SAP 4.4
Preliminary Review of Adaptation Options for Climate Sensitive Ecosystems:

Public Review Draft
Comment-Response Document

Non-government Comments

February, 2008

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1. Report-wide

REPORT-WIDE COMMENTS		
Reviewer	**Comment**	**Author Response**
Amanda Staudt, National Wildlife Federation	The 2007 IPCC Working Group II report presents a compelling case that a significant fraction of species will be committed to extinction by 2050, even if we make aggressive reductions in greenhouse gas emissions. Yet, the ES only explicitly mentions extinction twice (p. 1-5, lines 32 and p. 1-6, lines 32-33). Neither the Introduction (section 1.1) nor the Background (section 1.2) even mention the possibility of extinctions. As managers are faced with pending extinctions, they will need to make incredibly difficult choices and trade-offs, not the least being whether and what species to save from extinction. The ES and the report should acknowledge this challenge and offer some options for tackling it. In many cases, ecosystem and resource managers will need to fundamentally reconsider their management targets and baselines. Management targets are typically related to returning or preserving a protected area to some pristine state, often based on what climate conditions were a century or more ago. But, as the climate changes, such a goal could very well be impossible to meet, for example, if a vegetation regime is no longer viable in the protected area or if a protected species no longer finds suitable habitat there. This issue is mentioned on p. 1-8, line 10 in regard to National Parks ("'unimpaired' becomes a moving target as the baseline changes…"), but also should be highlighted as a grand challenge for ecosystem and resource managers of all sorts of ecosystems. Surprisingly, the issue of manual species relocation—a hugely challenging issue for future ecosystem management—is not addressed directly anywhere in the summary except for in Box 1-1 and Table 1-1.	The ES now mentions prioritization through triage – specifically, the need to review management goals and targets in light of observed and projected ecological changes because some management targets and actions may have to be abandoned. Also mentioned in the ES is the need to examine management goals in light of the fact that many of the goals themselves may have to be adjusted ("managing for change") because of the potential magnitude of changes in ecosystems and species. Finally, there are now seven adaptation approaches discussed in the ES. One of those approaches is relocation of organisms to appropriate habitats as conditions change.
Tom DeLuca, The	Opportunities for enabling and enhancing the ability of natural systems to	We disagree that the structure

REPORT-WIDE COMMENTS		
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Wilderness Society	adapt to a changing climate abound. It is crucial to acknowledge that although we must invest in continued research, there is enough information available to begin to enable our natural systems to adapt to their full capacity. By laying out key definitions and outlines, this chapter sets the stage for the report as a whole. At the present the outline provided in the Introduction drastically limits the available options that we can begin to use. It is important to note that because this report examines select federal lands as a context for reviewing adaptation options rather than functional resource types as a whole, it sets the precedent for continued institutional fragmentation. By breaking the report into sections based on institution, the very structure of the report perpetuates this problem. We must recognize within this report that what we protect is not the land, but the ecosystems that move across that land. Forests, wetlands, and other systems do not end at an agency's borders. Thus, the report must address additional topics in greater detail such as agency to agency communication and planning, federal and state interactions, initiatives to address private land issues that will affect our federally protected areas, land acquisition priorities, and the critical goals that all federal land management agencies must adopt.	of the report, as laid out in the Introduction, limits the available options. Only by understanding what our current goals are for managing our systems can we begin to understand what our adaptation options are. The structure also allows us to examine whether the goals themselves are feasible to achieve and what to do when ecological conditions are changing enough to warrant managing for those changes. We disagree that this approach continues institutional fragmentation: the Synthesis chapter and the ES address cross-institutional actions that may be taken to remove barriers to implementation and increase adaptive capacity to better address climate change impacts. Many of the topics mentioned by this reviewer are discussed throughout this report and especially in the Synthesis chapter.
Tom DeLuca, The	The Wilderness Society's greatest concern is that the management options	This comment seems to ignore

REPORT-WIDE COMMENTS		
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Wilderness Society	suggested throughout the subsequent chapters are treatments that may be appropriate in specific situations, but that are simply not possible on the grand scale and in the long term. Options that enhance ecosystems' ability to adapt are the most cost-effective strategies available to land managers. They will further benefit the public by staving off increasing management costs in the future, and also by building healthy, functioning systems that enhance ecosystem services. Adaptation is not the treatment that land managers can do; rather it is the result of natural systems when we restore their ability to resile to a healthy state, their ability to resist impacts, their genetic and species representation, their replication across the landscape, and their functional processes.	the purpose of adaptation as stated in this report. That purpose is to reduce the risk of adverse environmental outcomes through activities that increase the resilience of ecological systems to climate change (as taken directly from this report). Resilience refers to the amount of change or disturbance that a system can absorb without undergoing a fundamental shift to a different set of processes and structures (again as taken from this report). We do not see any conflict between the reviewer's comments and the content of this report. No change is necessary. etc.
Tom DeLuca, The Wilderness Society	The goals set forth in the disparate sections of this report, by which agencies set their priorities and value the outcomes, are in themselves management standards set given current or historic conditions rather than those conditions found in a changing climate. To value outcomes against goals that precede an understanding of the needs is to fail to enact the realignment and recognition that this chapter promotes. Chapter 2 is the chapter where we must outline the new paradigm, set the course for future management, and define the expectations against which we value the outcome of our work. Realign Chapter 2 to set a common goal for all federal land management agencies that assists the ability of natural ecosystems to persist in health during a changing climate.	With re-writing the Executive Summary, it now discusses not just adaptation options for increasing the resilience of ecosystems in the near term, but also the need to manage for change in the longer term as goals and management standards are rendered obsolete by a changing climate. However, we do not

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		set a common goal for all federal land management agencies because this document may not be policy-prescriptive.
Tom DeLuca, The Wilderness Society	These types of management options can be implemented today. The direction of this report diverges from the direction suggested by a wealth of leading scientists. The best analogy of this divergence is that of fire suppression verses the restoration of natural fire to the landscape. One direction creates a snowball effect that we do not have the capacity to maintain; the other pays multiple dividends in the long run. Human and financial capital must be invested wisely. Natural systems can adapt, and agencies can enable that adaptation by enacting proper management strategies today. Rework Chapter 2 to set the stage for 1) protecting adequate and appropriate space, 2) reducing non-climate stresses, 3) using active adaptive management, and 4) restoring natural and functional processes to our ecosystems.	With re-writing the ES to summarize the Synthesis chapter, these concepts are now discussed.
William L. Fang and Eric Holdsworth of the Edison Electric Institute	We are concerned that the draft is overly long (over 700 pages). It would be helpful if it was abbreviated. Also, there are a number of conclusions for most of the chapters and additional conclusions in Chapter 9. Some of the conclusions read like recommendations. Indeed, chapter 3 refers to both conclusions and recommendations. Others refer to "Synthesis and Conclusions". It is confusing. We think that there should be more uniformity in regard to the designation of the conclusions.	The case studies were moved to an appendix with summaries written to remain in the chapters. This reduced the length of the main part of the report significantly.
Amanda Staudt, National Wildlife Federation	The topic of how to manage climate-sensitive ecosystems and resources is incredibly complex and presents major intellectual, moral, and logistical challenges. We commend the CCSP for taking on this topic. This report moves the issue forward by compiling a wide range of useful information and introducing some new thinking on the issue. These comments offer a number of suggestions for improving the Executive Summary (ES). Unfortunately, the length of the report precluded a careful review of its entirety at this time.	Thank you.
William L. Fang	The Edison Electric Institute (EEI) appreciates the National Oceanic and	No response necessary.

REPORT-WIDE COMMENTS		
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and Eric Holdsworth of the Edison Electric Institute	Atmospheric Administration (NOAA) publishing in the Federal Register a notice of the availability for public comment by October 5, 2007 of the U.S. Climate change Science Program's (CCSP) second draft Synthesis and Assessment Production (SAP) 4.4 titled "Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources", which, according to the notice, "analyzes information on the state of knowledge of adaptation options for key, representative ecosystems and resources that may be sensitive to climate variability and change." The notice adds that the draft: Examines (1) the combined effects on ecosystems of climate changes and non-climate stressors, and consequent implications for achieving specific management goals; (2) adaptation approaches that reduce the risk of negative impacts on management goals; and (3) ways to overcome barriers or take advantage of opportunities to improve the likelihood of successful adaptation implementation. (emphasis added) (72 Fed. Reg. 46610; August 21, 2007)	
Eric Holdsworth of the Edison Electric Institute	We note that the key, representative ecosystems and resources examined are all Federal areas (i.e., National Forests, National Parks, National Wildlife Refuges, Wild and Scenic Rivers, National Estuaries, and Marine Protected Areas) that are all administered by Federal agencies under applicable Federal statutes, regulations, guidelines and policies that are generally described in the draft. Also, all are subject to multiple "stressors", as that term is defined in the draft Glossary (p. 10-5), which are in addition to the potential of global climate change. However, we understand that the purpose of the report and its conclusions are not intended to be limited to such Federal areas.	No response necessary.
Eric Holdsworth of the Edison Electric Institute	EEI particularly welcomes the SAP's focus on adaptation as we consider it important that the U.S. engage in actions that not only manage ecosystems and resources but also other impacts of global climate change, just as is done for other significant and myriad stressors, such as wildfires, weather events, water unavailability, impact of urbanization, pollution, etc. Recognition of the importance of adaptation is critical in coping with such stressors, including the	No response necessary.

REPORT-WIDE COMMENTS		
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	potential impacts, both negative and positive, of global climate change. We also take this opportunity to point out that last August, the National Center for Environmental Assessment (NCEA) of the Environmental Protection Agency (EPA) issued three Federal Register notices of the availability for public comment draft documents that, while not focusing on Federal areas, appear, in the case of two, at least, to relate to matters covered in this report. (72 Fed. Reg. 45045, 45046, and 45048; August 10, 2007) These are: "Effects of Climate Change on Aquatic Invasive Species and Implications for Management and Research"; and "Preliminary Assessment of Climate Change Effects on Stream and River Biological Indicators." Both seem to overlap to some degree SAP 4.4 draft. However, neither seem to consider or address adaptation.	

2. Executive Summary

EXECUTIVE SUMMARY			
Location	**Reviewer**	**Comment**	**Author Response**
Page 1-5, Line 39	Emily Therese Cloyd, US Climate Change Science Program	The term "system-resetting disturbances" implies that the disturbance will return the ecosystem to a state seen previously. However, it is likely that such disturbances will cause shifts or changes in ecosystem state such that a novel ecosystem state is achieved. Suggested revision: replace "system-resetting" with "system-changing" or "state change-inducing".	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. Also, we disagree with the comment. "Reset" means "set to zero" or "change the reading". It may or may not lead to a return to the previous state, and the context of the sentence does not imply otherwise.
Page 1-6, line 1	Amanda Staudt, National Wildlife Federation	"One opportunity is to develop emerging carbon markets…" Yes, this is an opportunity, but it also presents a threat to healthy forest and grassland ecosystems. As biomass and biofuel industries along with carbon sequestration become increasingly profitable, there will be increased pressures to manage ecosystems to meet these goals, possibly at the expense of their ability to support wildlife and meet other conservation objectives. The report should acknowledge these potential trade-offs.	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. The Forest Chapter gives this issue full treatment.

EXECUTIVE SUMMARY			
Page 1-6, Lines 13-16	Amanda Staudt, National Wildlife Federation	Seems like an emphasis on reactive management. What is the rationale for this emphasis? What is the role for proactive management of forests?	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. The Forest Chapter gives this issue full treatment.
Page 1-7, lines 24-27	Amanda Staudt, National Wildlife Federation	What about the threat of species losing habitat or going extinct as warming forces species farther and farther up mountain slopes?	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. Also, we disagree that a change was needed. The list did refer to impacts on species that live above treeline, which are the most vulnerable examples of the category to which the commenter is referring.
Page 1-8, Line 17-18	Emily Therese Cloyd, US Climate Change Science Program	Why is there no interest in or mention of preserving the parks and/or mitigating changes? This suggestion appears to go against the Parks Service mission of preserving unimpaired natural and cultural resources – and although "adjusting thinking" may be needed, that does not mean that preservation must be completely dropped.	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. Preservation is discussed in the Chapter Summary section of the National Parks chapter, and both preservation and mitigation are discussed in the chapter body.

EXECUTIVE SUMMARY			
Page 1-12 to 1-13	Amanda Staudt, National Wildlife Federation	Section 1.7: The discussion of climate change impacts on national estuaries focuses exclusively on sea-level rise and increasing storm intensity. While these are likely the two greatest threats to habitat integrity in marine estuaries, a number of other climate changes and non-climate stressors are going to affect plant and animal species. Increasing water temperature will affect the composition of species that survive in different estuaries, possibly creating disconnects in food chains. Changing precipitation patterns will affect runoff into estuaries, affecting the inflow of pollutants, sediments, etc. Problems with eutrophication will likely be exacerbated by warming waters. Ocean acidification might affect estuaries. These other climate and non-climate stressors should be discussed.	Both the Executive Summary and the Chapter Summary have been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to the chapter. Therefore, this comment is no longer applicable to the current Executive Summary and Chapter Summary. These issues are discussed in the National Estuaries chapter.

EXECUTIVE SUMMARY			
Page 1-12 to 1-13	Amanda Staudt, National Wildlife Federation	Section 1.7: One aspect that should be addressed in this section is that major investments have been made to restore estuary water quality and ecosystems to the healthy baselines of the late 1800s. Unfortunately, a lot of the restoration progress could be compromised unless future restoration efforts take climate change into consideration. Take, for example, efforts to replant sea grasses, which provide a critical habitat for many aquatic species. If the likely impacts of climate change are considered, then new grasses should be planted in the shallowest water that they can tolerate (to allow them to survive as sea level rises) and grass species that are at the coldest water they can tolerate should be planted (to allow them to survive as the water warms).	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. This issue is discussed in the National Estuaries chapter.
Page 1-14, Line 6-9	Amanda Staudt, National Wildlife Federation	It's surprising that sea-level rise is not mentioned as a factor affecting marine ecosystems.	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. Sea level rise is discussed in the Chapter Summary section of the National Estuaries chapter, and is discussed generally in the Executive Summary.

EXECUTIVE SUMMARY			
Page 1-4 to 1-15	Amanda Staudt, National Wildlife Federation	Use tables or other graphics to convey some of the background information. For example, include a table or box that provides a 2-3 sentence description of the authorizing legislation, mission, and current responsibilities of each management system.	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, these comments are no longer applicable to the current Executive Summary. However, in each chapter, graphics are used to convey background material.
Page 1-9, Line 7-8	Emily Therese Cloyd, US Climate Change Science Program	This statement calls for a program similar to or the same as the already-existing Climate Change Science Program and Global Change Research Information Office. In addition, it is very program prescriptive. Suggested revision: delete statement or reference existing US Global Change Research Program / Global Change Research Information Office / Climate Change Science Program. If the statement is meant to point out that some agencies are not a part of CCSP (e.g., FWS, NPS), perhaps the statement could reference the need for additional interaction between CCSP and these agencies.	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, these comments are no longer applicable to the current Executive Summary. We do agree with the need to remove prescriptive language and have modified the material in the National Wildlife Refuge chapter where the statement originated.

EXECUTIVE SUMMARY			
Page 1-10, Line 24-27	Amanda Staudt, National Wildlife Federation	The interplay between WSR areas and dam management is not clear in this discussion. Seems like dam management is a major consideration in helping WSRs adapt to climate change, but it's not clear from reading this section to what extent the WSR Act authorizes input into or control over decisions regarding upstream or downstream dams. Also, the discussion alludes to the fact that some of the WSRs have dams, but it's not clear what proportion of them do.	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. The Chapter Summary for Wild and Scenic Rivers refers to numbers of dams within 100 miles upstream of WSRs and discusses the importance of (voluntary) collaborations with dam managers.
Page 1-13, Line 16-18	Emily Therese Cloyd, US Climate Change Science Program	This sentence mentions only state agencies. Are national agencies also involved in developing the Coastal Habitat Protection Plan? If so, this should be explicitly stated in the sentence. If not, why is this case included in a report on federal climate change activities?	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. The Coastal Habitat Protection Plan lacks a mechanism to engage the relevant federal authorities. However, the National Estuaries bring to the table a wider range of managers and stakeholders, including those from federal, tribal, state, and local levels. This is explained in the National Estuaries chapter.
Page 1-11, line 27	Amanda Staudt, National Wildlife Federation	The experience in Alaska can serve as an early warning system, but more importantly, it can provide trial-and-error information about which adaptive management strategies were effective and should be applied to rivers farther south.	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary.

EXECUTIVE SUMMARY			
Page 1-16, line 15	Amanda Staudt, National Wildlife Federation	It is suggested that a "decision support model" be used to conduct sensitivity analyses. Do such models exist? Are there support systems in place to train people on how to use them? If such analyses are to be the "foundation for 'if/then' planning" as stated on lines 17-18, more information needs to be provided about how these tools will be developed, what they will entail, and how users will be trained and supported in their use.	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. Decision support tools are not the focus of this report. Therefore, expanding the discussion of such tools would go beyond the scope of this report.
Page 1-19, Lines 19-21	Amanda Staudt, National Wildlife Federation	Replication is proposed as a "bet hedging" strategy against habitat loss due to a "localized disaster." Doesn't it have broader application? In particular, it makes sense to have multiple habitat replicates because it is difficult to predict the microclimate conditions, developmental pressures, and influence of other stressors that may allow a habitat to persist in one location and to be lost in another.	Discussion on replication has been revised in the latest version of the Executive Summary, which now states that, "Replication centers on maintaining more than one example of each ecosystem or population within a reserve system, such that if one area is affected by a disturbance, replicates in another area provide insurance against extinction and a source for recolonization of affected areas." We believe that this broad statement covers all of the issues listed in this comment.

EXECUTIVE SUMMARY			
Page 1-21, Table 1.1	William L. Fang and Eric Holdsworth of the Edison Electric Institute (EEI)	Table 1.1 sets forth confidence levels for draft SAP 4.4 that differ from "confidence" levels and "likelihood of the occurrence/outcome" in the 2007 Working Group II's Summary for Policymakers (SPM) of the Intergovernmental Panel on Climate Change (IPCC). The draft appears to combine confidence and likelihood as follows: [Frame1] However, the IPCC treats them separately as follows (p. 21): <u>SPM-WG-II</u> [Frame2] If SAPs are going to utilize confidence and/or likelihood levels, EEI questions why they should be merged, as proposed in the draft, and why they should apparently deviate from those adopted by the IPCC. At a minimum, the SAPs should explain why the IPCC approach is not favored. We think consistency should rule, particularly since the draft often cites the IPCC.	The confidence exercise for this report has been extensively revised as per the 2005 IPCC guidance on uncertainty that informed the IPCC 2007 Assessments. We now qualitatively assess two components of confidence: evidence and agreement. The new discussion of confidence in the revised Executive Summary focuses clearly on confidence, not likelihood, and explains why. We believe this is the most appropriate approach, given the nature of the available evidence.

EXECUTIVE SUMMARY			
Page 1-14, Line 11	Emily Therese Cloyd, US Climate Change Science Program	The word "spread" is ambiguous – could mean either introducing the risks of climate change to new areas or reducing the risk of devastating loss by increasing the area of protection. Suggested revision: replace "spread" with "reduce".	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. Also, we disagree that the use of the term is ambiguous. "Risk-spreading" is common parlance, and the use of the term is clear given the context of the remainder of the sentence, which clearly indicates that it is indeed about "reducing the risk of loss by increasing area of protection".
Page 1-3	Amanda Staudt, National Wildlife Federation	The introduction should lay out the major challenges for managing ecosystems and resources under a changing climate; it should not start with the process for producing the report or the CCSP's overall assessment strategy. The material presented in the Introduction belongs in a foreword or preface. More importantly, the introduction, and the ES more generally, skirt around some of the biggest questions facing ecosystem managers: the likelihood of extinctions and shifting management targets. This summary should be much more direct on these topics, starting by identifying these challenges in the Introduction.	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report (including shifting management targets). We agree that the material in question should be moved to a preface.

EXECUTIVE SUMMARY			
Page 1-3, line 21	Amanda Staudt, National Wildlife Federation	"Because changes in the climate system are likely to persist…" The 2007 IPCC Working Group I report makes it very clear that changes in the climate system *will* persist into the future, even if we stopped emitting greenhouse gases today. Replace "are likely to" with "will."	We agree. Language in the revised Executive Summary now reads "Because changes in the climate system will continue into the future . . ."
Page 1-3, Line 25	William L. Fang and Eric Holdsworth of the Edison Electric Institute (EEI)	The statement that "the primary audience for this report is resource managers" is not consistent with the far broader statement (at p. 2-4, lines 33-37 of the "Introduction") about that "audience". There it is stated that "[t]he primary audience is resource and ecosystem managers at federal, state and local levels, tribes, non-governmental organizations" (NGOs), the latter of which presumably includes, or should include, both environmental and business NGOs, "and others in protected area management decisions. Additional audiences include scientists, engineers, and other technical specialists that will be able to use the information to set priorities for future research and to identify decision-support needs and opportunities." (emphasis added) We believe that both should be the same. Possibly, the best solution is to eliminate the reference to the "primary audience" in the Executive Summary and rely on the reference at p. 2-4 to the "Introduction".	The Executive Summary had been significantly revised and no longer contains this material. However, we disagree with the comment. We regard resource managers as including the people listed in the Intro as the primary audience -- the people who directly manage natural resources. The additional audiences are those that may be key to science and decision making at higher levels, but are not "in the trenches" of management. We think that the distinction is a useful one.

EXECUTIVE SUMMARY			
Page 1-3, Lines 27-29	William L. Fang and Eric Holdsworth of the Edison Electric Institute (EEI)	The sentence beginning on line 27 and ending on line 29 purports to define the term "Adaptation" in an abbreviated way that differs from the definition of this term in the draft Chapter 10, Glossary (p. 10-1). That definition, which defines the term both generally and in the context of climate, is as follows (p. 10-1): **Adaptation** –Adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation. Note that this usage is distinct from the definition of adaptation in the context of evolutionary biology. EEI believes that report should rely on that definition and not adopt a modified version thereof without stating reasons for the deviation or modification. Otherwise there would be need for a Glossary.	In this report, the focus is on adaptation to climate change via human activities. We make clear in the Intro (and Glossary) that there is a broader definition of adaptation, but that the remainder of the report will use the term adaptation to refer specifically to human adaptations to climate change, unless otherwise stated specifically (eg, where a chapter may need to mention potential for biological adaptation). Consistent with this, the revised Executive Summary now states "The term 'adaptation' *in this document* refers to adjustments in human social systems (e.g., managmeent) in response to climate stimuli and their effects." This indicates that we are focusing on one aspect of adaptation that is the mandate of this report.

EXECUTIVE SUMMARY			
Page 1-4, lines 7-19	Amanda Staudt, National Wildlife Federation	This material also belongs better in a forward or preface.	This information no longer appears in the revised Executive Summary.
Page 1-4 to 1-15	Amanda Staudt, National Wildlife Federation	Some of these sections are more focused and stronger than others (e.g., section 1.5. National Wildlife Refuges was well written, with clearly identified priorities; section 1.8 Marine Protected Areas was unfocused and included many generalizations). It was clearly pieced together from sections written by several different authors. Despite what looks like an effort to enforce some consistency across the sections, the information presented varies. For example, some sections clearly discuss the history of the federal protection status, while others don't. Some clearly describe how climate change will impact the ecosystem, while others don't. In general, these sections are too long and often are repetitive in identifying general issues that apply to all of them. It takes much too long to get to the interesting conclusions and synthetic discussion in Section 1.9.	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary.
Page 1-4 to 1-15	Amanda Staudt, National Wildlife Federation	Shorten significantly the discussion of each federally managed system to really highlight the unique adaptation challenges and opportunities specific to that system.	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary.

EXECUTIVE SUMMARY			
Page 1-4 to 1-15	Amanda Staudt, National Wildlife Federation	A table with the following organization could be an effective way to present a more complete and consistent picture of how climate change will impact these systems. It would also force the authors to consider what the biggest threats to each ecosystem are, rather than including lists of all the things that might be a problem. Color-coding the boxes (e.g., red=major threat, orange=minor threat, yellow=possible threat) would help a reader quickly ascertain what will be especially important for each ecosystem. A similar approach could be used to summarize which systems are especially susceptible to various non-climate stressors (see Executive Summary section of the Appendix).	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. Also, we disagree that adding material focused on a review of threats/impacts of climate and non-climate stressors would be appropriate– this report is not a review of impacts, but rather a review of adaptation options.

EXECUTIVE SUMMARY			
Page 1-4 and 1-5	Amanda Staudt, National Wildlife Federation	Section 1.3.2: Many of these options are generally applicable to all the ecosystems. Rewrite section to focus on those issues of specific importance to forests. It's not clear what item (4) in this list is getting at.	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. Material related to managing for, "…desired ecological processes…" has been revised in the Chapter Summary section of the National Forests chapter.
Page 1-5, Line 8	Emily Therese Cloyd, US Climate Change Science Program	The example of managing to suppress fire as a means of managing for resistance to climate change seems off. Using this management strategy in the past has led to some of the current wildfire problems. Suggested revision: the term "management to suppress fire" be changed to "management to reduce fire risk".	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. This issue is discussed fully in the National Forest chapter.

EXECUTIVE SUMMARY			
Page 1-5, Line 22-26	Emily Therese Cloyd, US Climate Change Science Program	This recommendation is poorly worded, with too many clauses and parenthetical statements. Consider revising to reduce confusion.	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. Similar material related to managing for, "…desired ecological processes…" has been revised for clarity in the Chapter Summary section of the National Forests chapter.
Page 1-5, Line 40	Emily Therese Cloyd, US Climate Change Science Program	Suggested revision: insert "opportunities for" between "consider" and "post-disturbance".	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. This material has been revised in the Chapter Summary section of the National Forests chapter.
Page 1-5, Line 45	Emily Therese Cloyd, US Climate Change Science Program	The source(s) for these identified barriers should be identified (interviews, workshops, etc.). Suggested revision: insert "Statements from a workshop indicated that barriers include…"	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report. Consistent with all of the other sections in the revised Executive Summary, the section on barriers and opportunities does not include references – although, as with all the other sections, references supporting the statements about barriers *are* presented in the Synthesis Chapter.
Page 1-5, Line 47	Emily Therese Cloyd, US Climate Change Science Program	Suggestion revision: delete comma after "and".	Due to substantial revisions to this chapter since the public review, this comment is no longer applicable.

