <p>There were high points. I especially liked the development of the ecosystem management topic in the chapter on National Wildlife Refuges. My only question on that as I was reading it was whether operational staff at refuges participated in the development. From the credits it seems clear that quite a number of USFWS staff participated but I do not have a sense of their level of understanding of the problems and issues the on-the-ground managers have to deal with. The National Park Service has a particularly difficult task in the context of climate change. Their mandate can be interpreted to mean they must preserve existing ecosystems and species; a very problematic task over the long term as climate and other abiotic drivers change. The chapter works its way through the various issues about why this needs to change from both policy and management perspectives and provides recommendations for how to</p>	

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	<p>approach the change. My main concern about this chapter is the potential it is providing a mixed message. In a few places it seems like the authors accept the thesis that preservation of the status quo is sound policy. At the same time one of the best sentences in the entire report is on p.4-21: "...even if maintenance of representative current biotic communities is possible as climate changes, such maintenance may not be desirable." Again, I appreciate the difficulties faced by the NPS and the authors of this chapter.</p>	
<p>Question 3. Does the Committee agree that the case studies are effective at demonstrating adaptation approaches and specific issues related to implementation? If the case studies could be improved to better demonstrate adaptation approaches, what specific improvements does the Committee recommend?</p>		
<p><i>Joe Arvai</i></p>	<p>It is difficult to tell from the Executive Summary alone what the key findings and recommendations are. The executive summary seems overly general, which is problematic given that it's intended audience—resource managers; page 1-3—will likely focus on this summary chapter. Many of the statements made seem rather uninformative, perhaps because important contextual details are absent; e.g., "...Working toward the goal of desired future functions (e.g., processes, ecosystem services) would involve managing current and future conditions (e.g., structure, outputs), which may be dynamic through changing climate, to sustain those future functions as climate changes...(page 1-5)".</p>	
<p><i>Eric Gilman</i></p>	<p>The case studies do not demonstrate adaptation approaches, but in some cases do highlight issues to be considered when implementing adaptation methods. The case studies included in the report do not provide examples of moving from concept to operationalizing alternative methods for climate change adaptation. This may simply be the result of there being few examples of implementation of climate change adaptation, which is documented in the Executive Summary as a key finding from the stakeholder workshops, "...for many of the management systems, management plans are only beginning to consider climate impacts, with few adaptation strategies yet being enumerated or implemented in the field" (p. 1-4). For example, the Florida Keys NMS case study marginally discusses how climate change adaptation methods could be implemented in the future, such as by identifying and protecting bleach-resistant reefs in the Keys, and considering possible expansion of coral reef range to higher latitudes. This and most of the other selected case studies were not appropriate if the purpose was to provide lessons learned from implementing adaptation methods.</p>	
<p><i>George M. Hornberger</i></p>	<p>Chapter 6, "Wild and Scenic Rivers" The case studies are very informative, but see my last comment in #2 above. The effects of climate change are unlikely to be good for rivers like the Rio Grande or the Wekiva, but direct anthropogenic effects on water and land use are likely to be dominant. This doesn't mean that climate change isn't important, but if there were options that would be beneficial for one or the other or for both, I think there would be a clear priority.</p>	
<p><i>Elizabeth L. Malone</i></p>	<p>Chapter 4, "National Parks" Only one short case study is given in the chapter, Rocky Mountain National Park. It is not clear why the chapter has only one case study or why this particular part was chosen. The text says RMNP "is a good example of the state at which most parks find themselves as they confront resource management in the face of climate change" (pages 4-31-32), but in fact it seems to have advantages over other parks: no danger of losing an iconic resource, like Glacier National Park; fewer visitors than other parks; "rich in information about its ecosystems and natural resources" (page 4-35, lines 2-3); and less pollution than other parks. Nevertheless, the adaptation approaches being initiated and planned are given in enough detail to be helpful. More detail and another case study would improve the helpfulness.</p>	
<p><i>Reed F. Noss</i></p>	<p>Case studies are often of value to put abstract concepts "on the ground," and the case studies in the report are generally useful for this purpose. However, the quality of case studies here is uneven, and some are of questionable value. The Tahoe National Forest case study (3.4), for example, is pretty much standard national forest management rhetoric. I was dismayed to see here the description of "Salvage and Planting Post-Fire" as among the "best-forest-</p>	

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	<p>management practices...consistent with adaptive conditioning for climate contexts...” (p. 3-53), ignoring abundant documentation in the recent peer-reviewed literature of the overwhelmingly negative ecological impacts of these practices. As pointed out later, in the Synthesis chapter of the report, today’s “best practices” may be tomorrow’s “bad practices.” In contrast, the following case study on the Olympic NF is more ecologically literate. The relevance of the Great Barrier Reef case study (8-42...) to adaptation options in the U.S. is questionable.</p>	
<p>David R. Patton</p>	<p>Case Studies (CS) are an effective way to identify problems and solutions at a local, regional and national level. The degree of resolution of the problems and solutions decreases from the local to national level. At the local level, such as on the Tahoe National Forest, more detail is required for decision-making than at the national level. The Handbook System is a source where information can be documented and made available for field use. The barriers and opportunities are well defined but an action plan relating to the barriers and opportunities is lacking. Action plans require that national policy be transmitted to lower levels of administration on the 600 National Forest Districts and this will be a major challenge for the National Forest System. Case Studies usually have a resolution to a problem to demonstrate how a problem or issue was resolved. None of the CSs have a resolution to a specific problem.</p> <p>A big gap is present in the representation of barriers and opportunities. National Forests CSs are missing for the Rocky Mountain Region from the Canadian border to Mexico. Two CSs on the West Coast and one in the Southeast leaves out a part of the U.S. where there could be barriers, such as livestock grazing (18,000 permits on BLM land for 2007). There should be a least one CS from each Region to have a good representation of the current Forest Service situation.</p> <p>There is only one CS for National Wildlife Refuge System (NWRS). While the CS does cover the Central Flyway Corridor from Alaska to Mexico and will be useful, it is certainly not all inclusive. The NWRS administrative structure is complex because of the distribution, size, ecological setting, and use designation of individual refuges. The NWRS includes 584 refuges, and over 30,000 production areas categorized into 37 wetland management districts. Many of these areas cannot be managed at an ecosystem or landscape level depending on the size and landform composition (agricultural land, etc.).</p>	
<p>Paul G. Risser</p>	<p>The extensive treatment of background information in the case studies is of questionable value. These cases are mostly from specific examples of well-known pieces of federal property. There are two points here. First, the value case studies would be a tight analysis of climate change (or other) stressors and the existing or proposed adaptive management strategies. This would give the user a clear example of the known or expected ecosystem response to climate change and the range of management strategies. These strategies could be ranked according to contingencies and confidence.</p> <p>Second, all of these federal properties are influenced by external conditions and adjacent systems. So, the case studies could serve as examples about how adaptive management strategies on the federal lands account or could account for the external conditions.</p>	
<p>Dan Tufford</p>	<p>I think the case studies are among the real gems of the report. I have a concern with their limited coverage at ecoregion and biome scales. I am fully aware that it is prohibitive to cover every significant scale for each management system. For some systems that would mean a case study of nearly all managed units. Even when there is scale redundancy within a management system at some point the marginal value in terms of new lessons learned would make another case study a questionable use of human resources. In a similar vein I also recognize that some of the lessons of the case studies transcend the specific location. I still am left, however, with uneasiness that the limited coverage may have left important insights unrecognized. On one end of the coverage spectrum is the</p>	

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	<p>National Parks chapter. I have a fairly good understanding of several resource management issues facing Congaree National Park, for example, and I am somewhat skeptical that the discussion of Rocky Mountain National Park really covered them all. I have a similar concern with the coverage of National Wildlife Refuges. At the other end of the coverage spectrum is the Wild and Scenic Rivers chapter, which I think provides a more complete assessment.</p> <p>My stated issue here is fairly obvious to anyone and the authors acknowledge it as well. What bothers me is the level of assurance the report projects that, in total, the case studies cover the important spatial and biophysical issues involved. That may well be correct but the assertion is made with no supporting discussion. Given the substantial differences in how the management systems function and the known geographic variability in ecosystem function I think there should be a little more transparency that something important may have been overlooked with this approach. As I stated earlier I understand there is a human resource cost to doing the case studies and I am not necessarily advocating for more of them.</p>	
<p>Question 4. Does the Committee agree that the major conclusions and synthetic themes of the Synthesis chapter are supported by, and representative of the underlying chapters?</p>		
<p><i>Joe Arvai</i></p>	<p>Based on what I have read, yes.</p>	
<p><i>Eric Gilman</i></p>	<p>Yes.</p>	
<p><i>Elizabeth L. Malone</i></p>	<p>The synthesis chapter supports and represents most of the underlying chapter themes and conclusions and usefully introduces concepts that are implicit in the chapters. However, the synthesis chapter should be strengthened in some areas.</p> <p>Themes that are very well supported include the need for monitoring, the need and problematic aspects of establishing baselines, the issue of uncertainty and handling the potential for multiple outcomes (scenarios), and implications of uncertainty and barriers/opportunities for meeting goals. (On page 9-12, the references to scenarios would be enriched by CCSP SAP 2.1B on scenarios and their use in climate change science.) The section on adaptive management (9.3.4) reflects what is in the chapters, both the concept and the fuzziness surrounding the concept. In particular, the adherence to management goals is at odds with the flexibility implied in adaptive management, where presumably both approaches and goals are candidates for revision. (This is echoed in a statement in section 9.4, “Adaptation responses to climate change are meant to reduce the risk of failing to achieve management goals” [page 9-20, lines 40-41], a very narrow view of what adaptation activities can be and do.)</p> <p>The first part of the synthesis chapter usefully makes explicit the mental models and underlying assumptions of the chapters with regard to adaptation and the guiding framework for impact assessments. One might well argue that the linear framework for impact assessments is ill suited to a dynamically changing and complex system, but both the management system chapters and the synthesis chapter use such a framework. Some of the tools reviewed in the synthesis chapter—notably, climate models and, to a large extent, impact models—are not discussed in the management system chapters, and here the synthesis chapter makes a contribution that benefits all of them.</p> <p>The emphasis on building resilience as an adaptation strategy is stronger in this chapter than in the underlying chapters. Indeed, the statement is made that “the goal of adaptation strategies is to reduce the risk of adverse environmental outcomes through activities that <i>increase the resilience</i> of ecological systems to climate change” (page 9-12, emphasis in the original). In the synthesis chapter this emphasis becomes an almost-pure “holding the line” strategy, without much of the flexibility to respond to changing ecosystems that Chapters 3-8 have. Even the chapter strategies of representation, replication, and supporting refugia for some species have a resilience emphasis</p>	

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	<p>here, although in the chapters these strategies may also be part of migrating species to other locations as climate changes rather than as building resilience. At the end of the very long section on resilience, the synthesis text seems to grudgingly acknowledge that climate change may overcome even the most resilient ecosystems and that wholesale change may be needed, but there is not much in between holding the line and giving up. In the middle of a paragraph in section 9.3.3 (“Confidence”) the statement is made, “It is important to note at this point that promoting resilience may be a management strategy that is useful only on shorter time scales (i.e., 10-30 years) because as climate change continues, various thresholds of resilience will eventually be exceeded” (page 9-18, lines 4-5). This statement should come much earlier, prior to or early in the resilience section.</p> <p>The synthesis chapter fails to adequately support and represent the other chapter themes of the social roles of stakeholders (both resource managers and others), partnerships, and agency managers in accomplishing management goals. The closest the synthesis chapter comes to these important themes is in discussing barriers and opportunities related to legislation and regulation, management policies and procedures, and human and financial capital (sections 9.4.1, 9.4.2, and 9.4.3). Perhaps because these sections do not have the concrete detail that the other chapters have, they seem more theoretical than useful. Statements such as, “Managers often lack sufficient support and decision-making tools to help guide them in selecting appropriate management approaches that address climate change” (page 9-26, lines 38-39), are not helpful for the intended audience but merely provide a catalogue of the usual laments. Moreover, it is difficult to reconcile this particular statement with the discussion of existing tools earlier in the chapter.</p> <p>The synthesis chapter should be strengthened with regard to representing the need for partnerships with people and organizations outside federal and other resource managers. Some of the chapters have very detailed sections on existing partnerships and the goals of such partnering, with clear statements that this is a critically important dimension of addressing multiple stresses, including climate change. These chapters also have more of a sense of how difficult it is to form/maintain such partnerships and have them yield good results. The synthesis chapter calls, for example, for integrated federal action, without consideration of the institutional implications (starting with feasibility). Only on page 9-34 (the second-to-last page of text) are important external issues, such as coastal development and private property issues, mentioned.</p> <p>An issue implicit in the chapters but not brought out—indeed, deemphasized—is the stress that human visitors and external human actors (e.g., industrial polluters, farmers who irrigate) place on federally managed lands. The latter stresses are referred to in the chapters as external factors that come from nowhere: pollution rather than polluters, water withdrawals rather than water managers and farmers, invasive species rather than the bringers of those species. Unless readers and managers know who the stressors are, how can they hope to know about pathways to address the stresses? The stresses from human visitors are to a degree unavoidable and indeed are usually part of mandates in re managing federal lands. However, these stresses may be ameliorated to at least some degree. Some national parks restrict visitors to a few roads (e.g., Denali), and all that I have visited use signs, literature, and rangers to teach visitors how to avoid damaging the natural resources. Management changes to avoid damage by visitors could be used as examples. Chapter 8 repeatedly refers to “no take” zones as a way to protect fish stocks, although they could equally be termed ways to prevent human damage.</p>	
<i>Reed F. Noss</i>	Yes, this is a good chapter.	
<i>Paul G. Risser</i>	The synthesis chapter is supported by the underlying chapters and does summarize the primary issues. However, as noted above, I still wonder if we should begin with the ‘synthesis’ chapter should be the first chapter, setting an analytical framework for the subsequent six system chapters. For the purpose, the synthesis chapter would need to	

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	be streamlined are organized more as a <i>guide</i> as opposed to a <i>summary</i> .	
Dan Tufford	The Synthesis is well done, although I did not study it at the same level of detail as some other chapters. Early in the chapter it discusses assessing impacts including tools, baseline information, and uncertainty so these get the emphasis they need. The chapter also brings to the surface what seems to me a problematic weakness in the report. As stated in the first paragraph of section 9.3 on p.9-12 the adaptation approaches are to support the ability of ecosystems to persist. Yet at several places in the report, including later in the Synthesis, persistence of existing ecosystem state over the long-term is recognized as doubtful or at least unknown. So the options for adaptation are all relegated to being short- to medium-term responses (maybe just short-term). The opening paragraphs of chapter 2 do not lead the reader to expect this temporal horizon. Section 9.5.3 provides the answer to the “what then” question but it is a very small part of the overall report. I fully understand that it is simply not possible to predict with much certainty long-term climate change or its impacts. All I am saying is there seems to be a disconnect between what the report intends to do (opening paragraphs of chapter 2) versus what it actually does (as stated in section 9.3).	
Question 5. Does the Committee agree that the key findings and recommendations presented in the Executive Summary are the most important and appropriate to bring forward to executive level managers and Congress?		
Joe Arvai	Absolutely. However, it’s unclear to me from both the Executive Summary and the Synthesis chapters what the purpose of the stakeholder workshops was. The brief section in the Introduction is equally, if not more, cryptic. Many authors and analysts have criticized stakeholder involvement processes that seem to be little more than a marginal addition—sometimes an afterthought—to what are typically viewed as fundamentally technical decision problems. It strikes me that stakeholder input would play a key role in this report but, without a basis for making judgments about its quality, I fear that many will view it in negative terms. I think the report should be more explicit about what exactly was done with respect to eliciting input from stakeholders.	
Eric Gilman	The following basic concepts, related to adapting to ecosystem responses to climate change, should be highlighted: (a) Emphasize that, while it is important to plan for adaptation to ecosystem responses to climate change, at the same time there is an urgent need to address the underlying anthropogenic causes of climate change. Furthermore, clarify that planning for adaptation is needed even if the U.S. and international community comply with internationally-accepted measures to reduce greenhouse gas and aerosol emissions: The effects from human-induced climate change by the production of greenhouse gases and aerosols are projected to continue for hundreds of years even if greenhouse gas concentrations were stabilized at present concentration levels. (b) “Managed retreat” through the implementation of land-use planning mechanisms, discussed previously in these comments. (c) When considering areas for augmented protection as a strategy for climate change adaptation, consider an area’s resistance and resilience to projected sea level and climate changes and contributions to adaptation strategies. For instance, mature mangrove communities will be more resilient to stresses, including those from climate change, than recently-established forests.	
George M. Hornberger	It is not easy to discern the key findings and recommendations in the ExecSumm. If there are recommendations, they are very “soft”, that is they are stated implicitly rather than explicitly. The first four paragraphs on page 1-16 give an excellent synthesis of useful ideas from the six systems. But I question whether the “recommendation” to use adaptive management is wise (as I mention in my general comments.) The problems of detecting changes in a “noisy” system and of attributing any changes detected to climate are real problems. Do the authors really think there is a reasonable prospect that this can be accomplished	

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	for ecological endpoints? That is, for any of the six systems how likely is it that we can “develop or modify monitoring schemes to track and substantiate vulnerabilities to climate change and assess the effects of management adaptations”? My own view is that one major message from the individual sections has been lost – that other stressors are likely to have big impacts regardless of how climate may or may not change at a particular location and that there are management options to alleviate these other stresses <i>that are likely to be good for climate change scenarios as well</i> . Does this not argue for a recommendation to pursue “no-regrets” options and not worry about the attribution problem? Finally, although I find it a noble (and scientifically correct) goal to “manage the nation’s lands and waters as one large system”, whether such a grandiose (implicit) recommendation will resonate with executive level managers and Congress remains to be seen.	
Reed F. Noss	Generally yes, but as noted above, the limitations of focusing on only 6 federal management systems should be clearly acknowledged, unless the report is radically rewritten to include a much broader spectrum of lands and waters. I also agree strongly with Gilman’s suggestions for highlighting several basic concepts.	
Paul G. Risser	The Executive Summary does include the key findings and recommendations for each of the six federal systems. However, this chapter brings into focus the concern with the current organization of the report. The text says managers may attempt to meet their management goals by <i>examining the existing literature and comparing likely climate change impacts with key ecological properties...</i> It seems to me that in fact this report should make process far easier for the manager by clearly identifying the key issues by both federal system type and by ecosystem type. If the report is just a literature review and case studies, then we have not advanced very far. If the by reading the Executive Summary, the user knows the likely impacts of climate (or other changes) on various systems and knows the range of potential management options, then we have made progress.	
Dan Tufford	Overall it seems to, although this was not one of my chapters to review.	
Question 6. Does the Committee agree that EPA effectively followed the CCSP Guidance on characterizing confidence levels for the proposed adaptation approaches presented in the Executive Summary and Synthesis?		
Eric Gilman	Yes.	
George M. Hornberger	<p>Executive Summary</p> <p>Table 1.1 does express confidence as suggested in guidance documents. I did not find a consistent expression of uncertainty throughout the document, however, so it is not clear what the basis for the authors’ entries in Table 1.1 were. Guidance # 1 is: “Instruct authors to incorporate explicit discussions of uncertainty throughout their report.” Although there was some discussion of uncertainty throughout the document, I did not find a consistent treatment, especially with respect to impact on adaptation approaches.</p> <p>Guidance #5 is: “Instruct authors to express the level of confidence in the current scientific understanding of an issue by being transparent about the amount of evidence available and the degree of consensus in the scientific community surrounding that issue.” I do not think that the basis for the evaluations (the amount of evidence) is presented. Thus, it is hard to argue for transparency.</p> <p>Chapter 6, “Wild and Scenic Rivers”</p> <p>Uncertainty is mentioned in several places, but I could not tell how the authors did their confidence assessment, nor do I see evidence presented that helps me. I tried to look at possible connections, but couldn’t really make headway. On page 6-29, does the option to “Designate more river corridors as wild and scenic” fall into the “replication” adaptation approach? If so, why is the level of confidence low? Is “Claim more water rights” in the “reduce anthropogenic stress” category? If so, why is confidence high? Is procurement of land conservation easements (under “Improve water monitoring capabilities on page 6-31) in the “Refugia” category? If so, why a “medium”</p>	

