SAP 4.3 “The effects of climate change on agriculture, biodiversity, land, and water resources”

Collated Public Comments and Responses

Period 11 September – 26 October 2007

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-1	General Comments	We appreciate the opportunity to comment on the US Climate Change Science Program's draft SAP 4.3. Please accept these comments on behalf of the Society of American Foresters representing professional foresters from the academic, government, private, and not-for-profit sectors. *We would like to confine our observations to Chapter 3 Land Resources, particularly the contents as it relates to forests. Generally, we are pleased with the attention paid in the report to the important role that forests play in the climate change dialogue. That said, we would offer the following general comments: *We would have liked to have seen increased coverage of the variability in and importance of soil carbon in relation to likely changes in temperature. How does the soil carbon vary among vegetative types and what are the likely effects of climate-induced changes of forests and shrub distribution on stability or release of soil carbon?*As related to the hydrologic cycles, we would suggest including a discussion of the role of forests and canopy density levels on the quality and	Comments noted.	No change. Given length constraints not all topics are covered in the detail that reviewers request.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-2	General	My overall impression is that this is a very incomplete document ignoring some of the most important issues regarding climate change. If it were a journal article I would recommend rejection.In particular let me comment on the executive summary aas I just don't have the time or interest in going through the rest there are much better documents than this one.		Document significantly revised throughout.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-3	General comment	This report fails to adress the effects of climate change on aquaculture. Aquaculture falls under both agriculture and water resources, yet gets no mention in the report. Aquaculture has been identified as one of the most critical and fastest growing agricultural industries. As tranditional wild harvest fisheries are failing at increasing numbers, aquaculture fills a growing void between the supply and demand of high quality nutrition. Although fisheries are adressed in the document, aquaculture is not. Obvious impacts of climate change on aquaculture include changes in temperture of aquatic systems, degradation of commercial waterfront (sea level rise), changes in habitat (sea level rise), freshwater supply, evaporation rates, changes in solar irradiance, etc. The expert writers of the report need to fully cover aqualulture in their review.	Partially agree	Many of these topics have been covered in further detail in revisions of the chapter. However, it was not possible to provide an exhaustive review of aquaculture in this report.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-4	Preface, Page vii, Lines 3-7:	The Global Change Research Act of 1990 (“GCRA”) requires the Climate Change Science Program (“CCSP”) to prepare, not less frequently than every 4 years, a Scientific Assessment which: (1) integrates, evaluates, and interprets the findings of the Program and discusses the scientific uncertainties associated with such findings; (2) analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity; and (3) analyzes current trends in global change, both human-[induced] and natural, and projects major trends for the subsequent 25 to 100 years. 15 U.S.C. § 2936. This Scientific Assessment is to be used by “all Federal agencies and departments” in “responding to human-induced and natural processes of global change pursuant to other statutory responsibilities.” 15 U.S.C. § 2938(b)(2). The first (and last) Scientific Assessment was transmitted to Congress in November, 2000. This 600-page report entitled Climate Change Imp	General comment from reviewer that is unrelated to changes needing to be made to this document.	No change to SAP 4.3 required.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-5	Executive summary, Page 9 , Line 21 :	The section on crops is terribly incomplete While there is mention in this section of northward migration of weeds there is no mention of northward migration of crops While the section says heat is bad for crops it makes no allowance for the fact that a warmer environment will help some crops that are marginal in the region because of a short growing season The notion of adaptation by changing crop planting/harvest dates, dates to maturity, irrigation, genetic manipulation are all missing What about some of the more modern predctions like increased drought , rainfall intensity ENSO events and hurricanes? What about increases in pests and diseases other than weeds What about adaptation through research needs What happens to yield variability What about soil moiseure and evaporation? All in all a very partial to the point of being biased treatment	Comment noted, however many of the elements the reviewer has listed as missing were in fact a part of the draft.	Entire chapter substantially re-written, however extensive additions to ES were not made.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-6	Executive summary , Page 10 , Line 19 :	In the rangeland section I feel that statements could be made outside of the great plains on NPP based on say grassland simulations that have been done under us national assessment and by use of Century. Single case leaves impression that grassland effects are positive. No discussion of adaptation concept in stocking rates or grass species. What about fire and drought effects? The overall outline says pasture and rangelands but I don't see rangelands discussed.Better than crops but still falls short	Comment noted. The Executive Summary section for Rangelands has been re-written to address these comments.	The entire Executive Summary section on Rangelands was re-written to better summarize information presented on Rangelands in Chapter 2. In regards to this particular comment, information is now presented for non-Great Plains grasslands (desert south-west, California, high-altitude rangelands; also, considerable information on Intermountain West Rangelands is presented in Arid Lands Section of Land Resources, Chapter 3). One of the bullets now deals with adaptation options. A new bullet makes the point that management (implicitly includes fire) trumps atmospheric and climatic change. Fire ecology is covered in the Arid Lands Section of Chapter 3, and we now reference that in the Rangelands section "Local and short-term changes". Comments in this section apply to rangelands, not pastures as the reviewer contends.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-7	Executive summary , Page 11 , Line 19	In the animal section. When the cast report was written I had to do the livestock section. I did some reading and recall statements about alered reproduction rates and appetite suppression none in here. I think reduced cold in northern areas is likely to have benefits again no mention What about adaptation, Mendelsohn argues in Africa a species shift is observed – away from cattle towards pigs and poultry. No mention of such here. I would think confined operations like pigs and chickens might have a different response because of potential for climate control, no mention here. Are there not breeds that are more adaptable like zebu crosses. No mention here. Link to grass supply should be made. the "even shifting of populations" statement makes it sound like this is unexpected but nomads have been doing for 1000 years what about heat waves, droughts, hurricanes	These points are addressed in the Agriculture chapter (Chapter 2).	This section was rewritten, and no longer addresses these issues as part of the summary.
Public Comment-8	Executive summary , Page 12 , Line 4 :	In the land resources section. This does not live up to its title it is a forest section. What about species migration. The introduction of the monitoring section illustrates non parallel treatment. Why isn't this done in other sections?	Content (Land resources: Forests and Arid Lands) established by prospectus agreed to by agencies that serves as charge to assessment authors.	Text was revised so that each sectoral section has an observation and monitoring discussion. Species migration is covered in more depth.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-9	Executive summary , subheadings	The subheadings are all messed up with items that are not part of other items done in a subservient subheading ie what goes under arid lands and are not crops and animals the same level?	Comment noted	Text revised; subheads numbering system addressed.
Public Comment-10	Executive summary , Page 14 , Line 4 :	Arid lands. Could you say something about stocking rates? Non parallel treatment, all effects everywhere depend on land use so why just single out here. Population growth also pretty important as is technological change more items just missing in this work.	Due to breadth of content, literature review and synthesis are limited both in terms of topics addressed. This is particularly true for this particular chapter, which is meant to condense and synthesize overall chapter findings.	No change, although some of these issues were in fact addressed in the draft.
Public Comment-11	Executive summary , Page 17 , Line 4 :	Water implications for cropping. Adaptation to less snow – more storage Discussion of groundwater? Regional discussion of areas where water is likely less particularly south. Effects of rainfall intensity shifts. Per capita stuff misleading how about population groth as a factor. Water quality discussion. Bay and estuary inflows. Sea level rise. Navigation implications	Many of these topics are discussed in the Agriculture chapter and the Water Resources chapter.	Text revised, significantly shortened, with much of these text removed.
Public Comment-12	Executive summary , Page 28 , Line 1 :	What about implications for work on adaptation. Research and investment needs. Pressure to increase irrigation. Income and welfare. International trade. Implications of biofuels. Technological progress. Land use in north south. Regional implications. Activity migration. Just too many omissions to mention	The reviewer notes some excellent points. Due to contraints imposed by the prospectus which did not provide for discussion of adaptation, however, many of the suggested topics are not covered in this report.	Text revised, and significantly shortened; The prospectus is given in the revision, along with an expanded explanation of why adaptation is not discussed.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-13	Introduction, Page 7, Lines 8-14:	(The time horizon of the report, which focuses on the next 25-50 years and not the 100 years covered by the IPCC climate model projections, would be much more useful if it considered both 25-50 year and 100 year time frames. Across the range of SRES emissions scenarios, climate conditions such as global surface temperature, ocean acidification, arctic sea ice melt, and sea level rise will continue to increase throughout this century (Meehl et al. 2007). Therefore, regardless of the emissions scenario adopted, the physical changes due to greenhouse gas emissions and their effects on agriculture, land resources, water resources, and biodiversity will continue to worsen and may even accelerate past mid-century. Considering only the next several decades (1) doesn't allow for a useful assessment of the range of impacts that agriculture, land resources, water resources, and biodiversity will experience; (2) limits the analyses to a time period when the worst effects of climate change will not have been realized; and (3) isn't useful for managers, agencies, and those involved	Partially agree. Both time frames are covered. We have chosen to emphasize near-term.	Description of time frame altered to further clarify why near-term focus was chosen.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-14	Introduction, Page 38:	(The U.S. Climate Context section should integrate more information provided by the IPCC Fourth Assessment report on regional climate projections in North America (Christensen et al. 2007). In addition, the report should include new information by Canadell et al. (2007) that rapid growth in CO2 emissions since 2000 coupled with a decline in efficiency of CO2 sinks on land and oceans in absorbing anthropogenic emissions is generating stronger than expected and sooner-than-expected climate forcing.)		Climate context section revised to include additional figures showing climate changes projected for North America. The information presented concentrates on changes projected by about 2030, in keeping with the time horizon emphasized in this report. We did not include detailed information about recent changes in emissions and sinks, as these topics are outside the scope of this report. It should also be noted that the Assessment evaluates the strength of the existing literature, and unfortunately, assessing whether the growth in radiative forcing is larger or smaller than expectation is beyond the scope of what we could report on. It is worth noting that the current rate of increase in radiative forcing is essentially the same as the original IS92a scenario from much earlier in the IPCC process. The authors believe that we have noted the importance (and relative confidence/uncertainties) in regional climate projections and context appropriately for the purpose of this assessment.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-15	Introduction, Page 42, Lines 13-28:	(This paragraph is internally inconsistent: first and last sentences contradict each other. The last sentence needs clarification as to its meaning: “While the effects of climate change on animals has been less studied than effects on plants, the impacts on ecosystem goods and services from people may be as large or larger.” Climate change is affecting plants and animals and thus the emergent properties of community structure and ecosystem services.)	Agree	Entire paragraph re-written.
Public Comment-16	Chapter 2, Page 48, Lines 6-24:	(These paragraphs appear to introduce an “analysis” of how changing climate conditions will affect crop production over the next 30 years. However, the approach, methods, and assumptions of the analysis are not stated until Section 2.61 on page 94, which makes this section extremely confusing. If these paragraphs and the two following sections (2.2, 2.3) are to make sense, the authors must convey that they are summarizing the information that they will present in detail in the remainder of the agriculture section.)	Agree.	The chapter was reorganized to state the assumptions and time scale in the beginning of the chapter