EXECUTIVE SUMMARY			
Page 1-6, Line 6-9	Emily Therese Cloyd, US Climate Change Science Program	This statement about adaptive management is confusing. If AM has been adopted as a principle, it should promote learning and action, thus providing flexibility and ability to act quickly. Suggested revision: delete "or when actions must be taken quickly."	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. The mention of AM in the revised Executive Summary no longer includes this phrase.
Page 1-6, Line 13-16 and 18-19	Emily Therese Cloyd, US Climate Change Science Program	These two statements oppose each other. Suggested revision: replace "…adjustments to management approaches could best be made…" with "…adjustments to management approaches often do not occur until…" (Line 15) so that the statement on Lines 18-19 is a logical extension of why a precautionary approach is needed.	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. The National Forests chapter summary does not have any statements similar to the one mentioned by this reviewer.
Page 1-6, Line 33	Emily Therese Cloyd, US Climate Change Science Program	The end of the sentence "without respect to protected area borders" doesn't make sense – of course species shift without respect to borders, as these are political boundaries that we have imposed, not necessarily natural boundaries that would limit range shifts. Suggested revision: replace "without respect to" to "and potentially outside of".	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary.
Page 1-7	Amanda Staudt, National Wildlife Federation	Section 1.4.3: paragraph is way too long, suggest paragraph breaks at lines 27, 34, and 39	Due to substantial revisions to this chapter since the public review, this comment is no longer applicable.

EXECUTIVE SUMMARY			
Page 1-8, Line 4	Emily Therese Cloyd, US Climate Change Science Program	Suggested revision: replace “than” with “as” at the beginning of the line.	Due to substantial revisions to this chapter since the public review, this comment is no longer applicable.
Page 1-8, Line 15	Emily Therese Cloyd, US Climate Change Science Program	Suggested revision: delete comma between feasible and management.	Due to substantial revisions to this chapter since the public review, this comment is no longer applicable.
Page 1-9, Line 1-2	Emily Therese Cloyd, US Climate Change Science Program	The three natural phenomena listed (migrants, flowering, insects) are all examples of changes in phenology to monitor and should be listed as such. Suggested revision: insert “such as” before “arrival and” on line 1 or change to “phenology (e.g., arrival and…for insects.)”	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary.

EXECUTIVE SUMMARY			
Page 1-9, Lines 32-33	William L. Fang and Eric Holdsworth of the Edison Electric Institute (EEI)	As stated in Chapter 5, p. 5-4, climate change is the fourth "crisis" that has and is facing the National Wildlife Refuge System (NWRS). According to that chapter, all of the four appear to be of equal precedent. Yet the sentence beginning on line 32, p. 1-9, states that the climate change crisis is "unprecedented in the scale of its impacts". However, the draft states (p. 5-4) that the third crisis is "international" and is still ongoing. It is difficult to see how this fourth crisis is "unprecedented". EEI urges that the words "but it is unprecedented in scale of its impacts" be changed consistent with p. 5-4, to, "but it is global and covers the full breadth and depth of the NWRS."	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. Material related to this issue has been revised and is included in the Chapter Summary of the National Wildlife Refuges chapter.
Page 1-11	Amanda Staudt, National Wildlife Federation	This is a very long paragraph to slog through. How about using bullets for each of the example case studies?	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary.

EXECUTIVE SUMMARY			
Page 1-11, Line 26-29	Emily Therese Cloyd, US Climate Change Science Program	The last statement in the paragraph ("Given the location…") may be misleading. If the rivers are indeed "pristine" it is possible that they may demonstrate greater resilience to change and therefore might not show the effects of climate change until later. If, however, the statement is referencing the northern location and the likelihood that change will occur faster at higher latitudes, this needs to be more clearly stated.	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. This issue is discussed in clear detail in the Wild and Scenic Rivers chapter.
Page 1-13, Line 26-27	Emily Therese Cloyd, US Climate Change Science Program	The wrong word ("insure") is used – should be "ensure." However, this statement is very pugilistic and should be reconsidered – either removed or restated in a less provocative manner. Suggested revision: "Continuing with the current management practices for estuarine ecosystems is likely to increase vulnerability of the systems to climate change."	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary.

EXECUTIVE SUMMARY			
Page 1-13, lines 42-43	Amanda Staudt, National Wildlife Federation	This sentence doesn't really add anything. Suggest cutting it.	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. Also, we disagree with the comment. The sentence is essentially defining what MPAs are/how they work, which seems a relevent way to open a discussion of a chapter devoted to the topic.
Page 1-14, Line 11-12	Amanda Staudt, National Wildlife Federation	Not sure that "spread the risks" is meaningful in this context. What risks are being spread exactly? Are the authors are trying to say that, by having larger and connected protected areas, there are more opportunities to manage the system so as to avoid species extinctions? This should be clarified.	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. Also, we disagree with the comment. The sentence does not refer to larger and more connected areas; it refers to protecting multiple replicates of a range of habitats as insurance against the risk of climate change losses.
Page 1-14, Line 24	Amanda Staudt, National Wildlife Federation	Since the Great Barrier Reef is the only ecosystem discussed in the ES that is not in the United States, its location should be clarified.	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary.

EXECUTIVE SUMMARY			
Page 1-14, Line 27	Emily Therese Cloyd, US Climate Change Science Program	Suggested revision: insert "both functional groups and" between "need to protect" and "the full range of species".	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary.
Page 1-14, Line 30-34	Amanda Staudt, National Wildlife Federation	Very general language, doesn't add much. Suggest cutting.	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. Material related to, "…overcoming the challenges of climate change..." and, "…creative collaboration…" has been revised in the Summary of the Marine Protected Areas chapter.
Page 1-15, Line 14-17	Emily Therese Cloyd, US Climate Change Science Program	Including this reference to the NMSP strategic plan and its recent formation of a climate change working group is both too far down "in the weeds" and immediately dates the document. Suggested revision: delete this sentence.	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary.

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Page 1-15, Line 43-45	Amanda Staudt, National Wildlife Federation	This statement seems out of place and should either be cut or expanded upon to make it clear why strategies to help MPAs are especially dependent on human social resilience. Aren't all the strategies discussed in the ES similarly dependent on human social resilience?	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. Material related to social resilience has been revised in the Summary of the Marine Protected Areas chapter.
Page 1-15, Line 45	Emily Therese Cloyd, US Climate Change Science Program	What does "human social resilience" mean? Suggested revision: replace "human social resilience" with "society's willingness and ability to change."	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report and no longer addresses specifics pertaining to each chapter. Therefore, this comment is no longer applicable to the current Executive Summary. Material related to social resilience has been revised in the Summary of the Marine Protected Areas chapter.
Page 1-16, Line 5	Emily Therese Cloyd, US Climate Change Science Program	The phrase "whether the management goals for a system are vulnerable" doesn't make sense, as the goals themselves are not vulnerable, but rather the ability to meet those goals. Suggested revision: insert "ability to meet" and change "are" to "is" so that the phrase reads "whether the ability to meet the management goals for a system is vulnerable".	Due to substantial revisions to this chapter since the public review, this comment is no longer applicable.

EXECUTIVE SUMMARY			
Page 1-16, lines 11-41	Amanda Staudt, National Wildlife Federation	We commend the authors for trying to provide some concrete guidance for resource managers, but think that what is presented here is not sufficiently well thought out and is not clearly presented. Adding a flow chart or decision tree illustrating how a resource manager or other relevant decision maker would step through the management practices would help to clarify for the reader what the authors are proposing. Such a flow chart/decision tree should include information requirements and inputs from other relevant experts.	The Executive Summary has been reorganized to capture the key synthetic messages of the overall report. Therefore, this comment is no longer applicable to the current Executive Summary. However, the individual management system chapters and the Synthesis chapter do provide greater detail in this area.

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Page 1-16, lines 11-41	Amanda Staudt, National Wildlife Federation	The strategy proposed has a conflicting message about the role and capacity of resource managers. On the one hand, it expects that resource managers will "examin[e] the existing literature and compare[e] likely climate change impacts with key ecological properties or components needed to reach management goals" (lines 13-14) This expects that resource managers have the time and expertise to read and interpret the existing climate change literature. In the same paragraph, it is said that the managers will use decision support models, conduct sensitivity analyses, and develop/modify monitoring schemes. All this seems like a tall order for individuals who are not trained in climate science. On the other hand, in the paragraph starting on line 33, the language suggests that resource managers are not capable of evaluating adaptation approaches themselves. Language such as "It is therefore essential to characterize for resource managers…" comes across as somewhat condescending. It seems that resource managers should be intimately involved in evaluating adaptation approaches for systems with which they have a lot of familiarity. The discussion of the management approach should more clearly define the roles and expectations of managers as well as other involved entities.	Due to substantial revisions to this chapter since the public review, these comments are no longer applicable. These issues are covered in the Synthesis chapter as per the commenter's suggestions.

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Page 1-16, lines 22-23	Amanda Staudt, National Wildlife Federation	"When the nature of a system's vulnerability to climate change is understood well enough to determine that action should be taken…" This statement seems open to wide interpretation. How is "understood well enough" defined? Who is responsible for making this determination? This decision is closely related to the issue of whether it is more appropriate to take proactive or reactive steps. Again, more explanation is needed here.	Due to substantial revisions to this chapter since the public review, this comment is no longer applicable. However, we do agree with the comment.

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Page 1-16, line 39	Amanda Staudt, National Wildlife Federation	Much more explanation is needed about Table 1.1. At a minimum, the basis for the estimates needs to be explained. A short rationale for each estimate would be helpful. It's not clear that different protected systems were evaluated in the same way, in part because presumably the authors for each chapter did their evaluations independently of the others. Did each team of authors use the same thought exercises and criteria for making their estimates? The way it is currently presented, my inclination is to disregard the table altogether because I have no basis for understanding or trusting the information presented. In addition, making a stronger connection between the terms in Box 1-1 and sections 1.3-1.8 would help to better support this table because there will have been some discussion about why certain systems are better suited to certain adaptation strategies.	The confidence exercise for this report has been extensively revised as per the 2005 IPCC guidance on uncertainty (which informed the 2007 Working Group's work). The new discussion of confidence in the revised Executive Summary is more extensive and includes the clarifications raised by the commenter. An Appendix containing each chapter team's write-up of the rationale for their estimate of each confidence level has also been added.

EXECUTIVE SUMMARY			
Page 1-16 to 1-17	Amanda Staudt, National Wildlife Federation	Section 1.9: The synthesis and conclusion section begins to move the discussion of managing climate-sensitive ecosystems forward in some interesting directions. But the section would benefit from some significant revisions and further thought. First, much of the discussion on the six federally managed systems (sections 1.3 – 1.8) includes statements that apply generally to all of the systems. I expected that these themes would be drawn out and discussed in the synthesis section, but found that not to be consistently the case. While reading through sections 1-3 to 1-8, I noted what I thought the major issues/themes that applied to all the systems were (before I read the synthesis and conclusion section). Here's my list: 1. Dealing with uncertainty, especially by implementing adaptive management 2. Cultural shifts, adjusting thinking (e.g., p. 1-8, line 16), and education needs within each agency (not mentioned in section 1.9) 3. Weighing proactive management vs. reactive management (not mentioned in section 1.9) 4. Considering and developing new baselines or management goals for ecosystems affected by climate change 5. Addressing habitat shifts beyond protected areas (not mentioned in section 1.9) 6. Improving coordination among government agencies, federal/state/local/private interests,	The Executive Summary has been significantly restructured and rewritten to focus on key themes from across the report that correspond to many of the commenter's suggested themes.

EXECUTIVE SUMMARY			
Page 1-16 to 1-17	Amanda Staudt, National Wildlife Federation	Section 1.9: The synthesis and conclusion section is used to introduce several new terms and concepts. It is the first place that "adaptive management" is defined (p. 1-16, lines 43-47) even though that term is used liberally earlier in the summary. The terms and concepts introduced in Box 1-1 are a useful way to begin categorizing the different sorts of adaptation actions that need to be considered. These terms are used only sporadically in the sections 1.3-1.8. There should be a much stronger connection between the framework established in Box 1-1 and the discussion of each system in sections 1.3-1.8. Suggest introducing these concepts in the Background (section 1.2).	Due to substantial revisions to this chapter since the public review, these comments are no longer applicable.
Page 1-17, lines 8-15	Amanda Staudt, National Wildlife Federation	Here's another place where the issues of extinctions and shifting baselines could be addressed much more directly. Further, there is a huge challenge in how to define new baselines for management. The magnitude of these challenges is understated here.	The Executive Summary has been significantly restructured and rewritten and these concepts are given greater emphasis.

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Page 1-17, lines 27-28	Amanda Staudt, National Wildlife Federation	"The most effective course may be to manage the nation's lands and waters as one large system…" What is the basis for this statement? Yes, there are benefits from a more coordinated strategy, but is it at all politically or logistically realistic to expect that all the lands could be managed as one system? There are very different and often conflicting management objectives for the different systems – how would these be reconciled? What would be the benefit of managing MPAs under the same strategy as National Forests? Suggest cutting this sentence or providing more explanation.	The Executive Summary has been significantly restructured and rewritten and no longer contains this passage.
Page 1-17, Line 27-29	Emily Therese Cloyd, US Climate Change Science Program	The phrase "The most effective course may be to manage the nation's lands and waters as one large system, with…coordinated stewardship of all of the parts" does not adequately capture the need to recognize and respond to challenges at the many government (local, state, federal, multinational) and ecological levels (community, watershed, basin, ecoregion, etc.). Suggested revision: Revise sentence to read "The most effective course may be to recognize the nation's lands and waters as one large system, with management strategies and ultimately ecosystem resilience emerging from coordinated stewardship of all of the parts."	The Executive Summary has been significantly restructured and rewritten and no longer contains this passage.

EXECUTIVE SUMMARY			
Page 1-19, Lines 9-11	Amanda Staudt, National Wildlife Federation	Why only address stresses that can be managed "locally"? There are non-local stresses that have local effects, for example, air pollution. Suggest cutting "locally."	We disagree with this comment. This report focuses on actions that resource managers can take, on the ground, in their own management areas, to protect their ecosystems directly – thus the particular approach in question is about localized stressors that are within the purview of a protected area manager to control.
Page 1-19, Line 13	Amanda Staudt, National Wildlife Federation	"…use" seems like an imprecise term here. Is the point that alternative or additional refuges should be protected (i.e., new lands added to current protected areas) or that different management strategies should be implemented in potential refugia places within already protected areas?	The answer is yes, to both questions. The term is purposefully broad in order to cover the full range of ways that refugia could be used.
Page 1-19, Line 16	Amanda Staudt, National Wildlife Federation	This box is the only use of the term "relocation" in the summary. Manually relocating species is a controversial issue and deserves more discussion of the pros and cons involved.	The Executive Summary has been substantially revised and is consistent in mentioning every adaptation approach equally.

EXECUTIVE SUMMARY			
Page 1-20, Line 2-3	Emily Therese Cloyd, US Climate Change Science Program	This table needs additional explanation, especially for the meaning of "NA" – Not applicable? Not able to evaluate? Without this information, it is difficult to evaluate the boxes that contain "NA" and therefore may lead readers to ask additional questions. For example, in the column for National Parks, "Refugia" is listed as "NA" for effectiveness as a management approach – but in many parks, there are numerous refugia that may merit additional protection and may serve as potential harbors for threatened species. You may also consider adding additional information about the IPCC approach to note that confidence estimates combine peer-reviewed literature and expert judgment.	The confidence exercise for this report has been extensively revised as per the 2005 IPCC guidance on uncertainty (which informed the 2007 Working Group's work). The new discussion of confidence in the revised Executive Summary is more extensive and includes the clarifications raised by the commenter.

3. Introduction

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Location	**Reviewer**	**Comment**	**Author Response**
Pages 2-8, Lines 11-16	William L. Fang and Eric Holdsworth, Edison Electric Institute (EEI)	The figures cited in the paragraph of section 2.4.4 cite Working Group I of the Intergovernmental Panel on Climate Change. We note that these figures appear to come from the second column of Table SPM-1 of the Group's Summary for Policymakers, which is for the years 1993-2003. However, the first column covers a longer period, 1961-2003. Indeed, the SPM states (p. 7): For 1993-2003, the sum of the climate contributions is consistent within uncertainties with the total sea level rise that is directly observed (see Table SPM-1). These estimates are based on improved satellite and *in situ* data now available. For the period 1961 to 2003, the sum of climate contributions is estimated to be smaller than the observed sea level rise. The TAR reported a similar discrepancy for 1910 to 1990. At a minimum, the dates should be included, along with a reference to the IPCC Working Group's Table.	We agree with the suggestion of including the reference to Table SPM-1 and have done so. We also included the dates (1993-2003) to the paragraph.
Page 2-8, Lines 27-28	William L. Fang and Eric Holdsworth, Edison Electric Institute (EEI)	As to North Atlantic tropical storms, the draft, citing a 2005 source, states: Changes in North Atlantic tropical storm activity <u>have also been correlated</u> with the warming of tropical seas since 1970 (<u>IPCC, 2007b</u>), although the precise nature of this relationship remains a topic of debate and investigation. <u>While the total number of tropical storms has not necessarily increased during this period, the intensity of storms has increased threefold (Emanuel, 2005), and the number and proportion of intense storms ahs nearly doubled. The storm surge associated with intense tropical storms compounds the impact of sea level rise in coastal areas</u>. (emphasis added)	We agree with this comment and have deleted this paragraph.

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		However, the increase in global temperature and the relationship to increased tropical storm/hurricane intensity or frequency has not been formally demonstrated by any scientific study. Some studies imply that the two are linked but despite the increases in global temperature no definitive increases in tropical storm/hurricane intensity or frequency have been documented. (Reference: World Meteorological Organization at http://www.un.org/apps/news/story.asp?NewsID=20952&cr=weather&Cr1=). Furthermore, the Intergovernmental Panel on Climate Change's Working Group I Summary for Policymakers, 2007, indicates only "observational evidence" of such correlations since 1870 and "suggestions" of "increased" intensity of tropical cyclones as follows (p. 8): There is observational evidence for an increase of intense tropical cyclone activity in North America since about 1970, correlated with increases of tropical sea surface temperatures. There are also suggestions of increased intense tropical cyclone activity in some other regions where concerns over data quality are greater. Multi-decadal variability and the quality of the tropical cyclone records prior to routine satellite observations in about 1970 complicate the detection of long-term trends in tropical cyclone activity. There is no clear trend in the annual numbers of tropical cyclones. (emphasis added) Finally, please note that a formal NOAA study (spring of 2007) focused on hurricane intensity in a warmed world and found hurricane frequency and intensity would actually be mitigated (Reference: NOAA at http://www.noaanews.noaa.gov/stories2007/s2840.htm). And the	

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		relationship between observed warming and hurricane intensity or frequency has not been documented by the World Meteorological Organization (Reference: World Meteorological Organization at http://www.un.org/apps/news/story.asp?NewsID=20952&cr=weather&Cr1=). Therefore, reference to this subject matter should be considered in this document.	
Page 2-10, Lines 13-45	William L. Fang and Eric Holdsworth, Edison Electric Institute (EEI)	Section 2.4.10 on page 2-10 titled "**Future Anticipated Climate Change**" cites extensively Working Group I's contribution to the Intergovernmental Panel on Climate Change's Fourth Assessment Report and makes a number of statements and "projections" about climate change for the United States and portions thereof with the probalistic words "will likely", "very likely", and "likely". However, our review of the Working Group's Summary for Policymakers (SPM) does not appear to give support to such specific statements and projections in regards to one country or region, namely the U.S. Possibly, the underlying report provides such specific regional support. If so, we believe the reference should so indicate. If not, then we question the basis for such statements.	The reviewers inferred correctly that the information cited came from the IPCC WG I's underlying report. Specifically the information cited is from the section on North America in Ch. 14 starting on p.889. No change necessary.
Pages 2-11 and 2-17, Lines 1-23, p. 2-11 and lines 1-2, p. 2-17	William L. Fang and Eric Holdsworth, Edison Electric Institute (EEI)	Section 2.5, "**Treatment of Uncertainty**," states that in this report "judgments and conclusions about adaptation will be associated with levels of confidence rather than likelihood" in evaluating "uncertainty" and then refers to Endbox 2.2 for the "Confidence Levels". However, we note that the draft report often cites the Intergovernmental Panel on Climate Change as a source for many statements by the draft's authors. However, Working Group II's SPM for the Fourth Assessment includes (p. 21) "Endbox 2" on uncertainty which describes a "set of terms" on uncertainties that "is common to all parts of the IPCC Fourth Assessment." We question why any CCSP SAP that relies heavily on the IPCC should develop a different sent of terms for uncertainties than that of the IPCC.	We think the reader has misunderstood the source of this report's confidence levels. We have not developed our own set of terms for uncertainties than that of the Intergovernmental Panel on Climate Change (IPCC). We are using the terminology established by the IPCC and published in their Working Group II's Third

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			Assessment Report. There are some small differences between that report and the Fourth Working Group II's SPM, but this latter report was not released when we were developing our confidence estimates for SAP 4.4.
Page 2-3, lines 1-3	Tom DeLuca, The Wilderness Society	The report states that "[s]trategies for protecting climate-sensitive ecosystems will be increasingly important for management because changes in the climate system are likely to persist into the future regardless of emissions mitigation." Change this statement to reflect the current scientific consensus that climate change impacts are happening and that they will persist, as is held by the general scientific consensus and the Intergovernmental Panel on Climate Change. The following statement would set a clearer and correct precedent: "[s]trategies for protecting climate-sensitive ecosystems will be increasingly important for management because impacts resulting from a changing climate system are already evident and will persist into the future regardless of emissions mitigation."	We agree. The suggested change was made.
Page 2-3, Lines 16-17	William L. Fang and Eric Holdsworth, Edison Electric Institute (EEI)	This definition of the term "adaptation" differs from the one in the draft Glossary, Chapter 10. EEI believes that the Glossary definition should control unless there is a reason provided for deviation. None is provided here.	We agree and have made this change.
Page 2-3, Line 17	Tom DeLuca, The	The report finds that, "[i]n biological disciplines, adaptation refers to the process of genetic change within a population due to natural selection,	We disagree. First, the definition of adaptation in

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	Wilderness Society	whereby the average state of a character becomes better suited to some feature of the environment (Groom Meffe, and Carroll, 2006)." The scope of the definition of biological adaptation is greater than genetic; the definition provided in this report is too narrow and results in a limitation of available options. In its current state, the definition does not support alternatives suggested later in the report. At the least, update the text to match the definition on chapter 3, page 31, line 22. In order to correct the sentence, replace it with the following statement: "[i]n biological disciplines, adaptation refers to the process of change within a population due to natural selection, whereby the average state of a character becomes better suited to some feature of the environment" (Groom, Meffe, and Carroll, 2006). Adaptation of species to climate change can occur through phenotypic plasticity, evolution, or migration to suitable sites, with the latter probably the most common response in the past (Noss 2001)" (Source: Noss RF. 2001. Beyond Kyoto: Forest Management in a Time of Rapid Climate Change. Conservation Biology 15(3):578-590).	the biological sciences is indeed a genetic one. The ability to adjust to changes in the environment through plasticity is called acclimation (or acclimatization), and is most explicitly not synonymous with adaptation – nor is migration. Adaptation has a precise definition referring to evolutionary change through natural selection that alters the genetic makeup of populations. Further, we point out in the report that we are not using the biological definition of adaptation throughout the remainder of SAP 4.4 anyway, but rather the definition in use by the Climate Change community, which is the following: "Adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or

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			expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation." Note that this usage is distinct from the definition of adaptation in the context of evolutionary biology." This broad definition in no way limits the available adaptation options, but in fact expands the options beyond what is available from the perspective of biological adaptation. No change is necessary.
Page 2-3, Line 30	Tom DeLuca, The Wilderness Society	The report states that: "[t]he purpose of adaptation strategies is to reduce the risk of adverse outcomes through activities that increase the resilience of ecological systems to climate change stressors (Scheffer et al., 2001; Turner, II et al., Thompkins and Adger, 2004)." Adaptation strategies include the promotion of both resistance and resilience; the definition of adaptation strategies should include both of these terms. Correct this sentence by replacing it with the following: "[t]he purpose of adaptation strategies is to reduce the risk of adverse outcomes through activities that	We disagree. We have defined resilience to include resistance (see discussion of resilience in the Synthesis chapter). No change is necessary.