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	confidence? In general, there appears to be no connection between what is presented in the Chapter and the entries in Table 1.1.	
<i>Elizabeth L. Malone</i>	<p>Chapter 4, “National Parks” Although the chapter contains a discussion of uncertainty, it does not apply confidence levels. Three types of impacts are discussed: foreseeable changes, known or imaginable changes, and unknown or unknowable changes (with the reminder that, “Perhaps the greatest uncertainties in predicting climate change and its effects are associated with the interaction of climate change and other human activities” [page 4-23, lines 23-24]). The management responses proposed are helpful at least at a theoretical level. Figure 4.8 is an excellent framework for thinking about how uncertainty and controllability interact to yield different management strategies. Any management strategy, but especially scenario-based planning and adaptive management, should include management of humans and human-caused stressors.</p> <p>A reference to Table 12.4 (and 1.1), along with a discussion of the rationale for choosing confidence levels in re the national parks, should be included in this chapter.</p> <p>Chapter 9, “Synthesis and Conclusions” The only assignment of confidence values to the statements made in the synthesis chapter comes in two paragraphs on pages 9-17 and 9-18 and Table 9.4. I agree that expert opinion is the valid way to determine these confidence values, but without some comparative rationale it is difficult to interpret the levels assigned. Why, for instance is there only one “very high” ranking for “reducing anthropogenic stresses”?</p>	
<i>Reed F. Noss</i>	Yes	
<i>David R. Patton</i>	Many reviewers will ask the question: Is there sufficient evidence presented in the report to arrive at the confidence levels assigned to each management system? If the confidence levels are based on Bayesian probabilities there has to be a prior probability assigned and this is usually a best guess. The authors and contributing authors were selected because of their knowledge and experience about the subjects and their best guesses are probably very close to reality. However, it would be helpful to discuss the technique and documentation of how the confidence levels were determined.	
<i>Paul G. Risser</i>	The report appears to have done so, but I confess to not having dug through the guidelines in great detail.	
<i>Dan Tufford</i>	Yes, for Table 1.12 and 9.4. It is inconsistent elsewhere.	
Question 7. Does the Committee agree with the decision to use information from a series of stakeholder workshops in addition to the published literature to identify and assess adaptation options and implementation issues for climate-sensitive ecosystems?		
<i>Eric Gilman</i>	Yes.	
<i>George M. Hornberger</i>	Yes, this is an essential step.	
<i>Elizabeth L. Malone</i>	<p>Chapter 4, “National Parks” I agree in general with the strategy; however, it is difficult to find what information originated with the stakeholder workshops. “Stakeholders,” however, should be a wider group than scientists and natural resource managers; policymakers and users of the national parks, at a minimum, should be involved in these conversations.</p> <p>Chapter 9, “Synthesis and Conclusions” The chapters demonstrate the usefulness of information gleaned from the stakeholder workshops. However, the synthesis chapter often states that the material in a particular section comes from the authors; are these “stakeholders” as well, or are they only the people who attended the workshops? Another use of the term</p>	

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	<p>“stakeholders” can be found on page 9-27, lines 4-10, where the stakeholders seem to be non-resource-managers and non-scientists who are ignorant blockers of adaptation. This use seems borderline pernicious, as stakeholder-users, for instance, have valuable input to give and can often be strong supporters of good management. Moreover, as the whole report states repeatedly, resource managers and scientists cannot claim to have “full information, sufficient expertise, or a long-term perspective” (page 9-27, lines 5-6); how, then, can they complain about stakeholders who are similarly lacking?</p>	
Reed F. Noss	Yes	
David R. Patton	<p>Workshops for stakeholders are an effective way to communicate from the general public to administrators and managers of federal lands. The main problem is getting local people who are not employees of the managing agencies to participate. To encourage detailed discussions another option is to have a working Focus Group that will address just a few problems at a time. Published literature forms the scientific base for all resource management and literature and must be a major part of the review and documentation process. Public input for managing federal lands is a process that will generate concerns and new ideas on managing natural resources and a continuing effort helps to reduce tension in decision-making at the local level.</p>	
Paul G. Risser	Yes, this is a very important part of the process. We will need to ensure that we respond appropriately.	
Dan Tufford	<p>In general I like workshops as a good way to generate ideas and information via the interactions among people with different perspectives. Care is necessary when using them for recommendations, however, because almost invariably some of the ideas, while quite good and scientifically accurate, are wildly unrealistic and thus can lead people away from more productive efforts. This is particularly likely when the participants are weighted with people with no actual experience with the systems being discussed. I made this point earlier as well.</p>	

Table 2. General Comments

Reviewer	Reviewer Comment	EPA Response to Comment
<i>Eric Gilman</i>	Overall, the report is encyclopedic and information-driven, and should be substantially pared down in length, and more concisely focus on key concepts and lessons learned regarding alternative approaches to adapting to ecosystem responses to climate change.	
<i>Eric Gilman</i>	<p>A section should be added to the report to explain how ecosystem adaptation to climate change as proposed in the report support the implementation of various relevant international initiatives, and specify under which international arrangement the US Government has legally binding or voluntary obligations. These international initiatives include, but are not limited to the:</p> <ul style="list-style-type: none"> • Millennium Development Goals • Millennium Ecosystem Assessment • Convention on Biological Diversity and World Summit on Sustainable Development Biodiversity Targets • Convention on Biological Diversity Island Biodiversity Programme of Work • Bali Strategic Plan 	
<i>Eric Gilman</i>	<p>In numerous parts of the report, authors confuse eustatic global sea-level changes with local relative changes. Assessing the vulnerability of a site-specific coastal ecosystem to projected changes in sea-level requires information on rates of change in relative sea-level. ‘Relative sea level change’ is the change in sea level relative to the local land, as measured at a tide gauge relative to a fixed benchmark. Sea level change measured at a tide gauge is a combination of the:</p> <ol style="list-style-type: none"> a) Change in eustatic (globally averaged) sea level (the change in sea level relative to a fixed Earth coordinate system), which, over human time scales, is due primarily to thermal expansion of seawater and the transfer of ice from glaciers, ice sheets and ice caps to water in the oceans; and b) Regional and local factors, such as vertical motion of the land from tectonic movement, the response of the Earth's crust to changes in the weight of overlying ice or water, coastal subsidence such as due to extraction of subsurface groundwater or oil, geographical variation in thermal expansion, and for shorter time scales, changes in salinity, winds, ocean circulation, and oceanographic processes such as El Nino phases and changes in offshore currents. For instance, warmer water and water at higher pressure (such as at greater depth) expands more than colder water and water under lower pressure for a given heat input, making the global average expansion affected by the distribution of heat within the oceans. 	
<i>Eric Gilman</i>	The report should consider the potential adverse effects on ecosystems from anthropogenic responses to relative sea-level rise and other climate change outcomes, which have the potential to exacerbate the adverse effects of climate change on ecosystems. For instance, we can expect an increase in the construction of seawalls and other coastal erosion control structures adjacent to landward margins of coastal ecosystems as the threat to development from rising sea-levels and concomitant coastal erosion becomes more apparent. Or, for example, areas experiencing reduced precipitation and rising temperature may have increased groundwater extraction to meet the demand for drinking water and irrigation. Increased groundwater extraction will increase sea-level rise rates relative to the elevation of coastal ecosystem sediment surfaces, increasing their vulnerability of reduced area, health and possible local extirpation.	

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Reviewer	Reviewer Comment	EPA Response to Comment
<i>Eric Gilman</i>	<p>Given uncertainties about future climate change and responses of ecosystems, there is a need to monitor and study changes systematically and regionally through international collaborative programs. This is insufficiently emphasized in the report. Projections are available over coming decades for rising sea level and changes in climate and weather. In the long term, these changes are expected to alter the position, area, structure and health of most communities. Establishing ecosystem baselines and monitoring gradual changes through regional networks using standardized techniques will enable the separation of site-based influences from global changes to provide a better understanding of ecosystem responses to climate change, and alternatives for mitigating adverse effects. The monitoring system, while designed to distinguish climate change effects on mangroves, would also therefore show local effects, providing coastal managers with information to abate these sources of degradation.</p> <p>While these techniques alone would not make it possible to determine causes of observed ecosystem changes to structure, area and functioning, as is possible through controlled experiments, regional standardized monitoring may provide the basis for scientists to make strong inferences of causation by global factors versus local influences on mangroves. For instance, coordinated observations of regional phenomena such as a mass mortality event of mangrove trees, or trend in reduced recruitment levels of mangrove seedlings, might be linked to observations of changes in regional climate such as reduced precipitation.</p>	
<i>Reed F. Noss</i>	The report is much too long. Ideally, it should be reorganized around major ecosystem types, as suggested above, which will eliminate much redundancy. Case studies could also be pared down to the highest quality one per chapter without any substantial loss of information.	
<i>Reed F. Noss</i>	Finally, a compliment: A wonderful thing about this report is its honest recognition of problems with current management and the barriers to change that exist within government agencies. Hopefully, the report will contribute to overcoming these barriers.	
<i>Paul G. Risser</i>	One must ask whether the report would be far more useful if it were entirely electronic with a portal front-end that simply allowed users to link information from various sections based on the user's specific interests and needs.	
<i>Paul G. Risser</i>	The volume provides a great deal of information and a wealth of literature review throughout the report as a whole and in each section. This relatively complete background is of course helpful as some level, at least to give the manager confidence that information is anchored in the literature. So, the authors are to be commended for their thoroughness.	
<i>Paul G. Risser</i>	In many cases the information summaries are unnecessarily verbose and repetitive—it is almost as if the authors were afraid of omitting any previous literature citation. In addition, many of the recommendations are so general as to be of limited use, e.g., <i>avoid sources of pollution</i> .	
<i>Paul G. Risser</i>	I wonder, however, if the chapters are not backward. That is, the first attention should be paid to what is known about each stressor and response. Each chapter might better start with one or several conceptual models detailing the primary stressor/response. Then the subsequent analyses can be directed management strategies that are associated with each stressor/response. The extensive “context” material can be referenced in the models and be included later in the chapters.	
<i>Elizabeth L.</i>	The background discussion of climate change impacts is very general, as it is in many chapters; these discussions	

Table 2. General Comments

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<i>Malone</i>	could be eliminated, since there is a section on global changes and impacts in the Introduction.	
<i>George M. Hornberger</i>	I think that some explanation of the terminology needs to be brought up to the ExecSumm. Chapter 2 does a good job of explaining clearly what the report is about and of defining terms as they are used. The ExecSumm, in contrast, is not very consistent. For example, the following terms appear in the ExecSumm: adaptation options, adaptive strategy, active adaptive management, adaptive environmental assessment, adaptive experiments, adaptation strategies, proactive planning actions, proactive management, management adaptations, place-based management. At best, this is a reflection of imprecision in use of language. At worst, it is a reflection of confusion about what is being said. In either case, if terminology is defined and then editing is done to make sure the terms as defined are used appropriately (and new, undefined terms are avoided), the ExecSumm would be much improved.	
<i>George M. Hornberger</i>	<p>I am skeptical about using adaptive management as a necessary framework. Part of the problem comes from a lack of agreement on exactly what the framework means. The entire program seems to be unsure. For example, the CCSP Strategic Plan (Chapter 11) seems to deflate any meaning that “adaptive management” might have, basically equating it with operational management¹ But in a presentation to BASC in March 2006 with an update to CCSP, Peter Schultz appears to support “passive adaptive management”². In the original concept, AM clearly meant an <i>experimental</i> approach, which is now termed “active adaptive management.” Within the SAP 4.4 report itself, I don’t sense a strong agreement on what is meant by the term. In the ExecSumm page 1-16, lines 43-47), adaptive management is expressed as originally conceived, i.e. as an experimental approach. Chapter 2, which I find to be a well written introduction, avoids much of the hyperbole that surrounds some of the other discussion. One can read lines 5-12 on page 2-12 as a (rather soft) suggestion that a form of passive adaptive management may be useful, at least in some cases. And finally, there are descriptions (and, I think, differences in what is meant) throughout the report, including: “Management Responses in Anticipation of Future Climate Change” (p3-35); “Adaptive Environmental Assessment and Management” (p4-25); “Adaptive Management” (p5-29); “Proactive Management” (p6-28); and “Ecosystem-based Management (EBM)” (p7-53).</p> <p>My sense is that there is agreement at a very general level, but the plethora of terms and associated prose is likely to get in the way of clear communication. If my inferences from my reading so far are correct, I believe that what is envisioned is an approach that uses scientific information about climate change to inform management plans, supports monitoring to gage the state of the system with respect to the management goals, allows adaptation of management options as the total system evolves, and recognizes pragmatism in that negotiation, trade-offs, and collaboration will often be the most important aspects of the operation. I think that the ExecSumm could provide a very useful service by making clear that there is a common framework, although exactly how implementation is done will vary. I think that explicit acknowledgement that strict implementation of adaptive management may not be a reasonable expectation except in restricted circumstances (e.g., see Wilhere³ or Walters⁴) would help. One way to do this without having to extensively rewrite the individual chapters might be to embrace the EBM concept which, as I understand it, advocates adaptive management to the extent feasible. But however it is done, I think the ExecSumm should aim to resolve apparent inconsistencies.</p>	
<i>David R. Patton</i>	There is considerable documentation of information presented in the draft report and this is to the credit of the authors of the chapters. However the level of use will probably be most beneficial to planners at the regional or national level and not on National Forest Districts or Wildlife Refuges. Most but not all of the information is a	

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	statement of need or what could be done without providing detail on the “how to do”. However, information at the management or specific ecosystem level may not be available in the literature. Cumulatively, the literature could be a state-of-knowledge publication on climate-sensitive ecosystems.	
<i>David R. Patton</i>	Climate change has no political or geographical boundary and throughout the draft there is information on stressors that could be the core topic of publication chapters within defined ecosystems. The information is scattered throughout the report but should be consolidated and made available to managers for decision-making, no matter what federal agency is involved. For National Forest and National Wildlife Refuge Systems the tables on Adaptation Options for Resource Managers comes the closest to providing direction and management guidelines. At this early stage in addressing climate change effects on sensitive ecosystems and resources these guidelines may be all that are needed until more research is completed or adaptive change has provided useful examples.	
<i>David R. Patton</i>	One of the tools for the toolbox could be a database with an annotation of all the literature cited and included as a CD in the final report.	
<i>David R. Patton</i>	Many reviewers will ask the question: Is there sufficient evidence presented in the report to arrive at the confidence levels assigned to each management system? If the confidence levels are based on Bayesian probabilities there has to be a prior probability assigned and this is usually a best guess. The authors and contributing authors were selected because of their knowledge and experience about the subjects and their best guesses are probably very close to reality. However, it would be helpful to discuss the technique and documentation of how the confidence levels were determined.	
<i>David R. Patton</i>	There is a strong indication that the authors believe it will be necessary to have representatives from agencies bordering the six ecosystems involved in the process of responding to climate change.	
<i>David R. Patton</i>	There is considerable uncertainty expressed by the authors on the effects of climate change and natural resources. This is evidenced by use of the words: “may”, “could”, “likely”, “most likely”, “might” etc. In spite of this uncertainty the authors identified barriers and issues and turned some uncertainty into opportunities.	
<i>David R. Patton</i>	Because of a continuing lack of federal agency funds and personnel there is a current and probably future need for a system to set priorities across the U.S at the landscape level, and in some cases to site-specific locations (small wildlife refuges).	
<i>David R. Patton</i>	The use of Level I Ecoregions by NWRS provides a way to organize ecological information into useful categories by regions with some commonalities of landscape features and biotic components. By continuing the process to Level III, NWRS might provide an example of an alternative to the use of administrative ecosystems to assess and evaluate climate change.	
<i>David R. Patton</i>	Will there be any cooperation to formalize issues and concerns with our neighboring countries of Canada and Mexico?	
<i>David R. Patton</i>	What efforts, if any, are being pursued by federal agencies to link the report to other climate change activities at the global level?	
<i>David R. Patton</i>	The report does not specifically address research needs although the opportunities are presented throughout the chapters. Will there be a specific research proposal attached when the current document is presented to Congress?	

Table 3. Chapter Specific Comments

Location	Reviewer	Reviewer Comment	EPA Response to Comment
Chapter 1. Executive Summary			
Executive Summary	Joe Arvai	It is difficult to tell from the Executive Summary alone what the key findings and recommendations are. The executive summary seems overly general, which is problematic given that its intended audience—resource managers; page 1-3—will likely focus on this summary chapter. Many of the statements made seem rather uninformative, perhaps because important contextual details are absent; e.g., “...Working toward the goal of desired future functions (e.g., processes, ecosystem services) would involve managing current and future conditions (e.g., structure, outputs), which may be dynamic through changing climate, to sustain those future functions as climate changes...(page 1-5)”.	
Executive Summary	Eric Gilman	<p>The following basic concepts, related to adapting to ecosystem responses to climate change, should be highlighted:</p> <p>(a) Emphasize that, while it is important to plan for adaptation to ecosystem responses to climate change, at the same time there is an urgent need to address the underlying anthropogenic causes of climate change. Furthermore, clarify that planning for adaptation is needed even if the U.S. and international community comply with internationally-accepted measures to reduce greenhouse gas and aerosol emissions: The effects from human-induced climate change by the production of greenhouse gases and aerosols are projected to continue for hundreds of years even if greenhouse gas concentrations were stabilized at present concentration levels.</p> <p>(b) “Managed retreat” through the implementation of land-use planning mechanisms, discussed previously in these comments.</p> <p>(c) When considering areas for augmented protection as a strategy for climate change adaptation, consider an area’s resistance and resilience to projected sea level and climate changes and contributions to adaptation strategies. For instance, mature mangrove communities will be more resilient to stresses, including those from climate change, than recently-established forests.</p>	
Executive Summary Page 1-19	Eric Gilman	Page 1-19 and elsewhere, use of the phrase “uncontrollable climate stresses” may be incorrectly interpreted to infer that causes of climate change are not controllable. While the effects from human-induced climate change by the production of greenhouse gases and aerosols are projected to continue for hundreds of years even if greenhouse gas concentrations were stabilized at present concentration levels, ultimately the cause of ecosystem stresses from climate change are controllable and can be mitigated.	
Executive Summary	Reed F. Noss	Generally yes [agree that the key findings and recommendations presented in the Executive Summary are the most important and appropriate to bring forward to executive level managers and Congress], but as noted above, the limitations of focusing on only 6 federal management systems should be clearly acknowledged, unless the report is radically rewritten to include a much broader spectrum of lands and waters. I also agree strongly with Gilman’s suggestions for highlighting several basic concepts.	

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Location	Reviewer	Reviewer Comment	EPA Response to Comment
Executive Summary Page 1-4	Reed F. Noss	On p. 1-4 of the Executive Summary, it is stated that “wildfires, nuisance species, extreme events, and air pollution are the most critical stressors within national forest (NF) boundaries, and climate change will amplify them further.” This ignores other major stressors in national forests, in particular: fire exclusion and suppression, logging (especially old-growth logging and salvage logging), and road-building.	
Executive Summary	Paul G. Risser	The Executive Summary does include the key findings and recommendations for each of the six federal systems. However, this chapter brings into focus the concern with the current organization of the report. The text says managers may attempt to meet their management goals by <i>examining the existing literature and comparing likely climate change impacts with key ecological properties...</i> It seems to me that in fact this report should make process far easier for the manager by clearly identifying the key issues by both federal system type and by ecosystem type. If the report is just a literature review and case studies, then we have not advanced very far. If the by reading the Executive Summary, the user knows the likely impacts of climate (or other changes) on various systems and knows the range of potential management options, then we have made progress.	
Executive Summary	George M. Hornberger	It is not easy to discern the key findings and recommendations in the ExecSumm. If there are recommendations, they are very “soft”, that is they are stated implicitly rather than explicitly. The first four paragraphs on page 1-16 give an excellent synthesis of useful ideas from the six systems. But I question whether the “recommendation” to use adaptive management is wise (as I mention in my general comments.) The problems of detecting changes in a “noisy” system and of attributing any changes detected to climate are real problems. Do the authors really think there is a reasonable prospect that this can be accomplished for ecological endpoints? That is, for any of the six systems how likely is it that we can “develop or modify monitoring schemes to track and substantiate vulnerabilities to climate change and assess the effects of management adaptations”? My own view is that one major message from the individual sections has been lost – that other stressors are likely to have big impacts regardless of how climate may or may not change at a particular location and that there are management options to alleviate these other stresses <i>that are likely to be good for climate change scenarios as well.</i> Does this not argue for a recommendation to pursue “no-regrets” options and not worry about the attribution problem? Finally, although I find it a noble (and scientifically correct) goal to “manage the nation’s lands and waters as one large system”, whether such a grandiose (implicit) recommendation will resonate with executive level managers and Congress remains to be seen.	
Chapter 2. Introduction			
Chapter 2 Page 2-3	Reed F. Noss	On p. 2-3 of the Introduction, resilience is discussed. But is resilience, as defined here, a reasonable goal in the face of massive climate change? The discussion later in the report (Synthesis chapter) correctly notes that this is largely a short-term strategy. Inevitably, critical thresholds will be crossed, regime shifts will occur, and managing for Holling-style resilience will be no longer possible.	