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-17	Chapter 2, Page 48, Lines 6-24:	(This analysis has limited utility because it covers only 30 years (until 2040) before more harmful conditions for crop production (the continuation of rising temperatures, increasing ozone levels, increasing temperature extremes, and drought) will be realized. In order to be useful for managers, agencies, and those involved in public sector research and development, this analysis must also be projected out further in time (for example, projections at 2050, 2075, and 2100) so that there is time to plan for and avoid national and global food shortages.)	The scope of the SAP report was directed toward the next 30 years in which there is certainty in the climate change.	There were some areas within the original report in which there was unclear expressions of the length of time covered in the report, these have been corrected.
Public Comment-18	Chapter 2, Page 48, Lines 6-24:	(The analysis has limited utility because it likely underestimates the average temperature rise projected by the IPCC for 2040. The IPCC Fourth Assessment report for western, central, and eastern North America projects average temperature increases of 3.4°C, 3.5°C, and 3.6°C, respectively, between 2080-2099 and 1980-1999 under an A1B business-as-usual scenario (Christensen et al. 2007, Table 11.1). Therefore, temperature increases by 2040 will likely be higher than 0.8°C.)	We agree that 0.8 C was low for the timescale of focus and the analysis was redone for 1.2oC.	The temperature change ws recomputed to be 1.2C and replaced in the chapter. All references to 0.8 C in the text have been changed to 1.2C.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-19	Chapter 2, Page 51, Line 27:	(The analysis of impacts to crop yield given changes in temperature, CO2, water availability, etc. does not comprehensively integrate the way that interactions between these factors will affect crop yield. For example, the analysis does not include the Long et al. (2006) study that found that elevated [CO2] enhanced yield by ~50% less than in enclosure studies, suggesting that there will be a much smaller CO2 fertilization effect on yield than currently assumed, and possibly little or no stimulation for C4 crops.)	Interactions among temperature, CO2, and water were discussed to extent that information was available in the scientific literature. The study by Long et al., 2006 was mentioned in the public comment draft.	The study by Long et al. (2006) has been added to discuss the study in the context of the CO2 studies.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-20	**Chapter 2, Page 15, Line 9**	The literature review of impacts by crop is very interesting, but the table that summarizes effects does not seem to be consistent with this discussion. for example, with maize the study of muchow seems to form the basis for the table but that study was very localized and found a much smaller impact than many other studies conducted at more appropriate scales, including the ones cited in the text. another excellent recent assessment of maize responses including nonlinear effects at high temperatures is by Wolfram Schlenkler, see: www.columbia.edu/~ws2162/SchlenkerRoberts.pdf which shows an effect of roughly 15% (i'm visually interpolating his results to .8 deg) that agrees much more with the cited study of Lobell and Asner (17% per degree) than with Muchow (2-3%). there are many other studies that also indicate a more severe response (e.g. dhakwa and campbell). why has the assessment chosen such conservative numbers? is there is a justification for this it needs to be made much more explicit. otherwise, i suggest using numbers more consistent with the	The Lobell and Asner work (17% per degree) is unlikely because the authors confounded temperature change with rainfall limitations. Text was changed to make that point. The follow-on effort of Lobell and Field attempted to separate the two, and came up with 8.3% per C, which is more reasonable. Text was modified to indicate disagreement in literature and lack of manipulative studies, and that certainty was only possible to likely.	Text was modified as follows "… but this response is unlikely because the confounding effect of rainfall was not considered." In addition, a full sentence was added at end of paragraph: "Given the disagreement in literature estimates and lack of real manipulative temperature experiments on maize, the certainty of the estimate in Table 2.6 is only possible to likely."

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-21	**Chapter 3, Page 173, Lines 12-14.**	The word “of” is missing. Should say ‘in favor of non-native’. Also consider deleting the word ‘changing’. Warmer climate should suffice.	Done	Yes
Public Comment-22	**Chapter 3, Page 7, lines 26-31.**	“…more uniform forest age structure, which is a legacy of logging…” We would question the accuracy of this statement. Logging over the past century has decreased uniform forest age structure across landscapes by breaking-up age classes, through the application of even-aged regeneration harvest on relatively small unit areas of even-aged forests.	Birdsey et al. 2006 clearly shows the historical pattern of US forest harvesting with a peak in the late 1800s and early 1900s. Changed sentence.	Added reference (Birdsey, R., K. Pregitzer, and A. Lucier. 2006. Forest carbon management in the United States: 1600–2100. Journal of Environmental Quality 35, 1461–1469). Added sentence to the last paragraph of section 3.4.3 "Fire suppression or a large portion of the landscape in a susceptible size class (a legacy from logging in the late 1800s and early 1900s (Birdsey et al. 2006)), may also play a role."