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		increase the resistance and resilience of ecological systems to climate change stressors (Scheffer et al., 2001; Turner, II et al., 2003; Tompkins and Adger, 2004)."	
Page 2-3, Lines 32-34	William L. Fang and Eric Holdsworth, Edison Electric Institute (EEI)	The sentence, beginning on line 32, defines the term "stressor" and states the source is the "U.S. Environmental Protection Agency, 2000". However, the draft Glossary also defines this term (p. 10-5). EEI fails to understand why the authors rely here on a 2000 EPA definition in light of the more recent Glossary. The SAPs should utilize the defined terms of each relevant Glossary unless there is a reason for deviation and it is explained. None appears here.	We agree that two different definitions should not be used and have changed the definition in the glossary to be consistent with what is in the text. No change is necessary to the Introduction.
Pages 2-4 – 2-5, Lines 42, p. 2-4 through line 12, p. 2-5	William L. Fang and Eric Holdsworth, Edison Electric Institute (EEI)	Section 2.2, p. 2-4, citing the National Research Council, states that "[s]takeholder interactions play a key role in maximizing the relevance, usefulness, and creditability of assessments and encouraging ownership of the results". The section then provides what it describes as "the appropriate composition of stakeholders for SAP 4.4", which "includes" a listing of four broad categories or ranges of such "Stakeholders". While the word "includes" could cover NGOs and others, it is not clear. However, we note that the several workshops for each of these chapters generally did not include such a broad range of stakeholders (e.g., p. 3-121 – the Forest Service workshop participants were largely governmental personnel; p. 4-51 – the National Park Service (NPS) apparently included in its workshop mostly NPS personnel, NPS retirees, and one person from a university plus an environmental NGO; p. 5-87, the Fish and Wildlife Service (FWS) held two workshops—one re: Alaska Refuges with all participants from the FWS and one broader workshop with FWS personnel and several environmental NGOs). We note that many of these Federal areas, and even non-Federal ecosystems and resources, often involve working relationships with energy and other business NGOs. However, the draft does not appear to mention their relevance and importance.	We think that the reviewers have misunderstood the purpose of these workshops and have clarified that purpose in the text. We had no intention of being comprehensive in our representation of every possible stakeholder group at these workshops. We knew that the public review of this document would provide all stakeholders with a chance to comment on it. We have clarified in the text that these workshops were meant to be small, targeted working sessions of experts in the resource management and

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		EEI thinks that broader stakeholder participation and involvement is clearly needed, not only for this report and its conclusions and recommendations, but most importantly for future assessments. Indeed, the report should explain how that should be achieved.	adaptation research fields to give us feedback on the scientific content and on the management options being considered to adapt to climate change. For each chapter, we will also provide a fuller list of those who were invited to each workshop, not just those who attended, so that the reader will know the intended breadth and make-up of each workshop. We disagree that this report needs broader stakeholder involvement. The authors vetted these chapters on numerous occasions and at their workshops with a number of individuals that could provide valuable feedback on the content of this report. And we disagree that this report should explain how broader stakeholder participation and involvement would be achieved for future assessments. No change is

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			necessary
Page 2-6, Lines 39-41	William L. Fang and Eric Holdsworth, Edison Electric Institute (EEI)	Citing the "Intergovernmental Panel on Climate Change (IPCC)", section 2.4.1 defines the term "[c]limate". First, we note that the cite does not reference which of the four IPCC assessments is being relied upon by the draft. Second, we point out that the definition is inconsistent with the IPCC's definition of "climate" in Annex B of its Working Group II's Third Assessment Report of 2001 which is: **Climate** – Climate in a narrow sense is usually defined as the "average weather," or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands of years. The classical period is 3 decades, as defined by the World Meteorological Organization (WMO). These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. We question why the SAP definition does not conform to that of the IPCC, which we think is long accepted. We note too that while the draft Glossary for this report defines the term "Climate Change", just as it is defined by the IPCC, the body of this draft appears to not reference that definition. We think it should.	We agree and have changed the definition in the intro to be the same as the definition in the glossary.
Pages: 2-6 – 2-7, Lines: 43, p. 2-6 through line 2, p. 2-7	William L. Fang and Eric Holdsworth, Edison Electric Institute (EEI)	The sentence beginning at p. 2-6, line 43, cites Working Group I of the IPCC regarding the "global average surface temperature over the last century". However, the statement seems inconsistent with Working Group I's Summary for Policymakers (SPM) comment about such temperature, which is as follows (p. 5): Eleven of the last twelve years (1995-2006) rank among the 12 warmest years in the instrumental record of global surface temperature (since 1850). The updated 100-year	We agree and made the following change to that paragraph: "This evidence includes an increase of 0.74 ± 0.18°C in global average surface temperature over the last century, and an even greater warming trend over

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		linear trend (1906-2005) of .74 [0.56 to 0.92]˚C is therefore larger than the corresponding trend for 1901-2000 given in the TAR of 0.6 [0.4 to 0.8]˚C. The linear warming trend over the last 50 years (0.13[0.10 to 0.16]˚ is nearly twice that for the last 100 years. The total temperature increase from 1850–1899 to 2001–2005 is 0.76 [0.57 to 0.95]°C. Urban heal island effects are real but local, and have a negligible influence (less than 0.006˚C per decade over land and zero over the oceans) on these values. (footnote omitted)	the last 50 years than over the last 100 years. Eleven of the last 12 years (1995-2006) are among the 12 warmest years since the instrumental record of global surface temperature was started in 1850 (IPCC, 2007b)."
Page 2-18, Line 1	Tom DeLuca, The Wilderness Society	Box 2.3. titled "Approaches to adaptation planning": The report continually uses the word "adaptation" for both 1) human responses to ecological adaptation needs and 2) organism/ecosystem adaptation to climate change impacts. This conflicting use makes the report difficult to understand. Change the title of Box 2.3 to "Approaches to management." Other sections of the report that use "adaptation" as a human response include Chapter 2, Page 18, Line 2; Chapter 3, Page 31, Line 22; and Chapter 3, Page 31, Line 28.	We disagree. We explain the difference between adaptation as defined by the IPCC and biological adaptation and then state that for the purposes of this report, we will use the IPCC's definition of adaptation: "Adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be

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			distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation." We made this distinction in definitions and uses clearer in the introduction but will not change the Table titles.
Page 2-18, Line 2	Tom DeLuca, The Wilderness Society	The report lists: "1. No adaptation: future climate change impacts are not planned for by the managing agency and are not acknowledged as likely to occur. 2. Reactive adaptation: climate change impacts are not planned for by the managing agency and adaptation takes place after the impacts of climate change have been observed. 3. Anticipatory adaptation…" As in Chapter 2, Page 18, Line 2 and Chapter 2, Page 18, Line 21, the report continually uses the word adaptation for 1) human adaptation and 2) organism/ecosystem adaptation. Adaptation will occur on some level by ecological systems. Those managing ecosystems have the option of no active management, (i.e. they may choose not to plan for responses, and not to improve/facilitate ecosystem resistance and resilience.). Again, the use of words is confusing; consider substituting 'adaptation,' in the context of human responses to ecological adaptation, with 'management' or 'response.' Change box 2.3 to state these options as management options: "1) No active management: future climate change impacts are not planned for by the managing agency and are not acknowledged as likely to occur 2) Reactive management: climate change impacts are not planned for by the managing agency and adaptation takes place after the impacts of climate change have been observed 3) Anticipatory management: …"	We disagree. We explain the difference between adaptation as defined by the IPCC and biological adaptation and then state that for the purposes of this report, we will use the IPCC's definition of adaptation: "Adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be

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			distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation." We made this distinction in definitions and uses clearer, but have not changed Box 2.3.
Page 2-18, Line 2	Tom DeLuca, The Wilderness Society	As mentioned in Chapter 3, page 39, line 15, an adaptive approach is one of our potential responses. The state of knowledge and the associated response as new information becomes available must be updated in order to adequately plan responses to climate impacts. The report currently includes this type of response in box 2.4, on chapter 2, page 18, and beginning on line 21 under 'Planning level' as 'recognition.' In reality it is an approach to planning and management, belonging in Box 2.3. This type of response is also used on chapter 3, page 39, line 15 under the term 'adaptive management.' Change box 2.3 to include this type of management approach by adding a 4th approach that states: "4. Active adaptive management: future climate change impacts are acknowledged as likely to occur by the managing agency and monitoring of potentially affected systems is set in place; responses to those impacts are planned for and reviewed as new information becomes available" (Source: Hansen LJ, Biringer JL, Hoffman JR (eds.) 2003. Buying Time: A User's Manual for Building Resistance and Resilience to Climate Change in Natural Systems. World Wildlife Fund).	We disagree. While we appreciate the suggestion of adding this as a fourth approach to adaptation planning, adaptive management is not a planning approach *per se*, it is an approach to implementing any given adaptation strategies. It is the way in which implementation may be carried out that encourages experimentation and learning to inform the planning process. No change is necessary.

4. National Forests

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Tom DeLuca, The Wilderness Society,	The objectives of the "Adaptation Options for Climate-Sensitive Ecosystems and Resources" as applied to Chapter 3 can be interpreted as follows: (1) provide a synthesis on the combined effects of climate change on forest ecosystems; (2) provide management strategies to reduce the risk of negative outcomes; (3) discuss opportunities or barriers that might influence the successful implementation of adaptation strategies. Unfortunately, in this effort Chapter 3 falls well short of expectations and fails to deliver a meaningful analysis on adaptive strategies, opportunities, or barriers. The general approach of Chapter 3's authors was to assume that system engineering (e.g. aggressive silvicultural treatments) is the primary means by which to improve the resiliency of forest ecosystems to climate change and that all impacts from climate change (e.g. increased wildfire occurrence) would require engineered solutions. This Chapter provides a weak and incomplete analysis of the potential impacts of climate change and does not adequately or accurately portray the concepts of resiliency or resistance. The authors fail to acknowledge that past forest practices are one of the major contributing factors to the current condition of our forests and their potential lack of resilience to climate change. There is little consideration of the role of ecological processes and attainment of resiliency through restoration of natural forest processes. The authors further appear to advocate management of the National Forests as an industrial timber plantation for the purpose of maximizing carbon sequestration. Many findings in Chapter 3 are based on conjecture, and although literature is cited in some cases, it is often mis-cited or not directly linked to the inaccurate statement. Clearly our public forest lands will be greatly influenced by climate change over the	We disagree with the reviewer's characterization of the chapter. We do not advocate a system engineering approach to adaptation. Nor do we advocate managing NFs as industrial timber plantations either for fiber or carbon. RE: Carbon sequestration. We included that discussion here because there is widespread discussion regarding potential uses of NFs for C sequestration, bioenergy, etc. It is important to point out that there are both possible tradeoffs and synergies between adaptation and mitigation options. We also disagree that we incorrectly characterized resilience and the reviewer is referred to the Prospectus for the definition of resilience there, which we used. We also disagree that our findings are based on conjecture; They were based on the literature and expert elicitation as we stated in the text. RE: reducing CC impacts via vegetation management. We included several other ideas / approaches as well. No change necessary.

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	next several decades making this document a potentially important contribution to a national management agenda. It is our feeling this Chapter grossly overestimates the efficacy of timber management in reducing the impact of climate change and grossly underestimates the power of ecological processes in maintaining resiliency in the face of climate change induced stressors. For these reasons, we suggest that this chapter undergo a major revision prior to release. Below are specific line by line comments; however, the very underpinnings of the chapter are flawed, thus limiting the likelihood for a successful re-write using the current structure and content.	

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Page 3-14, line 3	Tom DeLuca, The Wilderness Society	The report contains an important text omission by excluding consideration of past timber management as a stressor. This is a gross and inexcusable omission. Past timber harvests are greatly to blame for the current condition of our forests. For example, the 120 year old lodgepole pines that remained after the wholesale clear-cut operation in Butte at the turn of the century are currently plagued by the bark beetle. Multi-aged stands and mosaics on the landscape would have been far more resilient to the onslaught of climate change, insects, and diseases that are now evident and pervasive. Numerous other examples from all forest types could be listed. Unfortunately, past timbering activities are responsible for this forest's current stressed condition. Using harvesting to solve climate related stresses appears to be a circular mistake.	We agree and have added a paragraph to the major stressors section that briefly discusses the (past and present) stress caused by extractive activities (logging, grazing, and mining). The initial draft described logging, grazing, and mining in the Management and Approaches section as there are management controls in place that aim to mitigate / minimize the environmental impacts of these current activities. The USFS is only recently developing strategies

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			and methods to address the major stressors described in this section of the chapter.
Page 3-36, Line 22-24	Jaelith Hall Rivera, The Wilderness Society	The authors discuss large-scale thinning as an option to reduce stand densities in order to minimize drought effects, avoid large wildfire events, and insect and disease outbreaks under a changing climate. While they rightly point out that not all forest landscapes are amenable to thinning, the alternative they present is shelterwood cutting. These are very narrow management options, focused almost exclusively on silvicultural practices. Other management tools, like restoration of fire regimes through fire use or prescribed fire, should also be included. In addition, large wildfire events should not always "be avoided." In many high altitude forested ecosystems, large, stand-replacing fires are the norm. If fires in these landscapes do not present a danger to people or property, it should not be assumed that large wildfires need to be avoided or "managed away."	We disagree that the chapter is focused on very narrow management options. This text is only one example of many contained in the text. Additional examples are presented in this section and later sections which include what the reviewer is advocating. The text includes a discussion of the role of prescribed fire and restoration of historical fire regimes as management options for enhancing resilience. We have added text here to clarify that large wildfire events are typical in some areas, and that thinning may not be appropriate in some high elevation forests.
Page 3-36, Line 29	Tom DeLuca, The Wilderness Society	The report states: "However, not all forest landscapes and stands are amenable to thinning. In these situations, shelterwood cutting that mitigates extreme temperatures at the soil surface can facilitate continued cover by forest tree species while mitigating risks of fire, insects and disease (Graham et al., 1999). This approach is economically feasible in locations where wood	We disagree with the reviewer's suggestion because shelterwood may not be an appropriate silvicultural treatment depending on the objectives and tree species in

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		removed through thinnings and shelterwood cuttings can be marketed as small-dimensional wood managers in support of such an anticipatory approach to adaptation, it is critical that scientists and managers form a growing mutual understanding of information needs and research capabilities in the context of ongoing, trusted relationships (Slovic, 1993; Earle and Cvetkovich, et al., In Press). Further examples of such information needs are described in the next section and in the case studies (Box 3.6)." Delete these statements. It is crucial to note the role of genetic diversity in natural adaptation of an ecosystem. Shelterwood systems do not leave adequate residual genetic diversity, and should not be used in the place of thinning. (Source: Ledig FT. 1992. Human impacts on genetic diversity in forest ecosystems. OIKOS 63: 87-108; Colombo SJ, Buse LJ. (eds.) 1998. The Impacts of Climate Change on Ontario's Forests. Canadian Forest Service Forest Research Information Paper No. 143).	a particular stand. However, we do agree that it is important to highlight the need for attention to genetic considerations as well as the need to assess trade-offs between genetic erosion and benefits of the silvicultural practices to enhance tree growth and vigor and to reduce fire risk. We changed the text in the referenced section accordingly.
Page 3-46, Lines 16-26	Tom DeLuca, The Wilderness Society	While the report flags the promotion of connected landscapes, it does not suggest effective mechanisms to address them. Since the report is entitled "Adaptation Options" it should recommend solutions to the climate challenges it highlights.	We disagree. Ascertaining effectiveness of a particular strategy can only be done via evaluation. This report aimed to provide some ideas for potential adaptation options. Developing specific and prescriptive strategies and interventions for particular places was beyond the scope of the report and was viewed as being best left to agency staff in consultation with local stakeholders. It would be

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			overly prescriptive (and stepping beyond the authors' mandate) to say how to go about connecting landscapes. No change necessary.
Page 3-54, Lines 21-26	Tom DeLuca, The Wilderness Society	The report states that "[w]hile certain kinds of standardized post-fire restoration practices (e.g., Burned Area Emergency Rehabilitation procedures) are not climate-proactive, a post-event recovery team at the Pacific Southwest regional level is investigating dynamic approaches to recovery post-major disturbance. These approaches might include planning for long-term changes on disturbed sites and taking advantage of new planting mixes, broadening gene pool mixes, planting in new spacing and designs, etc." Here and elsewhere, post treatment monitoring is not discussed. Monitoring of treatment success is absolutely necessary for adaptive management, yet it is not prominently (if ever) discussed in this whole section.	We disagree with this comment. The conclusion (section 3.7.3.2) identifies monitoring as a major data gap and something that should be developed and implemented.
Page 3-57, Lines 21-28	Tom DeLuca, The Wilderness Society	The report finds that checkerboard ownership in Tahoe NF presents management obstacles. The report fails to recommend "adaptation options," or effective mechanisms, as solutions to climate challenges. Checkerboard ownership could fragment federal lands and make them less effective refuges for large populations of at-risk species. USFS research should identify highest priority inholdings and funding to purchase these lands from willing sellers must be an integral part of NFS policy and budget.	CCSP guidance precludes the kind of specific recommendation (including budgetary) suggested here. No change necessary.
Page 3-58, Lines 15-21	Tom DeLuca, The Wilderness Society	This section recognizes the challenges posed by remote settlements that are increasing the wildland-urban interface. However the report does not identify adaptive solutions in light of climate change. Development that extends wildland-urban interface increases human-induced impacts from introduction of	As noted above, CCSP guidance precludes making the kinds of statements that the reviewer recommends. No change necessary.

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		invasives to fire-susceptible dwellings and intolerance of smoke from prescribed fire. Forest Service must ramp up public education and advocate for land use regulations that discourage remote developments.	
Page 3-58, Lines 30-34	Tom DeLuca, The Wilderness Society	The report states that small management units make landscape management difficult. However, the report does not recommend "adaptation options," or effective mechanisms, as solutions to climate challenges.	We disagree. See lines 9-13 on p. 56. No change necessary.
Page 3-59, Lines 17-19	Tom DeLuca, The Wilderness Society	The report states that carbon markets and biomass will promote incentives for active adaptive management. Expanding biomass markets create both opportunities and threats. USFS needs to anticipate the possible negative impacts of expanding biomass markets, as well as noting the possibility that these markets will provide financial support for restoration to improve fire regimes. Overzealous biomass harvesting could damage resilience of forests to climate change (increased even-age management over large acreages that become more uniform, perhaps drier due to exposure, and hence more vulnerable to climate stresses). USFS should provide analysis and research capacity to anticipate possible negative impacts of biomass energy growth, and promote sustainable harvesting standards that protect forest health.	Although we agree with the reviewer's concern, space limitations preclude a more thorough analysis (than that given in lines 27-28, p. 78) given that issues related to mitigation are beyond the report's scope. No change necessary.
Page 3-67, Lines 39-46	Jaelith Hall Rivera, The Wilderness Society	This is one of the only places in the National Forest Section of this report that the management tool wildland fire use is mentioned. This management tool is one of the best ways to restore forest resiliency to climate change, while also reducing suppression costs and hazardous fuels. It should be discussed more thoroughly in the body of the report, not simply in a few lines in one case study.	We agree that this particular management approach is not specifically discussed outside of the case studies. We have revised the text to give more details on the current management approaches outlined in the National Fire Plan, of which wildland fire use and prescribed burning are

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			included.
Page 3-72, Lines 10-15	Tom DeLuca, The Wilderness Society	**"**Future water scarcity or less even-seasonal distribution will require a return to early National Forest emphasis on water management as a prime purpose. Prescribed fire management to shift Uwharrie NF to more fire and drought-tolerant species will increase water yields due to wider tree spacing. In the face of droughts and water shortages, National Forests may face pressure to increase water yield by reducing tree biomass in order to reduce evapotranspiration." The Forest Service will need to understand how management for increased water yield reinforces or conflicts with the goals of enhancing forest carbon stores and increasing ecological resilience to climate changes.	Although we agree with the reviewer's point, the chapter does acknowledge the need to assess potential trade-offs / conflicts between managing NFs for carbon and managing it for other values. No change necessary.
Pages 3-26, Line 40 and Page 3-27, Lines 1-3	Mary Krueger, The Wilderness Society, The Wilderness Society	The authors state that forest productivity will increase as CO_2 increases but that productivity is "expected to peak by 2030 and then start declining…" ***and*** "The feasibility of taking advantage of these opportunities may hinge on whether economic, political, and logistical barriers can be overcome (Richards, Sampson, and Brown, 2006), and fires can be prevented 4 (Scholze *et al.*, 2006)." This document seems divorced from the realities of National Forest System management. The barriers to organizational change are understated. If productivity increases are expected to peak by 2030 and decline thereafter, today's land managers using today's planning processes and formats will have to begin to address effective responses to climate change. The year 2030 is a little over 22 years away. That is only slightly longer than the (actual - 15-20 + years, as opposed to required - 10-15 years) planning period for a Land and Resource Management Plan (Forest or Grassland Plan). It's but a fraction of the planning horizon (150-200 years) typically used to evaluate likely	We disagree with the reviewer's assertion that the recommended management adaptations pertaining to planning are impractical. Land management plans for NFs can be (and are) amended as needed. No change needed.

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		conditions and determine desired conditions. Absent radical change in land management planning schedules, which the agency is not proposing, revision of those land management plans completed in the last few years will not occur again until sometime in the 2020s. Budgets, staffing and institutional resistance to planning make it likely that this will not change. For those forests that have yet to complete or start plan revision, agency direction will need substantial changes in order to push land management planning efforts in the direction desired. The 2005 Planning Rule (currently being analyzed in an EIS) will not provide this direction. Without substantial change in planning and implementation focus at the Forest and Grassland level, reactive management is the most likely future outcome.	
Page 3-34, Lines 23-26	Mary Krueger, The Wilderness Society	The term "short-term" needs to be understood in the context of Forest Service (FS) management and current laws, regulations, and practices. A "short-term high-value short-rotation timber" project usually has a 7-10 year harvest window from the time the first tree is cut. This has nothing to do with appeals and litigation of land management activities but is solely a function of contracting law and constraints on harvest speed meant to protect the U.S. Government (and U.S. taxpayers) from financial harm and the federal land base from environmental harm. Add to that time frame the reforestation time frame (reforestation must occur within 5-years of the end of the project, which could be decades into the future since the FS often starts the clock after the overstory removal cut of a two-stage harvest) and any required mitigation to "put the sale to bed" and it becomes easy to see that there really is no such thing as a "short-term" project. The only types of projects that should meet the criteria "not critical to	We disagree. In the context of the section referred to by the reviewer, 'short-term' refers to fruition of existing projects. No change necessary.

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		prepare for climate change" will be those projects currently under contract at the time the FS decides to issue definitive direction to the field. And even then, given the current speed of federal action, some contracts may need to be revisited.	
Page 3-35, Lines 32-36	Mary Krueger, The Wilderness Society	The report states that "[c]onstraints to implementing such changes may need to be removed in advance for timely adaptation to be able to occur when the opportunity arises." Additionally, the report refers to "[s]ignificant cost efficiencies, relative to the unplanned approach, may be achieved…" and "[c]onstraints to implementing such changes may need to be removed in advance…" Planned responses must incorporate review of potential actions in anticipation of implementing necessary management actions. In Addition, many of the barriers to effective management response in this case are a function of how - and when - Congress funds the Forest Service and how the Forest Service Washington Office funds the field. This problem is common to all land management agencies. Significant changes, and a great deal of creative thinking in order to avoid unintended consequences, will be needed to overcome these barriers especially at the Congressional level. Change the sentence beginning on line 34 to state: "Constraints to implementing such responses in a timely manor will require that forest managers run planned responses through appropriate analysis (e.g. NEPA review process) in anticipation of need before opportunities arise. In addition, Congress and agency leadership must address how and when these management activities are funded in order to effectively take advantage of adaptation opportunities.	Although we disagree with this comment, it is evident that the text could be easily misinterpreted. The point here was to say that a proactive adaptation approach to planning may mean that future barriers to implementing adaptation options will need to be anticipated and planned in advance. We clarified the text to elucidate the nuances implied.
Page 3-36, Line 34-37	Mary Krueger, The Wilderness Society	"To provide the most relevant information…it is critical that scientists and managers form a growing mutual understanding…in the context of ongoing, trusted relationships." The extent to which this is a barrier within the Forest Service should be	We disagree. We did not mean to imply that there is a wall (or even poor communication) among

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		identified and addressed. There has traditionally been a wall between branches of the agency, particularly between Research and the National Forest System. This (sometimes explicitly stated) wall has kept scientists and managers from interacting and learning from each other and has by extension also kept land managers from a lot of contact with the academic community. Specific agency direction may be needed to make this institutional change.	different branches within the USFS. We understand the opposite to be true. We would agree that the process of communicating scientific results and the transfer of that information to managers is dependent upon both scientists and managers working together to develop a mutual understanding of the current knowledge and information need. We have revised the text to reinforce that concept. With regard to the last sentence of the comment, CCSP guidance precludes prescribing specific agency actions / directions within this document. No change necessary.
Page 3-39, Line 34-36	Mary Krueger, The Wilderness Society	"Learning from experience and iteratively incorporating lessons into future plans - adaptive management in its broadest sense - is an appropriate lens…" In the last few years the Forest Service has spent a lot of time talking about adaptive management. The concept is imbedded in the 2005 Planning Rule (which is currently legally enjoined). The problem is that the agency seems to have forgotten in all this talk that monitoring, evaluation and reporting are key components of adaptive management; of "learning from experience." The agency has divorced land	We agree that we need to clarify our use of the term 'adaptive management'. We have introduced the concept of adaptive management in the Management Approaches section.

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		management planning and monitoring and evaluation from each other, thus removing requirements to accomplish any monitoring activities. The Forest Service (particularly NFS) has then made monitoring an "if we have the time, staff and money" activity, which of course means little or no action is taking place. The current course of action (or inaction) points to a future filled with appeals and litigation and hit or miss failures at the implementation level should monitoring remain a missing component of adaptive management.	
Page 3-16, Line 15-18	Jaelith Hall Rivera, The Wilderness Society	The report states that "warmer temperatures, in combination with their greater flammability of dead biomass associated with beetle mortality, set up some ecosystems for increasing dominance by lower elevation fire-tolerant species such as ponderosa pine and Douglas-fir…" This statement is unsupported by the facts. While flammability may increase temporarily immediately following beetle mortality, the subsequent loss of needles should render the stand less flammable. The relative flame resistance of dead trees has been observed from spruce beetle kills on the Kenai Peninsula to spruce budworm mortality in Colorado Douglas-firs. But even if it were true that dead trees were more flammable, fire would favor the reestablishment of lodgepole pine, not increased representation of other species.	We agree with the suggested revision and have modified the text.
Page 3-32, Lines 5-9	Jaelith Hall Rivera, The Wilderness Society	The report discusses management practices that "lower forest vulnerabilities to wildfire." This is counter-intuitive. It may be appropriate, in some instances, to develop and implement practices to lower forest vulnerabilities to <u>unnaturally severe</u> wildfire. However, this sentence implies that wildfires are unwanted in all forest systems and that forests are "vulnerable to wildfires." In fact, just the opposite is true. Most forested ecosystems in the United States are uniquely adapted to, and dependent upon, natural wildfire.	We agree with the reviewer's point that this could appear counter-intuitive as stated. We have revised the text to use the term used in the current FS strategic plan -- 'uncharacteristically severe' wildlife.

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Page 3-35, Lines 9-30	Jaelith Hall Rivera, The Wilderness Society	The report points out that large disturbances could be "windows of opportunity" for implementing adaptive practices, such as reforesting with species tolerant to low soil moisture and high temperature, using a variety of genotypes in the nursery stock, and moving plant genotypes and species into the disturbed area from other seed zones." Other adaptive practices include using disturbed landscapes as "management experiments" by, for example, reforesting an area after a fire or windfall event with a type of tree species that is better adjusted to the new or unfolding regional climate. The idea of "management experiments" is consistent with the uncertainty that accompanies climate change; however, such experiments must be designed at the landscape or regional level and involve a range of treatments, including maintenance of a significant portion of the land in reserves, such as wilderness, parks, and research natural areas. These experiments cannot be simply *ad hoc* "trial and error" following disturbance. "Assisted migration" may play a role in these experiments, but the post disturbance environment should not be treated simply as template for novel forms of plantation management.	We disagree with some parts of this comment and agree with others (e.g., experiments should be carefully planned and monitored). But, our intent was not to imply that all (or even any) of these management experiments would represent opportunities for creating new plantations or even plantation management. We have modified the text to add the importance of evaluation in the context of these management experiments.
Page 3-40, Lines 41-44 and Page 3-41, Lines 4-39	Jaelith Hall-Rivera, The Wilderness Society	The report notes that one set of adaptive options is to manage forest ecosystems and resources so that they are better able to "resist the influence of climate change." This is a sound management concept. However, the suggested methods focus almost solely on aggressive silvilcultural treatments. As mentioned in a previous comment, intensive harvesting has contributed to forests' negative response to stress. In addition, the implication, once again, is that fire is something that forests must "resist". This view is too narrow. One important way forests will be able to resist the effects of climate change is through restoration of key functions and processes, like fire. Other	We agree and have revised the text to include other management options to resist the influence of climate change.