Chapter 3. National Forests		
Chapter 3.2 Page 3-29	Reed F. Noss	On p. 3-29 (National Forests) it is stated that "...even under many of the somewhat wetter future scenarios, the Southeast is at risk of converting from a closed-forest region to a savanna, woodland, or grassland under temperature-induced drought stress and a significant increase in fire disturbance." This statement is highly misleading and ecologically ignorant. The Southeast, especially outside of the Appalachians, is mostly not a "closed-forest region." It is now well established that most of the Southeast (e.g., >60% of the misnamed "Southern Mixed Hardwood Forest" region) was actually longleaf pine savanna prior to European settlement (Ware et al. 1993 and many other sources). An increase in fire and a shift to more savanna and grassland vegetation would, in fact, move the region to a condition closer to pre-settlement vegetation and away from the closed-forest condition that, on many sites, is an artifact of fire exclusion and suppression. Nevertheless, substantial artificial firebreaks (e.g., roads, urban areas) and loss of native pyrogenic ground cover will make this ecological transition unlikely over much of the region.
Chapter 3.3.1.3 Page 3-36	Reed F. Noss	Although it is not a bad suggestion that "large-scale thinnings might be implemented to reduce stand densities in order to minimize drought effects, avoid large wildfire events, and insect and disease outbreaks under a changing climate," some caution is needed here. Construction of roads and use of heavy equipment to accomplish these thinnings will likely make stands more susceptible to invasion by non-native species and to soil erosion, among other problems.
Chapter 3.4	Reed F. Noss	Case studies are often of value to put abstract concepts "on the ground," and the case studies in the report are generally useful for this purpose. However, the quality of case studies here is uneven, and some are of questionable value. The Tahoe National Forest case study (3.4), for example, is pretty much standard national forest management rhetoric. I was dismayed to see here the description of "Salvage and Planting Post-Fire" as among the "best-forest-management practices...consistent with adaptive conditioning for climate contexts..." (p. 3-53), ignoring abundant documentation in the recent peer-reviewed literature of the overwhelmingly negative ecological impacts of these practices. As pointed out later, in the Synthesis chapter of the report, today's "best practices" may be tomorrow's "bad practices." In contrast, the following case study on the Olympic NF is more ecologically literate.
Chapter 3.4	David R. Patton	Case Studies (CS) are an effective way to identify problems and solutions at a local, regional and national level. The degree of resolution of the problems and solutions decreases from the local to national level. At the local level, such as on the Tahoe National Forest, more detail is required for decision-making than at the national level. The Handbook System is a source where information can be documented and made available for field use. The barriers and opportunities are well defined but an action plan relating to the barriers and opportunities is lacking. Action plans require that national policy be transmitted to lower levels of administration on the 600 National Forest Districts and this will be a major challenge for the National Forest System. Case Studies usually have a resolution to a problem to demonstrate how a problem or issue was resolved. None of the CSs have a resolution to a specific problem. A big gap is present in the representation of barriers and opportunities. National Forests CSs are missing for the Rocky Mountain Region from the Canadian border to Mexico. Two CSs on the West Coast and one in the Southeast leaves out a part of the U.S. where there could be barriers, such as livestock grazing (18,000 permits on BLM land for 2007). There should be a least one CS from each Region to have a good representation of the current Forest Service situation.

Chapter 4. National Parks		
Chapter 4	Elizabeth L. Malone	<p>The chapter on national parks, like the other chapters on management systems, provides very useful information about the state of knowledge, including the uncertainties that abound, and adaptation approaches, along with elements of implementation. Although it would be ideal to have a sort of “cookbook” of best practices, the chapter (and, overall, the report) make clear this is impossible, that management actions should be aimed at limiting damages from climate change and experimenting to find ways of easing the ecological transitions to new climate regimes.</p> <p>To be more helpful to managers, the chapter should more clearly distinguish the following:</p> <p>a. What is under the control of park managers, and what actions would require partnerships with others, support from the public and Congress, and continuing monitoring and research. This delineation would also help to clarify what is possible in the short, medium, and long terms.</p> <p>b. The line drawn between “Nature” and people. Some of the stressors on the parks clearly come from human activities, and these should in principle be more controllable than, say, fires ignited by lightning strikes during drought conditions. However, it is also true that people are part of Nature—and are certainly included in park ecosystems. Showing human visitors how to align with the ecosystems around them, for instance, should be a part of what park managers can control and a pathway to reducing stress on the parks.</p> <p>c. Native and nonnative species. Nonnatives seem to be treated by definition as harmful, but climate change is almost sure to cause species movement; will species that move because of climate change be considered invasive and harmful in their new places? The chapter begins a good discussion of this issue on page 4-21 but does not take it far enough to be useful to managers.</p>
Chapter 4.1.2 Page 4-10	Reed F. Noss	<p>On lines 12-13, the concept of “desired future conditions” is mentioned with implied approval. This concept is very problematic in the face of climate change and high levels of uncertainty. I suggest it be replaced with a concept of “desired future trajectory” or something similar, although even here goals will be difficult to accomplish.</p>
Chapter 4.3	Elizabeth L. Malone	<p>Although the chapter contains a discussion of uncertainty, it does not apply confidence levels. Three types of impacts are discussed: foreseeable changes, known or imaginable changes, and unknown or unknowable changes (with the reminder that, “Perhaps the greatest uncertainties in predicting climate change and its effects are associated with the interaction of climate change and other human activities” [page 4-23, lines 23-24]). The management responses proposed are helpful at least at a theoretical level. Figure 4.8 is an excellent framework for thinking about how uncertainty and controllability interact to yield different management strategies. Any management strategy, but especially scenario-based planning and adaptive management, should include management of humans and human-caused stressors.</p> <p>A reference to Table 12.4 (and 1.1), along with a discussion of the rationale for choosing confidence levels in re the national parks, should be included in this chapter.</p>

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Chapter 4.3.3	Elizabeth L. Malone	Section 4.3.3, “Incorporating Climate Change Considerations into Natural Resource Management,” parallels but improves upon the mental model depiction in the synthesis chapter because this chapter’s section speaks in terms of resources “at risk”—that is, incorporating the uncertainty of the whole process.	
Chapter 4.4	Elizabeth L. Malone	Only one short case study is given in the chapter, Rocky Mountain National Park. It is not clear why the chapter has only one case study or why this particular part was chosen. The text says RMNP “is a good example of the state at which most parks find themselves as they confront resource management in the face of climate change” (pages 4-31-32), but in fact it seems to have advantages over other parks: no danger of losing an iconic resource, like Glacier National Park; fewer visitors than other parks; “rich in information about its ecosystems and natural resources” (page 4-35, lines 2-3); and less pollution than other parks. Nevertheless, the adaptation approaches being initiated and planned are given in enough detail to be helpful. More detail and another case study would improve the helpfulness.	
Chapter 5. National Wildlife Refuges			
Chapter 5.1.4 Page 5-11	Reed F. Noss	P. 5-11, lines 7-14: It is an important point here that the NWRS policy on biological integrity, diversity, and environmental health should “not insist on a return to conditions no longer climatically appropriate,” but instead should view historic conditions as a “frame of reference” for understanding the impacts of climate change.	
Chapter 5.4	David R. Patton	There is only one CS for National Wildlife Refuge System (NWRS). While the CS does cover the Central Flyway Corridor from Alaska to Mexico and will be useful, it is certainly not all inclusive. The NWRS administrative structure is complex because of the distribution, size, ecological setting, and use designation of individual refuges. The NWRS includes 584 refuges, and over 30,000 production areas categorized into 37 wetland management districts. Many of these areas cannot be managed at an ecosystem or landscape level depending on the size and landform composition (agricultural land, etc.).	
Chapter 6. Wild and Scenic Rivers			
Chapter 6	George M. Hornberger	This is a nicely written chapter with a lot of good information.	
Chapter 6	George M. Hornberger	<p>The section on policy context is excellent and lays out clearly the options available (and hints at some of the difficulties of implementation of options). On the other hand, I think that the distinction between “reactive management” and “proactive management” artificially glorifies the latter and denigrates the former. There will always be a need for reactive management; for example, rescuing stranded canoeists can’t possibly be otherwise. And there will always be a need to repair damages caused by extreme events – this was true in the past and will be true in the future with or without climate change. I don’t disagree with the notion that proactive management measures should be considered carefully under climate change scenarios, but I think the utter dismissal of “reactive” approaches to bolster the claim that this should be done misses the mark.</p> <p>The basic problem with adaptive management is glossed over. The statement is made that many of the management actions needed are in response to risks of changes in the frequency and magnitude of extreme events. But suppose some management action is taken in the expectation that the 100-year flood is now in reality the 50-year flood. How would one assess whether the action was successful? In one case there might not be any observed flood over a couple of decades (even though the hypothesis was true) and in another case, one might have an extreme flood two years in a row. The authors</p>	

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		<p>obviously know this, but the way the prose is written does not make it clear what an adaptive strategy is in these cases. Because there are no detailed examples of management actions and options, it is not possible to figure out what the advice is.</p> <p>My main criticism is that an inference that comes to me quite strongly is not even stated explicitly. For many, many systems, other stressors (water withdrawals, nutrient enrichment, etc.) will continue to have a deleterious effect unless proactive management options are undertaken. It turns out that most such actions would also be beneficial for climate change effects. Why not recognize this explicitly and make appropriate recommendations?</p>	
Chapter 6	George M. Hornberger	<p>The case studies are very informative, but see my last comment above. The effects of climate change are unlikely to be good for rivers like the Rio Grande or the Wekiva, but direct anthropogenic effects on water and land use are likely to be dominant. This doesn't mean that climate change isn't important, but if there were options that would be beneficial for one or the other or for both, I think there would be a clear priority.</p>	
Chapter 6	George M. Hornberger	<p>Uncertainty is mentioned in several places, but I could not tell how the authors did their confidence assessment, nor do I see evidence presented that helps me. I tried to look at possible connections, but couldn't really make headway. On page 6-29, does the option to "Designate more river corridors as wild and scenic" fall into the "replication" adaptation approach? If so, why is the level of confidence low? Is "Claim more water rights" in the "reduce anthropogenic stress" category? If so, why is confidence high? Is procurement of land conservation easements (under "Improve water monitoring capabilities on page 6-31) in the "Refugia" category? If so, why a "medium" confidence? In general, there appears to be no connection between what is presented in the Chapter and the entries in Table 1.1.</p>	
Chapter 7. National Estuaries			
Chapter 8. Marine Protected Areas			
Chapter 8	Eric Gilman	<p>In the MPA chapter, and MPA portion of the Executive Summary, highlight the following key concepts:</p> <p>(a) Protecting areas of an ecosystem type that are resistant to climate change effects serves as a refuge, in part, to be a source to re-colonize adjacent areas degraded by climate change outcomes, and other disturbances.</p> <p>(b) Managers selecting sites and boundaries for individual protected areas, reviewing the effectiveness of existing protected areas, and designing protected area systems need to explicitly incorporate anticipated coastal ecosystem responses to climate change effects. For instance, planners need to account for the likely movements of habitat boundaries and species ranges over time under different sea level and climate change scenarios, as well as consider an areas' resistance and resilience to projected sea level and climate changes and contributions to adaptation strategies. For instance, mature mangrove communities will be more resilient to stresses, including those from climate change, than recently-established forests. Site-specific analysis of resistance and resilience to climate change when selecting areas to include in new protected areas should include, for example, how discrete coastal habitats might be blocked from natural landward migration, and how severe are threats not related to climate change in affecting the site's health.</p>	

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		<p>(c) Networks of protected areas, covering large geographical areas, spaced at suitable distances from one another, and including a representative and replicated spectrum of habitats, are thought to provide the greatest conservation benefit. Networks of protected areas are needed to achieve the biologically-necessary connectivity to permit the movement of species and exchange of genes. For instance, because eggs and larvae of certain marine species have a large dispersal distance, a small protected area will not ensure self-sustaining populations of these species unless the protected area is colonized by offspring produced in another protected area sufficiently close to exchange offspring. Also, some organisms require several habitats to be protected for various life history stages.</p> <p>(d) The selection of sites for protected areas should account for functional linkages between coastal ecosystems. For instance, protected areas designed to preserve biodiversity and relatively pristine habitats should incorporate adjacent coastal forests, mangroves, seagrass beds, and coral reefs to ensure all functional links are maintained in a least disturbed state. Protected areas designed in this manner will have optimal resistance and resilience to climate change and other stresses. The existence of functional links between coastal systems means that degradation of one habitat type will adversely affect the health of neighboring habitats. If a protected area encompasses only a single ecosystem type and does not include adjacent ecosystems, unsustainable activities occurring in adjacent areas could result in degradation of the resources within the protected area.</p> <p>(e) Coastal and marine protected areas have potential limitations, which can be avoided and minimized through careful planning and management:</p> <ul style="list-style-type: none"> • The resource use restrictions of a protected area may displace effort to adjacent and potentially more sensitive and valuable areas, where weaker management frameworks may be in place; • Local communities may have a limited area available for exploiting natural resources, and may have limited resources for managing a protected area, which results in only a small area of coastal and marine habitats being able to be practicably set aside as a no-take zone of a protected area, limiting the ecological value of the protected area due to its small size; • Protected areas can disproportionately affect certain sectors of the local community; and • Existence of a protected area may promote the misconception that the protected area is a panacea to rescue troubled fish stocks, and could cause managers to disregard the need to employ additional management techniques to achieve sustainable fisheries. 	
Chapter 8.4.2	Reed F. Noss	The relevance of the Great Barrier Reef case study (8-42...) to adaptation options in the U.S. is questionable.	
Chapter 8.1 Page 8-4 to 8-11	R. van Woesik	While the background, history and identification of the FKNMS Act, 1990, is fundamental to point out relevant management legislation, Chapter 8.1 does little to highlight adaptation options to protect and preserve the marine environment in general and the Florida Keys in particular. The authors should point out that the management plan for the Florida Keys was established to counteract local stressors and will not be effective at ameliorating or protecting local fauna and flora from climate change. The authors state that the science clearly suggests highly connected networks are the only option for climate change adaptive management. Yet, the authors never explicitly make a recommendation that a network of no-take areas is needed in the Florida Keys, specifically designed around hydrodynamic connectivity	

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		models. Instead the text is loaded with prose that state the obvious, for example simply stating that National Marine Sanctuary sites are “the ones in need of management in response to climate change” (page 8-11) tells us little about options. Furthermore, we learn little from the following (8.2.1.2 Key species) “Under various climate change scenarios, management strategies employed to protect key species may differ”, and “In all sanctuaries protected for biological reasons, biodiversity may be affected by climate change and must be managed to meet sanctuary goals.”	
Chapter 8.2 8-11 to 8-23	R. van Woesik	Current status of management system is really a brief review of some of the science issues rather than the status of the management and does little to blend the science with the management. In fact these issues are glaringly disparate. There is considerable emphasis on understanding the connectivity among ecosystems, which logically leads into arguments of MPA networks to facilitate larval exchange and inter-connection of meta-populations, which in turn may buffer these populations from climate-driven changes. Yet there is a disparity between the process in which the sanctuaries and MPAs were established and now maintained and the message coming from the sciences indicating that networks should be established. Clearly a network of no-take zones is essential. The rhetoric is repeated throughout Chapter 8. Yet there are no networks (but a note that the National Marine Sanctuary Program Goal is to expand the nationwide system of MPAs). Therefore, the management options are 1) to protect intact systems (Papahānaumouākea, Hawaii) and prevent further degradation (Florida Keys) by reducing anthropogenic stressors inside (fishing) and outside (pollution) the protected areas, while there is no law that facilitates the latter. Several blanket statements through Chapter 8.2 tell us little about a reasonable strategy to approach obvious problems. For Example, (page 8-15) “The addition of climate change may exacerbate effects of existing stressors and require new or modified management approaches”.	
Chapter 8.2.2.1 Page 8-15 to 8-19	R. van Woesik	<p>Ocean warming. “Temperature changes may result in new species assemblages and biological interactions that affect ecological processes such as productivity, nutrient fluxes, energy flow, and trophic webs”. While a loaded statement, it is first questionable that these four terms are really the most fundamental ecological processes of interest, and second, further expansion is necessary to explain how warming will affect the processes. In fact, this is not a semantic issue, but rather it is at the heart of the problem because if fundamental processes are understood, then ‘state variables’, such as macroalgae or coral cover could easily be predicted.</p> <p>The response of climate-sensitive corals reefs and bleaching is rightly discussed at length in the report. However the authors suggested that thermal stress is the only facet that influences coral response. Yet, the literature stresses that both water temperature and irradiance interact to produce the bleaching effect (Iglesias-Prieto et al 1992). This is important when discussions are held over adaptive management and refuges, later in the report. Indeed, there is a clear reciprocity between water temperature and irradiance, because corals perceive heat stress and intense irradiance, both, as photoinhibition (or as a further increase in excitation pressure over PS II) (Iglesias-Prieto et al 2004). Therefore, low or reduced irradiance during times of temperature stress reduces photoinhibition, coral bleaching and coral mortality, as does the reciprocal involving moderate water temperature at high irradiance. The factors associated with a bleaching event therefore involves not only temperature but also irradiance and by association the particulate constituents in the water column that may reduce irradiance. Therefore, when examining the cause and effect of coral bleaching, temperature and irradiance should not be considered separately. This is particularly relevant to management strategy options most suitable under global warming (on page 8-27). The authors suggest two types of coral reefs should be identified and given</p>	

	<p>high priority protection status: 1) reefs that survived bleaching (one assumes that the reef corals bleached but recovered, although this is not explicitly stated), and 2) reefs that were not exposed to elevated water temperatures in most recent coral bleaching episodes. Again, many localities that did not bleach, for example in 2005, experienced low irradiance, because coral bleaching is a function of a) water temperature, b) irradiance and c) the historical nature of both temperature and irradiance. In other words, some locations may have experienced low irradiance while water temperatures were high, and therefore did not bleach, or other localities may constantly be subjected to high temperature fluctuations, therefore, a regional temperature anomaly would not stress local reefs that are constantly exposed to such variation. Clarifying issues involving temperature, irradiance and their histories is critical for any adaptive management in the face of climate change. Section 8.3.2, is probably the most useful and relevant section of the report on marine protected areas and is particularly pertinent when considering the authors were charged to address adaptation options. The section on bleaching needs considerable expansion and elaboration because there is at least 20 years of research on this climate-sensitive phenomenon and the most visually obvious.</p> <p>Ocean acidification (8-17). The literature states that higher latitudes will show the first signs and most intensive responses to climate change because of the greater solubility of CO₂ in cooler waters. It is fair that the authors state that “management strategies have not yet been developed”(8-31) (to combat local changes in pH one would presume). However, there is no mention of the disparity between statements of geographical expansion because of increasing water temperatures and adaptive management to higher latitudes, because the higher latitudes, it is argued will become warmer, and therefore less likely to more soluble.</p> <p>Furthermore, and probably more importantly, the authors refer to range expansion as becoming ‘invasive’ (8-21), because the species extend past boundaries beyond their known native range. Surely, if management is to become adaptive and protected area networks are established, then under climate change many species will simply expand geographically. But in the authors terms these species will be considered as ‘invasive’ and given low management status, when in fact those very species are naturally adjusting to climate change and should be given priority status.</p> <p>The concept of invasive species is considered further, but in light of increased seawater temperatures resulting from climate change. The authors discuss the most fundamental aspect of reproductive output, which is strictly speaking the definition of adaptation, or differential reproductive output of individuals of populations. Insufficient emphasis has been placed on discussions of population adaptation to climate change (only, page 8-16, “that adaptation and acclimatization to increasing temperature is largely unknown and remains a research topic of paramount importance.”). Nevertheless, the authors mention that invasive species out compete native species because “they will spawn earlier and for longer periods”. This assumption is based solely on the incorrect premise that all marine reproduction events are temperature driven. More recent evidence and critical inquiry suggests that marine reproductive cycles are not simply temperature driven, particularly made evident by examining low latitude environments, where temperature changes as little as 2-3 degrees centigrade, and simultaneous mass spawning events are still evident, for example on low latitude reef corals. Irradiance and day length also plays a critical role in gametogenesis and the production of offspring.</p>	
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		<p>Freshwater influx (8-19). The freshwater influx argument is weak at best, most likely because it is based on one reference. The authors argue that increased runoff may cause greater stratification of water layers (Scavia et al 2002), which will result in reduced productivity of estuaries. There is no systems approach here, nor is there any reference to the considerable literature on freshwater discharge dating back over 100 years discussing and documenting the detrimental influences of osmotic shocks and subsequent mortality of marine organisms, particularly on adjacent coral reefs. Changes in precipitation associated with climate change have been widely documented and need more careful consideration for a number of marine systems. Furthermore, there is mention of discharge from large river systems, particularly the Mississippi River on adjacent systems (8-20), yet these large rivers may also influence marine protected areas downstream by changing irradiance and water quality (nutrients, pesticides etc.) as has been clearly shown on the Great Barrier Reef. The authors acknowledge that pollution was previously managed 'locally', but now add that "climate change stressors ...present greater challenges", without suggesting a solution to the challenges</p>	
<p>Chapter 8.2.3 Page 8-23 to 8-24</p>	<p>R. van Woesik</p>	<p>Management approaches: Finally, on page 8-23, four arguments and justifications are made to implement MPA networks. The authors argue that a network of MPAs would allow adaptation of marine management for climate change. The four justifications are given and discussed: 1) MPA networks are more effective than a single MPA at protecting the full range of habitat and community types because they spread the risk of loss from disturbances such as climate-change impact across a larger area. Yet, there are no MPA networks; 2) networks protect short- and long-distance dispersers; 3) Networks provide enhanced larval recruitment among adjacent MPAs; 4) Networks allow for protection at an appropriate scale, without the need to establish one extremely large reserve. The recent implementation of the Papahānaumokuākea Marine National Monument comes to mind, as it is downstream of the main Hawaiian Islands and it is one large reserve. Again, the arguments and the 'reality' are disjunct; there are no marine protected networks while all evidence points to a need. The authors again point to this issue on page 8-23 "In the long term, the most effective configuration would be a network of highly protected areas nested within a broader management framework". Such a framework should consider upstream activities to control and maintain high water quality (mentioned on page 8-26, regarding linking the MPAs into adjacent governance systems and reduce land-based pollution). Furthermore, on page 8-27, a network of MPAs reaches high prominence again, because of 'representation, replication, sustainability and connectivity'. Again, entire sections are dedicated to connectivity (8.3.1.1 and 8.3.3.2), source-and-sink concepts, larval transport, adult movement, and the theoretical effectiveness of networks. Although the most useful study by Airame et al (2003), suggested that no-take zones comprising 30-50% of a Sanctuary will sustain the system. Clearly, the Florida Keys National Marine Sanctuary, with only about 6% no-take zones, is not an effective strategy. Numerous authors have shown that marine reserves 10-20 km apart will facilitate larvae exchange and sustain most marine populations. The authors suggest that a management strategy should include a representative range of habitat types, and replication of those habitats will reduce the risk of loss (page 8-31). Clearly, the sooner the current goal to protect 30% of habitats as no-take zones is reached, the greater the chance of survival of coral reefs, which are particularly sensitive to global climate change.</p> <p>The authors (on page 8-24) suggest the most effective management strategy to preserve marine ecosystems is to include stakeholders in decision making, by engaging sanctuary advisory councils and hold public scoping meetings. While involving stakeholders is a necessary strategy it will not necessarily lead to some emergent adaptive management strategies and will simply shift the onus onto</p>	