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-23	**Chapter 3, Pages 15-16. Changes in Precipitation.**	Although the negative impacts of drought are mentioned, there is no literature review offered of the studies that have looked at thinning as a means of increasing tree water reserves and tree growth rates. Most notably two studies: Donner, B. and S. Running. 1986. Water stress response after thinning Pinus contorta stands in Montana. Forest Science 32(3):614-625, and more recently: Sala, A. G. Peters, L. McIntyre, and M. Harrington. 2005. Physiological responses of ponderosa pine in western Montana to thinning, prescribed fire and burning season. Tree Physiology 25(3):339-348. Both studies demonstrate a significant improvement in tree water availability following thinning.	Changed text.	Added sentence and refs to second to last paragraph of section 3.5.2. "Forest management by thinning trees can improve water available to the residual trees. (Donner and Running 1986; Sala et al. 2005)." Add references: Donner, B. and S. Running. 1986. Water stress response after thinning Pinus contorta stands in Montana. Forest Science 32, 614-625. and Sala, A. G. Peters, L. McIntyre, and M. Harrington. 2005. Physiological responses of ponderosa pine in western Montana to thinning, prescribed fire and burning season. Tree Physiology 25, 339-348.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-24	**Chapter 3, Pages 19-21. Fire frequency and severity.**	There is no mention of the impacts of thinning and fuels treatment on reducing the severe effects of wildfires. Page 19, line 19: “older trees may be more resistant [to drought]” is potentially a highly misleading statement as it is based on one study of physiological responses to season by different age classes of one tree species. That study did not measure overall tree age class survival and at most speculated about drought tolerances of different age classes.	First comment: agree. For the second comment, no change was made. As far as we know, this is the only study of drought tolerence by age class. Older trees use less water per unit leaf area, and often have deeper roots with more access to water.	Added sentence to the end of the first paragraph in section 3.5.5 to address the first comment: "Forest management options to reduce fire size and intensity are discussed in Synthesis and Assessment Product 4.4 (Preliminary review of adaptation options for climate-sensitive ecosystems and resources, U.S. Climate Change Science Program)."
Public Comment-25	**Chapter 3, Pages 21-24. Insect outbreaks.**	There is no mention of the multitude of research work that has documented the positive impacts of silvicultural treatments on forest insect outbreaks.	For large outbreaks, we would question the effectiveness of thinning treatments a slow, stopping, or even preserving the trees in the thinned stands. Also, treatments would need to be applied over a very large proportion of the forested landscape to have a chance of being effective. Nevertheless, mitigating and adapting to climate change is discussed in SAP 4.4	Added text: "Active management may increase the resiliancy of forests and arid lands to respond to climate change. For example, forest thinning can reduce fire intensity, increase drought tolerance and reduce susceptability to insect attack. Grazing management and control of invasive species can promote vegetation cover, reduce fire risk, and reduce erosion. These and options for managing ecosystems to adapt to climate change are discussed in Synthesis and Assessment Product 4.4 (Preliminary review of adaptation options for climate-sensitive ecosystems and resources, U.S. Climate Change Science Program)."

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-26	**Chapter 3, Pages 32-34. Key findings and conclusions.**	The report appears to ignore the positive impacts that active forest management may have on improving the resilience of forests to predicted increases in drought, wildfires, and insect outbreaks. The basic conclusion that more money needs to be spent on monitoring ignores both existing data reflecting measured increases in wildfire, drought, and insect-related mortality, and fails to address the active management strategies needed to address those same threats. It is incongruous to suggest more funding for monitoring of tree mortality while not likewise recognizing the need to simultaneously fund active management strategies to address tree mortality. For example, forest areas that have developed into contiguous expanses of similar age class and species should be managed to restore the diversity representative of historic disturbance patterns. Similarly, forested areas that are predicted to experience reduced precipitation, the associated drought stress and wildfire risks, and secondary pest and pathogen outbreak should have management practices implemente	Added text to objectives.	Added text: "Active management may increase the resiliancy of forests and arid lands to respond to climate change. For example, forest thinning can reduce fire intensity, increase drought tolerance and reduce susceptability to insect attack. Grazing management and control of invasive species can promote vegetation cover, reduce fire risk, and reduce erosion. These and options for managing ecosystems to adapt to climate change are discussed in Synthesis and Assessment Product 4.4 (Preliminary review of adaptation options for climate-sensitive ecosystems and resources, U.S. Climate Change Science Program)."

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-27	**Chapter 3, Page 32, lines 39-40.**	Tree growth and forest productivity are likely to increase slightly on average." This is a potentially misleading statement. It would more accurately read "tree growth may increase slightly in areas that are predicted to receive more moisture and decrease significantly in areas predicted to receive less moisture."	Sentence is no longer in the Findings and conclusions.	Finding deleted.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-28	**Chapter 3, Page 7, Lines 26-31:**	The following quote “more uniform forest age structure, which is a legacy of logging……”refers to the current state of our forestlands and this statement is false. The majority of our forestland is a fragmented mosaic of many different age classes and sizes due to several decades of logging. There are very few stands of uniform even-aged trees anymore except in plantation style forests found more in the Southern States and along the Northwest Coastline. Even those stands are usually no larger than 40 – 100 acres in size due to regulations in many states. There are many fire dominated landscapes on the globe that were historically composed of monotypical forests following large scale fires. In so many of those places, we are told that the correct ecosystem management approach is to manage on a larger scale and create larger more uniform disturbance patterns to create less “edge effect”. The original quote in lines 26-31 leave the reader with a mixed message or incorrect image.	We disagree. Birdsey et al. 2006 clearly shows the historical pattern of US forest harvesting wwith a peak in the late 1800's and early 1900's. Changed sentence.	Added reference (Birdsey, R., K. Pregitzer, and A. Lucier. 2006. Forest carbon management in the United States: 1600–2100. Journal of Environmental Quality 35, 1461–1469). Added sentence to the last paragraph of section 3.4.3 "Fire suppression or a large portion of the landscape in a susceptible size class (a legacy from logging in the late 1800s and early 1900s (Birdsey et al. 2006)), may also play a role."