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		restoration tools, like obliterating roads, protecting roadless landscapes, reducing fragmentation, etc., are also critical in helping forests resist the effects of climate change. Tools beyond silvicultural prescriptions should be discussed in this section.	
Page 3-41, Line 1-8	Tom DeLuca, The Wilderness Society	Is the assumption that resistance to climate change can be attained through harvesting timber and spraying weeds? Programmatically, a more ecologically sound approach to dealing with climate change is recommended. As stated before, this report leaves the reader convinced that simple silvicultural prescriptions can effectively reduce the impact of climate change. There is no sound basis for this argument. For context, about 8 million acres of land burned this year alone, which is an enormous amount of fuel reduction. It is impossible for timber harvests and fuel treatments to reach this level of fuel reduction, and these treatments do not accomplish the restorative effects that fire brings to the landscape.	We disagree. The chapter does not intentionally imply that timber harvesting and other silvicultural treatments are the only adaptation options to increase resistance. However, to avoid the potential for misinterpretation, we have emphasized the multiple benefits of reducing current anthropogenic stressors and current efforts to conserve biodiversity.
Page 3-41, Lines 27-28 and Page 3-42, Lines 39-41	Mary Krueger, The Wilderness Society	The report states that "mixed species plantations be developed, or that plantations are switched…", ***and*** refers to "intensive site preparation…replanting with high-quality, genetically appropriate and diverse stock, diligent stand improvement practices…" The authors seem out of touch with the realities of National Forest System (NFS) management. The references to plantations are confusing. Are the authors proposing a reversal of agency efforts over the last decades to get rid of NFS plantations? The level of site preparation, replanting (as opposed to natural regeneration), and stand improvement practices proposed also seem out of step with current agency practices and funding levels. Significant increases in funding will be needed if these activities are to be used more extensively in the future.	We disagree. We have modified the text according to comments on the same text by a reviewer below
Page 3-56,	Tom DeLuca,	The report identifies salvage logging as watershed management,	We agree that salvage logging

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Location	**Reviewer**	**Comment**	**Author Response**
Lines 20-24	The Wilderness Society	"[t]o decrease erosion and sediment loss following disturbance, there is widespread need in Tahoe NF to salvage-harvest affected trees and reforest soon after disturbance. This is the plan at present, but mostly cannot be implemented in adequate time due to time required for NEPA processing and general public opposition." The effects of salvage logging are quite the opposite. Salvage logging will in no way reduce erosion rates and will actually potentially increase erosion rates by increased soil exposure and soil compaction.	has a variety of responses depending upon the location and type of logging. These comments came from the managers in the TNF. No change necessary.
Page 3-77, Lines 37-42 and Page 3-75, Lines 1-2	Mary Krueger, The Wilderness Society	"There may also be a need to shift focus to managing for change, setting a goal of desired future function… The 2005 Planning Rule describes desired conditions as… Defining a goal as an ecosystem condition…could be undermined…" This is when timeliness and coordination of federal efforts comes into play. The Forest Service is currently in the process of trying to codify "desired conditions" as an integral component of the 2005 Planning Rule and thereby an integral component of future land management plans. Desired future functions have never been discussed by the agency in the planning context to date. Yet here the authors point out the likely failure of the desired condition approach in light of climate change.	Because the reviewer misinterpreted the text we have revised it to clarify that we are referring to the general process of planning vs. the specific details as elaborated in the 2005 planning rule.
Page 3-76, Lines 3-25	Jaelith Hall Rivera, The Wilderness Society	The report states that "appeals and litigation have restricted implementation of adaptive management practices and in some cases research experiments." This is a very broad statement and, in fact, recent studies seem to suggest the opposite. For example, regarding hazardous fuels reduction, both the GAO and Northern Arizona University found that wildfire prevention efforts are not hampered by the public comment and appeals process. If numbers to back up this assertion are not available or do not support this statement, it should be removed.	We agree. We have deleted this text from the chapter.
Page 3-76,	Mary Krueger,	"The 2005 Planning Rule specifically directs the Responsible	We disagree with the

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Lines 30-31	The Wilderness Society	Official to look at the larger landscape including across ownerships." This direction is contradicted by the new definition of "reasonably foreseeable future actions" and changes in how cumulative effects are to be analyzed as proposed by the Forest Service in 36 CFR Part 220 (Federal Register, Vol. 72, No. 158, pages 45998-46009). This new direction would allow land managers to essentially ignore anything happening on adjacent or nearby private land and other agency lands if "existing decisions, funding or identified proposals" have not occurred. Unfortunately, the specific direction in the FS NEPA regulations would likely limit the extent of the look as directed in the FS Planning Rule.	reviewer's conclusions and suggest that a definitive statement can not be made until the new planning rule is finalized. We have deleted the reference to the 2005 planning rule from the chapter as it is no longer the guiding language.
Page 3-9, line 34-39	Jaelith Hall Rivera, The Wilderness Society	The report states that "ecosystem composition, structure, and function will change as species respond to these changes in climate. Thus, as climate change interacts with other stressors to alter National Forest ecosystems, it will be important to focus as much on maintaining and enhancing ecosystem processes as on achieving particular composition." This is a critical point. One of the key ecosystem processes that must be maintained and enhanced is fire. While the report notes that fire is a major driver of forest dynamics (Chapter 3, Page 3-12, Line 16) and that "lack of fire or altered fire frequency and intensity are considered sources of stress in those ecosystems dependent upon fire (Chapter 3, Page 3-12, Line 23-25), most of the remainder of the National Forests section seems to imply that fire is something we want to "keep out" of forests or build up forests' resistance to. These types of statements appear in Chapter 3, Page 3-32, Line 5-9, Chapter 3, Page 3-36, Line 22-24, Chapter 3, Page 3-42, Line 25-46 - among other places.	We agree. We have revised the text to make sure that the chapter does not imply that fires are universally 'bad' and must be suppressed. That implication was certainly not our intent.
Page 3-20, Lines 11-12	William L. Fang and Eric	The sentence beginning on line 11 refers to "[c]hanges in climate", while the sentence beginning on line 13 refers to	We agree. To avoid confusion, we add the term

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	Holdsworth Edison Electric Institute (EEI)	"[c]limate change". The term "Climate Change" is defined in the draft Glossary. However, the term "climate" is not. The Intergovernmental Panel on Climate Change's (IPCC) Working Group II report for the Third Assessment Report defined "climate" as follows: **Climate –** Climate in a narrow sense is usually defined as the "average weather," or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands of years. The classical period is 3 decades, as defined by the World Meteorological Organization (MWO). These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. We ask whether the IPCC's definition of "climate" applies equally to the above sentence. We think it should, particularly since the report relies heavily on the IPCC as a source.	'climate' to the glossary along with the IPCC definition.
Page 3-26, Lines 3-6	Jaelith Hall Rivera, The Wilderness Society	The report points out that "at this time, the challenges associated with the harvest of small-diameter low value trees and residues are related to transportation costs and distance to markets." In fact, there are numerous other challenges associated with the harvest of small-diameter trees, many of which are just as important as transportation costs and distance to markets. These include sustainability of supply, availability of supply, the amount of water necessary to convert woody biomass to ethanol, and the impact of small-diameter tree removal on forest soils. These challenges should also be noted here. Focusing only on transportation costs and distance to markets is too narrow.	Although we agree with the reviewer's point, this text was deleted in the revision, as we cannot devote space to cover the numerous challenges comprehensively.
Page 3-26,	Jaelith Hall	The report states, "[m]any suggested approaches [for the National	We disagree with the

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Lines 3-6	Rivera, The Wilderness Society	Forests] duplicate long-recognized best forest management practices, where goals are to maintain healthy, vigorous growing stock, keep sites fully occupied with minimal spatial or temporal gaps in non-forest conditions and minimize disturbance by fire, insects and disease. Projects planned to delay return of CO_2 to the atmosphere, both in situ and post-harvest are most successful." Consistent with the tone of the chapter, this section would seem to advocate management of the National Forests as an industrial timber plantation for the purpose of maximizing carbon sequestration. Contrary to earlier suggestions, such treatment would be inconsistent with forest ecosystem management practices that recognize the National Forests as complex ecosystems. Many of the problems now plaguing the National Forests - problems that are made more acute by climate change - were created by this narrow-minded treatment of National Forests as industrial plantations. Minimization of post-disturbance "understocking," management for "full site occupancy," and futile attempts to eliminate fire and insects from the forest are the practices that resulted in the habitat loss that now endangers so many species. There is a role for carbon management on the National Forests, but it should be consistent with the goal of maintaining ecosystem composition, structure, and function.	reviewer's characterization of the chapter and think the reviewer misinterpreted the referenced text. The point we tried to emphasize was that many best management practices for reducing current anthropogenic stressors are also adaptive for climate change. In the revision, this text was placed in Goal 5 of the new FS Strategic Plan. The outcome for this goal is forests and grassland with sufficient long-term multiple socioeconomic benefits to meet the needs of society. Specific objectives are focused on providing a reliable supply of forest products and rangeland productive over time that is consistent with achieving desired conditions on NFS lands and helps support local communities, meeting energy resource needs and promoting market-based conservation and stewardship of ecosystem services.. This context should stress the balance between

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			goods and service and stewardship of ecosystem services
Page 3-31, Line 20	Tom DeLuca, The Wilderness Society	The report currently states: "[o]rganisms respond to environmental change (including climate change) in one of three ways: adaptation, migration, or extinction." However this statement conflicts with the very next sentence on that page, and also with definitions given in other sources (Source: Noss RF. 2001. Beyond Kyoto: Forest Management in a Time of Rapid Climate Change. Conservation Biology 15(3):578-590). Migration is a type of adaptation, and should not be included in the above sentence. If it is included, consider including other types of adaptation such as phenotypic plasticity, genetic change, etc. The best scenario might be to eliminate the sentence, relying instead on the sentence that follows in the text: "Adaptation typically refers to in situ phenological (e.g., breeding, flowering, migration), behavioral or genetic changes, but also includes in situ acclimation (adaptation to the changing environment while remaining in place)."	We disagree. We prefer to keep the sentence as it is because this description characterizes different aspects of how organisms can respond and these different aspects are further discussed in the text. No change necessary.
Page 3-31, Line 28	Tom DeLuca, The Wilderness Society	The report states that "[w]e focus on adaptation as interventions and adjustments made by humans in ecological, social, or economic systems in response to climate stimuli and their effects, such as fire, wind damage, and so on." As in Chapter 2, Page 18, Line 2 and Chapter 2, Page 18, Line 21, the report continually uses the word adaptation for 1) human adaptation and 2) organism/ecosystem adaptation. This conflicting use makes the report difficult to understand. Consider substituting "adaptation" (human) with "management" or "response." Consider replacing the text with: "We focus on management responses that enable adaptation through adjustments made by humans in ecological, social, or economic systems in response to climate stimuli and	We disagree with the reviewer's suggestion. The report specifies what we mean by 'adaptation' in the Introduction and we have endeavored to use the term in our chapter so that it is consistent with its use in the remainder of the report. No change necessary.

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		their effects, such as fire, wind damage, and so on."	
Page 3-31 – 3-32, Lines 30-33 on p. 3-31 and lines 15-17 on p.3-32	William L. Fang and Eric Holdsworth Edison Electric Institute (EEI)	The sentence beginning on line 30, p. 3-31, appears to define the term "adaptation", used in section 3.3 titled "**Adapting to Climate Change**" and 3.3.1 "**The Need for Anticipatory Adaptation**" and subsequent sections and thereafter in the draft. The sentence beginning on line 15, p. 3-32 defines "adaptive capacity". However, the source for both definitions is neither the draft Glossary (p. 10-1), which also defines "adaptation", "adaptive capacity", as well as "anticipatory adaptation" and adaptive management", as well as (at p. 10-3) "maladaptation". Instead, the source for "adaptation" is "Smit and Wandel, 2006". We believe that the draft should be bound by the Glossary definition unless there is a stated reason for deviating from the Glossary. Clearly, none is stated here.	We disagree. This section of the chapter provides additional context for readers and, moreover, explains that it is important to consider the different connotations of the term 'adaptation'. The beginning of the paragraph in question (line 28) is completely in agreement with the glossary definition. And the definition given from the social science literature is also consistent with the glossary definition. The subsequent paragraphs and the rest of the chapter do use the glossary definition. No change necessary.
Page 3-31, Line 35	Tom DeLuca, The Wilderness Society	The report states "[h]uman adaptation to climate change impacts is increasingly viewed as a necessary complementary strategy to mitigation…" As in Chapter 2, Page 18, Line 2 and Chapter 2, Page 18, Line 21, the report continually uses the word adaptation for 1) human adaptation and 2) organism/ecosystem adaptation, making the report difficult to understand. Consider substituting "adaptation" (human) with "management" or "response." Change the text to read: "Human action to facilitate or enable adaptation to climate change impacts is increasingly viewed as a necessary complementary strategy to mitigation…"	We disagree. Please see our response to the previous 2 comments. No change necessary.
Page 3-31,	Tom DeLuca,	The sentence, "[o]ptions for minimizing return of carbon to the	We disagree with the

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Line 35	The Wilderness Society	atmosphere include storing carbon in wood products (Wilson, 2006), or using biomass as bioenergy, both electrical and alcohol-based," should be deleted. This section is on the need for anticipatory adaptation (anticipatory management to facilitate adaptation), not mitigation, or even the nexus between adaptation and mitigation. As a result, the entire paragraph itself does not fit within this section. Additionally, the amount of carbon stored in wood products is a small fraction of the total carbon stored by standing trees. When emissions from logging residue and harvest, processing, and transport are accounted for, wood products storage becomes a questionable carbon sequestration strategy (Source: Ingerson, Ann L. 2007. U.S. Forest Carbon and Climate Change. Washington, D.C.: The Wilderness Society.).	reviewer's assertion that we should not mention mitigation options. A complete discussion of adaptation in National Forests must consider the potential synergies and trade-offs of adaptation and mitigation approaches. No change necessary.
Page 3-31, Line 42-44	Jaelith Hall Rivera, The Wilderness Society	The report states "[f]orest management practices designed to achieve mitigation goals of reducing greenhouse gases (CO_2 in particular) are diverse and have large potential mitigation contributions on the global to regional scales. Options for minimizing return of carbon to the atmosphere include storing carbon in wood products, or using biomass as bioenergy, both electrical and alcohol-based." Wood products and bioenergy may play a role in reducing carbon inputs to the atmosphere, but they are no panacea. The energy costs of harvesting and processing forest products and the potential release of carbon from the post-harvest environment must be factored into the total energy balance equation. If transportation distances, harvest inefficiencies, or ecosystem releases are too great, harvests may result in a NET LOSS of carbon to the atmosphere. The report should be written to acknowledge these potentialities.	We disagree. Although C storage in wood products and bioenergy options are no panaceas. any serious discussion and assessment of adaptation options in NFs would be incomplete if these issues were not mentioned or discussed at all. The report already mentions that there are potential tradeoffs between adaptation and mitigation approaches. A more detailed analysis is beyond the report's scope. No change necessary.
Page 3-33, Line 18	Tom DeLuca, The Wilderness	This line of the report currently states: "3.3.1.1 No Active Adaptation: An approach of 'no active adaptation' could be	We disagree. See our responses to similar

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	Society	described as event- or crisis-driven…" As in Chapter 2, Page 18, Line 2 and Chapter 2, Page 18, Line 21, the report continually uses the word adaptation for 1) human adaptation and 2) organism/ecosystem adaptation. This dual usage is confusing. The content later in this section uses the more appropriate term "reactive approach" and "response." Change the text of line 18 to match the content: "3.3.1.1 No active management: An approach of "no active management" could be described as event- or crisis-driven..."	comments above. No change necessary.
Page 3-34, Lines 23-26	Mary Krueger, The Wilderness Society	"Short-term projects, such as high value short rotation timber about to be harvested, could be considered not critical to prepare for climate change, assuming that the harvest will occur before…indirect effects of climate change emerge." This sentence should be dropped. It is not just about what happens up to the point the trees are cut, but what happens afterwards, how the ecosystem responds, whether reforestation goals are met, etc. Effective management in light of climate change is also not about the "indirect effects of climate change," but the cumulative effects of land management actions in concert with the direct, indirect, and reasonably foreseeable effects of climate change.	Although we agree that cumulative effects of all stressors in combination with climate change must be considered when devising specific adaptation approaches, we disagree that the sentence should be dropped.. In the context of the paragraph, this sentence expresses the point that it may be unnecessary to develop proactive adaptation strategies in all situations. No change necessary.
Page 3-41, Line 1-8	Tom DeLuca, The Wilderness Society	The reports states "[r]esistance practices include thinning and fuels abatement treatments at the landscape scale to reduce crown fire potential and risk of insect epidemic, maintaining existing fuel breaks, strategically placed area treatments that will reduce fuel continuity and drought susceptibility of forests, creating defensible fuel profile zones around high value areas (such as WUI, critical habitat, or municipal watersheds), and similar	We agree and have added a sentence to the paragraph based on the reviewer's suggestion.

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		treatments." However, building resistance into forest ecosystems involves a host of actions that either build defenses into a forest system or reduce the stress on species so that they are less susceptible to risks. Include such well-researched options such as assuring reasonable water use from forests, implementing appropriate road closures to minimize invasive species transportation, etc. (Christen D, Matlack G. 2006. Essays: The role of roadsides in plant invasions: a demographic approach. Conservation Biology 20(2):385-391). Creating resistance includes improving forest defenses against climate effects per se, but also creating resistance against climate-exacerbated disturbance impacts. In the arid West, this will almost always involve protecting resources from risks of climate-exacerbated drought, insect outbreak, and forest fire. Resistance practices include thinning and fuels abatement treatments at the landscape scale to reduce crown fire potential and risk of insect epidemic.	
Page 3-41, Line 1-8	Tom DeLuca, The Wilderness Society	In addition, a more economically sound approach to dealing with climate change is also recommended. It is highly questionable whether we can as a country afford this "harvest and spray" approach from an economic or budgetary standpoint. Eliminating below-cost timber sales and using creative collaborative options like stewardship contracting might help the agency develop innovative low-cost and locally-appropriate options for control of invasives, road decommissioning, fuels reduction, and other adaptation tools.	We disagree with the reviewer's characterization of the options presented as 'harvest and spray'. No change necessary.
Page 3-41, Line 21	Tom DeLuca, The Wilderness Society	The report finds that "[m]onitoring non-native species and taking aggressive early and proactive actions at key migration points to remove and block invasions are important steps to increase resistance." This statement misses the key elements to adaptive planning as mentioned in Chapter 3, Page 46, Line 6, regarding *Pinus radiata.* What is thought of as invasive behavior may	We agree, but note that "non-native" in the context of this paragraph referred to species with origins outside of the US / North America. In light of the specified discussion on

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		actually be a species migrating to a more appropriate range. Monitoring and adaptive management must be implemented. Change this statement to read: "Monitoring non-native species and taking aggressive, early, and proactive actions at key migration points to remove and block invasions are important steps to increase resistance. Monitoring species range distributions, however, may indicate that species once considered non-native to an area may be appropriately migrating into a new area. Creating processes to evaluate conditions before taking aggressive action is essential, so as not to prevent the very migration that may be necessary. These monitoring and adaptive actions are central to active-adaptive management."	page 46, we have modified the text.
Page 3-41, Line 25	Tom DeLuca, The Wilderness Society	The report states that "[b]uilding resistance to exacerbated effects of air pollution from climate change may require that aggressive thinning and age-control silvicultural methods are applied at broad landscape scales, that mixed species plantations be developed, or that plantations are switched to resistant species entirely (Papadopol, 2000)." Plantations are a liability in that the narrow genetic diversity, both within the species and as a single-species stand, does not allow for adequate safeguards against catastrophic outbreak, and that these outbreaks are likely to spread to neighboring forestlands. Switching to mixed species is a must, as is widening the genetic representation within a species. Chapter 2, page 18, line 17 notes this on a different scale, but the same applies here. Change the text beginning on line 25 to read as follows: "Building resistance to exacerbated effects of air pollution from climate change may require that aggressive thinning and age-control silvicultural methods are applied at broad landscape scales, that mixed species plantations are developed, that broader genetic parameters be used in plantations, or that plantations are switched to resistant species entirely…"	We agree and have inserted the reviewer's addition to the sentence.

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Page 3-41, Line 32	Tom DeLuca, The Wilderness Society	The report suggests "[c]reating larger management unit sizes, broad habitat corridors, and continuity of habitat would increase resistance of forest species to climate by improving their ability to migrate." Bridging the institutional fragmentation gap will be as important as landscape-scale management, in that multiple agencies must manage adjacent lands with some coordination to assure continuity of habitat (Malcolm JR, Canran LIU, Neilson RP, Hansen L, Hannah L. 2006. Global warming and extinctions of endemic species from biodiversity hotspots. Conservation Biology 20(2):538-548; Malhi Y, Meir P, Grace J. Unknown date. Forests in Flux: Climate Change: The Threats to the World's Forests. World Conservation Monitoring Centre). Change the text beginning on Line 32 to read as follows: "Creating larger management unit sizes, and bridging the gap within institutional fragmentation, broad habitat corridors, and continuity of habitat would increase resistance of forest species to climate by improving their ability to migrate."	We agree and have added a sentence to the paragraph based on the reviewer's comment.
Page 3-41, Line 36	Tom DeLuca, The Wilderness Society	The report states: "[r]esisting climate change influences on natural forests and vegetation will almost always require aggressive treatments, accelerating efforts and investments over time, and a recognition that eventually these efforts may fail as conditions cumulatively change." Chapter 3, Page 42, Line 7 fully lists options to increase resistance to climate change impacts and includes many opportunities to work with processes of change rather than against the direction of climate-related change, most of which are not aggressive treatments. These will be the most cost-effective solutions available, do not require predictive modeling, and are the most easily implemented options available (Spittlehouse DL. 2005. Adaptation to climate change in forestry. In Hooper TD (ed.) Proceedings of the Species at Risk 2004 Pathways to Recovery Conference. March 2-6, 2004, Victoria,	We disagree. This section of the chapter presents a range of options including some analysis about the likely effectiveness (or futility) of the option. The alternatives listed on page 42, line 7 cover the concepts the reviewer suggested we insert earlier in the section, but we think the range of issues is covered best with the current text. No change necessary

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		B.C. Species at Risk 2004 Pathways to Recovery Conference Organizing Committee, Victoria, B.C.). Change the text beginning on line 36 to read as follows: "Resisting climate change influences on natural forests and vegetation will at times require aggressive treatments, accelerating efforts and investments over time, and a recognition that eventually these efforts may fail as conditions cumulatively change. Most management options that create resistance are not treatments at all, rather they are management methods aimed at restoring vigor at the individual and system scale by restoring natural processes, maintaining keystone species, facilitating necessary migration, and reducing external stressors in an effort to provide individuals and systems with the health required to resist climate impacts in full health."	
Page 3-42, Line 25-46	Jaelith Hall-Rivera, The Wilderness Society	The report emphasizes the importance of maintaining resiliency in forested ecosystems if they are to adapt to climate change. This is a critical point. However, the authors note that an example of promoting resilience is a strategy that "combines practices to reduce fire or insect and disease outbreaks (resistance) in concert with deliberate and immediate plans to encourage return of the site to desired species post-disturbance (resilience)". This is a very narrow definition of "forest resilience." In fact, one critical aspect of restoring forest resilience is returning it to a fire-resilient state, i.e. one that functions within its normal fire regime. That is not captured in this section. Also, once again this section focuses on management tools that are almost exclusively limited to aggressive silvicultural intervention. There are numerous other options that encourage forest resiliency, including reducing forest fragmentation through road and culvert removal and the maintenance of large, intact roadless areas.	We disagree. Our intent was to capture a focused definition of resilience so as to be clear and not let that term be a catch-all term. In that situation, much of the nuance of 'resistance' and 'respond' are lost. Resilience really does imply a capacity to return to some former state or function after disturbance. That is a limited goal. The reviewer described restoring forest resilience as "returning it to a fire-resilient state, one that functions within its normal fire regime." What would be a 'normal fire regime' and over

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			what period of time would that definition pertain to.
Page 3-42, Line 25-46	Jaelith Hall-Rivera, The Wilderness Society	Resilience is not about man's ability to rebuild a forest stand to a composition that was not sustainable in the face of a changing climate; rather it is about our building the capacity of resilience into an ecosystem to enable it to resile to a healthy state. This definition is repeatedly used by leading authors and expands the management options to a broad array of proactive, anticipatory responses (Markham A. 1996. Potential impacts of climate change on ecosystems: a review of implications for policymakers and conservation biologists. Climate Research 6:171-191; Noss RF. 2001. Beyond Kyoto: Forest Management in a Time of Rapid Climate Change. Conservation Biology 15(3):578-590). Line 25 currently states "[a]n example of promoting resilience in forest ecosystems is a strategy that combines practices to reduce fire or insect and disease outbreaks (resistance) in concert with deliberate and immediate plans to encourage return of the site to desired species post-disturbance (resilience)." Replace this statement with: "An example of building resilience into forest ecosystems is a strategy that combines practices to restore health, vigor, and redundancy to forest ecosystems, so that after a disturbance they have the necessary keystone species, functional processes, and reserve of health to resile to a healthy state. The resiled system may incorporate different stands and new species mixes over time, but the system itself will have returned to a functional level, regardless of end composition."	The reviewer's definition and our definition of resilience differ. The reviewer's definition characterize managing for change – where species and functions would change in order to adapt to the changing climate. We have modified the text in an attempt to clarify that our definition of resilience is not about an ability to rebuild an unsustainable ecosystem. We are attempting to draw attention to the importance of recognizing change if that is what is needed in the face of climate change and the management of forest and rangelands.
Page 3-42, Line 38-46	Tom DeLuca, The Wilderness Society	The report states that where forests are "killed by fire or other disturbance, resilience could be promoted by maintaining some degree of shade as appropriate for the forest type; intensive site preparation to remove competing vegetation; replanting with high-quality, genetically appropriate and diverse stock; diligent	We agree that this text is not clear on what is meant by resilience. Decisions on the direction of management would be different for every forest and the result of a process of

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		stand-improvement practices; and minimizing invasion of non-native species. However, if the intent is to return a forest stand to its prior condition after disturbance under changing climate (i.e., to promote resilience), then deliberate, aggressive, intensive, and immediate actions may be necessary." Do we want to return these forests to their prior condition? Most low to mid elevation forests on roaded landscapes exist in a condition that was created by years of timber management and fire suppression. It is not clear how such deliberate, aggressive and intensive actions will improve resiliency over that induced by a natural process. Site preparation, planting, and spraying herbicides, might have a temporary positive effect of reducing erosion potential, but would potentially have numerous long-term impacts associated with soil disturbance, inappropriate planting stock, and non-target impacts from herbicide use. The arguments for these actions are based on conjecture regarding climate change and create a false demand for the same type of silvicultural prescriptions that have created fire susceptible forests today.	discernment, including many stakeholders. In some cases, returning the ecosystem to a former state may be the choice identified. We have modified the text to emphasize that an understanding of the ecological consequences of the changing climate is a critical component of identifying each adaptation strategies. We have also included literature describing the challenge of climate change and restoration. Climate change has the potential to significantly influence the practice and outcome of ecological restoration carried out for other purposes because of the changed biophysical settings that will be presvlaent in the future (Harris et al 2006).
Page 3-43, Line 1-2	Jaelith Hall Rivera, The Wilderness Society	Here, the suggestion is that a lack of public acceptance of silviculture hampers foresters' ability to achieve resilience. For support, the reader is directed to Sections 3.5 and 3.6 of the Case Studies, yet these sections provide no evidence that public acceptance presents a barrier to adaptation. Rather, these case studies suggest that, through collaboration, the public can be an important partner in overcoming the real barriers of resource shortages and insufficient policies. In its current context, this	We agree that this sentence is not pertinent to the paragraph. Collaboration with the public can be an important partner in overcoming the barriers of resource shortages. It has been deleted.