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		others. Performance measures are discussed, to more effectively assess the success of specific programs. However, the metrics do not include climate change; climate change metrics should be included. The authors further suggest that Condition Reports will provide summaries on the state of the resources and management responses that threaten the resources. The reports are meant to provide management with information to respond on “a site-by-site basis”. Such a process conflicts with earlier arguments made on MPA networks and further statements on ‘managing for resilience’ at the system level.	
Chapter 8.3.1 Page 8-26	R. van Woesik	<p>Suggesting that “managers should strive to maintain the maximum number of species in the absence of detailed data on ecological and species interactions”, and managers should continue to develop and implement strategies to reduce land-based pollution...(page 8-26), are relatively obvious statements, but there is no mention of how this should be done. Furthermore the dichotomy is introduced, without much consideration, that regional guidelines should encourage herbivory at low latitude, to reduce macroalgae, but reduce herbivory at high latitude to maintain kelp forests. It is often inferred that locally enhancing parrotfish and surgeonfish on coral reefs will lead to positive cascading effects that will increase coral cover, because recruitment will be increased. However, there is an urgent need to address the relevance of this assumption and in which context, before false hopes and incorrect trajectories are predicted, when in fact the problem occurs on multiple scales and increasing the biomass of these herbivores may have little influence on resilience. Besides, managing for high levels of herbivory at low latitude compared with managing for low biomass of herbivores at high latitude needs further consideration, especially in the face of global climate change when geographic boundary shifts are common place and if this dichotomy is correct, then, Where is the latitudinal boundary where we shift strategies? and Why is it there?</p> <p>Other management solutions discussed include: 1) more monitoring in MPAs (8-32) and 2) the use of satellites to forecast bleaching events. The later is even less convincing than the former. Remote tools, “help managers prepare for bleaching events so that when the event occurs, managers can have the necessary capacity in place to respond”. I wonder what that capacity is, and I wonder even more how they will respond? These two solutions do not facilitate management for climate change unless the monitoring is hypothesis driven and specific to assessing an adaptive management strategy.</p>	
Chapter 8.4 Page 8-34 to 8-63	R. van Woesik	Case studies (8.4) The cases do little but reiterate. They give few options of active forms of adaptive management except on the Great Barrier Reef, which is an exemplary example, but managed under entirely different laws (Australia).	
Chapter 9. Synthesis and Conclusions			
Chapter 9.1 Page 9-3	Reed F. Noss	The introduction to the Synthesis makes a straw man of the concepts of reference conditions and historic range of variability, essentially discounting them. I believe the tone here is inappropriately negative. As pointed out at other places in the document (e.g., p. 5-11, as noted above), historic conditions provide a frame of reference or point of departure to consider the effects of climate change. Moreover, it is noted appropriately throughout the report that intact ecosystems (which, by definition, are closer to historic conditions or the historic range of variability) will almost certainly be more resilient to climate change than ecosystems highly fragmented and degraded by human activity.	
Chapter 9.2.2 Page 9-5	Reed F. Noss	It is premature and self-serving to call The Nature Conservancy’s monitoring framework “an extremely successful framework for managers” (line 5). In fact, this system, depending on how it is implemented, might still qualify as “surveillance monitoring,” of questionable utility to adaptive management, as	

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		opposed to monitoring designed to test alternative a priori hypotheses relevant to management (see Nichols and Williams 2006; Trends in Ecology and Evolution 21:668-673). Indeed, a few pages later (p. 9-9), the discussion centers on “monitoring to inform management decisions” and correctly states that “the majority of monitoring that is needed is hypothesis-based and specifically targeted to either determine vulnerabilities or to assess the effects of management as part of an adaptive management strategy.” This statement is entirely consistent with the message of Nichols and Williams (2006), which should be cited.	
Chapter 9.3.1 Page 9-14	Reed F. Noss	lines 19-21: It is not true that “national parks, national wildlife refuges, and marine protected areas all manage for maintaining as many native species as possible...” In fact, many national parks are managed more to provide recreational opportunities for tourists, and many national wildlife refuges are oriented toward single-species management, especially for game species. For example, Finley NWR, in the Willamette Valley of Oregon, could focus on restoring native grassland, the most endangered natural community in that region. Instead, much of the NWR is managed intensively to grow crops of agricultural grains for the benefit of Canada Geese!	
Chapter 9.3.4 Page 9-19	Reed F. Noss	2 nd paragraph: Yes, “most resource agencies already have monitoring programs and sets of indicators...” The more important question is whether these programs are adequate. In fact, many have been found to do little besides test a simplistic null hypothesis of “no trend” for various species and resources, and lack the statistical power to do even that. As noted by Nichols and Williams (2006), these programs are surveillance monitoring, of little use for adaptive management, as opposed to hypothesis-driven monitoring.	
Chapter 9	Paul G. Risser	The synthesis chapter is supported by the underlying chapters and does summarize the primary issues. However, as noted above, I still wonder if we should begin with the ‘synthesis’ chapter should be the first chapter, setting an analytical framework for the subsequent six system chapters. For the purpose, the synthesis chapter would need to be streamlined and organized more as a <i>guide</i> as opposed to a <i>summary</i> .	
Chapter 9	Dan Tufford	The Synthesis is well done, although I did not study it at the same level of detail as some other chapters. Early in the chapter it discusses assessing impacts including tools, baseline information, and uncertainty so these get the emphasis they need. The chapter also brings to the surface what seems to me a problematic weakness in the report. As stated in the first paragraph of section 9.3 on p.9-12 the adaptation approaches are to support the ability of ecosystems to persist. Yet at several places in the report, including later in the Synthesis, persistence of existing ecosystem state over the long-term is recognized as doubtful or at least unknown. So the options for adaptation are all relegated to being short- to medium-term responses (maybe just short-term). The opening paragraphs of chapter 2 do not lead the reader to expect this temporal horizon. Section 9.5.3 provides the answer to the “what then” question but it is a very small part of the overall report. I fully understand that it is simply not possible to predict with much certainty long-term climate change or its impacts. All I am saying is there seems to be a disconnect between what the report intends to do (opening paragraphs of chapter 2) versus what it actually does (as stated in section 9.3).	
Chapter 9	Elizabeth L. Malone	The synthesis chapter supports and represents most of the underlying chapter themes and conclusions and usefully introduces concepts that are implicit in the chapters. However, the synthesis chapter should be strengthened in some areas. Themes that are very well supported include the need for monitoring, the need and problematic aspects of establishing baselines, the issue of uncertainty and handling the potential for multiple outcomes	

	<p>(scenarios), and implications of uncertainty and barriers/opportunities for meeting goals. (On page 9-12, the references to scenarios would be enriched by CCSP SAP 2.1B on scenarios and their use in climate change science.) The section on adaptive management (9.3.4) reflects what is in the chapters, both the concept and the fuzziness surrounding the concept. In particular, the adherence to management goals is at odds with the flexibility implied in adaptive management, where presumably both approaches and goals are candidates for revision. (This is echoed in a statement in section 9.4, “Adaptation responses to climate change are meant to reduce the risk of failing to achieve management goals” [page 9-20, lines 40-41], a very narrow view of what adaptation activities can be and do.)</p> <p>The first part of the synthesis chapter usefully makes explicit the mental models and underlying assumptions of the chapters with regard to adaptation and the guiding framework for impact assessments. One might well argue that the linear framework for impact assessments is ill suited to a dynamically changing and complex system, but both the management system chapters and the synthesis chapter use such a framework. Some of the tools reviewed in the synthesis chapter—notably, climate models and, to a large extent, impact models—are not discussed in the management system chapters, and here the synthesis chapter makes a contribution that benefits all of them.</p> <p>The emphasis on building resilience as an adaptation strategy is stronger in this chapter than in the underlying chapters. Indeed, the statement is made that “the goal of adaptation strategies is to reduce the risk of adverse environmental outcomes through activities that <i>increase the resilience</i> of ecological systems to climate change” (page 9-12, emphasis in the original). In the synthesis chapter this emphasis becomes an almost-pure “holding the line” strategy, without much of the flexibility to respond to changing ecosystems that Chapters 3-8 have. Even the chapter strategies of representation, replication, and supporting refugia for some species have a resilience emphasis here, although in the chapters these strategies may also be part of migrating species to other locations as climate changes rather than as building resilience. At the end of the very long section on resilience, the synthesis text seems to grudgingly acknowledge that climate change may overcome even the most resilient ecosystems and that wholesale change may be needed, but there is not much in between holding the line and giving up. In the middle of a paragraph in section 9.3.3 (“Confidence”) the statement is made, “It is important to note at this point that promoting resilience may be a management strategy that is useful only on shorter time scales (i.e., 10-30 years) because as climate change continues, various thresholds of resilience will eventually be exceeded” (page 9-18, lines 4-5). This statement should come much earlier, prior to or early in the resilience section.</p> <p>The synthesis chapter fails to adequately support and represent the other chapter themes of the social roles of stakeholders (both resource managers and others), partnerships, and agency managers in accomplishing management goals. The closest the synthesis chapter comes to these important themes is in discussing barriers and opportunities related to legislation and regulation, management policies and procedures, and human and financial capital (sections 9.4.1, 9.4.2, and 9.4.3). Perhaps because these sections do not have the concrete detail that the other chapters have, they seem more theoretical than useful. Statements such as, “Managers often lack sufficient support and decision-making tools to help guide them in selecting appropriate management approaches that address climate change” (page 9-26, lines 38-39), are not helpful for the intended audience but merely provide a catalogue of the usual laments. Moreover, it is difficult to reconcile this particular statement with the discussion of existing</p>	
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		<p>tools earlier in the chapter.</p> <p>The synthesis chapter should be strengthened with regard to representing the need for partnerships with people and organizations outside federal and other resource managers. Some of the chapters have very detailed sections on existing partnerships and the goals of such partnering, with clear statements that this is a critically important dimension of addressing multiple stresses, including climate change. These chapters also have more of a sense of how difficult it is to form/maintain such partnerships and have them yield good results. The synthesis chapter calls, for example, for integrated federal action, without consideration of the institutional implications (starting with feasibility). Only on page 9-34 (the second-to-last page of text) are important external issues, such as coastal development and private property issues, mentioned.</p> <p>An issue implicit in the chapters but not brought out—indeed, deemphasized—is the stress that human visitors and external human actors (e.g., industrial polluters, farmers who irrigate) place on federally managed lands. The latter stresses are referred to in the chapters as external factors that come from nowhere: pollution rather than polluters, water withdrawals rather than water managers and farmers, invasive species rather than the bringers of those species. Unless readers and managers know who the stressors are, how can they hope to know about pathways to address the stresses? The stresses from human visitors are to a degree unavoidable and indeed are usually part of mandates in re managing federal lands. However, these stresses may be ameliorated to at least some degree. Some national parks restrict visitors to a few roads (e.g., Denali), and all that I have visited use signs, literature, and rangers to teach visitors how to avoid damaging the natural resources. Management changes to avoid damage by visitors could be used as examples. Chapter 8 repeatedly refers to “no take” zones as a way to protect fish stocks, although they could equally be termed ways to prevent human damage.</p>	
Chapter 9.3.3 Page 9-17 & 9-18	Elizabeth L. Malone	The only assignment of confidence values to the statements made in the synthesis chapter comes in two paragraphs on pages 9-17 and 9-18 and Table 9.4. I agree that expert opinion is the valid way to determine these confidence values, but without some comparative rationale it is difficult to interpret the levels assigned. Why, for instance is there only one “very high” ranking for “reducing anthropogenic stresses”?	
Chapter 9.4.4.2 Page 9-27	Elizabeth L. Malone	The chapters demonstrate the usefulness of information gleaned from the stakeholder workshops. However, the synthesis chapter often states that the material in a particular section comes from the authors; are these “stakeholders” as well, or are they only the people who attended the workshops? Another use of the term “stakeholders” can be found on page 9-27, lines 4-10, where the stakeholders seem to be non-resource-managers and non-scientists who are ignorant blockers of adaptation. This use seems borderline pernicious, as stakeholder-users, for instance, have valuable input to give and can often be strong supporters of good management. Moreover, as the whole report states repeatedly, resource managers and scientists cannot claim to have “full information, sufficient expertise, or a long-term perspective” (page 9-27, lines 5-6); how, then, can they complain about stakeholders who are similarly lacking?	

Endnotes

¹ “Adaptive management decisions are operational decisions, principally for managing entities that are influenced by climate variability and change. These decisions can apply to the management of infrastructure (e.g., a waste water treatment plant), the integrated management of a natural resource (e.g., a watershed), or the operation of societal response mechanisms (e.g., health alerts, water restrictions). Adaptive management operates within existing policy frameworks or uses existing infrastructure, and the decisions usually occur on time scales of a year or less.”

² “Adaptive management requires: (1) close integration between natural and social scientists and policymakers in the formulation of goals and hypotheses, (2) clearly defined response indicators (endpoints!), and (3) monitoring and evaluation to identify and assess the implications of change in the response indicators relative to goals and objectives.” (<http://dels.nas.edu/basc/crc0306/schultz.ppt>)

³ Wilhere, GF. 2002. Adaptive management in habitat conservation plans. *Conservation Biology* 16: 20-29

⁴ Walters, 2007. Is adaptive management helping to solve fisheries problems? *AMBIO* 36: 304-307

References cited

Iglesias-Preito, R., Matta, J. L., Robins, W. A. and Trench, R. K., 1992. Photosynthetic response to elevated temperature in the symbiotic dinoflagellate *Symbiodinium microadriaticum* in culture. *Proc. Natl. Acad. Sci. USA* 89: 10302-10305.

Iglesias-Prieto R, Beltran VH, LaJeunesse T, Reyes-Bonilla H, Thome PE (2004) Different algal symbionts explain the vertical distribution of dominant reef corals in the eastern Pacific. *Proc Royal Soc Lond.*, B DOI 10.1098/rspb.2004.2757

APPENDIX A

**Charge Questions for the Adaptation for Climate-Sensitive Ecosystems and
Resources Advisory Committee (ACSERAC) Review of Draft Synthesis and
Assessment Product (SAP) 4.4: Preliminary Review of Climate-Sensitive Ecosystems
and Resources**

1. Does the Committee agree with the focus on six management systems from across federally owned and managed lands and waters as an effective way to review adaptation options for climate-sensitive ecosystems and resources?

2. Does the Committee agree that the report provides useful information for managers on the state of knowledge regarding ecosystem management decisions sensitive to climate change, the types of adaptation options available, and approaches for implementing adaptation options? If the usefulness of the report could be improved, what specific improvements does the Committee recommend?

3. Does the Committee agree that the case studies are effective at demonstrating adaptation approaches and specific issues related to implementation? If the case studies could be improved to better demonstrate adaptation approaches, what specific improvements does the Committee recommend?

4. Does the Committee agree that the major conclusions and synthetic themes of the Synthesis chapter are supported by, and representative of the underlying chapters?

5. Does the Committee agree that the key findings and recommendations presented in the Executive Summary are the most important and appropriate to bring forward to executive level managers and Congress?

6. Does the Committee agree that EPA effectively followed the CCSP Guidance on characterizing confidence levels for the proposed adaptation approaches presented in the Executive Summary and Synthesis?

7. Does the Committee agree with the decision to use information from a series of stakeholder workshops in addition to the published literature to identify and assess adaptation options and implementation issues for climate-sensitive ecosystems?

APPENDIX B

Responses to ACSERAC Charge Questions for CCSP SAP 4.4, *Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources*

from Dr. Joseph Arvai, Michigan State University

Charge Questions for the Adaptation for Climate-Sensitive Ecosystems and Resources Advisory Committee (ACSERAC) Review of Draft Synthesis and Assessment Product (SAP) 4.4: Preliminary Review of Climate-Sensitive Ecosystems and Resources

Comments on the Executive Summary (ES) and Synthesis (S) from Joe Arvai

1. Does the Committee agree with the focus on six management systems from across federally owned and managed lands and waters as an effective way to review adaptation options for climate-sensitive ecosystems and resources? **(ES, S)**

(ES) The focus on six management systems in the Executive Summary seems sensible. Other alternatives seem plausible, however, and it's unclear why these were not chosen. In lieu of a focus on National Forests, National Parks, National Wildlife Refuges, Wild and Scenic Rivers, National Estuaries, and Marine Protected areas, the report instead could have focused on grasslands, wetlands, savanna, forests (all by sub-type). I'm sure there was a good reason behind why the report focuses on federally managed systems; perhaps it could be stated in the Executive Summary.

(S) The Synthesis chapter seems to downplay the six systems types, quite appropriately I think, in favor of more general recommendations about management considerations. However, from the perspective of the decision sciences, many of these recommendations seem to be glossed over. See item 2, below.

2. Does the Committee agree that the major conclusions and synthetic themes of the Synthesis chapter are supported by, and representative of the underlying chapters? **(S)**

(S) It is my view that all of the major conclusions point in the correct general direction. However, many of these themes seemed to be glossed over. I am somewhat concerned about this because a report with this heft will likely steer many readers to just the Executive Summary and Synthesis chapters. As a result, I think these two chapters should be clear in terms of providing detailed guidance about the challenges that might be expected in the six system types as well as the management strategies for approaching them.

In terms of an illustrative example, I am concerned by what appears to be, at best, an overly simplistic view of adaptive management (including Figure 9.1). I think this reflects, in part, the short treatment it receives in this chapter. However, I also think that the collective understanding among many scientists and managers of adaptive management is growing weaker. This is a shame for two reasons: First, much of what is positive (and negative) about adaptive management is lost on users. Second, it further contributes to the general level of misunderstanding that surrounds the concept. In the end, I think that drawing attention to the adaptive management framework in the context of climate management is appropriate and I recommend that the discussion of it in this report be bolstered. Moreover, I think that the concept can be more easily applied to

climate change than many of the other resource management problems for which it was designed.

Adaptive management proceeds based on “experimentation” by simultaneously implementing varied policy treatments and then comparing their results to test clearly formulated hypotheses about the behavior of complex systems. Experimentation in this sense goes beyond management through trial and error and casual observation; it is structured and theoretically driven, designed to elicit specific responses from systems under study such that new knowledge can be incorporated systematically into future treatments.

While this experimental focus is especially appealing to scientists, adaptive management reaches beyond the goal of simply enhancing traditional scientific understanding of natural systems independent of human systems. The approach also recognizes that managed systems present moving targets influenced largely by human drivers and, therefore, explicitly incorporates these human factors into management experiments. By linking science and policy in this way, the objectives of adaptive management go beyond maximizing utility (from an environmental or human standpoint) relative to a previous baseline under a given management option to also include learning over time about complex and uncertain systems. The added appeal of adaptive management, therefore, lies in its ability to help inform the judgments of policy makers who must address complex problems with high levels of uncertainty.

Implementing adaptive management takes place in two phases: the challenging task of institutionalizing a framework in which intentional, varied, and comperable policies may be implemented, and the relatively easier task of learning over time by monitoring the responses of the system(s) on which the varied experimental policy “probes” have been enacted.

There are at least three reasons to believe *a priori* that adaptive management is a useful way to approach the problem of global climate change. First, any policy approach to global warming must incorporate the interaction of human behavior with the atmosphere, and vice versa. This point is obvious insofar as global warming is anthropogenic, but, more importantly, it is also true that mitigation and adaptation strategies themselves will interact with each other and with natural variables, creating a complicated dynamic of cause and effect where most important variables are both exogenous and endogenous. Adaptive management is well suited to incorporating this concern with the human-environment nexus.

Second, adaptive management is appealing because of the sheer complexity of the climate change problem coupled with the need to make management decisions under uncertainty. Even after over a quarter century of intense research, questions linger regarding the magnitude of human disturbance, climate sensitivity, impacts of realized climate change, and what mitigation and adaptation schemes will be most effective. Applying adaptive management to climate policy could provide policymakers with the flexibility needed to proceed and to learn over time, a preferable alternative to the current

stalemate in many countries and localities where uncertainty leads to incrementalism or inaction. Adaptive management may be especially valuable since many planners and decision makers—particularly those in North America—have reported little direct experience with climate change and its consequences from which to draw analogies and lessons.