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-29	**Chapter 3, Pages 15 – 16:**	Changes in Precipitation. We agree there are negative impacts from drought, however, this document does not even mention the numerous studies that have shown the benefits of tree thinning to increase water yields, forest health, and growth rates. Please include the 1986 study written by Bryan Donner and Steven Running on “Water Stress Response after thinning Pinus contorta stands in Montana (Forest Science (32)3 pgs 614-625; and most recently: Anna Sala, Gregory Peters, Lorna McIntyre, and Michael Harrington, 2005, Physiological responses of ponderosa pine in western Montana to thinning, prescribed fire and burning season, tree physiology (25) pgs 339-348. The results of both studies show increased water availability to the forest following thinning. Another study by P.H. Cochran and James Barrett, 1999, is “Thirty five year growth of ponderosa pine saplings in response to thinning and understory removal”, USDA Forest Service PNW-RP-512. This study shows the tremendous individual tree responses to thinning. The above should be included as literature cited in tl	Changed text.	Added sentence and refs to second to last paragraph of section 3.5.2. "Forest management by thinning trees can improve water available to the residual trees. (Donner and Running 1986; Sala et al. 2005)." Add references: Donner, B. and S. Running. 1986. Water stress response after thinning Pinus contorta stands in Montana. Forest Science 32, 614-625. and Sala, A. G. Peters, L. McIntyre, and M. Harrington. 2005. Physiological responses of ponderosa pine in western Montana to thinning, prescribed fire and burning season. Tree Physiology 25, 339-348.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-30	**Chapter 3, pages 19-21:**	Fire Frequency and Severity. In reviewing the document, there seems to be no mention of the impacts of thinning and fuels treatments on reducing the severe effects of wildfires. With so much at stake, how could this be overlooked? We have a great deal of control over fuels buildups, fuels accumulations, and neglect in managing our forests and grasslands. No, we won't be able to treat every acre as many are located in terrain that we just can't work on or access. We are able to make a big difference when we treat the resource and prevent heavy fuels buildups from accumulating. The document also states on page 19, line 19, that "older trees may be more resistant to drought". The statement is grossly misleading as it is based upon a single study involving only one tree species and the study neglected to measure overall age class survival. Do not use speculation studies in this Global Warming document when there is much data revealing the susceptibility of older trees that require more water to survive and make them most vulnerable to insects and disease outbreaks becaus	See response to Chapter 3, Pages 19-21 and Chapter 3, Pages 32-34.	Changes documented previously under Chapter 3, Pages 19-21 and Chapter 3, Pages 32-34.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-31	**Chapter 3 Pages 21-24:**	Insect Outbreaks: As mentioned above, there is so much evidence out there revealing the increased resistance of a thinned forest to insect infestations. Why is there no mention of these studies in the data? We are all aware of how overstocked and crowded our nation's forests have become and the heaviest insects mortality is found on public lands where increased thinning would be beneficial and minimize the spread of large beetle epidemics.	See responses under previous comments from Chapter 3, Pages 21-24 and Chapter 3, Pages 32-34.	See responses under previous comments from Chapter 3, Pages 21-24 and Chapter 3, Pages 32-34.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-32	**Chapter 3 Pages 32-34:**	Key findings and Conclusions: Unfortunately, this document fails to include the positive aspects of active forest management. We know that wildfires are increasing in size and intensity. We already know that insects and disease are taking their toll in unprecedented levels. So why does this document recommend more funds for monitoring and studying the problem??? Surely there is enough evidence in completed studies and historical data to prompt you to state in this document , "WE MUST ACT IMMEDIATELY AND TREAT OUR OVERCROWDED FORESTS WITH MORE THINNING AND, WHERE APPROPRIATE, MORE PRESCRIBED BURNING!!!" There is no question about the benefits. We know it increases water yields to the immediate forest and the entire watershed downstream. We know it reduces the effects of wildfire. No, it won't prevent the fires, but it does allow them to burn with a lower intensity so their natural benefits are revealed rather than the increasingly common total stand mortality which takes so much longer to recover. Address the following in forest management applications: **1.)**Th	Increased monitoring would help separate the effects of changes in climate from other causes. At present, this is very difficult, if not impossible to do. No recommendation of any kind is made, particularly regarding funding. Re the second comment, we are prohibited by our charter and the prospectus from making recommendations.	No change.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-33	**Chapter 3 Page 32 line 39-40:**	"Tree growth and forest productivity are likely to increase slightly on average". This statement may be slightly true for those areas that would see increased moisture, however, the many areas that are predicted to receive less moisture would see a decrease in growth and forest productivity. In addition, the increased growing season predicted under a warming trend would possibly counteract the increased moisture due to a plant's need to utilize every bit of the increased precipitation and then some. The Climate Change Report must take into account all of the possibilities and not just hypothesize that one single outcome should occur. Thanks you for taking our comments into consideration.	Sentence is no longer in the Findings and conclusions.	Finding deleted.
Public Comment-34	**Chapter 3, Pages: all:**	It is widely assumed in the report that anthropogenic climate change (ACC) will lead to an increase in disturbance regimes. While this is a widely held assumption, the hard data behind this assumption are lacking.	Westerling et al. 2006 paper clearly shows a link between warming and increased fires.	No change

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-35	**Chapter 3, Pages: 131, Lines 10,19:**	It is assumed that hurricanes will increase in frequency, but an increase in high altitude winds (shear), also predicted by general circulation models (GCMs), would have the effect of reducing hurricanes by interfering with their formation. A reduction in north-south temperature gradients would also make them weaker. In fact, the UN World Meteorological Association in 2007 said that no statement can be made at this time about the effects of ACC on hurricanes. For more details, refer to Kossin et al. (2007) who showed that for 85% of the world's hurricanes (i.e., except for Atlantic hurricanes), no trend can be established and Swanson (2007) who showed that upward trends for Atlantic hurricanes the past 20 years are consistent with patterns of the 1950s period, and not higher. Swanson, K.L, 2007. Impact of scaling behavior on tropical cyclone intensities. Geophysical Research Letters, 34, doi:10.1029/2007GL030851. Kossin, J.P., et al., 2007. A globally consistent reanalysis of hurricane variability and trends. Geophysical Research Letters, 34, L4815, doi: 10.1029/2006GL028836.	Thanks for pointing out these papers. The debate on hurricanes is far from over, but agree that their future increase or not is uncertain.	Findings and conclusions have been revised and do not now refer to hurricance or ice storms. Summary of findings and conclusions has been completely revised and does not now refer to hurricance or ice storms. See revised findings and conclusions for forests.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-36	**Chapter 3, Pages: 148, Line 17:**	It is stated in the report that ice storms will increase in the Southeast. GCMs do not and can not forecast ice storms. That level of detail is not possible with GCMs and various inferences are required to come to that conclusion. Repeated statements about future increases in ice storms are based on only a single reference (da Silva et al. 2006) which has not been validated by other studies.	Findings and colclusions have been revised and do not now refer to hurricance or ice storms. Summary of findings and conclusions has been completely revised and does not now refer to hurricance or ice storms.	See revised findings and conclusions for forests.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-37	**Chapter 3, Pages: 141, Lines 19-33:**	It is stated that fires will increase in size and severity. In Southwestern dry forest such as pinyon-juniper or open ponderosa pine, it is actually wet periods which increase fuel loads and continuity that set the stage for fire. The recent fires in the Southwest were preceeded by quite wet decades which allowed the forest to become much denser than was historically the case. In Australian bush and sequoia forest in California, it has also been shown that wet periods predispose to fires, not dry periods. During long dry periods fuel loads are too low for fire to carry. In other areas of the west, it is difficult to make clear statements about fire because current fuel conditions are unnatural relative to pre-fire suppression periods. Taking a longer term view (19th & 20th Centuries), the largest western fires in US and Canada were in the 1900s and prior to 1930, not since 1950. Because of fire suppression and fire barriers (e.g., roads, farms) it is unlikely that fire disturbance could increase as much as stated in the report. The fires in the past 2 decades a	We summarize the work of Westerling et al. (2006) to show that fire number and size has increased along with earlier snowmelt. The reviewer does not state peer review literature to back up his assertion.	No change.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-38	**Chapter 3, Pages: 141, Lines 34-35:**	The projection in Bachelet et al. 2001 that fires in the Southeast could lead to Savanna are based on GCM model versions that did not allow for increased precipitation with warming, and are thus out of date.	The reviewer is mistaken. GCMs used in the Bachelet 2001 paper simulated changes in precipitation as well as temperature. Changes in precipitation were indeed simulated in the GCMs used by the 2001 Bachelet paper. Details about the particular GCMs and their projections are found in the original reference.	No change.
Public Comment-39	**Chapter 3, Pages: 142, Line 1:**	Figure 3.7 showing a burned out forest is not “data” and gives the impression that this fire resulted from ACC, when no such implication is possible.	Most of the figures are not data, but illustrations. One of our findings and conclusions is related to fire and while, any one individual fire may not be climate related, the overall increase in number and size appears to be.	Changed figure caption to: " Figure 3.7 Ponderosa pine after the Hayman fire in Colorado, June 2002. While no one fire can be related to climate or changes in climate, research shows that the size and number of Western forest fires has increased substantially since 1985, and that these increases were linked with earlier spring snowmelt and higher spring and summer air temperature."