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		section echoes an unfortunate theme, repeated throughout the chapter, that foresters know what they need to do, if the public (and unnecessary processes mandating public involvement) could be eliminated from the management process. (Also see Chapter 3, Page 76, Line 9-14, wherin the Forest Service is positioned as the "expert" who urgently need to educate the ignorant public.) Such an attitude only reinforces public perceptions of the Forest Service as resistant to public involvement and misses an opportunity to cement real partnerships with the public in addressing climate change.	
Page 3-43, Line 10	Tom DeLuca, The Wilderness Society	The text "Managing for ecosystem change" should be deleted, because this section does not belong here, and is part of the previous section. As a whole, the current section (3.3.3) does not follow the outline defined in Box 2.3 in Chapter 2, Page 18, Line 1. Resistance, resilience, and "Enabling Forests to Respond to Change" (which is resilience if it resiles to health through climate change induced change), are all anticipatory responses ('Anticipatory adaptation'). Reorganize this section to follow the format suggested earlier in the report.	We disagree. We purposely included a section on managing for change in order to emphasize its importance. No change needed.
Page 3-47, Line 4	Tom DeLuca, The Wilderness Society	The text "[o]ptions Applicable to Both Forestalling Change and Managing for Change" should either be completely deleted from the document or replaced with "Options Applicable to Both Resistance and Resilience." Options applicable to forestalling change (resistance) and managing for change (to facilitate resilience) belong in prior sections on resistance and resilience. This section (3.3.3) should be reorganized to match the outline provided in Box 2.3 on Chapter 2, Page 18, Line 1.	We disagree. The definition of resilience that we used in this chapter is more consistent with forestalling change because it entails recovery to pre-disturbance conditions. As climate change proceeds, at some point, such recovery will no longer be feasible / sensible. No change necessary.
Page 3-48, Line 14-20	Tom DeLuca, The Wilderness Society	The report states: "[w]ell-established emergency and disaster triage steps can be modified to fit resource needs when conditions cannot be handled with traditional planning or institutional capacity. Triage in a natural-resource context sorts management	We disagree. This section proposed the need to develop a strategy for triage. Identifying how this

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		situations ("patients") into categories according to urgency, sensitivity, and capacity of available resources to achieve desired goals ("survival"). Cases are rapidly assessed and sorted into three to five major categories ("color tags") that determine further action." It is unclear who will determine the condition or extent of peril described in each of the five categories and who will determine what emergency response techniques are appropriate for these landscapes. Current efforts with Burned Area Emergency Rehabilitation approaches have generated mixed results at best. Agencies should pursue more sound ecological strategies to manage these landscapes rather than continuing to 'bloodlet our patients' with salvage logging and straw bale drops.	suggestion would be implemented is beyond the objectives of the report. Who will make these decisions will like vary but we stress the need to begin the consideration of such tradeoff.. No change necessary.
Page 3-49, Lines 8-10	Jaelith Hall Rivera, The Wilderness Society	The report states that, at present, use of rapid assessment and implementation processes is hampered by the demands for long public scoping and review often necessitated by environmental laws, such as NEPA. This is an overgeneralization. While NEPA scoping processes can be long, this is not always the case. If collaborative groups are in place, often the NEPA process is significantly shortened. Also, there are appropriate projects for which a shortened NEPA process can be utilized, like a Categorical Exclusion. In addition, this statement overlooks the fact that the requirements of environmental laws, like NEPA, are critical in ensuring that federal agencies contemplate the true environmental impacts of their decisions. This contemplation and assessment is still important even where rapid assessments are being made. The report also states that "NEPA delays implementation of actions" on Chapter 3, Page 67, Line 26. Again, this is an overgeneralization.	We agree. The sentence has been deleted.
Page 3-53, Lines 10-21	Jaelith Hall Rivera, The Wilderness	The Tahoe National Forest case study discusses post-disturbance treatments. The authors note that "many of these best-forest-management practices are consistent with adaptive conditioning	We disagree. Best-forest-management practices are implied in the discussion of

SPECIFIC COMMENTS			
Location	**Reviewer**	**Comment**	**Author Response**
	Society	for climate context as well [as for maintain ecosystem health]." They offer an example from the Tahoe NF. This example does not illustrate the point the authors are trying to make.	consideration of watershed protection measures. No change necessary.
Page 3-54, Lines 41-47	Tom DeLuca, The Wilderness Society	The paragraph titled "Resisting Planned Projects That May Not Succeed under Future Climate Conditions," explains that "[r]estoring salmon to TNF rivers is a goal in the current LMP (Fig. 3.15). With waters warming, however, future conditions of TNF rivers are not likely to provide suitable habitat for salmon. Thus, TNF is considering the option to not restore salmon. Meadow restoration is another example: Rather than proceeding with plans for extensive and intensive meadow restoration, some areas are being considered for non-treatment due to possible succession of non-meadow conditions in these locations." This statement should not be limited to salmon and meadow restoration. In a number of cases, this would apply to the forest stand management activities listed above.	We disagree. The point of the case study is not to give exhaustive examples, but rather representative examples of key issues. No change necessary.
Page 3-71, Lines 14-30	Tom DeLuca, The Wilderness Society	The report finds that "increased intensity of rainfall events risks severe erosion on trails and logging roads. More intensive rainfall events may increase soil erosion from roads/trails, which will likely increase the maintenance budget needed per mile of road/trail. Uwharrie NF Forest Plan states that roads will be repaired to prevent excessive run-off, but the current maintenance backlog and decreasing budgets make it unlikely all these actions can be supported financially." Likely increases in severe weather events reinforce the critical need to reduce the transportation network to a size that can be managed with realistic budgets. Transportation plans should account for emissions of visiting ORVs, logging equipment, and other vehicles as part of the greenhouse gas impact of National Forests.	We disagree. The case studies were written based upon the input from the NF staff. The text reflects the issues and suggestions they identified as being important and practical. No change necessary.
Page 3-73, Lines 7-10	Tom DeLuca, The Wilderness	Eastern forest scattered ownership patterns increase management challenges. In order to increase resilience to climate change,	Although we agree that the USFS will need to coordinate with other agencies, we have emphasized this

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	Society	National Forests must be managed in the context of the full landscape. The following issues are highlighted in the report; effective remedies will require a Forest Service mission that extends well beyond federal ownership boundaries.	exact point in the report. No change necessary.
Page 3-76, Lines 9-14	Jaelith Hall Rivera, The Wilderness Society	The Forest Service is positioned as the "expert" who urgently needs to educate the ignorant public. Such an attitude only reinforces public perceptions of the Forest Service as resistant to public involvement and misses an opportunity to cement real partnerships with the public in addressing climate change.	We disagree. The text does not contain the hubris inferred by the reviewer, but should rather be taken at face value: numerous stakeholders (including the general public and USFS managers) will need to learn in a collaborative manner about how to confront climate change. That is the message of the text. No change necessary.
Page 3-78, Lines 12-19	Tom DeLuca, The Wilderness Society	The report anticipates changes in human behavior and location due to climate changes. Private lands that link public land units could form critical migration corridors; others should be managed along with federal units to achieve sufficient scale to provide meaningful adaptive management units. Increased funding for easements and landowner incentives should be an integral part of Forest Service (particularly in State and Private Forestry) policy and budget.	Although we emphasize the need to facilitate collaborative management between the USFS and other entities, CCSP guidance precludes us from making recommendations for additional funding, new programs, or any other specific prescriptions. No change necessary.

5. National Parks

GENERAL COMMENTS		
Reviewer	**Comment**	**Author Response**
Kristen Brengel; Jaelith Hall, The Wilderness Society	The Park Service must take a lead role on region-wide, national, and international initiatives to stem the negative effects of climate change and work with Congress to ensure it has the resources –especially fiscal—to develop critical science and policy recommendations.	We neither agree nor disagree, but advocacy and policy prescriptions are outside the scope of this report.
Kristen Brengel; Jaelith Hall-Rivera, The Wilderness Society	The Wilderness Society is encouraged by most of the analysis in this section of the report. This section raises key concerns regarding ecosystem protection and preservation of National Park System units due to the effects of climate change. We share the concern that species extinction and major changes to landscapes such as melting glaciers will require new management approaches, more monitoring and evaluation of changes, and more regional efforts to address ecosystem changes due to climate change. We also appreciate your recommendations to provide more training and education for National Park Service staff that will be on the forefront of developing strategies to deal with the changing environment and atmosphere.	Thanks. No change needed.
Kristen Brengel; Jaelith Hall, The Wilderness Society	The effects of climate change are apparent in many National Park System units as this report states. Park lands tend to have intact ecosystems that are studied and monitored more regularly than other land management agencies and the monitoring information can help inform the public's knowledge of climate change. In fact, the public –through magazines, the web and movies— has witnessed the changes at Glacier National Park and southern Florida, some of the most visible examples of the effects of climate change.	Noted. No change needed.

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Location	**Reviewer**	**Comment**	**Author Response**
Page 4-17, line 31-33	Kristen Brengel; Jaelith Hall-Rivera, The Wilderness Society	This paragraph describes, in general, fire management in the Park Service. The report notes that "the use of fire as an ecological management tool and the decision to let naturally ignited fires burn is highly constrained by human settlements and infrastructure." While this is generally a true statement, this does not necessarily apply to many	We agree, and have amended the sentence beginning on line 31to read: "While NPS makes extensive use of fire as an

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		Park Service lands, especially those that are Wilderness or otherwise remote. This statement implies that the Park Service makes little or no use of fire as a management tool (i.e. Wildland Fire Use or WFU). In fact, just the opposite is true. The Park Service was one of the firsmt federal land management agencies to make use of natural fire as a management tool, as early as the 1960s. In fact, Park Service officials have recognized the important natural role of fire in ecosystems since the early 1900s, much earlier than the other federal land management agencies. Since the early 1990s, they have accomplished between 100,000 to 200,000 acres of fire use almost every year. This paragraph should be changed to reflect the fact that the Park Service makes extensive use of fire as a management tool.	ecological management tool, the decision to let naturally ignited fires burn is highly constrained by human settlements and infrastructure."
Page 4-7, line 27-38	Kristen Brengel; Jaelith Hall-Rivera, The Wilderness Society	This paragraph discusses the de-authorization or transfer of National Park System units to other land management agencies to demonstrate that the designations are not permanent. We strongly suggest setting aside this discussion in favor of the recommendations regarding proactive management and monitoring of park units. The National Park Service Organic Act and subsequent legislation provide legislative authority to conservation resources unimpaired and therefore provide a high degree of protection for these ecosystems. National Park System units must be leveraged to ensure all land management agencies address climate change through science and with natural resource protection and preservation as the goal. The Wilderness Society strongly recommends removing this paragraph.	We disagree. The example was used to illustrate unconventional approaches toward management, and its appearance in the introduction by no means is endorsement of de-listing. However, adapting to climate change is all about moving away from rigid and traditional modes of management. Our discussion on 4-7 reminds readers NPS has been unconventional in the past. We added a phrase to line 27; sentence now reads: "Although its overarching mission has remained

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			mostly unchanged, the NPS has undergone substantial evolution in management philosophy since 1916, and there are many examples that illustrate unconventional approaches to problems."
Page 4-21, line 37-38	Kristen Brengel; Jaelith Hall-Rivera, The Wilderness Society	The Park Service has various regulations and policies concerning visitor use that include where, when, and how the public can visit areas within a park unit. The Park Service should review its regulations and policies concerning visitor use to ensure wildlife habitat and other important natural resources are protected from potentially harmful visitor uses that perpetuate impacts due to climate change. For instance, all-terrain and other vehicle use on beaches spread invasive species in park units such as Glen Canyon National Recreation Area.	We agree, and added a paragraph on p 4-20 under current management practices that addresses visitor management. We also added this sentence on p. 4-21: "Parks may consider managing visitor use practices or patterns differently in order to people from inadvertently contributing to climate-change enhanced damage. "
Page 4-37, line 22-24	Kristen Brengel; Jaelith Hall-Rivera, The Wilderness Society	We agree that Park managers must address climate change in management and planning. The Park Service writes a general management plan for each unit then manages activities under separate "activity level" plans. Every activity level plan must comport with the general management plan, but the park managers continually run the risk of failing to address impacts and issues that the park unit is addressing on a larger scale. We believe it is critical that general management and activity level plans address climate change and acknowledge each park unit's goals for reducing impacts to climate change throughout the unit.	We agree, and a paragraph to this effect was added on p. 4-27.

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Page 4-22, Lines 20-25	William L. Fang and Eric Holdsworth Edison Electric Institute (EEI)	We recommend changing the words "Predictions of climate change" on lines 20-2 to "Projections of climate change" and on line 21, change "predict" to "project". We point out that this section 4.3.1 is titled "**Coming to Terms with Uncertainty**" and that the above words are used in sentences beginning on lines 20 and 21 with the source cited as "IPCC, 2007". However, we understand that the Intergovernmental Panel on Climate Change (IPCC), in its 2007 Fourth Assessment Report, did not make such statements as "predictions" or, for that matter, as "projections", particularly in light of the following definitions from Working Group I's "**Annex 1 Glossary**" (pp. 950-951; 943): **Projection –** A projection is a potential future evolution of a quantity or set of quantities, often computed with the aid of a model. Projections are distinguished from predictions in order to emphasize that projections involve assumptions— concerning, for example, future socio-economic and technological developments that may or may not be realized—and are therefore subject to substantial *uncertainty*. See also *Climate projection* and *Climate prediction.* **Climate prediction –** A climate prediction or climate forecast is the result of an attempt to produce an estimate of the actual evolution of the *climate* in the future, for example, at seasonal, interannual or long-term time scales. Since the future evolution of the *climate system* may be highly sensitive to initial conditions, such predictions are usually probabilistic in nature. See also *Climate projection; Climate scenario; Predictability.* **Climate projection –** A projection of the response of the *climate system* to *emissions* or *concentration scenarios* of *greenhouse gases* and	Done.

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		*aerosol*s, or *radiative forcing scenarios*, often based on simulations by *climate models*. Climate projections are distinguished from *climate predictions*, in order to emphasize that climate projections depend on the emissions/concentration/*radiative forcing scenario* used, which are based on assumptions concerning, for example, future socio-economic and technological developments that may or may not be realized and are therefore subject to substantial *uncertainty* (emphasis in original).	
Page 4-37, Lines 26-37	William L. Fang And Eric Holdsworth Edison Electric Institute (EEI)	The draft states: The National Park System contains some of the least degraded ecosystems in the United States. Protecting national parks for their naturally functioning ecosystems becomes increasingly important as these systems become more rare (Baron, 2004). However, all ecosystems are changing due to climate change and other human-caused disturbances, including those in national parks. Climate changes that have already been documented, coupled with other threats to national parks—including invasive species, habitat fragmentation, pollution, and alteration of natural disturbance regimes—constitute true global change. All natural resource managers are challenged to evaluate the possible ramifications, both desirable and undesirable, to the resources under their protection, and to develop strategies for minimizing harm under changing global conditions. "Unimpaired" becomes a moving target as the baseline changes in response to human activities. (emphasis added) We think that the use of the words "global change" in a context that covers not only global climate change and these other stressors is confusing, particularly in reference to U.S. national parks only. In the context of "climate change", we understand that the word "global"	We agree and have made two changes in response. Global change is commonly used today to describe multiple environmental changes (not only climate) occurring at both global and regional scales so we left it intact on line 33, but we changed the word "global" to "environmental." We also added a definition of "impair" on p. 4-8, line 25.

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		means the world and includes natural variability, not just "human activities". Further, we do not understand the use of the word "Unimpaired" in this context. Surely, no national park can be said to be "unimpaired" from its original baseline even absent the influence of, or response to, human-caused global climate change.	

6. National Wildlife Refuges

GENERAL COMMENTS		
Reviewer	**Comment**	**Author Response**
Maribeth Oakes, The Wilderness Society	One of the most significant statements comes early in the report, with the acknowledgement that refuges can no longer be managed as independent conservation units. This statement comes on the 10-year anniversary of the National Wildlife Refuge System Improvement Act, which established the wildlife-first mission and set forth the vision for creating a network of lands for the benefit of wildlife and wild places. The Act set a foundation for adopting an ecosystem approach to land management and to the stewardship of our nation's wildlife. To accomplish this goal, the Act required that comprehensive management plans be conducted on all refuges, and encouraged strategic growth of the System for conservation purposes. However, there is little uniformity in operational definitions for natural systems and standards in methodology to identify how each refuge can best contribute to maintaining biodiversity. The need for defining how the System can contribute within the larger ecosystem and landscape perspective remains a challenge of the FWS and should be noted in the report.	Agree. We have addressed these issues in sections 5.4.4 and 5.5.1.
Maribeth Oakes, The Wilderness Society	The authors of the report should be commended for highlighting several important research and management actions, which if implemented could advance FWS's ability to manage refuges as an interrelated network of lands. This includes conducting a baseline inventory of lands and species, creating models for determining species sensitivity to climate change, and acquiring lands for connectivity and creating wildlife corridors and buffer zones. And the report notes, to accomplish this goal FWS will need to establish partnerships with private landowners, and other public land managers to not only identify important land linkages, but to secure the lands, craft policies that manage the areas critical for wildlife movement and adaptation. The need for a well organized public awareness campaign about the growing problem of habit loss and fragmentation should be added to the report.	Agree. We address this issue by suggesting that refuges could serve as educational center for effects of climate change and other stressors e.g. habitat loss and fragmentation on wildlife and as demonstration sites for energy efficient management. See sections; 5.3.1; 5.3.2; 5.4.3; 5.5.1. We have also added a sentence to the conclusions (section 5.5) highlighting this issue: "In addition, National Wildlife Refuges especially those near urban centers could increase public awareness of the challenges facing

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		wildlife by developing educational kiosks that would provide information on the effects of climate change, habitat loss and fragmentation on refuge species."
Maribeth Oakes, The Wilderness Society	The Wilderness Society urges the authors to explore the value that wilderness on wildlife refuges could plays in protecting against fragmentation, reducing human disturbances and minimizing other stressors in ecological communities.	Agree. We have addressed this issue of wilderness in several places. See sections 5.2.2 and 5.4.4. Role of wilderness in refuges is also noted in Fig 5.5.
Maribeth Oakes, The Wilderness Society	The authors should be commended for their thorough history of the National Wildlife Refuge System (NWRS) and in linking the genesis and evolution of the System to the barriers and opportunities related to wildlife habitat management in the wake of climate change. The report details many of the notable problems facing NWRS, including changes in species migration, the loss of habitat from sea level rise and changing hydrology, and the other clearly identifiable places where habitat transformations will occur and where ecosystems are at risk.	Thank you.

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Page 5-5, line 38-44	Maribeth Oakes, The Wilderness Society	The Wilderness Society strongly supports the statement that "no longer can refuges be managed as independent conservation units…and that response must be global to match the scale of the threat." However, success will demand that equal emphasis be placed on planning at the refuge, state and national levels. To date, there tends to be an emphasis placed on state wildlife management plans as the basis for many decisions. Yet, the comprehensive plans completed at refuge level, if conducted in a through manner, are equally important in determining wildlife management actions. The need for leadership at the national level to ensure adequate funding of these planning processes is understated in the report.	Agree. In several places in the text we have cited the need for funding. See sections 5.4.3 and 5.4.7.
Page 5-6,	Maribeth	The report references existing models and projections that typically	Agree. We modified this

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line 12-15	Oakes, The Wilderness Society	span 100 years, which is good for developing long-term predictions. However, that timeframe might be too long for some species. The authors should include a reference to the need for wildlife modeling that looks at productivity and habitat changes within the next 20-50 years.	paragraph to indicate that we emphasize "decadal scale" dynamics in this chapter.
Page 5-9, line 15-27	Maribeth Oakes, The Wilderness Society	Refuge planning and the development of Comprehensive Conservation Plans (CCPs) must include explicit adaptation management strategies and a system-wide approach. The Wilderness Society agrees with the findings that information and resources needed by managers at individual refuges are not being met. The report could include references as to how a failure to address these basic management needs will stall progress in identifying and implementing adaptive management strategies.	Agree. We have identified the need for conducting vulnerability assessments for individual refuges as well as the refuge system establishing an interagency climate change information network (section 5.5.1).
Page 5-29, lines 13-17	Maribeth Oakes, The Wilderness Society	The report states that "the resilience/viability of populations and ecosystems on an individual refuge level may be increased through habitat augmentation and by enhancing the surrounding matrix through conservation partnerships, conservation easements, fee-title acquisitions, etc." The Wilderness Society strongly supports elevating land acquisition as a primary management approach.	Agree. Land acquisition specifically strategic growth is addressed 17 times in this report. Need for strategic growth is restated in take away messages (section 5.5.1).
Page 5-30, line 28-3	Maribeth Oakes, The Wilderness Society	Identifying climate change-related adaptive management strategies through the CCP planning process would be cost effective and provide valuable information for long-term health of species and wildlife habitat. However, in recent years, the FWS in its budget justification documents has moved money out of the planning line item. Planning must be elevated in importance as an effective management tool.	Agree. Planning is cited 17 times. In addition we call for "…a series of workshops that compare the costs and benefits of alternative management scenarios"; Also, see, "Conduct vulnerability assessments and identify conservation targets," (section 5.5.1).
Page 5-31, line 40-46	Maribeth Oakes, The Wilderness	In addition to recommending prescribed fires to reduce the risk of catastrophic wildfire, the report should highlight how the Refuge System is a leader in fire use as a management tool.	Agree. We added a concluding sentence to this paragraph "Refuge managers have played

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	Society		a leadership role in the prescriptive use of fire to achieve management objectives and are well positioned to continue that role."
Page 5-35, line 19-46	Maribeth Oakes, The Wilderness Society	When considering adaptation strategies to reduce adverse consequences to wildlife (particularly larger species that will have a more difficult time adapting to migratory changes) there is a need to look at acquiring lands for connectivity, the creation of wildlife corridors among protected lands, and buffer zones. FWS must develop a strategic land acquisition program (growth approach) to allow species to expand ranges without running into roads and other urban areas. Sustainable development and land acquisition can reduce vulnerability to climate change by enhancing adaptive capacity and increasing resilience. The report clearly identifies the need to manage wildlife refuges as a system; but since the agency is just beginning to address climate change challenges there is a need to give greater emphasis to the urgency for FWS to move forward with a strategic growth plan. FWS must develop plans for connectivity of landscapes, and ask for a report on a strategic approach for the longitudinal preservation/adaptation of species through land acquisition and wildlife management on a landscape size scale.	Agree. We have done this. See section 5.5.1, but add a sentence with specific reference to connectivity: "Increased emphasis on providing connectivity and dispersal corridors among units, especially for trust species that cannot fly, will be critical," and expand the connectivity issue in the sentence that follows.
Page 5-39, line 14-18	Maribeth Oakes, The Wilderness Society	Establishing a national interagency climate change information network could help ensure refuges are managed as a system and that coordination "will be a key element in climate change adaptation, as the scale of climate change impacts are such that refuges must be managed in concert with all public lands, and not in isolation."	Agree. We call for establishment of just such an exchange. See section 5.5.1.
Page 5-40, line 40	Maribeth Oakes, The Wilderness Society	The report highlights several important steps for determining research and management actions, which if implemented, could advance FWS's ability to manage refuges as an interrelated network of lands. The recommendations worth noting include establishing baseline	Agree. In several places in the chapter we call for, "…identification of species that occur on refuges," and detailed

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		inventory information, modeling, and education and training of refuge personnel. For planning and daily management needs, each refuge should be inventoried to provide data about abiotic and biotic resources. Abiotic data needed include information on topography, hydrology, boundaries and human-made features. Biotic needs are vegetation mapping, plant community descriptions, National Wetland Inventory data, lists of vertebrate fauna and flora on the refuge, quantitative abundance of species, and species of concern. There is a need to do comparative analysis of models on individual sites. Some modeling has been done on sea level rise, but every coastal refuge would benefit from modeling. Such modeling would help determine species sensitivity to climate change, and locations where there is a high probability of change, such as Alaska, deserts and coastal areas.	inventory of species, communities and unique ecological features on refuges, see section 5.4.4. We added a sentence to section 5.3.2 stipulating, "There is a need to model projected sea level rise, using a suite of models to address uncertainty, for each of the 161 coastal refuges to assess system-wide potential effects on refuge lands and habitats."
Page 5-64, line 13	Maribeth Oakes, The Wilderness Society	The document should give added emphasis to the immediate need for training and education of refuge staff. Refuge managers need land and wildlife management training, which includes guidance in identifying and responding to climate change effects. Technical assistance to refuge managers/planners would help ensure that each CCP identifies its own potential threats—drought, flooding, migration shifts of animals, late springs, hurricanes, etc. At the same time, each CCP should incorporate data on the implication of climate change in its planning for both the refuge and the ecosystem where it resides.	Agree. We have added a terminal bullet addressing training and education and the implications of this for CCPs. We also added a bullet in section 5.5.1: "Education and training of NWRS staff, at all levels, regarding potential implications of climate change for NWRS planning and sustainability is critical."
Page 5-5, line 25-33	Maribeth Oakes, The Wilderness	One of the most significant statements of the findings comes early in the report, when the authors note that "[n]o longer can refuges be managed as independent conservation units." Yet a few sentences	Disagree. In several places in the report we have indicated the importance of funding for

SPECIFIC COMMENTS			
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	Society	later, the report also notes that at present Fish and Wildlife Service (FWS) is at the beginning stages of addressing climate change. FWS and the Refuge System are the critical players in tackling this crisis. Therefore, it will be imperative for the leadership of the Refuge System to be advocates for securing the funds, resources and tools needed to adequately respond to and initiate new institutions/partnerships. The report could be strengthened by adding a brief statement on the need for FWS to be advocates for the resources and supports needed to respond to the climate challenge.	successfully responding to climate change. We do not believe that it is our role to advocate for funding.
Page 5-10, line 24-29	Maribeth Oakes, The Wilderness Society	The Wilderness Society agrees that the Refuge System's policy on biological integrity, diversity and environmental health is an important legal foundation for shifting NWRS management towards adaptation. The policy directs the Service to closely examine the environmental quality concerns affecting refuges, but there should be a call for creating performance goals and standards to measure biological diversity and environmental health, particularly as it relates to healthy populations.	Agree. We added to section 5.2.4 the following sentence: "Explicit performance goals and objectives tied to biological integrity, diversity and environmental health of refuges and the services conservation targets will be needed to assess the degree and effectiveness of NWRS response to the challenges of climate change."
Page 5-13, line 34-38	Maribeth Oakes, The Wilderness Society	The report notes that within the refuge system there is a need to reduce fragmentation and create land corridors for particularly isolated refuges surrounded by development. The Wilderness Society is pleased that the report affirms the Refuge Improvement Act mandate regarding strategic growth of the NWRS as necessary to increase biological integrity, diversity and environmental health of threatened and endangered species and at-risk ecosystems.	Agree.
Page 5-16, Lines 2-4	William L. Fang and Eric Holdsworth	Change the words "these predictions" to "these projections" in the sentence that begins on line 2 and ends on line 4. These words appear in a paragraph that starts on p. 5-15 and ends on page 5-16.	Agree. All quantitative predictions are based on assumptions as are projections.