Finally, adaptive management is inclusive and flexible in terms of the precise goals of climate change policy and the means used to achieve them. By definition, the approach seeks to apply a variety of policy treatments to a problem. As such, it could be used to pursue a range of policy goals in the areas of both mitigation (e.g., emissions reductions, farming practices and forestry) and adaptation (e.g., accommodating changes in temperature and precipitation patterns, planting new crops and protecting biodiversity, building seawalls to protect coastal areas from flooding). Likewise, the approach also possesses the flexibility to include policy treatments that address climate indirectly; indeed, it is hard to imagine a policy intervention that *only* achieves goals related to climate change. Conversely, there are many interventions that may be pursued and justified on the basis that they help to achieve other goals and address climate change only via a secondary pathway. An example of one such ‘no regrets’ intervention is the effort to enhance the efficiency of motor vehicles in order to reduce dependence on fossil fuel imports and improve local air quality. In sum, the flexibility and inclusiveness that is inherent to adaptive management is appealing from a political and practical standpoint insofar as it allows different managers—at the international, national, sub-national, and individual levels—to pursue different objectives and options when it comes to climate change policy depending on the values and incentives that are specific to their regions.

It is important to note, however, that implementing an adaptive framework is not without significant challenges (albeit ones that may be overcome). Indeed, all of the barriers discussed in this section apply to both adaptive management and adaptation to climate change. Rather than going into further detail about these here, I would point the authors to the following papers:

Arvai, J. L., G. Bridge, N. Dolsak, R. Franzese, T. Koontz, A. Luginbuhl, P. Robbins, K. Richards, K. Smith Korfmacher, B. Sohngen, J. Tansey, and A. Thompson. 2006.

Adaptive management of the global climate problem: Bridging the gap between climate research and climate policy. Climatic Change 78:217-225.

Gregory, R., D. Ohlson, and J. L. Arvai. 2006. Deconstructing adaptive management: Criteria for applications to environmental management. Ecological Applications 16:2411-2425.

It’s also curious that this section does not discuss non-ecological endpoints (as targets for adaptation/management). This is particularly noticeable in the discussion (in this section and elsewhere) of National Parks. Is there a reason why social objectives for adaptation—such as those relating to recreation in National Parks and property protection in the coastal zone—are not discussed?

Finally, I think this section would be more comprehensive and accurate if it discussed some of the difficulties associated with establishing attributes and measures for management endpoint (i.e., objectives). This section does discuss establishing important baselines against which changes could be measured but, I think, it goes too far when it suggests that this data will be critical in a decision making context. In my experience, data inputs for decision making have to be specific to the objectives of stakeholders and decision makers.

To be maximally informative for resource management, a key consideration is to ensure that measures of environmental health or quality are *decision-relevant* (as opposed to *science-relevant*). Many efforts by ecologists and resource managers aimed at identifying measures of environmental quality are little more than long lists of potentially important biological or physical factors (i.e., *science-relevant*) that are not useful from the standpoint of informing management decisions. To illustrate this point (though not in a climate change context), decades of research conducted in the lower Fraser River and its estuary in southwestern British Columbia yielded lengthy, detailed, and science-relevant data sets for parameters such as sedimentary metal and organic material content, dissolved oxygen levels, and benthic algal biomass. Very little of this information was useful for evaluating the effects of combined sewer overflow (CSO) events from nearby sewage treatment facilities on the ecology of the area and making subsequent decisions related to their management. This data vacuum resulted in a significant time lag (and further environmental degradation) between when a need for decision-relevant data was expressed and when additional research on the temporally- and spatially-dependent energy flow dynamics of certain key species that could be correlated with annual CSO events could be conducted

3. Does the Committee agree that the key findings and recommendations presented in the Executive Summary are the most important and appropriate to bring forward to executive level managers and Congress? **(ES)**

(ES) It is difficult to tell from the Executive Summary alone what the key findings and recommendations are. The executive summary seems overly general, which is problematic given that its intended audience—resource managers; page 1-3—will likely focus on this summary chapter. Many of the statements made seem rather uninformative, perhaps because important contextual details are absent; e.g., “...Working toward the goal of desired future functions (e.g., processes, ecosystem services) would involve managing current and future conditions (e.g., structure, outputs), which may be dynamic through changing climate, to sustain those future functions as climate changes...(page 1-5)”.

4. Does the Committee agree that EPA effectively followed the CCSP Guidance on characterizing confidence levels for the proposed adaptation approaches presented in the Executive Summary and Synthesis? **(ES, S)**

(ES, S) Based on what I have read, yes.

5. Does the Committee agree with the decision to use information from a series of stakeholder workshops in addition to the published literature to identify and assess adaptation options and implementation issues for climate-sensitive ecosystems? **(ES, S)**

(ES, S) Absolutely. However, it's unclear to me from both the Executive Summary and the Synthesis chapters what the purpose of the stakeholder workshops was. The brief section in the Introduction is equally, if not more, cryptic. Many authors and analysts have criticized stakeholder involvement processes that seem to be little more than a marginal addition—sometimes an afterthought—to what are typically viewed as fundamentally technical decision problems. It strikes me that stakeholder input would play a key role in this report but, without a basis for making judgments about its quality, I fear that many will view it in negative terms. I think the report should be more explicit about what exactly was done with respect to eliciting input from stakeholders.

APPENDIX C

Responses to ACSERAC Charge Questions for CCSP SAP 4.4, *Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources*

from Dr. Eric Gilman, IUCN Global Marine Programme

Eric Gilman, IUCN Global Marine Programme (eric.gilman@iucn.org) comments on the US EPA report:

“Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources. Synthesis and Assessment Product 4.4, U.S. Climate Change Science Program”

20 September 2007

In preparation for the October 22-23 2007 Federal Advisory Committee meeting, the Committee Chair and Vice Chair have assigned me with the task of providing replies to seven ‘charge questions’ specifically related to the report Executive Summary and section on Marine Protected Areas. As my area of expertise is focused on mangrove and other coastal wetland responses to changes in relative sea-level and other climate change outcomes, I have additionally directed my comments to address the charge questions to the adequacy of the report in addressing options for adaptation to these coastal ecosystems’ responses to climate change.

The first seven comments are the assigned ‘charge questions,’ which are followed by additional comments.

1. Does the Committee agree with the focus on six management systems from across federally owned and managed lands and waters as an effective way to review adaptation options for climate-sensitive ecosystems and resources?

(a) The organization of the report by categories of federally owned and managed properties is an ineffective structure to facilitate identifying optimal options for climate change adaptation. The report would be extremely more useful if organized by ecosystem type. Alternative adaptation strategies for an ecosystem type will generally apply regardless of the owner and manager. For instance, the word ‘mangrove’ occurs 57 times scattered in numerous sections throughout the 784 page report. Resource managers wishing to review best practices, for a site-specific context, to adapt to predicted mangrove responses to projected outcomes of climate change, would find the report much more efficient to use if it were organized by ecosystem type.

(b) A review of the state of knowledge regarding individual ecosystem responses to climate change should be included in the report, as this scientific understanding is the basis for identifying effective adaptation options. If the current report structure is maintained (organized by federal management system), then a new chapter should be added, with individual sections devoted to a review of responses to climate change for each ecosystem type. Ecosystem responses to changes in individual global warming environmental factors, and combined effects, should be covered, including change in relative sea-level, extreme high water events, storminess, precipitation, temperature, atmospheric CO₂ concentration, health of functionally linked neighboring ecosystems, as well as human responses to climate change.

(c) It is unclear why ‘marine protected areas’ is a separate category from other federally managed properties, as several categories of federally owned and managed property contain coastal and marine waters and are examples of MPAs (i.e. National Sanctuaries, National Estuaries, National Wildlife Refuges, National Parks, Naval Defensive Seas). The concepts identified in the MPA section are applicable to all of the other management systems covered in the report.

(d) Naval Defensive Seas should be included as a federally managed, owned and extremely well enforced property and MPA.

2. Does the Committee agree that the report provides useful information for managers on the state of knowledge regarding ecosystem management decisions sensitive to climate change, the types of adaptation options available, and approaches for implementing adaptation options? If the usefulness of the report could be improved, what specific improvements does the Committee recommend?

Overall, the report identifies key concepts for climate change adaptation, but provides very few site-specific examples of how these concepts can be implemented. As a result, due to the lack of specific guidance for implementing adaptation methods, it is unlikely that resource managers will modify their planning and management actions to better incorporate predicted ecosystem responses to climate change based on the production of this report.

(a) Managed retreat as a method for adapting to ecosystem responses to relative sea-level rise should be highlighted in the executive summary and main text. This concept is discussed in the Executive Summary (section 1.7.2) and the chapter on National Estuaries, but is applicable to all six management systems and ecosystem types. “Managed retreat” involves implementing land-use planning mechanisms before the effects of climate change become apparent, which can be planned carefully with sufficient lead time to enable economically viable, socially acceptable, and environmentally sound management measures. As an example, based on the well documented understanding that coastal ecosystem response to rising sea-level relative to the coastal ecosystem’s sediment surface is to migrate landward, removing obstacles to this natural landward migration is a recommended adaptation measure to reduce reductions in area of coastal ecosystems in response to relative sea-level rise.

With managed retreat, coastal development could remain in use until the eroding coastline becomes a safety hazard or begins to prevent landward migration of mangroves, at which time the development can be abandoned or moved inland. Adoption of legal tools, such as rolling easements, can help make such eventual coastal abandonment more acceptable to coastal communities. Zoning rules for building setbacks and permissible types of new development can be used to reserve zones behind current mangroves for future mangrove habitat. Managers can determine adequate setbacks by assessing site-specific rates for landward migration of the mangrove landward margin. Construction codes can be instituted to account for relative sea level rise rate projections to allow for the natural inland migration of mangroves based on a desired lifetime for the coastal development. Any new construction of minor coastal development structures, such as

sidewalks and boardwalks, should be required to be expendable with a lifetime based on the assessed sites' erosion rate and selected setback. Otherwise, the structure should be portable. Rules could prohibit landowners of parcels along these coasts from constructing coastal engineering structures to prevent coastal erosion and the natural inland migration of mangroves. This managed coastal retreat will allow mangroves to migrate and retain their natural functional processes, including protecting the coastline from wind and wave energy.

(b) Clarify that, in referring to ecological restoration, which can contribute to mitigating anticipated ecosystem degradation in response to climate change, through a specific definition, that this does not include habitat conversion (i.e. converting mudflats into coastal wetlands as a means to offset anticipated reductions in area and health of coastal wetlands as a result of responses to climate change).

(c) There is a dearth of research and experiences for climate change adaptation for certain ecosystems, e.g., pelagic marine ecosystems. In these instances it is important to identify research priorities as part of the approach for adaptation.

(d) For each ecosystem, the report should use the IPCC's fourth assessment as a baseline and starting point for information on the state of knowledge for internationally accepted options for adaptation to ecosystem responses to climate change.

3. Does the Committee agree that the case studies are effective at demonstrating adaptation approaches and specific issues related to implementation? If the case studies could be improved to better demonstrate adaptation approaches, what specific improvements does the Committee recommend?

The case studies do not demonstrate adaptation approaches, but in some cases do highlight issues to be considered when implementing adaptation methods. The case studies included in the report do not provide examples of moving from concept to operationalizing alternative methods for climate change adaptation. This may simply be the result of there being few examples of implementation of climate change adaptation, which is documented in the Executive Summary as a key finding from the stakeholder workshops, "...for many of the management systems, management plans are only beginning to consider climate impacts, with few adaptation strategies yet being enumerated or implemented in the field" (p. 1-4). For example, the Florida Keys NMS case study marginally discusses how climate change adaptation methods could be implemented in the future, such as by identifying and protecting bleach-resistant reefs in the Keys, and considering possible expansion of coral reef range to higher latitudes. This and most of the other selected case studies were not appropriate if the purpose was to provide lessons learned from implementing adaptation methods.

4. Does the Committee agree that the major conclusions and synthetic themes of the Synthesis chapter are supported by, and representative of the underlying chapters?

Yes.

5. Does the Committee agree that the key findings and recommendations presented in the Executive Summary are the most important and appropriate to bring forward to executive level managers and Congress?

The following basic concepts, related to adapting to ecosystem responses to climate change, should be highlighted:

(a) Emphasize that, while it is important to plan for adaptation to ecosystem responses to climate change, at the same time there is an urgent need to address the underlying anthropogenic causes of climate change. Furthermore, clarify that planning for adaptation is needed even if the U.S. and international community comply with internationally-accepted measures to reduce greenhouse gas and aerosol emissions: The effects from human-induced climate change by the production of greenhouse gases and aerosols are projected to continue for hundreds of years even if greenhouse gas concentrations were stabilized at present concentration levels.

(b) “Managed retreat” through the implementation of land-use planning mechanisms, discussed previously in these comments.

(c) When considering areas for augmented protection as a strategy for climate change adaptation, consider an area’s resistance and resilience to projected sea level and climate changes and contributions to adaptation strategies. For instance, mature mangrove communities will be more resilient to stresses, including those from climate change, than recently-established forests.

6. Does the Committee agree that EPA effectively followed the CCSP Guidance on characterizing confidence levels for the proposed adaptation approaches presented in the Executive Summary and Synthesis?

Yes.

7. Does the Committee agree with the decision to use information from a series of stakeholder workshops in addition to the published literature to identify and assess adaptation options and implementation issues for climate-sensitive ecosystems?

Yes.

Comments Not Fitting within the Seven ‘Charge Questions’

1. Overall, the report is encyclopedic and information-driven, and should be substantially pared down in length, and more concisely focus on key concepts and lessons learned regarding alternative approaches to adapting to ecosystem responses to climate change.

2. A section should be added to the report to explain how ecosystem adaptation to climate change as proposed in the report support the implementation of various relevant international initiatives, and specify under which international arrangement the US Government has legally binding or voluntary obligations. These international initiatives include, but are not limited to the:

- Millennium Development Goals
- Millennium Ecosystem Assessment
- Convention on Biological Diversity and World Summit on Sustainable Development Biodiversity Targets
- Convention on Biological Diversity Island Biodiversity Programme of Work
- Bali Strategic Plan

3. In numerous parts of the report, authors confuse eustatic global sea-level changes with local relative changes. Assessing the vulnerability of a site-specific coastal ecosystem to projected changes in sea-level requires information on rates of change in relative sea-level. ‘Relative sea level change’ is the change in sea level relative to the local land, as measured at a tide gauge relative to a fixed benchmark. Sea level change measured at a tide gauge is a combination of the:

- c) Change in eustatic (globally averaged) sea level (the change in sea level relative to a fixed Earth coordinate system), which, over human time scales, is due primarily to thermal expansion of seawater and the transfer of ice from glaciers, ice sheets and ice caps to water in the oceans; and
- d) Regional and local factors, such as vertical motion of the land from tectonic movement, the response of the Earth's crust to changes in the weight of overlying ice or water, coastal subsidence such as due to extraction of subsurface groundwater or oil, geographical variation in thermal expansion, and for shorter time scales, changes in salinity, winds, ocean circulation, and oceanographic processes such as El Nino phases and changes in offshore currents. For instance, warmer water and water at higher pressure (such as at greater depth) expands more than colder water and water under lower pressure for a given heat input, making the global average expansion affected by the distribution of heat within the oceans.

4. Page 1-19 and elsewhere, use of the phrase “uncontrollable climate stresses” may be incorrectly interpreted to infer that causes of climate change are not controllable. While the effects from human-induced climate change by the production of greenhouse gases and aerosols are projected to continue for hundreds of years even if greenhouse gas concentrations were stabilized at present concentration levels, ultimately the cause of ecosystem stresses from climate change are controllable and can be mitigated.

5. In the MPA chapter, and MPA portion of the Executive Summary, highlight the following key concepts:

(a) Protecting areas of an ecosystem type that are resistant to climate change effects serves as a refuge, in part, to be a source to re-colonize adjacent areas degraded by climate change outcomes, and other disturbances.

(b) Managers selecting sites and boundaries for individual protected areas, reviewing the effectiveness of existing protected areas, and designing protected area systems need to explicitly incorporate anticipated coastal ecosystem responses to climate change effects. For instance, planners need to account for the likely movements of habitat boundaries and species ranges over time under different sea level and climate change scenarios, as well as consider an areas' resistance and resilience to projected sea level and climate changes and contributions to adaptation strategies. For instance, mature mangrove communities will be more resilient to stresses, including those from climate change, than recently-established forests. Site-specific analysis of resistance and resilience to climate change when selecting areas to include in new protected areas should include, for example, how discrete coastal habitats might be blocked from natural landward migration, and how severe are threats not related to climate change in affecting the site's health.

(c) Networks of protected areas, covering large geographical areas, spaced at suitable distances from one another, and including a representative and replicated spectrum of habitats, are thought to provide the greatest conservation benefit. Networks of protected areas are needed to achieve the biologically-necessary connectivity to permit the movement of species and exchange of genes. For instance, because eggs and larvae of certain marine species have a large dispersal distance, a small protected area will not ensure self-sustaining populations of these species unless the protected area is colonized by offspring produced in another protected area sufficiently close to exchange offspring. Also, some organisms require several habitats to be protected for various life history stages.

(d) The selection of sites for protected areas should account for functional linkages between coastal ecosystems. For instance, protected areas designed to preserve biodiversity and relatively pristine habitats should incorporate adjacent coastal forests, mangroves, seagrass beds, and coral reefs to ensure all functional links are maintained in a least disturbed state. Protected areas designed in this manner will have optimal resistance and resilience to climate change and other stresses. The existence of functional links between coastal systems means that degradation of one habitat type will adversely affect the health of neighboring habitats. If a protected area encompasses only a single ecosystem type and does not include adjacent ecosystems, unsustainable activities occurring in adjacent areas could result in degradation of the resources within the protected area.

(e) Coastal and marine protected areas have potential limitations, which can be avoided and minimized through careful planning and management:

- The resource use restrictions of a protected area may displace effort to adjacent and potentially more sensitive and valuable areas, where weaker management frameworks may be in place;

- Local communities may have a limited area available for exploiting natural resources, and may have limited resources for managing a protected area, which results in only a small area of coastal and marine habitats being able to be practicably set aside as a no-take zone of a protected area, limiting the ecological value of the protected area due to its small size;
- Protected areas can disproportionately affect certain sectors of the local community; and
- Existence of a protected area may promote the misconception that the protected area is a panacea to rescue troubled fish stocks, and could cause managers to disregard the need to employ additional management techniques to achieve sustainable fisheries.

6. The report should consider the potential adverse effects on ecosystems from anthropogenic responses to relative sea-level rise and other climate change outcomes, which have the potential to exacerbate the adverse effects of climate change on ecosystems. For instance, we can expect an increase in the construction of seawalls and other coastal erosion control structures adjacent to landward margins of coastal ecosystems as the threat to development from rising sea-levels and concomitant coastal erosion becomes more apparent. Or, for example, areas experiencing reduced precipitation and rising temperature may have increased groundwater extraction to meet the demand for drinking water and irrigation. Increased groundwater extraction will increase sea-level rise rates relative to the elevation of coastal ecosystem sediment surfaces, increasing their vulnerability of reduced area, health and possible local extirpation.

7. Given uncertainties about future climate change and responses of ecosystems, there is a need to monitor and study changes systematically and regionally through international collaborative programs. This is insufficiently emphasized in the report. Projections are available over coming decades for rising sea level and changes in climate and weather. In the long term, these changes are expected to alter the position, area, structure and health of most communities. Establishing ecosystem baselines and monitoring gradual changes through regional networks using standardized techniques will enable the separation of site-based influences from global changes to provide a better understanding of ecosystem responses to climate change, and alternatives for mitigating adverse effects. The monitoring system, while designed to distinguish climate change effects on mangroves, would also therefore show local effects, providing coastal managers with information to abate these sources of degradation.

While these techniques alone would not make it possible to determine causes of observed ecosystem changes to structure, area and functioning, as is possible through controlled experiments, regional standardized monitoring may provide the basis for scientists to make strong inferences of causation by global factors versus local influences on mangroves. For instance, coordinated observations of regional phenomena such as a mass mortality event of mangrove trees, or trend in reduced recruitment levels of mangrove seedlings, might be linked to observations of changes in regional climate such as reduced precipitation.

APPENDIX D

Responses to ACSERAC Charge Questions for CCSP SAP 4.4, *Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources*

from Dr. George Hornbereger, University of Virginia

Comments on Executive Summary --GMH

GENERAL

Before addressing the questions that were posed for us, I have two general comments.

First, I think that some explanation of the terminology needs to be brought up to the ExecSumm. Chapter 2 does a good job of explaining clearly what the report is about and of defining terms as they are used. The ExecSumm, in contrast, is not very consistent. For example, the following terms appear in the ExecSumm: adaptation options, adaptive strategy, active adaptive management, adaptive environmental assessment, adaptive experiments, adaptation strategies, proactive planning actions, proactive management, management adaptations, place-based management. At best, this is a reflection of imprecision in use of language. At worst, it is a reflection of confusion about what is being said. In either case, if terminology is defined and then editing is done to make sure the terms as defined are used appropriately (and new, undefined terms are avoided), the ExecSumm would be much improved.

My second comment is that I am skeptical about using adaptive management as a necessary framework. Part of the problem comes from a lack of agreement on exactly what the framework means. The entire program seems to be unsure. For example, the CCSP Strategic Plan (Chapter 11) seems to deflate any meaning that “adaptive management” might have, basically equating it with operational management¹. But in a presentation to BASC in March 2006 with an update to CCSP, Peter Schultz appears to support “passive adaptive management”². In the original concept, AM clearly meant an *experimental* approach, which is now termed “active adaptive management.” Within the SAP 4.4 report itself, I don’t sense a strong agreement on what is meant by the term. In the ExecSumm page 1-16, lines 43-47), adaptive management is expressed as originally conceived, i.e. as an experimental approach. Chapter 2, which I find to be a well written introduction, avoids much of the hyperbole that surrounds some of the other discussion. One can read lines 5-12 on page 2-12 as a (rather soft) suggestion that a form of passive adaptive management may be useful, at least in some cases. And finally, there are descriptions (and, I think, differences in what is meant) throughout the report, including: “Management Responses in Anticipation of Future Climate Change” (p3-35); “Adaptive Environmental Assessment and Management” (p4-25); “Adaptive Management” (p5-29); “Proactive Management” (p6-28); and “Ecosystem-based Management (EBM)” (p7-53).