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-40	**Chapter 3, Pages: 148-149, entire sec 3.5.8:**	In the section on changes to plant communities, various major vegetation type changes are discussed. Clarification as to which models and scenarios were used is needed for these projections. If precipitation changes were not simulated and the models projected upper end warming scenarios, then these predictions are unrealistic. It also needs to be clarified that numerous studies have shown that such projected changes could take hundreds to thousands of years because trees are long-lived and tolerant of varying climate (Loehle and LeBlanc, 1996; Loehle 2000; 2003; Botkin et al., 2006).	Changes in precipitation were indeed simulated in the GCMs used by the 2001 Bachelet paper. Details about the particular GCMs and their projections are found in the original reference. Added caveat sentence (to several that were already in the text).	Added Reference: Loehle, C. and D. C. LeBlanc. 1996. Model-Based Assessments of Climate Change Effects on Forests: A Critical Review. Ecological Modelling 90:1-31. Added sentence to section 3.5.8, para 3: "Because trees are long-lived species and may tolerate growing conditions outside of their current climate envelopes, they may be slower to change than modeled (Loehle and LeBlanc 1996). "

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-41	**Ref:**	Botkin, Daniel B., Henrik Saxe, Miguel B. Araújo, Richard Betts, Richard Bradshaw, Tomas Cedhagen, Peter Chesson, Margaret B. Davis, Terry Dawson, Julie Etterson, Daniel P. Faith, Simon Ferrier, Antoine Guisan, Anja Skjoldborg Hansen, David Hilbert, Peter Kareiva, Craig Loehle, Chris Margules, Mark New, Flemming Skov, Matthew J. Sobel, David Stockwell, and Jens-Christian Svenning. 2007. Forecasting Effects of Global Warming on Biodiversity. Bioscience 57:227-236 Loehle, C. and D. C. LeBlanc. 1996. Model-Based Assessments of Climate Change Effects on Forests: A Critical Review. Ecological Modelling 90:1-31. Loehle, C. 2000. Forest Ecotone Response to Climate Change: Sensitivity to Temperature Response Functional Forms. Canadian Journal Forest Research 30:1632-1645. Loehle, C. 2003. Competitive Displacement of Trees in Response to Climate Change or Introduction of Exotics. Environmental Management 32:106-115.	See response to Chapter 3, Pages: 148-149, entire sec 3.5.8	See response to Chapter 3, Pages: 148-149, entire sec 3.5.8

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-42	**Chapter 3, Page 7, Lines 26-31**	The line stating "…more uniform forest age structure, which is a legacy of logging…" is completely untrue. Logging across the past century has decreased uniform forest age structure across all landscapes.	Birdsey et al. 2006 clearly shows the historical pattern of US forest harvesting with a peak in the late 1800's and early 1900's. Changed sentence.	Added reference (Birdsey, R., K. Pregitzer, and A. Lucier. 2006. Forest carbon management in the United States: 1600–2100. Journal of Environmental Quality 35, 1461–1469). Added sentence to the last paragraph of section 3.4.3 "Fire suppression or a large portion of the landscape in a susceptible size class (a legacy from logging in the late 1800s and early 1900s (Birdsey et al. 2006)), may also play a role."

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-43	**Chapter 3, Pages 15-16**	Although the negative impacts of drought are mentioned there is no literature review offered of all the studies that have looked at thinning as a means of increasing tree water reserves and tree growth rates. Most notably, the following two studies should be reviewed; Bryan Donner and Steven Running, 1986 Water Stress Response after thinning Pinus Contorta Stands in Montana, Forest Science (32) 3 pgs 614-625; and more recently, Anna Sala, Gregory Peters, Lorna McIntyre and Michael Harrington, 2005, Physiological responses of ponderosa pine in western Montana to thinning, prescribed fire and burning season, Tree Physiology (25) pgs 339-348. These studies show a significant improvement in tree water availability following thinning. In addition, P.H. Cochran and James Barrett, 1999, Thirty-five year growth in ponderosa pine saplings in response to thinning and understory removal, USDA Forest Service PNW-RP-512 shows tremendous individual tree responses to thinning, though does not go into detail as to the specific physiological reasons.	Changed text.	Added sentence and refs to second to last paragraph of section 3.5.2. "Forest management by thinning trees can improve water available to the residual trees. (Donner and Running 1986; Sala et al. 2005)." Add references: Donner, B. and S. Running. 1986. Water stress response after thinning Pinus contorta stands in Montana. Forest Science 32, 614-625. and Sala, A. G. Peters, L. McIntyre, and M. Harrington. 2005. Physiological responses of ponderosa pine in western Montana to thinning, prescribed fire and burning season. Tree Physiology 25, 339-348.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-44	**Chapter 3, Pages 19-21, Line 19**	No mention of the impacts of thinning and fuels treatments on reducing the severe effects of wildfires. "…older trees may be more resistant (to drought)" is a gross and potentially completely misleading statement as it is based on one study of physiological responses to season by different ages of one tree species. That study did not measure overall tree age class survival and at most speculated about drought tolerances of different age classes.	OK	See response to Chapter 3, Pages 19-21, fire frequency and severity section.
Public Comment-45	**Chapter 3, Pages 21-24**	No mention of the abundance of work that has documented the positive impacts of cultural treatments on forest insect outbreaks.	See response to previous comments on Chapter 3, Pages 21-24 (insect outbreaks) and Chapter 3, Pages 32-34 (key findings and conclusions).	See response to previous comments on Chapter 3, Pages 21-24 (insect outbreaks) and Chapter 3, Pages 32-34 (key findings and conclusions).

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-46	**Chapter 3, Pages 32-34**	These pages completely ignore the positive impacts that active forest management may have on improving the resilience of forests to predicted increases in drought, wildfires and insect infestations. The basic conclusion that more money needs to be spent on monitoring completely ignores earlier cited statistics about measured increases in wildfires, drought and insect related mortality. Where is the active management component? Suggested additions to this section; 1) Forested areas that have developed into contiguous expanses of similar age and species composition should be actively managed to help restore species and age class diversity on a scale that represents historical disturbance patterns. 2) Forested areas that re predicted to experience reduced patterns of precipitation, increase growing season duration by therefore increasing drought stress and related wildfires and secondary pest and pathogen outbreaks should have active forest management practices implemented that decrease vegetative water demands (potential evapotranspiration). 3) Forested areas w	Added text to objectives.	Added text: "Active management may increase the resiliancy of forests and arid lands to respond to climate change. For example, forest thinning can reduce fire intensity, increase drought tolerance and reduce susceptability to insect attack. Grazing management and control of invasive species can promote vegetation cover, reduce fire risk, and reduce erosion. These and options for managing ecosystems to adapt to climate change are discussed in Synthesis and Assessment Product 4.4 (Preliminary review of adaptation options for climate-sensitive ecosystems and resources, U.S. Climate Change Science Program)."