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Location	**Reviewer**	**Comment**	**Author Response**
	Edison Electric Institute (EEI)	The paragraph discusses how climate change will affect the National Wildlife Refuge System by magnifying the "influences of other threats" and by introducing new threats or variations on existing ones. The paragraph then states that "[c]urrent and projected threats have the potential to undermine the mission of the NWRS and the achievement of its goals." Finally, it gives examples of projections, not predictions, from the Intergovernmental Panel on Climate Change (IPCC). Indeed, the reference sentence speaks of "a great deal of uncertainty with these predictions". We point out that the IPCC 's Working Group II "Annex B: Glossary of Terms" for the Third Assessment Report distinguishes the term "projections" from "predictions" saying that former involves "assumptions" . . . "that may or may not be realized" and thus are "subject to substantial uncertainty" and are made with the "aid of a model" (p. 22). In short, there is no apparent basis for the words "these predictions".	Substituting project for predict merely displays a lack of understanding of statistical terminology. However, to be consistent with IPCC we have replaced predictions with projections throughout the chapter.
Page 5-18, Lines 24-26	William L. Fang and Eric Holdsworth Edison Electric Institute (EEI)	In the sentence that begins on line 24, change the words "predicting" and "predicted" to "projecting" and "projected", respectively. The Intergovernmental Panel on Climate Change's Working Group I "Annex I Glossary" for the Fourth Assessment Report defines the term "projection" by distinguishing it from a prediction, noting (p. 950-951) that a projection "is a potential future evolution of a quantity or set of quantities, often computed with the aid of a model," and that "projections involve assumptions…that may or may not be realized and are therefore subject to substantial uncertainty." That Glossary also defines the terms "Climate Prediction" and "Climate Projection", explaining (p. 943) that the former "is the result of an attempt to produce an estimate of the actual evolution of the *climate* in the future (for example, at seasonal, interannual, or long-time	Agree. "Predictions" has been replaced with "projections" throughout the chapter.

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		scales)." Consistent with the IPCC's definition, we therefore believe the above change should be adopted.	
Page 5-39, line 11-13	William L. Fang and Eric Holdsworth Edison Electric Institute (EEI)	We note also that on page 5-39, lines 11-13, the draft states "[I]t is probable that the stress from climate change will continue to increase over time . . .". (emphasis added)	Disagree. No emphasis added.
Page 5-60, Lines 37-40	William L. Fang and Eric Holdsworth Edison Electric Institute (EEI)	Change "predicted effects of climate change" on lines 37-38 to "projected effects on climate change". This sentence begins by noting "uncertainty about the impact and scale" of such "predicted effects". The Intergovernmental Panel on Climate Change's Working Group I Report for the Fourth Assessment in "Annex I: Glossary" recognizes distinctions between a prediction and a projection, noting that projections involve "assumptions" and "uncertainties". (see pages 950-951) (see also a "Prediction versus Projection—Forecast versus Possibility" by Dr. Mike MacCracken, U.S. Global Change Research Program, mmaccrac@usgcrp.gov, Feb. 22, 2001).	Agree. Global replacement of projected for predicted to be consistent with IPCC. However, any quantitative "predictions" also have stated assumptions and uncertainties as any statistician or quantitatively competent biologist will tell you.

7. Wild and Scenic Rivers

GENERAL COMMENTS		
Reviewer	**Comment**	**Author Response**
Jackie Diedrich, Interagency Wild and Scenic Rivers Coordinating Council	We appreciate this opportunity to review the draft chapter and the authors' use of many of our technical reports in the body of the paper. However, the chapter also includes a number of inaccuracies in explaining the intent and scope of the Act, particularly in introductory sections. We are not suggesting it need serve as a primer on the Act; however, misunderstanding of several key tenets of the Act has the potential to undermine the important role of wild and scenic rivers (WSR) in climate-change monitoring and, perhaps, the recommendations of this report. We only recently became aware of this opportunity for review and do not have time as a Council to suggest line-by-line changes. However, we'd be glad to work with authors to address the following concerns and provide modified text, if given a month or so advance.	We have included a number of edits to the manuscript in response to this and they are linked to the below specific comments byt this reviewer.

SPECIFIC COMMENTS			
Location	**Reviewer**	**Comment**	**Author Response**
Page 6-5, Figure 6.3	Jackie Diedrich, Interagency Wild and Scenic Rivers Coordinating Council	You might also consider the Omnibus Oregon Wild and Scenic Rivers Act (1988) as a milestone (adding 40 rivers on a statewide basis) and, most recently, partnership rivers: http://www.nps.gov/ncrc/programs/pwsr/	We decided to leave the figure as is as we want to maintain the same level of detail of various milestones listed in the chart.
Page 6-15, lines 4-13	Jackie Diedrich, Interagency Wild and Scenic Rivers Coordinating Council	We agree that federal dams influence many designated rivers. However, we recommend this section be restated; Section 7(a) directs the river-administering agencies to review ACOE/BOR (and other federally assisted) water resources project proposals to protect river values. Other federal agencies are directed in Section 12(a) to protect rivers consistent with the purposes of the Act. Note: Federal dams cannot influence 250 WSRs, since the	We agree and have edited the chapter appropriately including citing Section 7(a) of the WSR act.

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		National System total is 165. Note: The NPS partnership rivers are not managed as park units. You might also explain that the BLM and USFS also administer WSRs by their general statutory authorities to meet the purposes of the Act.	
Page 6-4, lines 32-39	Jackie Diedrich, Interagency Wild and Scenic Rivers Coordinating Council	The partial quote of 'free-flowing' from Section 16(b) of the WSRA is misleading. Through the unambiguous definition in this section, and the explicit role outlined for the federal river-administering agencies re review of proposed water resources projects in Section 7, the Act is intended to protect designated rivers from significantly more in-waterway proposals than as suggested in this introduction as "major dams or obstructions." **"16(b)** "Free-flowing," as applied to any river or section of a river, means existing or flowing in natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway. The existence, however, of low dams, diversion works, and other minor structures at the time any river is proposed for inclusion in the national wild and scenic rivers system shall not automatically bar its consideration for such inclusion: *Provided*, That this shall not be construed to authorize, intend, or encourage future construction of such structures within components of the national wild and scenic rivers system." In addition to dams, Congress explicitly directed review of any federally assisted "modification of the waterway" such as: "…water diversion projects; fisheries habitat and watershed restoration/enhancement projects; bridges and other roadway construction/ reconstruction projects; bank stabilization projects; channelization projects; levee construction;	These were very helpful comments and this section of the chapter has been extensively revised.

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		recreation facilities such as boat ramps and fishing piers; and activities that require a 404 permit from the ACOE" (IWSRCC Technical Report, *Wild & Scenic Rivers Act: Section 7*, pp 3-4). Free-flow has not, as suggested in this introduction, been interpreted to mean "water quality is high." The framers anticipated that keeping rivers connected to their floodplains would help protect water quality and achieve conservation goals. However, water quality is an explicit part of the three-fold purpose for which every river is added to the National System -- free-flowing condition, water quality and outstandingly remarkable natural, cultural and recreational values. We appreciate that this introduction need not explain the Act in detail; however, for purposes of the remainder of this chapter it needs to be accurate. As stated in your next section (6.2), "[WSRs] are not fully protected from human impacts." We agree. However, what make a WSR different than any other river and potentially valuable in climate change science is the identification of river-specific outstandingly remarkable values (ORVs), and the monitoring and protection of these ORVs, free-flow and water quality over time by the federal river-administering agencies (or, for 18 state-administered federally designated WSRs, state and local governments).	
Page 6-5, Figure 6.2	Jackie Diedrich, Interagency Wild and Scenic Rivers Coordinating Council	Wild and Scenic Rivers in the US, has a number of obvious inaccuracies.	Yes, page 6-5 significantly edited to correct inaccuracies about the Act including deleting an entire paragraph.

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Location	**Reviewer**	**Comment**	**Author Response**
Page 6-5, Figure 6.3	Jackie Diedrich, Interagency Wild and Scenic Rivers Coordinating Council	Selected Milestones - Designated rivers are 'wild and scenic rivers' not 'wild and/or scenic' and administered in one of three classifications: wild, scenic or recreational.	Done.
Page 6-5, lines 23-38	Jackie Diedrich, Interagency Wild and Scenic Rivers Coordinating Council	This section misstates the values as "scenic or free-flowing condition" rather than free-flow, water quality and river-specific ORVs. The fact that many WSRs flow on federal lands is not the basis for management by a federal agency. Rather, each river added by Congress is to be administered by a federal agency (BLM, NPS, USFWS, and USFS) with appropriate partnership with state and local authorities. This distinction matters as a comprehensive management plan is required for each Congressionally designated river to provide a framework for protecting and enhancing the river's values. The content of the plan is what has the potential to support climate change science. Robust plans will include a detailed description of a river's values at the date of its designation (baseline conditions), and a monitoring scheme.	We agree and have already edited the relevant text throughout this chapter in response to an earlier comment.
Page 6-5, lines 33-38	Jackie Diedrich, Interagency Wild and Scenic Rivers Coordinating Council	The paragraph that discusses water resources projects (**lines 33-38**) is incorrect. Section 7(a) has different evaluation standards dependent on which federally agency assists and where the project is located: • The FERC (Federal Energy Regulatory Commission) is prohibited from licensing any project work under the Federal Power Act within the designated river corridor. • All other federally assisted water resources projects within the waterway of the designated river must be determined by the river-administering agency not to result in any	We agree. This section of the chapter has been edited and revised to correct this as explained above.

SPECIFIC COMMENTS			
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		"direct and adverse effects" to the river's free-flowing condition, water quality or ORVs. • All federally assisted water resources projects below, above or on a stream tributary to the designated river must be determined by the river-administering agency not to "invade the [designated river] area or unreasonably diminish the scenic, recreational, and fish and wildlife values present in the area on the date of [its] designation." Through Section 7 Congress recognized that some water resources projects might occur within the watershed but only to the extent they do not unreasonably diminish stated values within the designated component.	
Page 6-8, lines 5-9	Jackie Diedrich, Interagency Wild and Scenic Rivers Coordinating Council	The discussion of the diversity of rivers in the National System in this section is helpful context. However, the description of "wild" rivers may be misleading. Yes, rivers classified as wild are undammed and with riparian corridors least modified by human activities. However, at date of designation, rivers classified as scenic and recreational are also to remain free-flowing and protected over the long term. Perhaps 6.2.2.2 could be characterized as wild segments or entire designated rivers classified as wild that are headwaters systems and that flow through largely unmodified watersheds.	We agree. These lines have been edited to clarify
Page 6-9, lines 40-42	Jackie Diedrich, Interagency Wild and Scenic Rivers Coordinating Council	This section misstates the authority of the river-administering agency relative to in-corridor lands. The Act confers no regulatory authority to the river-administering on nonfederal lands within the river corridor. It provides the unifying protection of Section 7(a) to prevent the harmful effects of federally assisted water resources projects and directs that each component be administered to "protect and enhance" the river's values. This protection scheme requires a partnership with other federal, state,	We agree and have corrected this misstatement clarifying that land must be federal for the administering authority to fully protect.

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		local agencies, tribal nations, landowners and river users within the designated river corridor and, to the greatest extent possible, within the watershed.	
Page 6-11, figure 6.8	Jackie Diedrich, Interagency Wild and Scenic Rivers Coordinating Council	Location of Dams and WSRs is inaccurate (see comment at Figure 6.2).	We agree and are correcting innacuracies.
Page 6-14, lines 15-20	Jackie Diedrich, Interagency Wild and Scenic Rivers Coordinating Council	This section inaccurately describes the 'protect and enhance' standard of Section 10(a). Quoting from the IWSRCC Technical Report, *Wild & Scenic River Management Responsibilities* (p. 26): "This section is interpreted as a nondegradation and enhancement policy for all rivers, regardless of classification. The river manager must seek to protect existing river-related values and, to the greatest extent possible, enhance those values."	We agree. The text has been edited to clarify that classification does not determine level of protection.
Page 6-16, lines 15-25	Jackie Diedrich, Interagency Wild and Scenic Rivers Coordinating Council	This section confuses free-flow with water quality/quantity (see previous discussion at 6.1). The section excerpted from out technical report, *Water Quantity and Quality* (pp 10-11) is specific to water protection strategies not protecting the river's free-flowing condition.	We agree. We went back to the original report and have now edited the text to be correct.
Page 6-29, lines 42-46	Jackie Diedrich, Interagency Wild and Scenic Rivers Coordinating Council	In Section 10(a) the Act requires the river-administering agency to protect and enhance the river's free-flowing condition, water quality and all ORVs. Any potential conflict between ORVs will be accounted for in development of the comprehensive river management plan. Recreation activities and amount of such use, even if an ORV, may not adversely affect nonrecreation ORVs.	Reviewer comment not really relevant; text reads that natural asset MOST at risk should be a priority. Authors stand by recommendation and thus no edits here.
Page 6-19 –	William L. Fang	The sentence that begins on line 43, p. 6-19 and ends on line 5, p.	Authors disagree: actually the

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6-20, Lines 43, p. 6-19-5, p. 6-20	And Eric Holdsworth Edison Electric Institute (EEI)	6-20, is stated, in quotation marks as being sourced from the "latest IPCC (2007a) assessment reports". However, the relevant source appears to be a four column "Table SPM-2" (see p. 9 of the Summary for Policymakers), which is titled "Recent trends, assessments of human influence on the trend, and projections for extreme weather events for which there is an observed late 20th Century trend", and which includes important footnotes. As we understand the table, they are "global" projections, not projections for the "United States." In short, we believe that the sentence is not a direct quote for the relevant table.	relevant part of the IPCC is SPM-1 on page 7. And we say global in the text already and say temperature will vary regionally and precipitation trends are less certain. Then we directly quote and conclude saying it is the "world" that can be expected to be warmer. i.e., we do not extract text or extend inappropriately to certain regions.
Page 6-20, Lines 7-16	William L. Fang And Eric Holdsworth Edison Electric Institute (EEI)	The sentence that begins on line 7, states that "[t]he average global surface temperature is projected to increase by 1.2 – 6.4° during the 21St Century (IPCC, 2007a), but may be greater in the western United States, thus more strongly affecting rivers" in several named states. Apparently, the source of the first part of the statement attributed to the IPCC is Table SPM-3 of the IPCC's Working Group II report for the Fourth Assessment (p. 13). However, the table provides more than one range. The draft apparently selected only one scenario, namely "AIFI", which includes a "Best estimate" of "4.0". It is the highest scenario. We question why the draft selected that scenario. Further, the remainder of the sentence applicable to rivers in the U.S. apparently is not based on the IPCC source. Yet the juxtaposition of the global temperature projection by the IPCC with the reference to U.S. rivers could be construed as the IPCC table being applicable to U.S. rivers, which is not the case.	The range has been changed to apply across all model scenarios for the best estimate, as recorded in Table SPM-3 (1.8 to 4.0). You're correct that the remainder of the sentence about rivers in the U.S. is not based on the IPCC source. We have rewritten this section to be clearer about the sources for each statement. The section now reads as: Increases will vary geographically and seasonally. For instance, in summer rivers in Nevada, Utah, and Idaho will be most strongly affected (Fig. 6.12). In the past, for snowmelt-

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			dominated rivers in the western United States, temperature increases have affected the onset of the spring pulse and the timing of the center of mass for flow (Stewart, Cayan, and Dettinger, 2005) (Fig. 6.12).

8. National Estuaries

GENERAL COMMENTS		
Reviewer	**Comment**	**Author Response**
Braxton Davis, SC Dept of Health and Environmental Control, SC Dept of Health and Environmental Control	Members of the work group agreed that, while the report focuses on "federally owned and managed lands and waters" (p.1-3 line 10), it omits a key federal statute and program - the Coastal Zone Management Act - and should not be considered complete without describing the important role of coastal zone management programs in advancing coastal adaptation to climate change, the existing authorities of these programs to address sea level rise and other climate-related impacts, and the ongoing activities of these programs under the CZMA's federal - state partnership. I have attached a newly released report from our work group that describes the role of coastal management programs in adaptation to climate change, related research and planning activities, and state needs with respect to federal agencies and programs. We hope our report will inform your synthesis report, and that equally strong emphasis will be placed on the National Coastal Zone Management Program alongside the other federal/state partnership programs, such as the National Estuary Program, described in your report (see National Estuaries section of the Appendix).	We disagree that CZMA has been omitted (see Appendix table 7.6.1). However, we agree that this act and its implementation relative to climate change planning deserve more emphasis and appreciate the recent report provided by the CSO Climate Change Work Group. Thus, the requested changes have been made as additions to the text in Section 7.2.3 "Legislative Mandates Guiding Management of Stressors".

SPECIFIC COMMENTS			
Location	**Reviewer**	**Comment**	**Author Response**
Page 7-51, line 21	Amanda Babson, AAAS Science and Technology Policy Fellow at EPA ORD/NCEA/GCRP	This may be an appropriate place to bring up aquaculture, not necessarily as a poor management choice, but as a management factor that affects resiliency. Discussion of aquaculture and mariculture is noticeably missing from this chapter.	We agree. We added this as suggested in this section.
Page 7-103, Box 7.2	Amanda Babson, AAAS Science and Technology Policy Fellow at EPA	Winds should be added to the "Water column mixing is affected by" category.	We agree. This addition has been made.

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Location	**Reviewer**	**Comment**	**Author Response**
	ORD/NCEA/GCRP		
Page 7-64 – 7-67, Conclusions numbered (3), (11), and (14)	Edison Electric Institute (EEI)	Unlike several of the other chapters of the draft, Chapter 7 provides in section 7.5, titled "Conclusions", a list of 16 numbered paragraphs under the title "Management Response." Most of the list do seem to be a management response specifically applicable to activities of the 28 national estuaries that form the U.S. National Estuaries Program. However, some conclusions seem to go beyond management initiatives applicable to that Program. For example, item (3) p. 7-64, lines 36-41, refers to "management at the global scale by capping greenhouse gas emissions," which would require an international treaty that certainly would apply to more than this U.S. program. Another example is item (14) regarding "pursuit" of an Executive Order on climate change, which is proposed to be "analogous" to the 1994 Environmental Justice in Minority Populations and Low-Income Populations Executive Order 12898, in order "to increase awareness of the potential for catastrophe on our coasts." Both of these seem to be policy recommendations and not conclusions. Moreover, there does not appear to be anything in Chapter 7 that would give support to these items and, of course, they are not included in section 7.4.5, which is titled "**Recommendations for Environmental Management in the Face of Climate Change**." In the case of item (3), we note that the U.S. is currently in discussions with a number of nations to adopt non-mandatory approaches to global climate change that will include developing countries. Indeed, the President	We disagree. On item (3), we do not advocate any policy on greenhouse gas emissions but instead repeat the scientific content of the IPCC report saying that future warming is inevitable if emissions are not capped, and, even if they are, several decades of inertia relative to warming and its consequences are built into the climate system memory already. We indeed admit that this would require international cooperation, which goes beyond the scope of National Estuaries. However, we make no such recommendation. The peer review comments of the FACA panel indeed emphasized need for SAP4.4 to emphasize this issue of how warming will continue for decades even if greenhouse gas emissions were reduced soon. No change is necessary to point (3).

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		spoke on September 28, 2007 to representatives of 16 other nations that are large greenhouse gas emitters and others concerning his proposals for addressing globally "Energy Security and Climate Change." In regards to item (14), we observe that, as shown in draft Appendix 7.6, there is a rather extensive list of Federal legislative authorities for the protection and restoration of estuaries that, according to the draft chapter, would appear to afford a considerable basis for substantively evaluating the impacts of climate change, including its effects "on our coasts", without the need of an executive order, particularly one "analogous" to the above-referenced Order that we understand was adopted because of a lack of emphasis on health or environmental effects on such populations. A similar situation does not exist for climate change because, as just noted, there exists a panoply of authorities and research that, together with the Framework Convention on Climate Change, helps to focus interests "on our coasts" as well as other impacts. In short, we do not see the relevance of either of these items as conclusions.	On item (14), regarding the usefulness of an executive order, we agree that this may reflect a policy decision rather than a conclusion of science. However, we note that denial of climate change and its effects have postponed comprehensive review and planning at the federal level that could lead to management adaptations. For this reason, several states have taken independent action through gubernatorial executive orders (Maryland, Washington, South Carolina) to initiate planning for management adaptations to climate change. Here we have acted by removing this suggested management response at the executive level.
Page 7-41, line 28-31; Page 7-43, line 24-29	Braxton Davis, SC Dept of Health and Environmental Control	Specific references to existing state sea level rise policies and regulations (p. 7-41 lines 28-31; p. 7-43 lines 24-29) may be inaccurate or dated given the findings of our attached report. (We are very interested in the Maine, Rhode Island, and Massachusetts policies that seem to mirror other states' beachfront "retreat" policies for	We disagree that this is an inaccurate reflection of regulations in those three states. In response to this comment, we re-examined Titus (2000) and its

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		properties adjacent to coastal wetlands. Is this accurately portrayed... and/or is this referring to bulkhead or development prohibitions adjacent to coastal wetlands? I believe that CT and NJ are also working on wetland restoration/refugia strategies/policies in response to sea level rise, but at this point I'm not aware of any regulations that specifically allow for landward migration of wetlands... this could be something that we've missed in our research).	extensive documentation by footnote of Table III and its entries on state responses to sea level rise and erosion. What we report here is amply supported by the detailed footnotes. Nevertheless, we did make one change, omitting Maine because the Maine policy does not really apply to wetlands along estuarine shorelines, which are rare in that state.
Page 7-29, line 41-43	Amanda Babson, AAAS Science and Technology Policy Fellow at EPA ORD/NCEA/GCRP	I disagree with the causality of the statement. While enhanced stratification can lead to longer residence times, the reverse is not true. If there is a particular system where this is the case, it needs to be specified. In general, reduced freshwater inflow is likely to decrease stratification.	We agree. We have modified the passage here to avoid misleading readers on this point. This change has been made.
Page 7-9, Lines 9-12	William L. Fang And Eric Holdsworth Edison Electric Institute (EEI)	The sentence beginning on line 9, defines the term "stressor". However, the proposed definition differs from the definition of that term in the draft Glossary (p. 10-5). In our view, the Glossary definition should apply, unless there is some reason given for a deviation or modification. None is given. We urge substituting a reference to the Glossary in lieu of the sentence.	We agree. The change has been made.
Page 7-19, Lines 20-39	William L. Fang and Eric Holdsworth Edison Electric Institute (EEI)	Change the words "prediction" and "predictions" wherever they appear on lines 20-39 to "projection" and "projections".	We agree. The change has been made.

SPECIFIC COMMENTS			
Location	**Reviewer**	**Comment**	**Author Response**
Page 7-19, Lines 20-30	William L. Fang and Eric Holdsworth Edison Electric Institute (EEI)	The paragraph that begins on line 20 states that the "2007 IPCC report provides a summary of the results of multiple credible modes of climate change" and then refers to those results as "predictions". We note that Working Group I of the 2007 assessment report (Annex I Glossary) defines the terms "climate predictions" and "climate projections" and distinguishes between each. It is our understanding from those definitions that the above "results" from models are not intended by the IPCC to be predictions. (see also an article by the CCSP's former Director, Dr. MacCracken, titled "Prediction versus Projection – Forecast versus Possibility", Feb. 22, 2001, maccrac@usgcrp.gov.)	We agree. The change has been made.
Page 7-4 & 7-60, line 14-16	Amanda Babson, AAAS Science and Technology Policy Fellow at EPA ORD/NCEA/GCRP	Letters (a) and (b) in caption are reverse of what they are in figure.	We agree. The change has been made.

9. Marine Protected Areas

GENERAL COMMENTS		
Reviewer	**Comment**	**Author Response**
Ellen Druffel, Palmyra Atoll Research Consortium	The chapter provides a comprehensive review of how climate change can affect MPAs. They provide examples of how individual systems can be monitored for past climate change and be managed to minimize effects of this change on the ecosystems. To that end, may we suggest that though not officially included in the MPAs discussed in this chapter, Palmyra Atoll could be mentioned as an example of a national wildlife refuge that is currently being studied by climate scientists. Palmyra Atoll is the only undeveloped and unpopulated wet atoll left in the tropical Pacific and contains a diverse coral reef system. Paleoclimate studies at Palmyra by Cobb et al (2003) have shown that ENSO activity was found to vary considerably during the past millennia. Positioned between the upwelling zone of the South Equatorial Current and the warm pool extending from the western Pacific, Palmyra corals are being used to reconstruct paleoclimate records of SST, upwelling intensity and seawater salinity, in an effort to learn more about ENSO and the Interdecadal Pacific Oscillation. Mention of Palmyra coral climate studies might be included at one of these locations in the text: p.8-28 line 9, p.8-33 line 10.	We agree and added text to section 8.3.4.1.
John Ogden, Florida Institute of Oceanography	Ecosystem-based management (EBM): I am surprised to see that EBM is not featured in this discussion. Virtually all of the management actions technically involve this concept, embodying holistic and comprehensive attention to the whole ecosystem. For example, ask any coral reef manager from Australia what they are doing to manage the Great Barrier Reef and they will say EBM.	We agree and have added text in sections 8.1.1 and 8.5.1.
John Ogden, Florida Institute of Oceanography	Zoning: One of the critical tools for EBM is marine spatial management or zoning. Marine protected areas (MPAs) are a tool of marine spatial management or zoning. Zoning is a tool to manage human behavior which is critical if coral reefs are to survive. Thus MPAs are important but not sufficient. They must be implemented within the context of other zones encompassing the entire coral reef region, including the landward portions which confine and limit human uses. In my opinion, the chapter should be more emphatic that management of a coral reef means management by zones including but not limited to MPAs.	We agree and there is more on these topics in the revision of 8.5 as well as more text on land-sea linkages elsewhere.

GENERAL COMMENTS		
Reviewer	**Comment**	**Author Response**
Judith Lang, Independent Scientist	Without active leadership in carbon emissions reduction, the US can forget achieving the part of Goal 2 that aims to provide either national or international leadership for MPA management.	We agree, but the topic of mitigation is beyond the scope of this report.
John Ogden, Florida Institute of Oceanography	Suggested citations: Crowder, L.B., G. Osherenko, O.R. Young, S. Airame, E.A. Norse, N. Baron, J.C. Day, F. Douvere, C.N. Ehler, B.S. Halpern, S.J. Langdon, K.L. McLeod, J.C. Ogden, R.E. Peach, A.A. Rosenberg, and J.A. Wilson. 2006. Resolving mismatches in U.S. ocean governance. Science 313: 617-618. Young, O.R., G. Osherenko, J. Ekstrom, L. B. Crowder, J. Ogden, J. A. Wilson, J. C. Day, F. Douvere, C. N. Ehler, K. McLeod, and R. Peach. 2007. Solving the Crisis in Ocean Governance: Place-Based Management of Marine Ecosystems. Environment 49(4): 20-32.	We agree and have added these citations.
Richard B. Aronson, Dauphin Island Sea Lab	On the whole this chapter is a well-balanced look at the potential role of MPAs in staving off the negative effects of projected climate change.	