¹ “Adaptive management decisions are operational decisions, principally for managing entities that are influenced by climate variability and change. These decisions can apply to the management of infrastructure (e.g., a waste water treatment plant), the integrated management of a natural resource (e.g., a watershed), or the operation of societal response mechanisms (e.g., health alerts, water restrictions). Adaptive management operates within existing policy frameworks or uses existing infrastructure, and the decisions usually occur on time scales of a year or less.”

² “Adaptive management requires: (1) close integration between natural and social scientists and policymakers in the formulation of goals and hypotheses, (2) clearly defined response indicators (endpoints!), and (3) monitoring and evaluation to identify and assess the implications of change in the response indicators relative to goals and objectives.” (<http://dels.nas.edu/basc/crc0306/schultz.ppt>)

My sense is that there is agreement at a very general level, but the plethora of terms and associated prose is likely to get in the way of clear communication. If my inferences from my reading so far are correct, I believe that what is envisioned is an approach that uses scientific information about climate change to inform management plans, supports monitoring to gauge the state of the system with respect to the management goals, allows adaptation of management options as the total system evolves, and recognizes pragmatism in that negotiation, trade-offs, and collaboration will often be the most important aspects of the operation. I think that the ExecSumm could provide a very useful service by making clear that there is a common framework, although exactly how implementation is done will vary. I think that explicit acknowledgement that strict implementation of adaptive management may not be a reasonable expectation except in restricted circumstances (e.g., see Wilhere³ or Walters⁴) would help. One way to do this without having to extensively rewrite the individual chapters might be to embrace the EBM concept which, as I understand it, advocates adaptive management to the extent feasible. But however it is done; I think the ExecSumm should aim to resolve apparent inconsistencies.

SPECIFIC

1. Does the Committee agree with the focus on six management systems from across federally owned and managed lands and waters as an effective way to review adaptation options for climate-sensitive ecosystems and resources?

The focus on six systems is fine. There is unevenness in how the ExecSumm handles the six, however. The sections on Adapting to Climate Change, for example, are all over the place. For National Forests, a total of six options are listed. For NWRs, the options are not enumerated, but one can see that some are listed (along with a “recommendation” for forming a national interagency climate change council!). For WSRs, options are not presented; rather a general plea for “proactive management” is made. For Estuaries, it is not clear what items are management options and what are wishes for how people will behave in the future. For MPAs, the primary option is expansion and this is followed by a case study and a general plea for stakeholder involvement. Insights from case studies are similarly uneven. In fact, I think that significant rewriting is called for. In NPs, do you really want to say what University curricula should be? In NWRs, Does “The primary opportunities for enhancing implementation of adaptation options include (1) creating n institutional culture where employees are rewarded for being proactive catalysts for adaptation to climate change” carry any meaning? In WSRs, the claim is made that Alaska rivers are “laboratories.” This is presented only in a box, not in the Chapter itself. It is made only as a statement, with no evidence or argument to support the notion. It is hard to see how this is truly an insight from the case studies. For MPAs, I do not see where the last two paragraphs have anything to do with insights from the case studies. Overall, there is precious little specificity attached to the lessons learned.

³ Wilhere, GF. 2002. Adaptive management in habitat conservation plans. *Conservation Biology* 16: 20-29

⁴ Walters, 2007. Is adaptive management helping to solve fisheries problems? *AMBIO* 36: 304-307

5. Does the Committee agree that the key findings and recommendations presented in the Executive Summary are the most important and appropriate to bring forward to executive level managers and Congress?

It is not easy to discern the key findings and recommendations in the ExecSumm. If there are recommendations, they are very “soft”, that is they are stated implicitly rather than explicitly.

The first four paragraphs on page 1-16 give an excellent synthesis of useful ideas from the six systems. But I question whether the “recommendation” to use adaptive management is wise (as I mention in my general comments.) The problems of detecting changes in a “noisy” system and of attributing any changes detected to climate are real problems. Do the authors really think there is a reasonable prospect that this can be accomplished for ecological endpoints? That is, for any of the six systems how likely is it that we can “develop or modify monitoring schemes to track and substantiate vulnerabilities to climate change and assess the effects of management adaptations”? My own view is that one major message from the individual sections has been lost – that other stressors are likely to have big impacts regardless of how climate may or may not change at a particular location and that there are management options to alleviate these other stresses *that are likely to be good for climate change scenarios as well*. Does this not argue for a recommendation to pursue “no-regrets” options and not worry about the attribution problem? Finally, although I find it a noble (and scientifically correct) goal to “manage the nation’s lands and waters as one large system”, whether such a grandiose (implicit) recommendation will resonate with executive level managers and Congress remains to be seen.

6. Does the Committee agree that EPA effectively followed the CCSP Guidance on characterizing confidence levels for the proposed adaptation approaches presented in the Executive Summary and Synthesis?

Table 1.1 does express confidence as suggested in guidance documents. I did not find a consistent expression of uncertainty throughout the document, however, so it is not clear what the basis for the authors’ entries in Table 1.1 were.

Guidance # 1 is: “Instruct authors to incorporate explicit discussions of uncertainty throughout their report.” Although there was some discussion of uncertainty throughout the document, I did not find a consistent treatment, especially with respect to impact on adaptation approaches.

Guidance #5 is: “Instruct authors to express the level of confidence in the current scientific understanding of an issue by being transparent about the amount of evidence available and the degree of consensus in the scientific community surrounding that issue.” I do not think that the basis for the evaluations (the amount of evidence) is presented. Thus, it is hard to argue for transparency.

Does the Committee agree with the decision to use information from a series of stakeholder workshops in addition to the published literature to identify and assess adaptation options and implementation issues for climate-sensitive ecosystems?

Yes, this is an essential step.

Comments on Chapter 6 - WSRs - GMH

1. Does the Committee agree with the focus on six management systems from across federally owned and managed lands and waters as an effective way to review adaptation options for climate-sensitive ecosystems and resources?

This is a nicely written chapter with a lot of good information.

2. Does the Committee agree that the report provides useful information for managers on the state of knowledge regarding ecosystem management decisions sensitive to climate change, the types of adaptation options available, and approaches for implementing adaptation options? If the usefulness of the report could be improved, what specific improvements does the Committee recommend?

The section on policy context is excellent and lays out clearly the options available (and hints at some of the difficulties of implementation of options). On the other hand, I think that the distinction between “reactive management” and “proactive management” artificially glorifies the latter and denigrates the former. There will always be a need for reactive management; for example, rescuing stranded canoeists can’t possibly be otherwise. And there will always be a need to repair damages caused by extreme events – this was true in the past and will be true in the future with or without climate change. I don’t disagree with the notion that proactive management measures should be considered carefully under climate change scenarios, but I think the utter dismissal of “reactive” approaches to bolster the claim that this should be done misses the mark.

The basic problem with adaptive management is glossed over. The statement is made that many of the management actions needed are in response to risks of changes in the frequency and magnitude of extreme events. But suppose some management action is taken in the expectation that the 100-year flood is now in reality the 50-year flood. How would one assess whether the action was successful? In one case there might not be any observed flood over a couple of decades (even though the hypothesis was true) and in another case, one might have an extreme flood two years in a row. The authors obviously know this, but the way the prose is written does not make it clear what an adaptive strategy is in these cases. Because there are no detailed examples of management actions and options, it is not possible to figure out what the advice is.

My main criticism is that an inference that comes to me quite strongly is not even stated explicitly. For many, many systems, other stressors (water withdrawals, nutrient enrichment, etc.) will continue to have a deleterious effect unless proactive management

options are undertaken. It turns out that most such actions would also be beneficial for climate change effects. Why not recognize this explicitly and make appropriate recommendations?

3. Does the Committee agree that the case studies are effective at demonstrating adaptation approaches and specific issues related to implementation? If the case studies could be improved to better demonstrate adaptation approaches, what specific improvements does the Committee recommend?

The case studies are very informative, but see my last comment in #2 above. The effects of climate change are unlikely to be good for rivers like the Rio Grande or the Wekiva, but direct anthropogenic effects on water and land use are likely to be dominant. This doesn't mean that climate change isn't important, but if there were options that would be beneficial for one or the other or for both, I think there would be a clear priority.

6. Does the Committee agree that EPA effectively followed the CCSP Guidance on characterizing confidence levels for the proposed adaptation approaches presented in the Executive Summary and Synthesis?

Uncertainty is mentioned in several places, but I could not tell how the authors did their confidence assessment, nor do I see evidence presented that helps me. I tried to look at possible connections, but couldn't really make headway. On page 6-29, does the option to "Designate more river corridors as wild and scenic" fall into the "replication" adaptation approach? If so, why is the level of confidence low? Is "Claim more water rights" in the "reduce anthropogenic stress" category? If so, why is confidence high? Is procurement of land conservation easements (under "Improve water monitoring capabilities on page 6-310) in the "Refugia" category? If so, why a "medium" confidence? In general, there appears to be no connection between what is presented in the Chapter and the entries in Table 1.1.

7. Does the Committee agree with the decision to use information from a series of stakeholder workshops in addition to the published literature to identify and assess adaptation options and implementation issues for climate-sensitive ecosystems?

Yes.

APPENDIX E

Responses to ACSERAC Charge Questions for CCSP SAP 4.4, *Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources*

From Dr. Elizabeth L. Malone, Joint Global Change Research Institute, University of Maryland

Comments on the Charge Questions for CCSP SAP 4.4, *Adaptation Options for Climate-Sensitive Ecosystems and Resources*

Elizabeth L. Malone, Joint Global Change Research Institute, College Park, MD

NOTE: My background and expertise are in sociology (institutional, cultural, economic issues) and communications.

Chapter 4, “National Parks”

General/miscellaneous comment: The background discussion of climate change impacts is very general, as it is in many chapters; these discussions could be eliminated, since there is a section on global changes and impacts in the Introduction.

1. Does the Committee agree with the focus on six management systems across federally owned and managed lands and waters as an effective way to review adaptation options for climate-sensitive ecosystems and resources?

The focus on six management systems, it should be said, is at odds with the title of the SAP. However, such a focus allows this chapter to illuminate factors that are under the control of its managers. The chapter contains a wealth of information about various ecosystems in the national parks, sometimes focusing on one type (especially in “Stressors of Concern”), but several dimensions of adaptation require a richer analysis than an ecosystem-by-ecosystem organization provides. As the chapter itself says, “Preparing for and adapting to climate change is as much a cultural and intellectual challenge as it is an ecological one” (page 4-6, lines 32-33).

a. The chapter emphasizes the dependence of various ecosystems on each other. Principal examples of this are animals that spend different phases of their lives in different ecosystems (fish, migratory birds) and the impacts of water withdrawals and pollution upstream from federally managed lands.

b. The organization of particular agencies and the multiple enabling legislative acts are important for consideration of how the particular types of systems are and can be managed. The history of the national parks is helpful in understanding how various management arrangements evolved, including planning documents and public input.

c. The focus on management systems allows the necessity for partnerships in adaptation approaches and activities to emerge.

2. Does the Committee agree that the report provides useful information for managers on the state of knowledge regarding ecosystem management decisions sensitive to climate change, the types of adaptation options available, and approaches for implementing adaptation options? If the usefulness of the report could be improved, what specific improvements does the Committee recommend?

The chapter on national parks, like the other chapters on management systems, provides very useful information about the state of knowledge, including the uncertainties that abound, and adaptation approaches, along with elements of implementation. Although it would be ideal to have a sort of “cookbook” of best practices, the chapter (and, overall, the report) make clear this is impossible, that management actions should be aimed at limiting damages from climate change and experimenting to find ways of easing the ecological transitions to new climate regimes.

To be more helpful to managers, the chapter should more clearly distinguish the following:

- a. What is under the control of park managers, and what actions would require partnerships with others, support from the public and Congress, and continuing monitoring and research. This delineation would also help to clarify what is possible in the short, medium, and long terms.
- b. The line drawn between “Nature” and people. Some of the stressors on the parks clearly come from human activities, and these should in principle be more controllable than, say, fires ignited by lightning strikes during drought conditions. However, it is also true that people are part of Nature—and are certainly included in park ecosystems. Showing human visitors how to align with the ecosystems around them, for instance, should be a part of what park managers can control and a pathway to reducing stress on the parks.
- c. Native and nonnative species. Nonnatives seem to be treated by definition as harmful, but climate change is almost sure to cause species movement; will species that move because of climate change be considered invasive and harmful in their new places? The chapter begins a good discussion of this issue on page 4-21 but does not take it far enough to be useful to managers.

Section 4.3.3, “Incorporating Climate Change Considerations into Natural Resource Management,” parallels but improves upon the mental model depiction in the synthesis chapter because this chapter’s section speaks in terms of resources “at risk”—that is, incorporating the uncertainty of the whole process.

3. Does the Committee agree that the case studies are effective at demonstrating adaptation approaches and specific issues related to implementation? If the case studies could be improved to better demonstrate adaptation approaches, what specific improvements does the Committee recommend?

Only one short case study is given in the chapter, Rocky Mountain National Park. It is not clear why the chapter has only one case study or why this particular part was chosen. The text says RMNP “is a good example of the state at which most parks find themselves as they confront resource management in the face of climate change” (pages 4-31-32), but in fact it seems to have advantages over other parks: no danger of losing an iconic resource, like Glacier National Park; fewer visitors than other parks; “rich in information about its

ecosystems and natural resources” (page 4-35, lines 2-3); and less pollution than other parks. Nevertheless, the adaptation approaches being initiated and planned are given in enough detail to be helpful. More detail and another case study would improve the helpfulness.

6. Does the Committee agree that EPA effectively followed the CCSP Guidance on characterizing confidence levels for the proposed adaptation approaches presented in the Executive Summary and Synthesis?

Although the chapter contains a discussion of uncertainty, it does not apply confidence levels. Three types of impacts are discussed: foreseeable changes, known or imaginable changes, and unknown or unknowable changes (with the reminder that, “Perhaps the greatest uncertainties in predicting climate change and its effects are associated with the interaction of climate change and other human activities” [page 4-23, lines 23-24]). The management responses proposed are helpful at least at a theoretical level. Figure 4.8 is an excellent framework for thinking about how uncertainty and controllability interact to yield different management strategies. Any management strategy, but especially scenario-based planning and adaptive management, should include management of humans and human-caused stressors.

A reference to Table 12.4 (and 1.1), along with a discussion of the rationale for choosing confidence levels in re the national parks, should be included in this chapter.

7. Does the Committee agree with the decision to use information from a series of stakeholder workshops in addition to the published literature to identify and assess adaptation options and implementation issues for climate-sensitive ecosystems?

I agree in general with the strategy; however, it is difficult to find what information originated with the stakeholder workshops. “Stakeholders,” however, should be a wider group than scientists and natural resource managers; policymakers and users of the national parks, at a minimum, should be involved in these conversations.

Chapter 9, “Synthesis and Conclusions”

1. Does the Committee agree with the focus on six management systems across federally owned and managed lands and waters as an effective way to review adaptation options for climate-sensitive ecosystems and resources?

The focus on six management systems, it should be said, is at odds with the title of the SAP. However, such a focus allows chapters to illuminate factors that are under the control of the agencies who manage various types of national lands. The chapters contain a wealth of information about various ecosystems, sometimes focusing on one type (e.g., Chapters 7 and 8), but several dimensions of adaptation require a richer analysis than an ecosystem-by-ecosystem organization.

- a. The chapters and especially the synthesis chapter emphasize the dependence of various ecosystems on each other. Principal examples of this are animals that spend different phases of their lives in different ecosystems (fish, migratory birds) and the impacts of water withdrawals and pollution upstream from federally managed lands.
 - b. In all chapters, the organization of particular agencies and the multiple enabling legislative acts are important for consideration of how the particular types of systems are and can be managed.
 - c. The focus on management systems allows the necessity for partnerships in adaptation approaches and activities to emerge.
4. Does the Committee agree that the major conclusions and synthetic themes of the Synthesis chapter are supported by, and representative of the underlying chapters?

The synthesis chapter supports and represents most of the underlying chapter themes and conclusions and usefully introduces concepts that are implicit in the chapters. However, the synthesis chapter should be strengthened in some areas.

Themes that are very well supported include the need for monitoring, the need and problematic aspects of establishing baselines, the issue of uncertainty and handling the potential for multiple outcomes (scenarios), and implications of uncertainty and barriers/opportunities for meeting goals. (On page 9-12, the references to scenarios would be enriched by CCSP SAP 2.1B on scenarios and their use in climate change science.) The section on adaptive management (9.3.4) reflects what is in the chapters, both the concept and the fuzziness surrounding the concept. In particular, the adhesion to management goals is at odds with the flexibility implied in adaptive management, where presumably both approaches and goals are candidates for revision. (This is echoed in a statement in section 9.4, “Adaptation responses to climate change are meant to reduce the risk of failing to achieve management goals” [page 9-20, lines 40-41], a very narrow view of what adaptation activities can be and do.)

The first part of the synthesis chapter usefully makes explicit the mental models and underlying assumptions of the chapters with regard to adaptation and the guiding framework for impact assessments. One might well argue that the linear framework for impact assessments is ill suited to a dynamically changing and complex system, but both the management system chapters and the synthesis chapter use such a framework. Some of the tools reviewed in the synthesis chapter—notably, climate models and, to a large extent, impact models—are not discussed in the management system chapters, and here the synthesis chapter makes a contribution that benefits all of them.

The emphasis on building resilience as an adaptation strategy is stronger in this chapter than in the underlying chapters. Indeed, the statement is made that “the goal of adaptation strategies is to reduce the risk of adverse environmental outcomes through activities that *increase the resilience* of ecological systems to climate change” (page 9-12, emphasis in the original). In the synthesis chapter this emphasis becomes an almost-pure “holding the

line” strategy, without much of the flexibility to respond to changing ecosystems that Chapters 3-8 have. Even the chapter strategies of representation, replication, and supporting refugia for some species have a resilience emphasis here, although in the chapters these strategies may also be part of migrating species to other locations as climate changes rather than as building resilience. At the end of the very long section on resilience, the synthesis text seems to grudgingly acknowledge that climate change may overcome even the most resilient ecosystems and that wholesale change may be needed, but there is not much in between holding the line and giving up. In the middle of a paragraph in section 9.3.3 (“Confidence”) the statement is made, “It is important to note at this point that promoting resilience may be a management strategy that is useful only on shorter time scales (i.e., 10-30 years) because as climate change continues, various thresholds of resilience will eventually be exceeded” (page 9-18, lines 4-5). This statement should come much earlier, prior to or early in the resilience section.

The synthesis chapter fails to adequately support and represent the other chapter themes of the social roles of stakeholders (both resource managers and others), partnerships, and agency managers in accomplishing management goals. The closest the synthesis chapter comes to these important themes is in discussing barriers and opportunities related to legislation and regulation, management policies and procedures, and human and financial capital (sections 9.4.1, 9.4.2, and 9.4.3). Perhaps because these sections do not have the concrete detail that the other chapters have, they seem more theoretical than useful. Statements such as, “Managers often lack sufficient support and decision-making tools to help guide them in selecting appropriate management approaches that address climate change” (page 9-26, lines 38-39), are not helpful for the intended audience but merely provide a catalogue of the usual laments. Moreover, it is difficult to reconcile this particular statement with the discussion of existing tools earlier in the chapter.

The synthesis chapter should be strengthened with regard to representing the need for partnerships with people and organizations outside federal and other resource managers. Some of the chapters have very detailed sections on existing partnerships and the goals of such partnering, with clear statements that this is a critically important dimension of addressing multiple stresses, including climate change. These chapters also have more of a sense of how difficult it is to form/maintain such partnerships and have them yield good results. The synthesis chapter calls, for example, for integrated federal action, without consideration of the institutional implications (starting with feasibility). Only on page 9-34 (the second-to-last page of text) are important external issues, such as coastal development and private property issues, mentioned.

An issue implicit in the chapters but not brought out—indeed, deemphasized—is the stress that human visitors and external human actors (e.g., industrial polluters, farmers who irrigate) place on federally managed lands. The latter stresses are referred to in the chapters as external factors that come from nowhere: pollution rather than polluters, water withdrawals rather than water managers and farmers, invasive species rather than the bringers of those species. Unless readers and managers know who the stressors are, how can they hope to know about pathways to address the stresses? The stresses from human visitors are to a degree unavoidable and indeed are usually part of mandates in re

managing federal lands. However, these stresses may be ameliorated to at least some degree. Some national parks restrict visitors to a few roads (e.g., Denali), and all that I have visited use signs, literature, and rangers to teach visitors how to avoid damaging the natural resources. Management changes to avoid damage by visitors could be used as examples. Chapter 8 repeatedly refers to “no take” zones as a way to protect fish stocks, although they could equally be termed ways to prevent human damage.

6. Does the Committee agree that EPA effectively followed the CCSP Guidance on characterizing confidence levels for the proposed adaptation approaches presented in the Executive Summary and Synthesis?