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-47	**Chapter 3, Page 32, Line 39-40**	This is a very misleading statement. A more accurate statement would read, "…tree growth may increase slightly in areas that are predicted to receive more moisture and decrease significantly in areas predicted to receive less moisture."	Sentence is no longer in findings and conclusions	Statement deleted.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-48	**Chapter 4, page 4, line 43-44:**	Comments: delete "Climate model projections for increased temperatures, and (averaged across many models) modest increases in precipitation are expected to lead to streamflow declines." and replace with "Despite climate model projections for modest increases in precipitation, climate models (averaged) project streamflow declines, particularly in the summertime, primarily due to a shrinking snowpack that melts off earlier and a foreseeable decline in groundwater contributions to summertime baseflow, induced both anthropogenically and via climatic conditions that disfavor groundwater recharge, notably increasing temperatures and resultant increasing evapotranspiration and decreasing soil moisture content". Reasoning: the suggested deleted sentence needs to be explained due to its inherently illogical reasoning. In addition, groundwater merits discussion as groundwater plays a key role in summertime low flows and is too often ignored in climate change discussions.	OK	This statement has been reworded.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-49	**Chapter 4, page 5, line 6:**	Comments: after "may have substantial impacts on" insert "fish, notably in the Pacific Northwest where many salmonid species are already threatened or endangered, and on" Reasoning: states in the PNW are spending hundreds of millions to recover fish populations, merits discussion.	What the reviewer is suggesting is specific to a small part of the country. If we add those sort of qualifiers it introduces imbalances elsewhere at a level that the report can't possibly address.	No change made.
Public Comment-50	**Chapter 4, page 5, line 19-22**:	Comments: on line 19, after "This is" insert "primarily" and on line 20 delete "as well as" and replace with "and, to a lesser extent, to" Reasoning: per capita water use declines are primarily due to conservation, not changes in water law - the statement should be parsed accordingly.	OK	Some wordsmithing to the effect suggested has been done.
Public Comment-51	**Chapter 4, page 5, line 24:**	Comments: delete the "." after "Southwest" and insert, ", and where current conflicts between farms, fish and people will be exacerbated (Great Basin, Klamath Basin, Columbia River Basin et al.)" Reasoning: the SW is but one area - not mentioning the conflicts in the Great Basin, Klamath Basin and Columbia River Basin ignores some of the most contentious water battles in the US.	Partially agree. The fact remains though, that the PNW is a water-rich region, and the stresses will be greatest where population growth is highest, and the resource most limited -- the obvious example of which is the SW.	Minor change made.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-52	**Chapter 5:**	(The Biodiversity chapter is the lowest-quality chapter in this report and unfortunately wastes the reviewer's time. The chapter has many uncompleted sections (headings with no text), inadequate sections, nonsensical organization (multiple sections out of order and with mislabeled number headings), un-cited information and incorrect citations, and unpolished writing. The quality of the sections is extremely variable, with some sections being covered in too much detail and others inadequately. In its current form with the paucity of information, this chapter does not provide a useful reference for anyone seeking information on this subject. Chapter 5 should have undergone much more internal review and editing before being released for public comment.)	Noted.	Revision addresses these issues.
Public Comment-53	**Chapter 5**:	(Chapter 5 would be more informative if it followed the guiding questions for this report (pages 6-7) and organized itself (following the structure of the other chapters) into the following topics: -observed changes and trends; -future (predicted) changes and impacts. This chapter would also be more informative if it covered additional topic such as genetic and evolutionary consequences of climate change.)	Agreed.	Revised chapter now more closely follows structure of other chapters and guiding questions.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-54	**Chapter 5, Page 220, Lines 10-27:**	(This section deserves a better introduction that touches on pertinent topics such as: -the rapid rate of change in climate conditions that species are currently facing that limits the potential for adaptation; -the multiplicity of interacting threats faced by species including climate change, habitat loss, pollution, invasive species, etc. ; -the predictions for massive species extinctions due to climate change. For example, using a mid-range climate scenario, Thomas et al. (2004) predicted that 15-37% of species are already committed to extinction by 2050. Malcolm et al. (2006) estimated that 11-43% of endemic species in biodiversity hotspots will go extinct by the end of the century under a scenario of doubled carbon dioxide concentrations, which includes an average of 56,000 endemic plants and 3,700 endemic vertebrate species.)	There are inevitably some topics that have not been explored, although a growing literature exists. This is related to the governing prospectus for the assessment.	We have discussed the potential for mis-match of species with their climate envelopes. However, because of the focus of the assessment on the next several decades, the equilibrium analyses of the "committed to extinction" papers are not strictly relevant, since they inevitably apply to longer time periods.
Public Comment-55	**Chapter 5, Page 220, Line 12:**	(Reference should be Peters and Lovejoy (1992); Peters and Darling (1985) was also an important early paper.)	Agreed.	Correct Peters and Lovejoy 1992 citation added.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-56	**Chapter 5, Page 220, Lines 10-27:**	(If this chapter is going to discuss changes in community composition as stated, it needs to have a clear section on this.)	Outline of areas to be covered has changed in this draft.	Areas to be covered include: • Changes in Distributions and Phenologies in Terrestrial Ecosystems • Changes in Coastal and Near-Shore Ecosystems • Changes in Pests and Pathogens • Changes in Marine Fisheries and Ecosystems • Changes in Particularly Sensitive Ecosystems • Ecosystem Services and Expectations for Future Change • Adequacy of Monitoring Systems
Public Comment-57	**Chapter 5, Page 220, Lines 10-27:**	(Since this chapter separates out analyses of terrestrial and marine systems, this should be noted in the introduction. Separate sections on marine and terrestrial systems are appropriate since species face a somewhat different suite of constraints and threats in each system).	Outline of areas to be covered has changed in this draft, with marine and terrestrial ecosystems separated.	Areas covered include: • Changes in Distributions and Phenologies in Terrestrial Ecosystems • Changes in Coastal and Near-Shore Ecosystems • Changes in Pests and Pathogens • Changes in Marine Fisheries and Ecosystems • Changes in Particularly Sensitive Ecosystems • Ecosystem Services and Expectations for Future Change • Adequacy of Monitoring Systems