SPECIFIC COMMENTS			
Location	**Reviewer**	**Comment**	**Author Response**
Page 8-25, line 22	John Ogden, Florida Institute of Oceanography	This is one of the more important and interesting areas of this whole report. The question is: To what extent does the amelioration of stresses that can be managed, e.g. fishing, land-based pollution, etc. increase the "resilience" or ability to recover from stresses such as climate change that essentially cannot be managed? The report seems to accept this as a fact, but in truth it is more an article of faith. Nevertheless, I urge the authors to explore this question further. In my view this is perhaps the best way that management can be an experiment to examine this question.	We agree and have modified the text in this section.
Page 8-31, line 25	Judith Lang, Independent Scientist	Given the widespread recognition of the coming dangers to coral reefs and other ecosystems (Arctic, Pleistocene relicts) that are proving to be very fragile in our too-rapidly warming world, this	We agree, but note that it is beyond the scope of this report to

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		would be a good section to introduce the *concept* that reef management must expand from merely seeking to adapt or searching for the holy grail of resilience, and actively strive to reduce the local sources of the warming, plus draw national attention to the general need for reduced carbon emissions, while reducing local stressors.	address mitigation.
Page 8-34, lines 1-15	Richard B. Aronson, Dauphin Island Sea Lab	Absent here and elsewhere is any discussion of strategies for the outreach components of MPAs educate the public to reduce greenhouse gas emissions. According to this document, GBRMPA is doing it, so why shouldn't we?	We agree and have added text to this section, but note that it is beyond the scope of this report to address mitigation.
Page 8-63, line 25	Judith Lang, Independent Scientist	This section should also include the need for management to actively work to reduce carbon emissions lest all their other splendid efforts prove insufficient to prevent the degradation of their MPAs.	We agree, but note that it is beyond the scope of this report to address mitigation.
Page 8-113, line 4	Judith Lang, Independent Scientist	Goal 1, Objective 1, a comment: Without active leadership in carbon emissions reduction, all program capacities are unlikely to protect resources.	We agree, but note that it is beyond the scope of this report to address mitigation.
Page 8-62, line 26	Judith Lang, Independent Scientist	A golden opportunity has been missed in this section to come right out and honestly note how pitiful is the current US response to the climate challenge in comparison to that being implemented in the GBR. Surely the recent recognition by the US Administration that human efforts will be needed to reduce carbon emissions provides an umbrella under which comments can now be presented to the public.	We agree, but note that it is beyond the scope of this report to address mitigation.
Page 8-12, lines 39-42	Richard B. Aronson, Dauphin Island Sea Lab	Acidification is not the only climatically-related factor that might reduce habitat complexity. A more immediate concern is that bleaching will kill corals, and subsequent bioerosion will reduce complexity (although from Glynn's experience in the Eastern Pacific there might be an initial increase in topographic heterogeneity). The effects of acidification might be moot if most of the corals die bleach	We agree and have added text to this section.

SPECIFIC COMMENTS			
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		on a more-or-less continuous basis.	
Page 8-22, lines 20-43	Richard B. Aronson, Dauphin Island Sea Lab	A number of diseases could well show enhanced incidence or virulence as temperatures increase. However, this document glosses over the fact that white-band disease was the primary cause (though not the only cause) of reduced coral cover on Caribbean reefs from the late 1970s through the early 1990s. That outbreak did not, so far as I know, correspond to a period of particularly elevated temperature (despite claims in Lesser's recent paper in JEMBE).	We agree and added text to this section.
Page 8-41, line 42	Judith Lang, Independent Scientist	How can anyone reasonably assume that Florida's reefs will remain "in sufficiently good condition" given the documented decreases in live coral cover presented in references like Gardner et al. 2003; Porter and colleagues?	We agree and added text to this section.
Page 8-16, line 26	John Ogden, Florida Institute of Oceanography	Cite the following: Ogden, J.C. and R.L. Wicklund. (eds.) 988. Mass bleaching of coral reefs in the Caribbean: A research strategy. NOAA National Undersea Research Program Research Report 88-2, 51p. (This was the first scientific workshops on the phenomenon of bleaching prior to the first Senate hearings (1987, Weicker and Hollings) on the matter.)	We agree and have added this citation.
Page 16, line 45-46	Judith Lang, Independent Scientist	Please clarify that reduced grazing due to disease in urchins and overcollection of herbivorous fishes and polluted waters (including excessive terrestrial sediments) have also contributed to the Caribbean-wide declines in recent decades (e.g., Mumby 2006, Ecol. Applications 16: 747 for grazing effects; perhaps Kruczynski, 1999's Water Quality Concerns in the Keys… white paper for pollution (NB, all forms of pollution, not just those controversial nutrients). I realize these topics are considered later but this paragraph could easily be taken out of context as "proof" that NOAA is blaming all the declines in the Keys to "external" global climate change as a strategy to avoid dealing with local stressors–which doubtless sounds offensive to NOAA employees but is commonly heard nowadays.	We agree and have added text to this section.
Page 17,	Judith Lang,	See McNeil et al., 2004, Geophysical Research Letters 31:L22309:	We agree and have

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Location	**Reviewer**	**Comment**	**Author Response**
line 25	Independent Scientist	for a counter view in which increasing temperature will counterbalance the decreased pH (at least at sub-bleaching temperatures).	added text and the citation.
Page 20, line 7-12	Judith Lang, Independent Scientist	Subsurface outflows of groundwater are a second form of non-point source pollution, particularly in regions lacking major riverine systems to funnel surface runoff into coastal oceans; it would be appropriate to cite some USGS papers relevant to US reefs here.	We agree and added text.
Page 8-21, lines 32-37	Richard B. Aronson, Dauphin Island Sea Lab	Mumby et al. (2006) is not especially strong evidence for the notion that removing even a single keystone species destabilizes coral reef ecosystems and makes them more susceptible to climate change. Mumby showed that parrotfish inside MPAs have the capability of controlling macroalgae.	We agree and have added a citation for their 2007 paper, which goes on to show an effect on coral recruitment rates.
Page 22, line 16	Judith Lang, Independent Scientist	Lionfish are already well established in the Bahamas (see Snyder and Burgess 2007 Coral Reefa 26: 175; http://www.blackbeard-cruises.com/scuba-diving-cruises.php) and two at least have been collected in Cuban waters (Pedro Alcolado, pers. comm..).	We agree and have added text and the citation.
Page 8-22, line 40	Judith Lang, Independent Scientist	It would be appropriate to add a sentence describing the outbreaks of white plague in corals that initially appeared to be recovering from the severe 2005 bleaching event (as Eakin's paper and Wilkinson's books are still in prep., can cite Miller et al., 2006, Coral Reefs25: 418).	We agree and have added text and a citation.
Page 8-30, line 2	Judith Lang, Independent Scientist	Add "pathogens and parasites" to the list of undesirable organisms dispersed by currents.	We agree and have added text.
Page 8-35, line 27	Judith Lang, Independent Scientist	"Millions of visitors…" doesn't need repeating so soon after its use in line 38 of the previous page.	We agree and deleted the sentence.
Page 8-37, line 14	Judith Lang, Independent Scientist	Add "paleoclimatic analyses of coral skeletons (Eakin et al. 2006)" to the list of environmental monitoring in the Keys (See Eakin et al., Proc. 10th Int. Coral Reef Symp. 588-596).	We agree and have added text and the citation.

SPECIFIC COMMENTS			
Location	**Reviewer**	**Comment**	**Author Response**
Page 8-37, line 45	Judith Lang, Independent Scientist	Add (But see Lang et al. 1992 for "during- and-after" surveys at four sites). Also mention the FRRP program which is beginning to comprehensively tackle the large-scale aspects of bleaching in southern Florida, and clarify the extent to which tagging of select colonies to determine their individual fates versus random sampling of condition at larger scales is desired for this "before-during-after" research. Ref. = Lang, J.C., H.R. Lasker, E.H. Gladfelter, P. Hallock, W.C. Jaap, F.J. Losada and R.G. Muller. 1992. Spatial and temporal variability during periods of "recovery" after mass bleaching on western Atlantic coral reefs. Amer. Soc. Zool. 32: 696-706.	We agree and have added text and the citation. The FRRP is discussed elsewhere.
Page 8-39, line 6	Judith Lang, Independent Scientist	The Smiith et al. mss.cited here has been submitted to Oceanography and Marine Biology (Ault and Smith, white paper to AGRRA Project, Aug. 2007).	We disagree – these appear to be two different papers.
Page 8-40, line 27	Judith Lang, Independent Scientist	Substitute epizooitic for epidemic after disease.	We agree and modified the text.
Page 8-39, lines 11-31	Richard B. Aronson, Dauphin Island Sea Lab	This is an accurate portrayal of what Aronson and Precht said in their paper, stated in a refreshingly positive way!	Thank you.
Page 8-40, lines 14-46	Richard B. Aronson, Dauphin Island Sea Lab	Again, and excellent and sober review of the issues and evidence surrounding northward range extensions of corals with climatic warming.	Thank you.

10. Synthesis

SYNTHESIS COMMENTS			
Location	**Reviewer**	**Comment**	**Author Response**
Page 9-3, Lines 31-32	William L. Fang And Eric Holdsworth Edison Electric Institute (EEI)	The sentence that begins on line 32 makes reference to "feedback from the stakeholder workshops." However, the term "stakeholder" in regards to these workshops seems to be rather narrow in scope. Indeed, our review of the participants of several of the workshops does not indicate a broad range of participants (*e.g.*, p. 3-121 – Forest Service participants were largely from the government; p. 4-51 – the National Park Service workshop included mostly NPS personnel, NPS retirees, and one academic plus an environmental NGO). We note that many of the Federal areas often involve working relationships with energy and other business NGOs, as well as with entities and interests located outside the boundaries of the Federal areas. However, there is little evidence of their input. We think the draft should address the need for broader "stakeholder" (i.e., public) input in the management of the Federal areas.	We agree that this needs to be clarified. The sentence has been altered to indicate that workshops were *expert* workshops comprised of resource management scientists and representatives of managing agencies. This has also been better clarified in the Introduction chapter of the report. We had no intention of being comprehensive in our representation of every possible stakeholder group at these workshops. We knew that the public review of this document would provide all stakeholders with a chance to comment on it. We clarified in the text that these workshops were meant to be small, targeted working sessions of experts in the resource management and adaptation research fields to give us feedback on the scientific content and on the management options being considered to adapt to climate change. For each chapter, we have also provided a fuller list of those who were invited to each workshop, not just those who attended, so that the reader knows the intended make-up of each workshop.

SYNTHESIS COMMENTS			
Location	**Reviewer**	**Comment**	**Author Response**
Page 9-10, Lines 12-16	William L. Fang And Eric Holdsworth Edison Electric Institute (EEI)	Section 9.2.3.1 "**Examples of sources of Uncertainty**" begins with a reference to seven "families" of emission scenarios citing "(IPCC, 2007), all differing in their climate projections." It then provides global mean temperature "projections from 1.4-5.8°C (2.5-10.5°F)". However, according to the Working Group I's Summary for Policymakers (SPM) for the Fourth Assessment Report, that range is from the Third Assessment Report, not the Fourth Assessment Report. Indeed, the SPM states (p. 13): Best estimates and *likely* ranges for globally average surface air warming for six SRES emissions marker scenarios are given in this assessment and are shown in Table SPM-3. For example, the best estimate for the low scenario (B1) is 1.8°C (*likely* range is 1.1°C to 2.9–C), and the best estimate for the high scenario (A1FI) is 4.0°C (*likely* range is 2.4°C to 6.4°C). Although these projections are broadly consistent with the span quoted in the TAR (1.4 to 5.8°C), they are not directly comparable (see Figure SPM-5). The AR4 is more advanced as it provides best estimates and an assessed likelihood range for each of the marker scenarios. The new assessment of the likely ranges now relies on a larger number of climate models of increasing complexity and	Correct. We have updated the numbers to 1.1 to 6.4°C.

SYNTHESIS COMMENTS			
Location	**Reviewer**	**Comment**	**Author Response**
		realism, as well as new information regarding the nature of feedbacks from the carbon cycle and constraints on climate response from observations. (emphasis added) We think that the reference to "IPCC, 2007" is misleading in light of the above explanation.	
Page 9-12 and 9-13, Lines 30-33 on p. 9-12 and 2-4 on p. 9-13	William L. Fang And Eric Holdsworth Edison Electric Institute (EEI)	This paragraph notes that "confidence levels are presented in Table 9.4 (p. 9-54) and that they should be a "key consideration" in "deciding which adaptation approaches to implement for a given system." However, the Table 9.4 confidence levels differ from those of the Intergovernmental Panel on Climate Change's Working Group II Summary for Policymakers Fourth Assessment Report (p. 21). We question why this and other SAPS, assuming the need for such levels, seek to establish a different format for such levels. If they are to be used, we think they should be uniform with the IPCC, unless there is a basis for deviating and that basis is explained.	The confidence exercise for this report has been extensively revised as per the IPCC guidance on uncertainty for the 2007 reports. Thus the corresponding section has been rewritten consistent with the IPCC language and approach.

11. Appendix

11.1. Executive Summary

Relates to a comment from Amanda Staudt, National Wildlife Federation, on Page 21 of this document:

	National Forests	National Parks	National Wildlife Refuges	Etc.
Increased temperature	Will exacerbate air pollution stressor	[not clear from ES how authors think increase temp will impact parks]	Expected to cause major changes in 16 Alaskan refuges, comprising 82% of total NWRS area	
Change in precipitation patterns	Complicate western water management	[not clear from ES how authors think increase temp will impact parks]		
Sea level rise	N/A	N/A	Threatens 161 coastal refuges	
Etc.				

11.2. National Estuaries

Relates to a comment from Braxton Davis, SC Dept of Health and Environmental Control, SC Dept of Health and Environmental Control, on Page 105 of this document:

The Role of

Coastal Zone Management Programs in Adaptation to Climate Change

Final Report of the
CSO Climate Change Work Group

September, 2007

The Role of Coastal Zone Management Programs in Adaptation to Climate Change

Synthesis Report from the CSO Climate Change Work Group

Work Group Members

Braxton Davis, SC Dept of Health and Environmental Control, Chair (SC)
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Tom Calnan (TX)
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We appreciate the support of NOAA's Office of Ocean and Coastal Resource Management and Rhode Island Sea Grant for providing additional information on coastal states' climate change policies and activities.

September 2007

Table of Contents

Executive Summary

Coastal areas are vulnerable to climate change, especially with respect to accelerated sea level rise and lake level changes, shoreline erosion, increased storm frequency or intensity, changes in rainfall, and related flooding. Other impacts may include changes in chemical (ocean acidification) and physical characteristics (thermal stratification) of marine systems, saltwater intrusion into groundwater aquifers, increased harmful algal blooms, spread of invasive species, habitat loss (especially coastal wetlands), species migrations, and changes in population dynamics among marine and coastal species. Preparing for these impacts has been termed "adaptation" by the coastal research and management community. As state and local governments consider future climate change policies and strategies, coastal zone management programs will play an important role in identifying vulnerabilities and fostering adaptation to climate change.

The Coastal States Organization's (CSO) Climate Change Work Group prepared this report to explore the current and future roles of state coastal zone management programs in addressing climate change. While other reports have synthesized broader state-level climate change initiatives, this report aims to:

- Inform Congress and federal agencies of the role of state coastal zone management programs in addressing climate change;
- Inform CSO & NOAA's efforts to reauthorize the Coastal Zone Management Act;
- Inform federal agencies of key research, information, and policy needs; and
- Provide for information exchange among coastal states and territories.

The CSO Work Group developed and distributed a survey to the full membership of the Coastal States Organization. Recognizing that there are many programs at the federal and state level that address climate change either directly or indirectly, CSO focused its survey questions specifically on the roles of state and territory coastal zone management programs authorized under the CZMA. The survey did not cover the activities/needs of Sea Grant, National Estuarine Research Reserves (NERRs), National Estuary Programs (NEPs), or other partners. A total of eighteen state coastal programs responded to the survey. The summary of results is provided below. Please refer to the full text for the complete list of recommendations and context for the suggestions outlined here:

Coastal Programs' Involvement in Climate Change Initiatives
Several state coastal programs are addressing climate change issues via statewide, interagency climate change partnerships or commissions – often under Governors' climate change initiatives. The coastal programs are providing information for, or responding to, specific action items generated by these state climate commissions. In this capacity, coastal programs are playing a key role in ensuring the consideration of coastal impacts and adaptation strategies.

Adaptation Strategies
Coastal programs are beginning to address climate change by examining the social, environmental, and economic impacts of accelerated sea level rise scenarios, resulting shoreline changes, and potential adaptation strategies. Existing coastal zone management programs and policies were based upon a relatively predictable rate of sea level rise. The challenge for coastal managers is to devise adaptations strategies for a variety of sea level rise scenarios and adjust these in the future as forecasting improves. New policies are being developed to address the siting of public infrastructure, site-level project planning, wetland conservation and restoration, shoreline building setbacks, building elevations, and alternatives to shoreline "armoring." Coastal programs are interested in decision-

support tools that compile historical shorelines, geomorphology, socioeconomic data, and model projections. Coastal programs are partnering with Sea Grant and NERRs for extension and outreach activities.

Mitigation Strategies for Greenhouse Gas Emissions
While some coastal programs have permitting, enforcement, or other management authorites that support them in playing a significant role in reducing emissions through direct and/or indirect management of coastal activities, many state coastal zone management programs are focused primarily on developing strategies for adaptation to the social, environmental, and economic coastal impacts of climate change over the coming decades. The development of mitigation strategies for greenhouse gas emissions is considered appropriate and encouraged for those coastal programs with sufficient authorities and missions.

State Data Collection/Research Efforts and Future Needs
To better understand the effects of accelerated sea level rise on coastal communities and resources, state coastal programs are increasingly sponsoring or supporting research and data collection efforts focused on:

- Historic shoreline position maps; historic shoreline erosion rates, inventories of shoreline features and conditions;
- Acquisition of high resolution topography and bathymetry;
- Sea level rise inundation models;
- Storm surge - sea level rise linked inundation models;
- Shoreline change modeling based on sea level rise projections;
- Sea level rise vulnerability analyses/socio-economic studies;
- Environmental/habitat changes associated with sea level rise (e.g. coastal wetlands, salt wedge migration).

A common concern of state coastal managers is that their research efforts and those conducted by the federal government be well coordinated and not duplicative. The states welcome a discussion on the efforts listed above, and cited the following as their continuing research and information needs:

High Resolution Topography and Bathymetry

- Consistent temporal and spatial coverage of high-resolution topography and bathymetry data (for example, LIDAR, shallow water-penetrating LIDAR);
- Training for coastal program managers in shoreline delineation, mapping, vertical and horizontal reference datums, and legal

definitions.

Inundation Mapping vs. Shoreline Change Modeling

- Federal guidance for modeling local- and subregional-scale shoreline changes associated with varying sea level rise projections;
- Guidance for monitoring changes along "sheltered" coastlines.

Impacts of Accelerated Sea Level Rise

- Federal guidance on best practices, case studies, trainings, workshops, and/or software tools focused on community-level and statewide vulnerability assessments and adaptation planning for state coastal programs.
- Improved models that predict coastal wetland and beach migration and vertical accretion in response to accelerated sea level rise, information on the costs of response options, and the consequences of taking no action.
- Assessments of social, legal, and economic issues related to shoreline "retreat," armoring, renourishment, and "no action" alternatives across developed and urbanized coastlines.

Other Climate Change Impacts

- Information, research, and guidance on a variety of other climate change issues, such as the introduction of invasive species, ocean acidification, ecosystem migration, freshwater resources, and storm surge models.
- Federal guidance for modeling local/regional-scale effects of storm events coupled with rainfall, river flooding, and sea level rise projections.

Federal Policy Needs

Participants called for a clear federal strategy for intergovernmental coordination on coastal adaptation to climate change. A key component of this strategy should be a new, stronger focus on interagency cooperation between NOAA, state coastal management programs, FEMA, and state floodplain managers. Suggestions were also made for the development of regional "clearinghouses" for ongoing information exchange among federal, state, and local programs and research activities. Finally, the federal Coastal Zone Management Act should be recognized by Congress and the Administration as one of the primary statutes that can foster adaptation to climate change at the state and local levels.

Introduction

Socioeconomic and environmental impacts of climate change are projected to be most significant in coastal areas of the United States.[1-3] The U.S. population is concentrated in coastal areas,[4] where communities and natural resource-based economies are especially vulnerable to accelerated sea level rise and lake level changes, shoreline erosion, increased storm frequency or intensity, changes in rainfall, and related flooding. Other impacts may include changes in chemical (ocean acidification) and physical characteristics (thermal stratification) of marine systems, saltwater intrusion into groundwater aquifers, increased harmful algal blooms, spread of invasive species, habitat loss (especially coastal wetlands), species migrations, and changes in population dynamics among marine and coastal species. These impacts will vary regionally, but scientists contend that many are likely to be experienced in the coming decades - even if greenhouse gas emissions are reduced significantly.[1-2]

Preparing for and coping with the impacts of climate change has been termed "adaptation" by the coastal research and management community. Many of these impacts will require adaptation solutions that cross federal, state, regional, and local agencies, programs, policies, and political jurisdictions. A number of federal agencies and programs have begun to explore information needs and policy options at the federal level; however, state and local governments have immediate responsibilities for managing many of the resources and communities that are likely to be impacted by climate change. Some states and local governments have launched major initiatives focused on reducing greenhouse gas emissions. Attention toward adaptation has been more limited and recent.[5] As state and local governments consider future climate change policies and strategies, coastal zone management programs will play an important role in identifying climate change impacts, vulnerabilities, and opportunities for adaptation; and fostering interagency collaboration on climate change issues.

The Coastal States Organization (CSO) was established in 1970 to represent the Governors of the nation's thirty-five coastal states, commonwealths and territories on legislative and policy issues relating to the sound management of coastal, Great Lakes and ocean resources. In January 2007, CSO established a Climate Change Work Group, which was charged with three key tasks:

1) Tracking and responding to federal legislative proposals related to climate change;

2) Developing a draft CSO Climate Change Policy Statement;

3) Assessing state activities and needs related to climate change.

The Work Group drafted this report in response to the third task. The report explores the current and future roles of state coastal programs in addressing climate change, and identifies the states' shared needs for federal agencies and programs to consider. More specifically, the report seeks to:

Inform Congress and federal agencies on the role of state coastal zone management programs in addressing climate change;

Inform CSO and the National Oceanic and Atmospheric Administration's (NOAA) efforts to reauthorize the Coastal Zone Management Act;

Inform federal agencies of key research, information, and policy needs; and

Provide for information exchange among coastal states and territories.

Approach

The Work Group developed and distributed a survey to the full membership of the Coastal States Organization (Appendix A). Recognizing that there are many programs at the federal and state level that address climate change either directly or indirectly, CSO focused its survey efforts specifically on the roles of state and territory coastal zone management programs authorized under the federal Coastal Zone Management Act (CZMA). Each of these programs is unique: some include a broad range of "networked" state and local agencies and policies that are coordinated or supported through the CZMA; others are more centralized within a single agency. As a result, the missions, jurisdictions, and policies of state-level coastal programs vary with respect to climate-related activities. The Work Group did not distribute the survey to, and therefore this report does not cover, the activities and needs of Sea Grant, National Estuarine Research Reserves, National Estuary Programs, or other partners. Some of these national programs are currently developing parallel reports.

Fifteen state coastal programs initially responded to the survey, and the results were synthesized in a draft report. The draft report was edited by the CSO Climate Change Work Group, then distributed to the full CSO membership for review and input. In response to the draft report, three additional programs provided information for the final report, bringing the total number of state responses to eighteen. Additional edits were received and incorporated from seven state programs. Preliminary results of the survey were also presented and discussed in June 2007 at a meeting of the state-federal Coastal Coordination Committee in Washington, DC; and at a special session during the Coastal Zone 2007 Conference in Portland, OR. Under each section below, CSO has summarized the responses of the state participants.

Results

Coastal Programs' Involvement in Climate Change Initiatives

Several state coastal programs are addressing climate change issues via statewide, interagency climate change partnerships – often under Governors' climate change initiatives. The coastal programs are providing information for, or responding to, specific action items generated by these state climate commissions. In this capacity, coastal programs are playing a key role in ensuring the consideration of coastal impacts and adaptation strategies. For example:

Maryland's Coastal Program is chairing and staffing an Adaptation and Response Working Group for their Governor's Commission on Climate Change (Executive Order 01.01.2007.07). The Working Group is developing a "Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change" for the Governor and General Assembly in 2008.

Washington's Coastal Program is involved in the Washington State Governor's Climate Change Challenge (Executive Order No. 07-02). Washington's Coastal Program is part of a Coastal and Infrastructure Preparation/Adaptation Working Group that will examine the specific steps for the state to take to prepare for impacts to the coastline.

South Carolina's Coastal Program serves on a "Crosscutting" Technical Work Group under the Governor's Climate, Energy, and Commerce Advisory Committee (Executive Order 2007-04) and is highlighting coastal impacts and potential adaptation strategies.

New Jersey's Coastal Program helped organize a Climate Change Summit chaired by the Governor, members of his Cabinet, financial services and insurance industry leaders, and recognized experts from the scientific community and industry. The Coastal Program intends to address issues raised by the participants related to sea level rise, flooding and coastal storms.

California's Coastal Commission is working with the State's Ocean Protection Council to respond to state climate change legislation (AB 32). The Council recently adopted a resolution to inform mitigation and adaptation strategies statewide. In December 2006, the Commission held the first in a series of climate change workshops designed to inform the Commission on climate change, and to help identify specific actions within the Commission's authority to reduce greenhouse gas emissions and adapt to anticipated impacts of global warming.

The San Francisco Bay Conservation and Development Commission (BCDC) is updating its *San Francisco Bay Plan* policies on sea level rise and developing new policies pertaining to climate change. BCDC is also working with the California Ocean Protection Council, the State Climate Action Team, and joined with three other regional agencies to develop a comprehensive strategy aimed at reducing greenhouse gas emissions and adapting to the impacts of climate change.

Louisiana's Coastal Program is participating in a state/ nongovernmental organization initiative entitled "Climate, Energy, and the Coast." The initiative is focused on the restoration of Louisiana's wetlands.

Oregon's Coastal Program is working with Oregon Sea Grant, South Slough National Estuarine Research Reserve, and the Governor's Office of Climate Change to convene an interagency forum to develop a climate change report for the 2009 Oregon legislature.

Massachusetts' Coastal Program chaired and staffed a Coastal Hazards Commission comprised of state legislators, state agency representatives, and local officials to address erosion and flooding primarily due to storms, decreased sediment supplies, and sea level rise. The Coastal Hazards Commission released a report in May 2007 with 29 recommendations including one to map and model climate change and sea level rise data related to coastal hazards in Massachusetts.