The only assignment of confidence values to the statements made in the synthesis chapter comes in two paragraphs on pages 9-17 and 9-18 and Table 9.4. I agree that expert opinion is the valid way to determine these confidence values, but without some comparative rationale it is difficult to interpret the levels assigned. Why, for instance is there only one “very high” ranking for “reducing anthropogenic stresses”?

7. Does the Committee agree with the decision to use information from a series of stakeholder workshops in addition to the published literature to identify and assess adaptation options and implementation issues for climate-sensitive ecosystems?

The chapters demonstrate the usefulness of information gleaned from the stakeholder workshops. However, the synthesis chapter often states that the material in a particular section comes from the authors; are these “stakeholders” as well, or are they only the people who attended the workshops? Another use of the term “stakeholders” can be found on page 9-27, lines 4-10, where the stakeholders seem to be non-resource-managers and non-scientists who are ignorant blockers of adaptation. This use seems borderline pernicious, as stakeholder-users, for instance, have valuable input to give and can often be strong supporters of good management. Moreover, as the whole report states repeatedly, resource managers and scientists cannot claim to have “full information, sufficient expertise, or a long-term perspective” (page 9-27, lines 5-6); how, then, can they complain about stakeholders who are similarly lacking?

APPENDIX F

Responses to ACSERAC Charge Questions for CCSP SAP 4.4, *Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources*

from Dr. Reed F. Noss, University of Central Florida

Responses to ACSERAC Charge Questions

Reed F. Noss

1. Does the Committee agree with the focus on six management systems from across federally owned and managed lands and waters as an effective way to review adaptation options for climate-sensitive ecosystems and resources?

No. A focus on the six management systems provides helpful examples of how changes in the management of lands and waters, and changes in management and monitoring philosophy, can facilitate adaptation to climate change. Nevertheless, I worry that a restricted focus on six management systems will give the impression that effective adaptation to climate change can be accomplished through management initiatives on these lands and waters alone. This would be a highly fallacious assumption, especially because of (1) the fragmented nature of these management units; and (2) their incomplete representation of ecosystem types and species.

Given potentially dramatic range shifts of native species, invasions of non-native species, and other regional to continental-scale phenomena, a broader consideration of landscapes and seascapes is necessary. Looking only at terrestrial ecosystems, adding BLM and DoD lands to the six management systems would provide rather good representation of ecosystems and regional-scale connectivity in the far western U.S. (i.e., from the Rocky Mountains westward). In the remainder of the country, however, the full suite of federal lands still represents a fraction of ecosystem diversity and is highly fragmented. Here, the addition of state, county, and private lands is more critical.

I concur with Eric Gilman that the report might be better organized by ecosystem type. However, from that initial organization, it would still be useful to discuss what every federal land-managing agency could do within its particular structure and mandate to address the key issues. The discussion could then move to consideration of adaptation options on state, county, tribal, and private lands, with appropriate examples.

2. Does the Committee agree that the report provides useful information for managers on the state of knowledge regarding ecosystem management decisions sensitive to climate change, the types of adaptation options available, and approaches for implementing adaptation options? If the usefulness of the report could be improved, what specific improvements does the Committee recommend?

I was impressed with the quality of writing and, for the most part, the scientific content of the report. Although there was some unevenness among chapters in this respect, I found the chapter on estuaries, for example, very compelling – this could be published as a review paper on the topic. So, in general I agree that the report adequately summarizes the state of knowledge regarding ecosystem management decisions.

Regarding adaptation options available to managers, the report could be improved by providing more specific and concrete suggestions on what to do differently. There are some such suggestions, but in part because the report is of outrageous length, these

suggestions tend to be buried in a mass of verbiage. The most specific suggestions can be found in the boxes on “adaptation options” for each management system. These are useful, but are still arguably not specific and direct enough to tell a manager precisely what to do. I acknowledge that detailed directions will be largely case-specific, but perhaps the case studies could have provided this level of detail.

3. Does the Committee agree that the case studies are effective at demonstrating adaptation approaches and specific issues related to implementation? If the case studies could be improved to better demonstrate adaptation approaches, what specific improvements does the Committee recommend?

Case studies are often of value to put abstract concepts “on the ground,” and the case studies in the report are generally useful for this purpose. However, the quality of case studies here is uneven, and some are of questionable value. The Tahoe National Forest case study (3.4), for example, is pretty much standard national forest management rhetoric. I was dismayed to see here the description of “Salvage and Planting Post-Fire” as among the “best-forest-management practices...consistent with adaptive conditioning for climate contexts...” (p. 3-53), ignoring abundant documentation in the recent peer-reviewed literature of the overwhelmingly negative ecological impacts of these practices. As pointed out later, in the Synthesis chapter of the report, today’s “best practices” may be tomorrow’s “bad practices.” In contrast, the following case study on the Olympic NF is more ecologically literate. The relevance of the Great Barrier Reef case study (8-42...) to adaptation options in the U.S. is questionable.

4. Does the Committee agree that the major conclusions and synthetic themes of the Synthesis chapter are supported by, and representative of the underlying chapters?

Yes, this is a good chapter.

5. Does the Committee agree that the key findings and recommendations presented in the Executive Summary are the most important and appropriate to bring forward to executive level managers and Congress?

Generally yes, but as noted above, the limitations of focusing on only 6 federal management systems should be clearly acknowledged, unless the report is radically rewritten to include a much broader spectrum of lands and waters. I also agree strongly with Gilman’s suggestions for highlighting several basic concepts.

6. Does the Committee agree that EPA effectively followed the CCSP Guidance on characterizing confidence levels for the proposed adaptation approaches presented in the Executive Summary and Synthesis?

Yes

7. *Does the Committee agree with the decision to use information from a series of stakeholder workshops in addition to the published literature to identify and assess adaptation options and implementation issues for climate-sensitive ecosystems?*

Yes

Other Comments:

1. The report is much too long. Ideally, it should be reorganized around major ecosystem types, as suggested above, which will eliminate much redundancy. Case studies could also be pared down to the highest quality one per chapter without any substantial loss of information.
2. On p. 1-4 of the Executive Summary, it is stated that “wildfires, nuisance species, extreme events, and air pollution are the most critical stressors within national forest (NF) boundaries, and climate change will amplify them further.” This ignores other major stressors in national forests, in particular: fire exclusion and suppression, logging (especially old-growth logging and salvage logging), and road-building.
3. On p. 2-3 of the Introduction, resilience is discussed. But is resilience, as defined here, a reasonable goal in the face of massive climate change? The discussion later in the report (Synthesis chapter) correctly notes that this is largely a short-term strategy. Inevitably, critical thresholds will be crossed, regime shifts will occur, and managing for Holling-style resilience will be no longer possible.
4. On p. 3-29 (National Forests) it is stated that “...even under many of the somewhat wetter future scenarios, the Southeast is at risk of converting from a closed-forest region to a savanna, woodland, or grassland under temperature-induced drought stress and a significant increase in fire disturbance.” This statement is highly misleading and ecologically ignorant. The Southeast, especially outside of the Appalachians, is mostly not a “closed-forest region.” It is now well established that most of the Southeast (e.g., >60% of the misnamed “Southern Mixed Hardwood Forest” region) was actually longleaf pine savanna prior to European settlement (Ware et al. 1993 and many other sources). An increase in fire and a shift to more savanna and grassland vegetation would, in fact, move the region to a condition closer to presettlement vegetation and away from the closed-forest condition that, on many sites, is an artifact of fire exclusion and suppression. Nevertheless, substantial artificial firebreaks (e.g., roads, urban areas) and loss of native pyrogenic ground cover will make this ecological transition unlikely over much of the region.
5. P. 36 (National Forests): Although it is not a bad suggestion that “large-scale thinnings might be implemented to reduce stand densities in order to minimize drought effects, avoid large wildfire events, and insect and disease outbreaks under a changing climate,” some caution is needed here. Construction of roads and use of heavy equipment to accomplish these thinnings will likely make stands more susceptible to invasion by non-native species and to soil erosion, among other problems.

6. P. 4-10 (National Parks): On lines 12-13, the concept of “desired future conditions” is mentioned with implied approval. This concept is very problematic in the face of climate change and high levels of uncertainty. I suggest it be replaced with a concept of “desired future trajectory” or something similar, although even here goals will be difficult to accomplish.
7. P. 5-11, lines 7-14: It is an important point here that the NWRS policy on biological integrity, diversity, and environmental health should “not insist on a return to conditions no longer climatically appropriate,” but instead should view historic conditions as a “frame of reference” for understanding the impacts of climate change.
8. P. 9-3: The introduction to the Synthesis makes a straw man of the concepts of reference conditions and historic range of variability, essentially discounting them. I believe the tone here is inappropriately negative. As pointed out at other places in the document (e.g., p. 5-11, as noted above), historic conditions provide a frame of reference or point of departure to consider the effects of climate change. Moreover, it is noted appropriately throughout the report that intact ecosystems (which, by definition, are closer to historic conditions or the historic range of variability) will almost certainly be more resilient to climate change than ecosystems highly fragmented and degraded by human activity.
9. P. 9-5: It is premature and self-serving to call The Nature Conservancy’s monitoring framework “an extremely successful framework for managers” (line 5). In fact, this system, depending on how it is implemented, might still qualify as “surveillance monitoring,” of questionable utility to adaptive management, as opposed to monitoring designed to test alternative a priori hypotheses relevant to management (see Nichols and Williams 2006; *Trends in Ecology and Evolution* 21:668-673). Indeed, a few pages later (p. 9-9), the discussion centers on “monitoring to inform management decisions” and correctly states that “the majority of monitoring that is needed is hypothesis-based and specifically targeted to either determine vulnerabilities or to assess the effects of management as part of an adaptive management strategy.” This statement is entirely consistent with the message of Nichols and Williams (2006), which should be cited.
10. P. 14, lines 19-21: It is not true that “national parks, national wildlife refuges, and marine protected areas all manage for maintaining as many native species as possible...” In fact, many national parks are managed more to provide recreational opportunities for tourists, and many national wildlife refuges are oriented toward single-species management, especially for game species. For example, Finley NWR, in the Willamette Valley of Oregon, could focus on restoring native grassland, the most endangered natural community in that region. Instead, much of the NWR is managed intensively to grow crops of agricultural grains for the benefit of Canada Geese!
11. P. 9-19, 2nd paragraph: Yes, “most resource agencies already have monitoring programs and sets of indicators...” The more important question is whether these programs are adequate. In fact, many have been found to do little besides test a simplistic null hypothesis of “no trend” for various species and resources, and lack the statistical power to do even that. As noted by Nichols and Williams

- (2006), these programs are surveillance monitoring, of little use for adaptive management, as opposed to hypothesis-driven monitoring.
12. Finally, a compliment: A wonderful thing about this report is its honest recognition of problems with current management and the barriers to change that exist within government agencies. Hopefully, the report will contribute to overcoming these barriers.

APPENDIX G

Responses to ACSERAC Charge Questions for CCSP SAP 4.4, *Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources*

from Dr. David R. Patton, Northern Arizona University

TO: Susan Julius, U.S. Environmental Protection Agency
FROM: David R. Patton, Northern Arizona University
DATE: October 15, 2007

SUBJECT: Preliminary Response to EPA questions

I am responding to the Charge Questions for ACSERAC and in particular questions 1, 2, 3, 6 and 7 for the National Forests and National Wildlife Refuges. For this preliminary report I will respond with my concerns and not with a “yes or no” to questions until the committee has discussed the issues.

Question 1. Does the Committee agree with the focus on six management systems from across federally owned and managed lands and waters as an effective way to review adaptation options for climate-sensitive ecosystems and resources?

One stated goal is to provide useful information on potential adaptation options for Key representative ecosystems. However the six ecosystems are administrative units that do not include the Bureau of Land Management (BLM) and Indian Reservations (IRs). BLM and IRs are important in the western U.S. because they border other federal lands. Decisions made by BLM and IRs particularly affect National Forest lands. In addition BLM administers 258 million acres in 11 western states compared to 193 million acres in National Forests and 275 Indian Reservations across the U.S. have 56 million acres.

BLM will make the case that the agency contributes as much or more biodiversity than the Forest Service. The current six choices for climate-sensitive ecosystems represent a broad spectrum of administration and management situations but the addition of BLM and IRs will strengthen the knowledge of stressors and adaptive opportunities.

In the introduction to the National Forest chapter a point was made that the Forest Service has 27 major forest types in the continental U.S., Hawaii and Puerto Rico. These types are the official forest cover types for the U.S. included in the National Atlas (USGS 2000). Ecosystems (ecological systems) are generally identified by a vegetation formation (wetland, forestland, shrubland, etc.), cover or vegetation type (forest cover types or potential natural vegetation), and ecoregions (Bailey’s Forest Service system or Omerick’s EPA system) and not by administrative boundaries. NWRS used the EPA ecoregions to group refuges into a Level I classification. The ecosystem and not the administrative approach would add a measure of scientific creditability to the review process of options for climate-sensitive ecosystems. While it may be too late to organize the current draft along some ecological designation this approach should be stressed where possible.

Question 2. Does the Committee agree that the report provides useful information for managers on the state of knowledge regarding ecosystem management decisions sensitive to climate change, the types of adaptation options available, and approaches for

implementing adaptation options? If the usefulness of the report could be improved, what specific improvements does the Committee recommend?

There is considerable documentation of information presented in the draft report and this is to the credit of the authors of the chapters. However the level of use will probably be most beneficial to planners at the regional or national level and not on National Forest Districts or Wildlife Refuges. Most but not all of the information is a statement of need or what could be done without providing detail on the “how to do”. However, information at the management or specific ecosystem level may not be available in the literature. Cumulatively, the literature could be a state-of-knowledge publication on climate-sensitive ecosystems.

Climate change has no political or geographical boundary and throughout the draft there is information on stressors that could be the core topic of publication chapters within defined ecosystems. The information is scattered throughout the report but should be consolidated and made available to managers for decision-making, no matter what federal agency is involved. For National Forest and National Wildlife Refuge Systems the tables on Adaptation Options for Resource Managers comes the closest to providing direction and management guidelines. At this early stage in addressing climate change effects on sensitive ecosystems and resources these guidelines may be all that are needed until more research is completed or adaptive change has provided useful examples.

One of the tools for the toolbox could be a database with an annotation of all the literature cited and included as a CD in the final report.

Question 3. Does the Committee agree that the case studies are effective at demonstrating adaptation approaches and specific issues related to implementation? If the case studies could be improved to better demonstrate adaptation approaches, what specific improvements does the Committee recommend?

Case Studies (CS) are an effective way to identify problems and solutions at a local, regional and national level. The degree of resolution of the problems and solutions decreases from the local to national level. At the local level, such as on the Tahoe National Forest, more detail is required for decision-making than at the national level. The Handbook System is a source where information can be documented and made available for field use. The barriers and opportunities are well defined but an action plan relating to the barriers and opportunities is lacking. Action plans require that national policy be transmitted to lower levels of administration on the 600 National Forest Districts and this will be a major challenge for the National Forest System. Case Studies usually have a resolution to a problem to demonstrate how a problem or issue was resolved. None of the CSs have a resolution to a specific problem.

A big gap is present in the representation of barriers and opportunities. National Forests CSs are missing for the Rocky Mountain Region from the Canadian border to Mexico. Two CSs on the West Coast and one in the Southeast leaves out a part of the U.S. where there could be barriers, such as livestock grazing (18,000 permits on BLM land for 2007).

There should be a least one CS from each Region to have a good representation of the current Forest Service situation.

There is only one CS for National Wildlife Refuge System (NWRS). While the CS does cover the Central Flyway Corridor from Alaska to Mexico and will be useful, it is certainly not all inclusive. The NWRS administrative structure is complex because of the distribution, size, ecological setting, and use designation of individual refuges. The NWRS includes 584 refuges, and over 30,000 production areas categorized into 37 wetland management districts. Many of these areas cannot be managed at an ecosystem or landscape level depending on the size and landform composition (agricultural land, etc.).

Question 6. Does the Committee agree that EPA effectively followed the CCSP Guidance on characterizing confidence levels for the proposed adaptation approaches presented in the Executive Summary and Synthesis?

Many reviewers will ask the question: Is there sufficient evidence presented in the report to arrive at the confidence levels assigned to each management system? If the confidence levels are based on Bayesian probabilities there has to be a prior probability assigned and this is usually a best guess. The authors and contributing authors were selected because of their knowledge and experience about the subjects and their best guesses are probably very close to reality. However, it would be helpful to discuss the technique and documentation of how the confidence levels were determined.

Question 7. Does the Committee agree with the decision to use information from a series of stakeholder workshops in addition to the published literature to identify and assess adaptation options and implementation issues for climate-sensitive ecosystems?

Workshops for stakeholders are an effective way to communicate from the general public to administrators and managers of federal lands. The main problem is getting local people who are not employees of the managing agencies to participate. To encourage detailed discussions another option is to have a working Focus Group that will address just a few problems at a time. Published literature forms the scientific base for all resource management and literature and must be a major part of the review and documentation process. Public input for managing federal lands is a process that will generate concerns and new ideas on managing natural resources and a continuing effort helps to reduce tension in decision-making at the local level.

Additional Comments and questions.

There is a strong indication that the authors believe it will be necessary to have representatives from agencies bordering the six ecosystems involved in the process of responding to climate change.

There is considerable uncertainty expressed by the authors on the effects of climate change and natural resources. This is evidenced by use of the words: “may”, “could”,

“likely”, “most likely”, “might” etc. In spite of this uncertainty the authors identified barriers and issues and turned some uncertainty into opportunities.

Because of a continuing lack of federal agency funds and personnel there is a current and probably future need for a system to set priorities across the U.S at the landscape level, and in some cases to site-specific locations (small wildlife refuges).

The use of Level I Ecoregions by NWRS provides a way to organize ecological information into useful categories by regions with some commonalities of landscape features and biotic components. By continuing the process to Level III, NWRS might provide an example of an alternative to the use of administrative ecosystems to assess and evaluate climate change.

Will there be any cooperation to formalize issues and concerns with our neighboring countries of Canada and Mexico?

What efforts, if any, are being pursued by federal agencies to link the report to other climate change activities at the global level?

The report does not specifically address research needs although the opportunities are presented throughout the chapters. Will there be a specific research proposal attached when the current document is presented to Congress?

APPENDIX H

Responses to ACSERAC Charge Questions for CCSP SAP 4.4, *Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources*

from Dr. Paul G. Risser, University of Oklahoma Research Cabinet

Responses to ACSERAC Charge Questions
Paul G. Risser
October 15, 2007

1. Does the Committee agree with the focus on six management systems from across federally owned and managed lands and waters as an effective way to review adaptation options for climate-sensitive ecosystems and resources?

The report is organized around six federally-managed systems: national forests, national parks, national wildlife refuges wild and scenic rivers, national estuaries and marine protected areas. The general approach is to address three topics in each system: effects of climate and other stressors, existing and possible management options mostly based on case studies, and obstacles to implementing management options.

Focusing on the six management systems is certainly convenient from an administrative point of view. However, there are two deficiencies with this approach. First, despite the common general framework, the treatment of each section is different, some focusing the need to insist on changes in philosophy (e.g. parks) and others with a focus on planning. As a result, the report never really synthesizes the different emphases and lacks the potential power and richness of laying out and analyzing the different conceptual approaches.

Second, obviously many, even most, ecosystem types occur in more than one management system. Under the current focus on six management systems, the user has no easy way of synthesizing information and management techniques by ecosystem type. There is a summary (Box 1.11 in the Executive Summary) of the kinds of adaptation approaches, but these are only helpful at the most general level. A manager trying to meet management goals, for example, for riparian forest would like to benefit from the case studies for riparian forests from multiple management systems.

This horizontal deficiency in the report could be solved to some degree by a synthesis across major ecosystem types. Although it would add to an already too long report, the synthesis could refer to specific entries in the existing chapters.

Finally, one must ask whether the report would be far more useful if it were entirely electronic with a portal front-end that simply allowed users to link information from various sections based on the users specific interests and needs.

2. Does the Committee agree that the report provides useful information for managers on the state of knowledge regarding ecosystem management decisions sensitive to climate change, the types of adaptation options available, and approaches for implementing adaptation options? If the usefulness of the report could be improved, what specific improvements does the Committee recommend?

The volume provides a great deal of information and a wealth of literature review throughout the report as a whole and in each section. This relatively complete background is of course helpful as some level, at least to give the manager confidence that information is anchored in the literature. So, the authors are to be commended for their thoroughness.

In many cases the information summaries are unnecessarily verbose and repetitive—it is almost as if the authors were afraid of omitting any previous literature citation. In addition, many of the recommendations are so general as to be of limited use, e.g., *avoid sources of pollution*.

I wonder, however, if the chapters are not backward. That is, the first attention should be paid to what is known about each stressor and response. Each chapter might better start with one or several conceptual models detailing the primary stressor/response. Then the subsequent analyses can be directed management strategies that are associated with each stressor/response. The extensive “context” material can be referenced in the models and be included later in the chapters.

3. Does the Committee agree that the case studies are effective at demonstrating adaptation approaches and specific issues related to implementation? If the case studies could be improved to better demonstrate adaptation approaches, what specific improvements does the Committee recommend?