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-58	**Chapter 5, Page 220, Line 33:**	(The structure of Section 5.2 and 5.3 is confusing and I recommend the following changes in organization: (1) The introduction to Section 5.2 "Changes in Distribution and Phenology in Terrestrial Ecosystems" should be combined with the introductory information of Section 5.3, since these two sections are covering the same topic and become redundant. (2) This new introduction to this section should be followed by sub-sections discussing changes in distribution and phenology of plants (which would replace the awkward "Growing season length and net primary production" section on page 221), migratory birds, butterflies, mammals and amphibians. This would eliminate Section 5.3.3 "Wildlife and population contractions" which makes no sense since previously discussed migratory birds and butterflies are wildlife structured as populations. (3) I also recommend that this section remove the discussion of net primary production which doesn't fit in the distribution and phenology category and move it to its own section.)	Agreed	Comment 1 & 2 Accepted: 5.2 Changes in Distribution and Phenologies in Terrestrial Ecosystems 5.2.1 Growing season length and net primary production shifts 5.2.2 Biogeographical and phenological shifts 5.2.2.1 Migratory birds 5.2.2.2 Butterflies 5.2.2.3 Mammals 5.2.2.4 Amphibians ... Comment 3, not accepted. Primary production discussion underscores changes in productivity that underscores borad ecosystem-level changes in response to climate change that have yet to or are ust beginning to drive changes in populations of individual species. It is important to keep in the section.
Public Comment-59	**Chapter 5, Page 222, Line 18:**	(The Beever et al. (2003) study only looked at pikas in the Great Basin and not across the species' range.)	Updated citations in revision.	Li and Smith 2005 citation & information added.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-60	**Chapter 5, Page 224, Line 40:**	(The butterfly range shift section should also discuss upward (in elevation) shifts in distribution, citing two studies: (Wilson et al. 2005, Franco et al. 2006)).	Agreed.	Wilson et al. (2007) documented uphill shifts of 293 m in butterfly species richness and composition in the central Spain between 1967-1973 and 2004-2005, consistent with an upward shift in mean annual isotherms, resulting in a net decline in species richness in approximately 90% of the study region (Wilson et al 2007). In Britain, Franco et al (2006) documented climate change as a driver of local extinction of three species of butterflies and found range boundaries retracted 70-100 km northwards for Aricia artaxerxes, Erebia aethiops and 130-150 m uphill for Erebia epiphron which were consistent with estimated latitudinal and elevational temperature shifts of 88 km northwards and 98 m uphill over the 19-year study period (Franco et al 2006).
Public Comment-61	**Chapter 5, Page 226, Line 1:**	(The first sentence is also true for other taxonomic groups like birds and so shouldn't be confined to a generalization for mammals. This point would be better made in the introduction to Section 5.2.)	Agreed	Introduction revised to account for a variety of wildlife - including mammals, birds, amphibians, etc.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-62	Chapter 5, Page 226, Line 1:	(The mammals section needs more information and analysis in order to be useful. For example, bring in important case studies of (1) phenological shifts in hibernation of mammal species, (2) the distributional shifts in arctic and red foxes (competition), and (3) the loss of American pika populations from lower elevations in the Great Basin (direct thermal stress) (Beever et al. 2003, Grayson 2005).)	Agree	Mammal section greatly expanded in updated chapter; includes Beever citation and a discussion of phenology.
Public Comment-63	**Chapter 5, Page 226, Line 10:**	(The amphibians section needs a more sophisticated and complete analysis on the effects of climate change on phenology. Beebee (2002) provides a concise summary of studies, including analysis of why some species show a signal while others do not—information which should be added to the one-sentence paragraph on lines 23-25. As must be evident to the authors, this section is woefully lacking information on changes in distribution, mismatches and extinctions.)	Agree.	Section now greatly expanded and includes a more sophisticated and complete analysis of the effects of climate change on amphibians.
Public Comment-64	**Chapter 5, Page 226, Line 32:**	(Climate drivers: completely unclear as to what this section will discuss.)		Section deleted in recent revision.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-65	**Chapter 5, Page 226, Line 34:**	(A discussion of the ways that climate change affects ecosystem services is a very big topic to cover (carbon storage, flood control, pollination, water availability, etc.) but would be useful. This section should be combined with Section 5.7 beginning on page 244.)	Agreed.	Change made.
Public Comment-66	**Chapter 5, Page 227, Line 3:**	(The purpose of section 5.6.2 is unclear. Are these research needs for better understanding how climate change will affect distribution and phenology? If so, clarify and develop. In the second paragraph, the discussion of using large-scale climate indices like the PDO to understand ecological systems must be developed or deleted. There is an extensive literature on using large-scale climate indices versus local indices to predict ecological processes that would improve this point: (Forchhammer and Post 2004, Hallett et al. 2004)).	OK	Section deleted in the revised version.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-67	**Chapter 5, Page 227, Line 22:**	(Section 5.8 "Changes in Coastal and Nearshore Ecosystems" would be best combined with Section 5.5 "Climate change, marine fisheries, and marine ecosystem change" under an all-encompassing "Climate change and marine ecosystems" section that focuses on coastal and nearshore ecosystems, including the three major coastal current systems that run along the west coast (California Current and Alaska Current) and east coast (Gulf Stream) of the United States. This would encompass the major marine ecosystems within United States waters, since the EEZ extends to 200 nautical miles, which are the focus of this report as stated on page 220, lines 23-24. This section should include a focused discussion on observed and predicted impacts to coral reefs (section 5.3.3), estuarine communities including mangroves and sea grasses (page 230, lines 34-43), and add a brief discussion on kelp bed and intertidal communities).	Partially agree	We have revised both subsections of chapter 5 dealing with coastal and marine issues. The coastal section now has a much-expanded discussion of corals, along with sections on coastal wetlands and the rocky intertidal. The marine section focuses almost exclusively on fisheries and the physical factors that affect them. Both sections focus on the US, but draw on examples from other regions as appropriate. The California coastal current discussion is framed as a case study.
Public Comment-68	**Chapter 5, Page 228, Line 13:**	(Would be helpful to include more specific information on the large scale of the 1997-1998 bleaching event: 10-16% of world's living coral reefs died and western Indian Ocean reefs lost up to 46% of living reef-building corals (Hoegh-Guldberg 2005)).	Done.	Change made.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-69	**Chapter 5, Page 229, Lines 2-8:**	(The paragraph on the impacts of ocean acidification on corals should be expanded due to the great importance of this topic.)	Agreed	Expanded section specifically on corals and acidification has been added.
Public Comment-70	**Chapter 5, Page 229, Line 23:**	(The discussion of sea level rise should point out that the IPCC projections underestimate sea level rise, discussed in Meehl et al. (2007: 820), due to the inability to accurately model feedbacks in land ice melt. The IPCC projection of 18-59 cm in this century assumes a negligible contribution to sea level rise by 2100 from loss of Greenland and Antarctic ice, but leading experts have stated that that conclusion is no longer plausible due to multiple positive feedback mechanisms including dynamical processes such as the formation of moulins, reduced surface albedo, loss of buttressing ice shelves, and lowered ice surface altitude (Hansen et al. 2005, Hansen 2006). Melting of the Greenland ice sheet has accelerated far beyond what scientists predicted even just a few years ago, with a more than doubling of the mass loss from Greenland due to melting observed in the past decade alone (Rignot and Kangaratnam 2006). The acceleration in the rate of melt is due in part to the creation of rivers of melt water, called “moulins,” that flow down several miles to the base of the ice sheet	Agreed	**Addition made**: Because of its importance as a contributing stress to coastal and intertidal habitats, projections of mean sea-level rise have been important to understand. Projections for sea level rise by 2100 vary from 0.18 to 0.59 m (±0.1-0.2) (IPCC 2007) to 0.5 to 1.4 m (Rahmstorf 2007). Some observational evidence suggests that recent IPCC estimates may be conservative and underestimate the rate of sea level rise (Meehl et al. 2007). The IPCC projection of 18-59 cm in this century assumes a negligible contribution to sea level rise by 2100 from loss of Greenlaand Antarctic ice. Melting of the Greenland ice sheet has accelerated far beyond what scientists predicted even just a few years ago, with a more than doubling of the mass loss from Greenlanddue to melting observed in the past decade alone (Rignot and Kangaratnam 2006). The acceleration in the rate of melt is due in part to the creation of rivers of melt water, called “moulins,” that flow down several miles to the base of the ice sheet, where they lubricatarea between the ice sheet and the rock, speeding the movement of the ice

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-71	**Chapter 5, Page 230, Line 4:**	(The Arctic section 5.3.5 fits better in the Sensitive Ecosystems section 5.6.2 and should be coupled with the polar bear discussion.)	Done.	Change made as suggested.
Public Comment-72	**Chapter 5, Page 231, Line 13:**	(The Pests and Pathogens section 5.4 needs more logical organization. The Mountain Pine beetle explosion case study could be presented as a more compelling analysis of the interaction between climate change and other factors in influencing the frequency and magnitude of pest outbreaks.)	Agreed.	The Pests and Pathogens section was greatly revised and reorganized. There is now a separate Mountain Pine Beetle section that discusses the issues laid out by Shaye Wolf, including a look at poleward migration of pests and pathogens, and the effects of climate change and invasive plants.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-73	**Chapter 5, Page 234, Line 17:**	(This first paragraph does not provide a useful introduction to framing a discussion of how climate change is affecting and is predicted to affect marine ecosystems. The emphasis and detail on the IGBP-GLOBEC program provides too narrow a focus. Although the goals and findings of the IGBP-GLOBEC program are important, succinct mention of linkages found by IGBP-GLOBEC research between ocean climate variability and zooplankton and fish populations should be confined to subsequent sections that discuss observed biological responses to physical changes. Instead, this entire section on climate change and marine ecosystem should be better organized to provide a complete overview of this topic rather than a mix-match of information. I recommend the following structure: (1) overview of the marine ecosystems found in U.S. waters, (2) the abiotic (physical and chemical) changes to oceans due to global warming (sea temperature increase, ocean acidification, rising sea level, changes in circulation) that have been observed and which are predicted to occur, using the most recent 2007 IPCC	Agreed.	Introduction now provides an overview of US marine systems. In the revised chapter, Section 5.4 now covers in depth many of the areas of information and the marine ecosystem interactions that the reviewer requested.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-74	**Chapter 5, Page 234, Line 35**:	(The Climate Regime Shifts section has very important information but would be more useful if it were framed and presented differently. First, better to call this section “Ocean climate variability” and to recognize in the introductory sentence that ocean climate varies on multiple temporal and spatial scales. Then, recognize the importance of low frequency oscillations that occur on decadal (NAO, PDO) and inter-annual (ENSO) temporal scales across ocean basins in driving oceanographic variability. Secondly, this section should distinguish between natural ocean climate variability (NAO, PDO, ENSO) and how anthropogenic climate change (ocean warming) is influencing and is predicted to influence this basin-scale climate forcing.)	Agreed.	Section 5.4 now covers this in far greater depth - including NAO, PDO and ENSO information. See revised section 5.4