North Carolina's Coastal Program serves on a Legislative Commission on Global Climate Change, which will issue its final report no later than April 15, 2008.

Some coastal programs are taking lead roles in regional partnerships to address hazards related to climate change, among other issues. For example, the Northeast Regional Ocean Council recently proposed the development of an action plan to render New England a "Coastal Hazards Ready" region, including the identification of infrastructure at risk from accelerated sea level rise. The Southern New England Ocean Partnership has also named coastal hazards (including climate adaptation) as an initial priority.

In 2006, nearly two-thirds of the coastal states reported to NOAA that "coastal hazards" were a high priority, and developed 5-year strategies to address issues such as flooding, shoreline erosion, and coastal storms in their most recent program updates (309 Assessment and Strategies).[6] Although many of these coastal hazards exist without human-induced climate change, they are expected to intensify in future climate scenarios. Therefore, even in states that have not engaged in broad climate change initiatives, related policies are already being developed and advanced by most coastal zone management programs.

Adaptation Strategies

To date, most coastal programs have primarily focused on the potential social, environmental, and economic impacts of accelerated sea level rise, resulting shoreline changes, and adaptation strategies. Existing coastal zone management programs and policies were based upon a relatively predictable rate of sea level rise. The challenge for coastal managers is to devise adaptations strategies for a variety of sea level rise scenarios and adjust these in the future as forecasting improves. For example:

Maryland's Coastal Program developed "A Sea Level Response Strategy for the State of Maryland." The Strategy set forth short and long-term objectives, along with key activities, to address the three primary impacts of sea level rise - erosion, flooding, and inundation - and recommended policies and actions to reduce vulnerability to sea level rise.

The San Francisco Bay Conservation and Development Commission mapped areas along the shoreline of San Francisco Bay that are vulnerable to sea level rise and require more focused adaptation planning.

Delaware's Coastal Program published an updated version of *"Striking a Balance"* in 2005. This report expands on the issues of sea level rise, coastal processes, and related impacts to habitats and coastal water quality.

South Carolina's Coastal Program is launching a multi-year "Shoreline Change Initiative" in 2007 to address beachfront and estuarine shoreline management issues, as well as concerns about intensifying sea level rise and coastal storms.

Maine's Coastal Program published a report entitled "Anticipatory Planning for Sea Level Rise Along the Coast of Maine" in 1994. More recently, in 2006, the Maine Coastal Program funded the Maine Geological Survey to develop a report on "Impacts of Future Sea Level Rise on the Coastal Floodplain."

Connecticut's Coastal Program is working with the flood management section of Inland Water Resources Management Division of the state Department of Environmental Protection (DEP) to acquire high-resolution digital elevation maps for improved coastal hazard planning. The Coastal Program also provided a technical review and assessment of potential sea level rise impacts for the 2007-2010 DEP Hazard Mitigation Plan.

North Carolina's Coastal Program, in collaboration with the Division of Water Resources, will address sea level rise and other issues in the State's first comprehensive beach and inlet management plan (to be completed by March 2009).

Based on these and other planning efforts, states are beginning to implement a number of specific policies and strategies to encourage adaptation to climate change impacts:

Establishing public infrastructure siting policies	Massachusetts' Cape Cod Commission requires new and redeveloped infrastructure, such as stormwater systems and roadways, to consider sea level rise in their design.
	New York's Long Island Sound Coastal Program requires consideration of sea level rise when siting and designing projects involving substantial public expenditures.
Including effects of climate change in site-level project planning	Washington State's Coastal Program is examining use of the State Environmental Policy Act (SEPA) to incorporate effects of climate change in project planning.
	California's Coastal Program requires applications for new shorefront development (buildings and shore protection) to consider an increase in sea level in the examination of flooding and wave hazards. The anticipated rise in sea level has been similar or slightly higher than historic trends.
Modifying wetland conservation and restoration policies	New Jersey's Coastal Program is developing methodologies, protocols, regulations, and/or guidance documents designed to accommodate the adaptation of coastal wetlands to sea level rise.

	Connecticut's Coastal Program has developed recommendations for a bi-state Habitat Restoration Committee of the Long Island Sound Study (NEP) to devise a new strategy for estuarine restoration, including avoiding risky restoration projects such as low marsh, restoring tidal wetlands adjacent to lands where marine transgression can occur, identifying refugia sites (future marine transgression areas) for protection, and seed banks to protect the most threatened plants species.
Increasing shoreline setbacks	California's Coastal Program considers future increases in bluff erosion when establishing bluff edge setback criteria.
	North Carolina's Coastal Resources Commission has approved draft rule language that increases setbacks for single-family homes greater than 5,000 sf to 60 times the erosion rate, and increases setbacks for all structures between 10,000 and 100,000 sf by creating a graduated setback that increases with structure size.
Increasing "free board" above Base Flood Elevation	Massachusetts' Coastal Program serves on a technical advisory committee to the Board of Building Regulations & Standards, and recommended that the State Building Code include 2 ft of freeboard in V zones and coastal dunes to accommodate sea level rise and mapping accuracy.
Promoting alternatives to shoreline "armoring"	Maryland's Coastal Program has developed a "Living Shoreline Stewardship Initiative" that promotes and encourages shoreline stabilization alternatives through demonstration projects, field assessments of location suitability, education and outreach programs, and grant/funding support for project construction.
	Virginia's Coastal Program is undertaking a "Living Shorelines" initiative to develop improved design criteria, a contractor certification program, information on shoreline conditions, revised policies, and outreach materials to promote the use of nonstructural or "hybrid" approaches to shoreline stabilization.

Encouraging the consideration of climate change impacts in state and local planning efforts	Maryland's Coastal Program ensured that sea level rise considerations were included in the recent Comprehensive Conservation and Management Plan for the Maryland Coastal Bays National Estuary Program; the Chesapeake 2000 Bay Agreement; the Baltimore and Prince George's County Hazard Mitigation Plans; the Coastal Bays Hazards Initiative; and the Worcester County Comprehensive Plan.
	New Jersey's Coastal Program is working to develop consistent, comprehensive municipal coastal hazards mitigation plans that address climate change-related issues.
	California's Coastal Program staff are participating in the State's Multi-Hazard Mitigation Plan and urging the Governor's Office of Emergency Services to include global warming issues in the Plan; and are encouraging coastal communities to amend their local coastal plans (LCPs) to include an element that focuses on sea level rise, erosion, flooding, and other climate change impacts.
	Virginia's Coastal Program is working with 8 regional planning district commissions (PDCs) that provide technical assistance to the 87 localities of the coastal zone. As part of this assistance, PDCs have helped localities develop FEMA-approved "All Hazards Plans" that address preparedness and response to events such as hurricanes.
	Rhode Island's Coastal Program is undertaking a project with RI Sea Grant to incorporate climate change/sea level rise considerations into siting, building standards criteria and policies that would eventually become part of the State CZM enforceable policies for the Upper Narragansett Bay and Metro Bay Special Area Management Plans.
	Texas' Coastal Program is supporting local geohazard maps that include sea level rise, erosion rates, wetlands, and other information, such as one developed as a planning tool for the City of Galveston by the University of Texas (http://www.beg.utexas.edu/coastal/GalvHazIdx.htm). A similar map is being developed with CZ Section 309 funding for Mustang Island and the City of Port Aransas.

	Washington's coastal program is investigating how and whether to address climate change through city and county Shoreline Master Programs.
Development of GIS-based decision-support and visualization tools	Maine's Coastal Program is supporting the state Geological Survey's development of a GIS-based compilation of historical shorelines, beach and dune geomorphology, development setbacks, 100-year flood vulnerability, Erosion Hazard Areas, sea-level rise inundation, etc. to improve decisionmaking with respect to dune restoration, beach nourishment, infrastructure changes, etc.
	Connecticut's Office of Long Island Sound Programs (OLISP), through partnerships with USGS and the Long Island Sound Integrated Coastal Observing System (University of Connecticut), will host a NOAA Coastal Fellow in the fall of 2007 to develop a coastal hazards visualization website with data layers accessible through a browser-based Internet Mapping Service.
	Maryland's Coastal Program Coastal Program recently launched an interactive web portal (Shorelines Online) that centralizes information and data on coastal hazards management and sea level rise.
	Massachusetts' Coastal Program compiled a Coastal Hazards Characterization Atlas for the South Shore that presents shoreline variables, including sea level rise, to aid local officials in the review of projects proposed in areas vulnerable to coastal hazards.
	North Carolina provides access to shoreline data and aerial photography online through an interactive coastal hazards mapping tool. Long-term erosion rates can be super-imposed on aerial imagery.
Supporting outreach/extension activities, often through partnerships with NERRS or Sea Grants	Puerto Rico's Coastal Management Program and Sea Grant co-sponsored a climate change roundtable with the University of Puerto Rico in May 2007.
	Rhode Island's Coastal Program recently partnered with the RI Sea Grant to hold a one-day Sea Level Rise Workshop focused on policy and science issues.

	Massachusetts' Coastal Program has a NOAA Coastal Management Fellow developing a "StormSmart Coasts" Program that includes a website, fact sheets, case studies, and a series of regional workshops to assist local officials assess resources and create new regulatory tools and plans.
	Washington's coastal program participates and partners with Padilla Bay NERR, which through its Coastal Training program provides popular informational sessions related to climate change including topics such as estuaries, alternative energy, and how to teach climate change.

Mitigation Strategies for Greenhouse Gas Emissions

According to the survey results, state participants held differing views on the role of coastal programs in addressing greenhouse gas emissions through indirect (e.g. promoting energy efficiencies) or direct (e.g. energy siting) approaches. In some states, coastal programs are undertaking specific activities to reduce emissions through interagency partnerships. For example:

California's Coastal Commission and the San Francisco BCDC are working with sister state agencies, such as the California Air Resources Board and Energy and Public Utilities Commission, to develop programs to reduce greenhouse gas emissions and to conduct research aimed at achieving renewable energy sources.

Virginia's Coastal Program is involved in a partnership with the American Lung Association to promote "Commute Smart Virginia" by funding bus signs, events and radio ads that encourage carpooling, using public transit, and taking other actions to reduce greenhouse gas emissions.

Maryland's Coastal Program supports a Green Building Network – an informal group of over 3,000 architects, builders, contractors, developers, planners, landscape architects, and citizens focused on promoting the design and construction of buildings and sites in a manner that encourages efficient use of natural resources and raw materials, protects the environment, and promotes sustainable communities. The Coastal Program has also funded a number of "Environmental Design" projects with green development aspects.

Maine's Coastal Program is comprised of networked agencies with jurisdiction over environmental siting and reviews of energy facilities, and has been involved in several environmental scoping efforts related to in-stream tidal power projects.

In other states, greenhouse gas emissions were considered, for the most part, to be outside of the jurisdiction of the coastal zone management program or overlapping with other state agencies' jurisdictions. All approved state coastal programs have some authority for energy facility siting, and can review federal energy projects through the "federal consistency" provision of the Coastal Zone Management Act. However, some states indicated that while they have authorities to influence the siting of energy facilities, coastal programs often do not have authority to regulate emissions.

CSO participants agreed that, while some coastal programs are playing a significant role in reducing emissions through direct and/or indirect management of coastal activities, a fundamental role for state coastal zone management programs is in fostering adaptation to the social, environmental, and economic coastal impacts of climate change over the coming decades. The development of mitigation strategies for greenhouse gas emissions was considered appropriate and encouraged for coastal programs with sufficient authorities and missions.

Existing Funding Sources and Future Needs

State coastal programs have used some core federal program funds (CZMA Section 306) to support climate change-related activities, and are increasingly utilizing CZMA Section 309 Enhancement Grants to study or plan for climate change impacts (e.g. ME, MD, DE, NC, NJ, SC, VA). Some coastal programs have also pursued funds from a variety of other state and federal sources, including other NOAA branches, the Environmental Protection Agency (EPA), U.S. Army Corps of Engineers (USACE), Federal Emergency Management Agency (FEMA), and U.S. Geological Survey (USGS), and even some private sources.

A number of states indicated a need for additional financial support to better address climate change. Funds are needed for research and data acquisition, as well as to expand permitting and enforcement/compliance activities. Technical and planning staff are needed to work with existing coastal program staff, other federal, state, and local agencies, and academia to address key climate change issues and to build capacity. State coastal programs also cited the need for federal coordination at the regional scale to better address shoreline management issues, including the establishment of a "clearinghouse" for information exchange among federal, state, and local agencies, programs, and research activities.

State Data Collection/Research Efforts and Future Needs

State coastal programs are increasingly sponsoring or supporting research and data collection efforts to better understand and predict the impacts of accelerated sea level rise on coastal communities and resources, including:

- Historic shoreline position maps; historic shoreline erosion rates, inventories of shoreline features and conditions (CT, DE, MA, ME, MD, NC, SC, TX, VA, WA);
- Acquisition of high resolution topography (LIDAR – LIght Detection And Ranging) (CT, DE, MD, ME, NC, NJ, TX, VA);

and bathymetry (CA, MA, NC);

• Sea level rise inundation models (CA, CT, DE, MD, ME, NC, NH, NJ, BCDC, TX);

• Storm surge - sea level rise linked inundation models (CT, DE, MD, NC);

• Shoreline change modeling based on sea level rise projections (DE, NC, TX, WA);

• Sea level rise vulnerability analyses/socio-economic studies (DE, ME, NC, NJ, BCDC);

• Environmental/habitat changes associated with sea level rise (e.g. coastal wetlands, salt wedge migration) (CT, DE, ME, NC, NJ, TX).

A common concern of state coastal managers is that their research efforts, and those conducted by the federal government and academia, should be well coordinated and not duplicative. The states welcome a discussion on the efforts listed above, and cited the following as their primary research and information needs:

High Resolution Topography and Bathymetry
High-resolution topography and nearshore bathymetry data were described as a critical need in 7 state responses, and as a recent and critical acquisition for inundation/storm surge mapping in 5 other responses to the CSO survey. In some cases, high-resolution spatial data are available for beachfront areas, but do not capture the full extent of estuarine or "sheltered" shorelines. Funding to support one-time Light Detection and Ranging (LIDAR) mapping was obtained, to varying extents, from FEMA, USACE, the NOAA Coastal Services Center, or through state and local interagency partnerships.

LIDAR mapping of state coastal zones is a high priority in order to begin assessing the most vulnerable areas by overlaying sea level rise projections onto digital elevation models. Current topography data are often at coarse 10-20 foot contour intervals at the scale of USGS 7.5' topographic maps (1:24,000), and do not have sufficient detail for impact studies, modeling, or policy and regulatory use. **There is a strong need for consistent temporal and spatial coverage of high-resolution topography and bathymetry;** at least one state indicated a preference for full coastal LIDAR coverage on an *annual* basis. **High-resolution bathymetry (e.g. shallow water-penetrating LIDAR) data are also needed to support assessments of shoreline changes,** since shoreline positions do not accurately convey changes to sand volumes and the steepness of shoreline slopes.

The National Research Council recently described this lack of standardized, uniform geospatial data in the coastal zone:[7]

> "This inability to produce a seamless map (or chart) across the land-water interface is a severe impediment to understanding the many processes that are continuous across the shoreline. The lack of standardization has also led

> government agencies, the research community, and the private sector to undertake the expensive and time-consuming task of separately generating new data and maps to accompany almost all new studies and initiatives. The lack of coordination of coastal zone mapping efforts inevitably leads to the potential for redundancy of surveys or products. At least 15 federal agencies are involved in the primary collection or use of coastal geospatial data, often with responsibilities shared among multiple divisions within the same agency. In addition, a plethora of state and local agencies, academic institutions, and other organizations also gather and use coastal zone information. This has resulted in a chaotic collection of potentially overlapping, and often uncoordinated, coastal mapping and charting products that can frustrate the efforts of users to take advantage of existing datasets and build on past studies.

The CSO survey conducted here reinforces the NRC report's findings that:

> "**Specific areas where better coordination among federal agencies is urgently needed include high-resolution topographic and bathymetric data acquisition at the land-water interface**, including aerial and satellite imagery, Light Detection and Ranging (LIDAR) surveys, bathymetric surveys, seamless topographic/bathymetric Digital Elevation Models (DEMs)/Digital Depth Models (DDMs), and derived products for mapping shoreline change, habitat change, hazard vulnerability, and coastal erosion and inundation" (emphasis added), and
>
> "There is a widespread need for more and better data to be collected in the coastal zone… [including] enhanced bathymetric data, particularly in very shallow coastal waters. These data provide the basic geospatial framework for almost all other studies and are a key component for derived products such as offshore habitat maps."

Inundation Mapping vs. Shoreline Change Modeling

Many of the state coastal programs have begun, or will soon begin, to conduct assessments of the potential impacts of sea level rise using basic inundation mapping that compares various projections of future sea level rise against high resolution coastal topography (digital elevation models). These inundation maps will help coastal programs identify the lands most vulnerable to sea level rise, and estimate impacts associated with storm surge and flooding events on a large scale. Several of these maps have also been produced by federal agencies on a regional scale, including the EPA and the USGS.[8-9]

While these models of coastal inundation exist in some areas of the country, and detailed shoreline erosion models exist in some areas, few models appear to combine the two. Sea level rise, storm surge, erosion, circulation, wave climates, sediment budgets, and other shoreline changes are interrelated. Large-scale inundation models are effective in identifying low-lying lands, but coastal states and communities will need more detailed and complex models of future changes in coastal geomorphology, hydrological conditions, and human alterations and responses (seawalls, sand replenishment, etc.) in order to adequately assess social, environmental, and economic vulnerabilities. The EPA has established a Coastal Elevations and Sea Level Rise Advisory Committee to address these

issues through a study of the impacts of sea level rise across the mid-Atlantic region (New York to North Carolina) as part of the U.S. Climate Change Science Program.[10] **State coastal programs would benefit from the development of uniform methods for modeling local- and regional-scale shoreline changes associated with varying sea level rise projections; as well as guidance for monitoring changes along "sheltered" coastlines.**[11]

Impacts of Accelerated Sea Level Rise on Social and Economic Resources

A related need exists for coastal programs in assessing vulnerabilities to anticipated sea level rise. The potential for significant losses of economic and cultural resources, such as public infrastructure (wastewater treatment systems, roads, ports, public facilities, river flood protection levees and bridge clearances for shipping interests),[12] historic and cultural sites, shoreline property values, and coastal tourism activities, among other losses, are difficult to quantify, but need to be anticipated and planned for in light of sea level rise projections, shoreline change models, and potential adaptation strategies. **NOAA should partner with other federal agencies to provide best practices, case studies, trainings/workshops, and/or software tools focused on community-level and statewide vulnerability assessments and adaptation planning for state coastal programs.**

Impacts of Accelerated Sea Level Rise on Coastal Habitats

Several coastal programs have begun focusing on the impacts of accelerated sea level rise on coastal wetlands, as well as potential conservation, mitigation, and restoration strategies. However, further research is needed to better understand natural erosion and deposition cycles in tidal marshes, and to improve our ability to predict the effects of accelerated rates of sea level rise. Natural sediment sources, the movement of sediment within the system, and the locations and rates of sediment deposition need to be quantified for discreet shoreline reaches in order for predictive capabilities to be developed. Artificial sediment supply needs to be further evaluated as a mitigation option. Similarly, beaches respond to the background sea level rise rate through the accumulation of sand on the berm and dune from wave and wind forces. The ability of sand supplies in coastal systems to keep pace with an accelerated rate of sea level rise is not well understood. **There continues to be a need for improved models that predict the migration and/or vertical accretion of coastal wetlands and beaches in response to accelerated sea level rise, information on the costs of response options, and the consequences of taking no action. There is also a need for research on the anticipated role of sea level rise in beach nourishment frequency and volumetric requirements; as well as the potential use of artificial sediment supplies to "nourish" coastal wetlands.**

Other habitats at risk include submerged aquatic vegetation, coral reefs, oyster reefs, and fringing maritime forests. Thermal and chemical changes in coastal waters may affect marine species survival and distributions. Further research is needed to understand the potential for latitudinal habitat changes as northern climates begin to resemble today's southern climates.

Other Climate Change Impacts
As described in the opening paragraph of this report, coastal zones are subject to a wide variety of climate change impacts, many of which are not well understood. **State coastal programs need further information, research, and guidance on issues like invasive species introductions, ocean acidification, ecosystem migration, freshwater resources, and improved storm surge models.** Participants suggested that coastal and ocean observing systems within the U.S. Integrated Ocean Observing System (IOOS) will generate useful information products related to real-time and projected climate, storm surge, and physical, chemical, and biological changes in ocean and coastal systems. Guidance is also needed for modeling local/regional-scale effects of storm events coupled with rainfall, river flooding, and sea level rise projections.

Policy Analyses
There is a general need for federal support of state and local policy analyses to increase awareness among state coastal program managers of adaptation strategies and policy options, such as those described in this report, as well as their potential implications. In particular, **there is a need for assessments of the social, legal, and economic issues related to sea level rise and shoreline "retreat," armoring, renourishment, and "no action" management alternatives across developed and urbanized coastlines.**

Information Synthesis
While the EPA and other federal agencies provides excellent synthesis products related to climate change, **state coastal programs need a "clearinghouse" for federal, state, and local programs, research activities, and other information related to climate change in their region.** Coastal programs need to be aware of research that the USACE, FEMA, USGS, EPA, NOAA and others are conducting (or have conducted) in their state or region, and of management activities and lessons learned by neighboring states. State coastal programs also described a need for a single source for the most up-to-date sea level rise and climate projections and information at the national level, including documented coastal and ocean changes that have occurred or are occurring due to climate change. Beyond a single inventory, state participants expressed an interest in establishing sustained mechanisms for regional collaboration on climate change issues.

Technical Training
Coastal states recognize that a sustained technical training strategy for state and local government officials and coastal decision-makers is also required to help address the ongoing need for informed decisions regarding climate change. Many states, working with partner agencies, have conducted workshops on climate change issues such as sea level rise. Effective coastal training programs are already in place that can be utilized to help meet this need; examples include the NERRS Coastal Training Programs that provide science-based training for local decision-makers, and NOAA's Coastal Services Center training programs on GIS and coastal hazards.

Training needs for state and local officials include:

- local and regional perspectives on impacts of climate change;
- technical training in shoreline delineation, mapping, and vertical and horizontal reference datums, mapping errors and error quantification;
- sea level rise, shoreline change models, and adaptation strategies for coastal communities;
- monitoring and mitigating impacts associated with ecological changes, such as wetlands migration.

The NERRS Coastal Training Programs, NOAA's Coastal Services Center, and Sea Grant should partner with state coastal programs to design and conduct technical training programs targeting state and local officials.

Federal Policy Needs

Federal Coordination on Coastal Adaptation

There is a need for a clear federal strategy for intergovernmental coordination on coastal adaptation to climate change. The strategy should clearly define the roles of the various federal agencies, and the mechanisms by which federal programs will coordinate with state partners on coastal adaptation issues. Because the impacts of climate change will vary regionally, and because regional coastal/ocean governance initiatives are well underway, an opportunity exists to develop a regional framework for federal-state coordination on climate change adaptation. (Some states also pointed to a parallel need for a clear federal strategy for the reduction of greenhouse gas emissions).

A key component of this federal strategy for coastal adaptation should be a new, stronger focus on interagency cooperation between NOAA, state coastal management programs, FEMA, and state floodplain managers. The recent collaboration between the NOAA Coastal Services Center and the Association of State Floodplain Managers (ASFPM) that led to the development of the "No Adverse Impact (NAI) in the Coastal Zone" toolkit is an encouraging first step.[13] Several state coastal programs advocated the NAI policy in survey responses, and described a need for further training or workshops on this subject. However, because FEMA's flood-related programs are critical drivers of shoreline development and are the basis for many local ordinances, NOAA and state coastal programs also need to be made aware of or included in these activities. This includes: the ongoing Flood Map Modernization Initiative,[14] any federal discussions regarding modifications of the National Flood Insurance Program, and any other opportunities to advance floodplain policies that take into account erosion and sea level rise projections and increased risks of storm damage in local ordinances of coastal communities.

Expanding the Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) should be recognized by Congress and the Administration as one of the primary statutes that can foster adaptation to climate change at the state and local levels. States coastal programs often directly manage shoreline development, and work closely with local governments on land use planning, habitat acquisition, and a variety of other activities. States coastal programs also play a key role in coordinating state and local agencies, and have the authority to review and condition federal permits in the coastal zone.

State coastal programs are interested in amending the CZMA to expand their climate change authorities and to allow states and territories to develop specific coastal climate change plans or strategies. States also support increased funding for climate change activities and support legislation that would encourage NOAA and other agencies to assist the states via technical assistance, mapping, modeling, data, and forecasting products, and intergovernmental coordination. However, federal activities related to coastal adaptation should be coordinated closely with states by involving coastal zone management programs early in the planning process.

Next Steps

Among other goals, this report is intended to educate Congress and federal agencies and programs about coastal states' needs with respect to climate change. The Coastal States Organization will distribute the report to federal officials, and hopes that Congress, the federal Coastal Coordination Committee, the Joint Subcommittee on Ocean Science and Technology (JSOST), the Council for Environmental Quality's Subcommittee on the Integrated Management of Ocean Resources (SIMOR), and others will suggest ways that the federal government might help address the needs identified in this report.

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Appendix A: CSO Survey

The Coastal States Organization's Climate Change Work Group is preparing a report that explores the current and future roles of state coastal programs in addressing climate change.

To do this, we need your help!

While other reports have synthesized broader state-level climate change initiatives (e.g. www.pewclimate.org), this report is being developed to:

- Inventory what actions the state CZM programs are taking on climate change;
- Educate Congress on the role state CZM programs can play in climate change;
- Inform CSO and NOAA on CZMA "Envisioning the Future of Coastal Management" efforts and reauthorization;
- Inform federal science programs on key research, information, and data needs;
- Provide information exchange among states on the strategies and approaches states are using to address climate change.

Under each item below, please concisely summarize the activities or needs of your state or territory's coastal zone management program in 200 words or less. We recognize there are many programs at the federal and state level that address climate change either directly or indirectly; however, the purpose of this survey is to find out specifically what the CZM programs are doing and what they need in the future.

For the purpose of this survey, we have defined the following terms for you:

- CZM or Coastal Program – This is limited to the state CZM programs authorized under the Coastal Zone Management Act. Please do not report on the National Estuarine Research Reserves, Sea Grant, National Estuary Programs, or other partners' activities.

- Climate Change – Regional changes in climate due to global warming, which may result in a variety of impacts to coastal areas, including sea level rise, lake level changes, ocean acidification, habitat loss, loss of freshwater resources, and increased frequencies or intensities of coastal storms, among others.

- Involvement – The CZM program has had a specific function, grant task, or mechanism (e.g. government coordination) to be involved in or carry out activities related to climate change in the past ten years.

The results of this survey will be compiled by members of the Climate Change Work Group and synthesized into a final report.

We ask you to please send an electronic copy of your completed survey to Braxton Davis, SC Dept of Health and Environmental Control (DavisBC@dhec.sc.gov) or Jena Carter (jcarter@coastalstates.org) **by May 23, 2007**.