The extensive treatment of background information in the case studies is of questionable value. These cases are mostly from specific examples of well-known pieces of federal property. There are two points here. First, the value case studies would be a tight analysis of climate change (or other) stressors and the existing or proposed adaptive management strategies. This would give the user a clear example of the known or expected ecosystem response to climate change and the range of management strategies. These strategies could be ranked according to contingencies and confidence.

Second, all of these federal properties are influenced by external conditions and adjacent systems. So, the case studies could serve as examples about how adaptive management strategies on the federal lands account or could account for the external conditions.

4. Does the Committee agree that the major conclusions and synthetic themes of the Synthesis chapter are supported by, and representative of the underlying chapters?

The synthesis chapter is supported by the underlying chapters and does summarize the primary issues. However, as noted above, I still wonder if we should begin with the ‘synthesis’ chapter should be the first chapter, setting an analytical framework for the subsequent six system chapters. For the purpose, the synthesis chapter would need to be streamlined and organized more as a *guide* as opposed to a *summary*.

5. *Does the Committee agree that the key findings and recommendations presented in the Executive Summary are the most important and appropriate to bring forward to executive level managers and Congress?*

The Executive Summary does include the key findings and recommendations for each of the six federal systems. However, this chapter brings into focus the concern with the current organization of the report. The text says managers may attempt to meet their management goals by *examining the existing literature and comparing likely climate change impacts with key ecological properties...* It seems to me that in fact this report should make process far easier for the manager by clearly identifying the key issues by both federal system type and by ecosystem type. If the report is just a literature review and case studies, then we have not advanced very far. If the by reading the Executive Summary, the user knows the likely impacts of climate (or other changes) on various systems and knows the range of potential management options, then we have made progress.

6. *Does the Committee agree that EPA effectively followed the CCSP Guidance on characterizing confidence levels for the proposed adaptation approaches presented in the Executive Summary and Synthesis?*

The report appears to have done so, but I confess to not having dug through the guidelines in great detail.

7. *Does the Committee agree with the decision to use information from a series of stakeholder workshops in addition to the published literature to identify and assess adaptation options and implementation issues for climate-sensitive ecosystems?*

Yes, this is a very important part of the process. We will need to ensure that we respond appropriately.

APPENDIX I

Responses to ACSERAC Charge Questions for CCSP SAP 4.4, *Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources*

from Dr. Dan Tufford, University of South Carolina

Dan Tufford, University of South Carolina, tufford@sc.edu
Synthesis and Assessment Product (SAP) 4.4: Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources. EPA respectfully submits the following general charge questions:

1. Does the Committee agree with the focus on six management systems from across federally owned and managed lands and waters as an effective way to review adaptation options for climate-sensitive ecosystems and resources?

This focus makes sense as an organizing approach given the substantially different origins and missions of each of the management systems. It is particularly useful because in the absence of a significant change in mission each will be required to use adaptation approaches that may be very different. This comes through very clearly in the various sections. This same aspect makes it difficult to understand whether the combined and integrated set of approaches will result in an effective national response to climate change for natural resource management.

I also think the issue of interaction among management systems and other environmental laws may not have gotten effective treatment. For example, if ensuring habitat for an endangered species would force an action that is strongly suspect of being ecologically unsound in the context of climate change, would the requirements of the ESA or sound ecosystem management prevail? This type of question is alluded to several times but not clearly answered. So I am sure the issue was thought about a great deal by the teams and may be addressed to the best extent possible, but it still stood out for me.

2. Does the Committee agree that the report provides useful information for managers on the state of knowledge regarding ecosystem management decisions sensitive to climate change, the types of adaptation options available, and approaches for implementing adaptation options? If the usefulness of the report could be improved, what specific improvements does the Committee recommend?

Overall I think it does a pretty good job of this. I have a concern with the emphasis on resilience, in particular the frequent references to increasing or enhancing resilience. As an emergent property, resilience may not be responsive to tinkering by humans. At the very least it will be difficult or impossible to know if our actions actually did increase resilience. In most situations we have no quantitative understanding of resilience so talk of increasing it may be misleading in that sense. What we do know is that human activity is a cause of stress on ecosystems so it makes sense to plan to reduce anthropogenic stress so that natural resilience can operate as it evolved to do. Section 9.3.1 in the Synthesis is a very good discussion that includes these points and more.

These points are acknowledged at several places in the report and the Synthesis is quite clear that dependence on resilience may have a low utility value for adaptation over the long term. I will have more to say about this in a later section.

There were high points. I especially liked the development of the ecosystem management topic in the chapter on National Wildlife Refuges. My only question on that as I was reading it was whether operational staff at refuges participated in the development. From the credits it seems clear that quite a number of USFWS staff participated but I do not have a sense of their level of understanding of the problems and issues the on-the-ground managers have to deal with.

The National Park Service has a particularly difficult task in the context of climate change. Their mandate can be interpreted to mean they must preserve existing ecosystems and species; a very problematic task over the long term as climate and other abiotic drivers change. The chapter works its way through the various issues about why this needs to change from both policy and management perspectives and provides recommendations for how to approach the change. My main concern about this chapter is the potential it is providing a mixed message. In a few places it seems like the authors accept the thesis that preservation of the status quo is sound policy. At the same time one of the best sentences in the entire report is on p.4-21: "...even if maintenance of representative current biotic communities is possible as climate changes, such maintenance may not be desirable." Again, I appreciate the difficulties faced by the NPS and the authors of this chapter.

3. Does the Committee agree that the case studies are effective at demonstrating adaptation approaches and specific issues related to implementation? If the case studies could be improved to better demonstrate adaptation approaches, what specific improvements does the Committee recommend?

I think the case studies are among the real gems of the report. I have a concern with their limited coverage at ecoregion and biome scales. I am fully aware that it is prohibitive to cover every significant scale for each management system. For some systems that would mean a case study of nearly all managed units. Even when there is scale redundancy within a management system at some point the marginal value in terms of new lessons learned would make another case study a questionable use of human resources. In a similar vein I also recognize that some of the lessons of the case studies transcend the specific location. I still am left, however, with uneasiness that the limited coverage may have left important insights unrecognized.

On one end of the coverage spectrum is the National Parks chapter. I have a fairly good understanding of several resource management issues facing Congaree National Park, for example, and I am somewhat skeptical that the discussion of Rocky Mountain National Park really covered them all. I have a similar concern with the coverage of National Wildlife Refuges. At the other end of the coverage spectrum is the Wild and Scenic Rivers chapter, which I think provides a more complete assessment.

My stated issue here is fairly obvious to anyone and the authors acknowledge it as well. What bothers me is the level of assurance the report projects that, in total, the case studies cover the important spatial and biophysical issues involved. That may well be correct but the assertion is made with no supporting discussion. Given the substantial differences in

how the management systems function and the known geographic variability in ecosystem function I think there should be a little more transparency that something important may have been overlooked with this approach. As I stated earlier I understand there is a human resource cost to doing the case studies and I am not necessarily advocating for more of them.

4. Does the Committee agree that the major conclusions and synthetic themes of the Synthesis chapter are supported by, and representative of the underlying chapters?

The Synthesis is well done, although I did not study it at the same level of detail as some other chapters. Early in the chapter it discusses assessing impacts including tools, baseline information, and uncertainty so these get the emphasis they need. The chapter also brings to the surface what seems to me a problematic weakness in the report. As stated in the first paragraph of section 9.3 on p.9-12 the adaptation approaches are to support the ability of ecosystems to persist. Yet at several places in the report, including later in the Synthesis, persistence of existing ecosystem state over the long-term is recognized as doubtful or at least unknown. So the options for adaptation are all relegated to being short- to medium-term responses (maybe just short-term). The opening paragraphs of chapter 2 do not lead the reader to expect this temporal horizon. Section 9.5.3 provides the answer to the “what then” question but it is a very small part of the overall report. I fully understand that it is simply not possible to predict with much certainty long-term climate change or its impacts. All I am saying is there seems to be a disconnect between what the report intends to do (opening paragraphs of chapter 2) versus what it actually does (as stated in section 9.3).

5. Does the Committee agree that the key findings and recommendations presented in the Executive Summary are the most important and appropriate to bring forward to executive level managers and Congress?

Overall it seems to, although this was not one of my chapters to review.

6. Does the Committee agree that EPA effectively followed the CCSP Guidance on characterizing confidence levels for the proposed adaptation approaches presented in the Executive Summary and Synthesis?

Yes, for Table 1.12 and 9.4. It is inconsistent elsewhere.

7. Does the Committee agree with the decision to use information from a series of stakeholder workshops in addition to the published literature to identify and assess adaptation options and implementation issues for climate-sensitive ecosystems?

In general I like workshops as a good way to generate ideas and information via the interactions among people with different perspectives. Care is necessary when using them for recommendations, however, because almost invariably some of the ideas, while quite good and scientifically accurate, are wildly unrealistic and thus can lead people away from more productive efforts. This is particularly likely when the participants are

weighted with people with no actual experience with the systems being discussed. I made this point earlier as well.

APPENDIX J

Responses to ACSERAC Charge Questions for CCSP SAP 4.4, *Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources*

from Dr. Robert van Woesik, Florida Institute of Technology

Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources. Synthesis and Assessment Product 4.4, U.S. Climate Change Science Program. Specific comments on Chapter 8 (Marine Protected Areas).

R. van Woesik; 15 October 2007

Comments on Chapter 8: MARINE PROTECTED AREAS

Chapter 8.1 While the background, history and identification of the FKNMS Act, 1990, is fundamental to point out relevant management legislation, Chapter 8.1 does little to highlight adaptation options to protect and preserve the marine environment in general and the Florida Keys in particular. The authors should point out that the management plan for the Florida Keys was established to counteract local stressors and will not be effective at ameliorating or protecting local fauna and flora from climate change. The authors state that the science clearly suggests highly connected networks are the only option for climate change adaptive management. Yet, the authors never explicitly make a recommendation that a network of no-take areas is needed in the Florida Keys, specifically designed around hydrodynamic connectivity models. Instead the text is loaded with prose that state the obvious, for example simply stating that National Marine Sanctuary sites are “the ones in need of management in response to climate change” (page 8-11) tells us little about options. Furthermore, we learn little from the following (8.2.1.2 Key species) “Under various climate change scenarios, management strategies employed to protect key species may differ”, and “In all sanctuaries protected for biological reasons, biodiversity may be affected by climate change and must be managed to meet sanctuary goals.”

Chapter 8.2 Current status of management system is really a brief review of some of the science issues rather than the status of the management and does little to blend the science with the management. In fact these issues are glaringly disparate. There is considerable emphasis on understanding the connectivity among ecosystems, which logically leads into arguments of MPA networks to facilitate larval exchange and inter-connection of meta-populations, which in turn may buffer these populations from climate-driven changes. Yet there is a disparity between the process in which the sanctuaries and MPAs were established and now maintained and the message coming from the sciences indicating that networks should be established. Clearly a network of no-take zones is essential. The rhetoric is repeated throughout Chapter 8. Yet there are no networks (but a note that the National Marine Sanctuary Program Goal is to expand the nationwide system of MPAs). Therefore, the management options are 1) to protect intact systems (Papahānaumouākea, Hawaii) and prevent further degradation (Florida Keys) by reducing anthropogenic stressors inside (fishing) and outside (pollution) the protected areas, while there is no law that facilitates the latter. Several blanket statements through Chapter 8.2 tell us little about a reasonable strategy to approach obvious problems. For Example, (page 8-15) “The addition of climate change may exacerbate effects of existing stressors and require new or modified management approaches”.

8.2.2.1. Ocean warming. “Temperature changes may result in new species assemblages and biological interactions that affect ecological processes such as productivity, nutrient fluxes, energy flow, and trophic webs”. While a loaded statement, it is first questionable that these four terms are really the most fundamental ecological processes of interest, and second, further expansion is necessary to explain how warming will affect the processes. In fact, this is not a semantic issue, but rather it is at the heart of the problem because if fundamental processes are understood, then ‘state variables’, such as macroalgae or coral cover could easily be predicted.

The response of climate-sensitive corals reefs and bleaching is rightly discussed at length in the report. However the authors suggested that thermal stress is the only facet that influences coral response. Yet, the literature stresses that both water temperature and irradiance interact to produce the bleaching effect (Iglesias-Prieto et al 1992). This is important when discussions are held over adaptive management and refuges, later in the report. Indeed, there is a clear reciprocity between water temperature and irradiance, because corals perceive heat stress and intense irradiance, both, as photoinhibition (or as a further increase in excitation pressure over PS II) (Iglesias-Prieto et al 2004). Therefore, low or reduced irradiance during times of temperature stress reduces photoinhibition, coral bleaching and coral mortality, as does the reciprocal involving moderate water temperature at high irradiance. The factors associated with a bleaching event therefore involves not only temperature but also irradiance and by association the particulate constituents in the water column that may reduce irradiance. Therefore, when examining the cause and effect of coral bleaching, temperature and irradiance should not be considered separately. This is particularly relevant to management strategy options most suitable under global warming (on page 8-27). The authors suggest two types of coral reefs should be identified and given high priority protection status: 1) reefs that survived bleaching (one assumes that the reef corals bleached but recovered, although this is not explicitly stated), and 2) reefs that were not exposed to elevated water temperatures in most recent coral bleaching episodes. Again, many localities that did not bleach, for example in 2005, experienced low irradiance, because coral bleaching is a function of a) water temperature, b) irradiance and c) the historical nature of both temperature and irradiance. In other words, some locations may have experienced low irradiance while water temperatures were high, and therefore did not bleach, or other localities may constantly be subjected to high temperature fluctuations, therefore, a regional temperature anomaly would not stress local reefs that are constantly exposed to such variation. Clarifying issues involving temperature, irradiance and their histories is critical for any adaptive management in the face of climate change. Section 8.3.2, is probably the most useful and relevant section of the report on marine protected areas and is particularly pertinent when considering the authors were charged to address adaptation options. The section on bleaching needs considerable expansion and elaboration because there is at least 20 years of research on this climate-sensitive phenomenon and the most visually obvious.

Ocean acidification (8-17). The literature states that higher latitudes will show the first signs and most intensive responses to climate change because of the greater solubility of CO₂ in cooler waters. It is fair that the authors state that “management strategies have not

yet been developed”(8-31) (to combat local changes in pH one would presume). However, there is no mention of the disparity between statements of geographical expansion because of increasing water temperatures and adaptive management to higher latitudes, because the higher latitudes, it is argued will become warmer, and therefore less likely to more soluble.

Furthermore, and probably more importantly, the authors refer to range expansion as becoming ‘invasive’ (8-21), because the species extend past boundaries beyond their known native range. Surely, if management is to become adaptive and protected area networks are established, then under climate change many species will simply expand geographically. But in the authors terms these species will be considered as ‘invasive’ and given low management status, when in fact those very species are naturally adjusting to climate change and should be given priority status.

The concept of invasive species is considered further, but in light of increased seawater temperatures resulting from climate change. The authors discuss the most fundamental aspect of reproductive output, which is strictly speaking the definition of adaptation, or differential reproductive output of individuals of populations. Insufficient emphasis has been placed on discussions of population adaptation to climate change (only, page 8-16, “that adaptation and acclimatization to increasing temperature is largely unknown and remains a research topic of paramount importance.”). Nevertheless, the authors mention that invasive species out compete native species because “they will spawn earlier and for longer periods”. This assumption is based solely on the incorrect premise that all marine reproduction events are temperature driven. More recent evidence and critical inquiry suggests that marine reproductive cycles are not simply temperature driven, particularly made evident by examining low latitude environments, where temperature changes as little as 2-3 degrees centigrade, and simultaneous mass spawning events are still evident, for example on low latitude reef corals. Irradiance and day length also plays a critical role in gametogenesis and the production of offspring.

Freshwater influx (8-19). The freshwater influx argument is weak at best, most likely because it is based on one reference. The authors argue that increased runoff may cause greater stratification of water layers (Scavia et al 2002), which will result in reduced productivity of estuaries. There is no systems approach here, nor is there any reference to the considerable literature on freshwater discharge dating back over 100 years discussing and documenting the detrimental influences of osmotic shocks and subsequent mortality of marine organisms, particularly on adjacent coral reefs. Changes in precipitation associated with climate change have been widely documented and need more careful consideration for a number of marine systems. Furthermore, there is mention of discharge from large river systems, particularly the Mississippi River on adjacent systems (8-20), yet these large rivers may also influence marine protected areas downstream by changing irradiance and water quality (nutrients, pesticides etc.) as has been clearly shown on the Great Barrier Reef. The authors acknowledge that pollution was previously managed ‘locally’, but now add that “climate change stressors ...present greater challenges”, without suggesting a solution to the challenges.

Management approaches: Finally, on page 8-23, four arguments and justifications are made to implement MPA networks. The authors argue that a network of MPAs would allow adaptation of marine management for climate change. The four justifications are given and discussed: 1) MPA networks are more effective than a single MPA at protecting the full range of habitat and community types because they spread the risk of loss from disturbances such as climate-change impact across a larger area. Yet, there are no MPA networks; 2) networks protect short- and long-distance dispersers; 3) Networks provide enhanced larval recruitment among adjacent MPAs; 4) Networks allow for protection at an appropriate scale, without the need to establish one extremely large reserve. The recent implementation of the Papahānaumokuākea Marine National Monument comes to mind, as it is downstream of the main Hawaiian Islands and it is one large reserve. Again, the arguments and the ‘reality’ are disjunct; there are no marine protected networks while all evidence points to a need. The authors again point to this issue on page 8-23 “In the long term, the most effective configuration would be a network of highly protected areas nested within a broader management framework”. Such a framework should consider upstream activities to control and maintain high water quality (mentioned on page 8-26, regarding linking the MPAs into adjacent governance systems and reduce land-based pollution). Furthermore, on page 8-27, a network of MPAs reaches high prominence again, because of ‘representation, replication, sustainability and connectivity’. Again, entire sections are dedicated to connectivity (8.3.1.1 and 8.3.3.2), source-and-sink concepts, larval transport, adult movement, and the theoretical effectiveness of networks. Although the most useful study by Airame et al (2003), suggested that no-take zones comprising 30-50% of a Sanctuary will sustain the system. Clearly, the Florida Keys National Marine Sanctuary, with only about 6% no-take zones, is not an effective strategy. Numerous authors have shown that marine reserves 10-20 km apart will facilitate larvae exchange and sustain most marine populations. The authors suggest that a management strategy should include a representative range of habitat types, and replication of those habitats will reduce the risk of loss (page 8-31). Clearly, the sooner the current goal to protect 30% of habitats as no-take zones is reached, the greater the chance of survival of coral reefs, which are particularly sensitive to global climate change.

The authors (on page 8-24) suggest the most effective management strategy to preserve marine ecosystems is to include stakeholders in decision making, by engaging sanctuary advisory councils and hold public scoping meetings. While involving stakeholders is a necessary strategy it will not necessarily lead to some emergent adaptive management strategies and will simply shift the onus onto others. Performance measures are discussed, to more effectively assess the success of specific programs. However, the metrics do not include climate change; climate change metrics should be included. The authors further suggest that Condition Reports will provide summaries on the state of the resources and management responses that threaten the resources. The reports are meant to provide management with information to respond on “a site-by-site basis”. Such a process conflicts with earlier arguments made on MPA networks and further statements on ‘managing for resilience’ at the system level.

Suggesting that “managers should strive to maintain the maximum number of species in the absence of detailed data on ecological and species interactions”, and managers should continue to develop and implement strategies to reduce land-based pollution...(page 8-26), are relatively obvious statements, but there is no mention of how this should be done. Furthermore the dichotomy is introduced, without much consideration, that regional guidelines should encourage herbivory at low latitude, to reduce macroalgae, but reduce herbivory at high latitude to maintain kelp forests. It is often inferred that locally enhancing parrotfish and surgeonfish on coral reefs will lead to positive cascading effects that will increase coral cover, because recruitment will be increased. However, there is an urgent need to address the relevance of this assumption and in which context, before false hopes and incorrect trajectories are predicted, when in fact the problem occurs on multiple scales and increasing the biomass of these herbivores may have little influence on resilience. Besides, managing for high levels of herbivory at low latitude compared with managing for low biomass of herbivores at high latitude needs further consideration, especially in the face of global climate change when geographic boundary shifts are common place and if this dichotomy is correct, then, Where is the latitudinal boundary where we shift strategies? and Why is it there?

Other management solutions discussed include: 1) more monitoring in MPAs (8-32) and 2) the use of satellites to forecast bleaching events. The later is even less convincing than the former. Remote tools, “help managers prepare for bleaching events so that when the event occurs, managers can have the necessary capacity in place to respond”. I wonder what that capacity is, and I wonder even more how they will respond? These two solutions do not facilitate management for climate change unless the monitoring is hypothesis driven and specific to assessing an adaptive management strategy.

Case studies (8.4) The case do little but reiterate. They give few options of active forms of adaptive management except on the Great Barrier Reef, which is an exemplary example, but managed under entirely different laws (Australia).

References cited

Iglesias-Preito, R., Matta, J. L., Robins, W. A. and Trench, R. K., 1992. Photosynthetic response to elevated temperature in the symbiotic dinoflagellate *Symbiodinium microadriaticum* in culture. *Proc. Natl. Acad. Sci. USA* 89: 10302-10305.

Iglesias-Prieto R, Beltran VH, LaJeunesse T, Reyes-Bonilla H, Thome PE (2004) Different algal symbionts explain the vertical distribution of dominant reef corals in the eastern Pacific. *Proc Royal Soc Lond.*, B DOI 10.1098/rspb.2004.2757