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-75	**Chapter 5, Page 234, Line 35:**	(The Climate Regime Shifts section must include a discussion of the El Niño Southern Oscillation since this is the most important basin-scale climate forcing affecting productivity along the west coast of the United States. This section should briefly describe the (1) physical changes that occur with the oscillation of the NAO, PDO, and ENSO in a way that is slightly more understandable to the reader, (2) the biological consequences of this physical forcing, and (3) how anthropogenic climate change will influence basin-scale ocean climate forcing (i.e. How will warmer sea surface temperatures interact with ENSO events? Is global warming changing the frequency or intensity of El Niño events?) It is important to include all 3 oscillations (NAO, PDO, and ENSO) since these affect marine ecosystems along the east and west coast of the United States. This section must be accompanied by a figure if the reader is to understand where the currents are (Alaska Current, California Current) and what regions the NAO, PDO, and ENSO affect; otherwise many readers will be co	Agreed	Section 5.4 now covers ENSO in greater depth.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-76	**Chapter 5, Page 235, Line 37:**	(The California Current System is mentioned but not defined. The California Current is defined later on page 236, lines 33-43 and page 237, lines 1-6. It would be clearer to briefly define the California Current System in an introductory section (see above comment Chapter 5, Page 234, Line 17) or in the "Climate Regime Shifts" section in the context of how the PDO and ENSO influence the Alaska Current and California Current Systems. The high productivity of the California Current System should be emphasized.)	Agreed	See revised Section 5.4
Public Comment-77	**Chapter 5, Page 236, Line 10:**	(ENSO and its biological consequence must be given a more thorough analysis due to its significance in influencing productivity along the west coast of the United States. See comment Chapter 5, Page 234, Line 35.)	Agreed	ENSO is covered in much greater detail in revision - see Section 5.4 Climate Change, Marine Fisheries & Ecosystem Change.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-78	**Chapter 5, Page 236, Lines 19-23:**	(The discussion of ocean warming is not adequate. Ocean temperature rise is mentioned only briefly in one sentence of the "Global climate context of the report on p. 23, lines 34-35: "Observations since 1961 show that the average temperature of the global ocean has increased to depths of at least 3,000 meters, and that the ocean has been absorbing more than 80 percent of the heat added to the climate system." Therefore, this section should provide more detail about observed and predicted ocean temperature change and how increases in temperature will affect marine organisms. As examples of pertinent information, global ocean temperatures have increased by 0.31 °C on average in the upper 300 m during the past 60 years (1948-1998) (Levitus et al. 2000), and locally, some ocean regions are experiencing even greater warming (Bindoff et al. 2007). Changes in ocean heat content have penetrated as deep as 3000 m. Global ocean temperatures increased by 0.10 □C in the upper 700 m between 1961-2003 (Bindoff et al. 2007) and by 0.037 °C in the upper 3000 m (Levitus et al. 2005). N	Agreed	More information has been provided in section 5.4, however given length constraints not all topics are covered in the detail that reviewers request.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-79	**Chapter 5, Page 236, Lines 19-23:**	(Ocean acidification is an extremely important topic due to the devastating impacts it will have on organisms that rely on calcium carbonate to build and strengthen their exoskeletons—impacts which will cascade up the trophic web. It is a gross oversight to exclude a review of ocean acidification from a report covering the effects of climate change on biodiversity and is not "too huge" a topic to "adequately reviewed." This section should include an overview of the mechanics of ocean acidification and discuss current and predicted biological consequences. The results of several important studies of the impacts on marine biota from changes in ocean pH under different emissions scenarios should be reported. Caldeira and Wickett (2005)found that global surface pH was reduced by 0.3 pH units between 2000-2100 under the low SRES emission scenario (B1) and by 0.5 pH units under the high SRES emissions scenario (A2). Many studies have found that changes in pH of this magnitude are extremely detrimental to marine organisms that rely on calcium carbonate to build their skeletons (Calde	Done.	**New Text:** Increasing sea surface temperatures are expected to continue as global temperatures rise. It is possible that these warmer waters are also increasing the intensity of the tropical storms in the region (Mann and Emmanuel 2006; Sriver and Huber 2006; Elsner 2006; Hoyos et al. 2006). As global temperatures rise, sea level will continue to rise providing additional challenges for corals. Increasing depths change light regimes, and inundated land will potentially liberate additional nutrients and contaminants from terrestrial sources, especially agricultural and municipal.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-80	**Chapter 5, Page 237, Line 17:**	(Section 5.5.1 on "Observed and Projected Impacts" contains good information. However, (1) this section should not be confined to the California Current System if this report is to adequately cover marine ecosystems in the United States. It must also cover the Alaska Current and Gulf Stream. (2) This list includes physical and biological changes produced by physical changes and as described in Comment, this section would do well to distinguish the two. (3) This entire section needs citations. (4) This section should also include the increased spread of exotic species (Stachowicz et al. 2002).)	This section has been substantially revised, citations added, and the scope expanded beyond only the California Current. However, the California current is still highlighted as a case study, due to the large amount of research that has been conducted and published on it.	Citations added.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-81	**Chapter 5, Page 237, Lines 23-30:**	(The "Snowpack and Rainfall" paragraph overlaps with the "Freshwater Input" paragraph and the two should be combined and developed. Give more specific information about the impacts to salmon, sturgeon, and other anadromous fishes from altered patterns and quantities of freshwater runoff. Add information about impacts to estuarine systems from changes in runoff. On page 238, lines 3-5, the sentence "This will greatly alter coastal stratification, plume formation and evolution, and the transport of anadromous populations" is not useful unless it states how these will be altered and what the significance is. "Plume formation and evolution" needs to be better explained as this will not make sense to many readers.)	OK	Passage deleted.
Public Comment-82	**Chapter 5, Page 237, Line 32:**	(The impacts of increased water temperature are much more wide-ranging than to salmon alone. Important discussion points to include are how thermal tolerances and development of marine organisms will be affected.)		Coverage of anadromous fishes is limited in this document. We have discussed salmon as a case study and recognize that other anadromous fish may have similar responses to changes in climate and climate variability, depending of course on their particular biologies.
Public Comment-83	**Chapter 5, Page 238, Lines 7-11:**	(May want to supplement this information from Bakun (1990) with Snyder et al. (2003)).	Agreed	Information supplemented with Snyder et al. 2003.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-84	**Chapter 5, Page 238, Lines 13-19:**	(Include information on trends in increased stratification in the California Current system in Palacios et al. (2004)).	OK	This section revised, bullet removed.
Public Comment-85	**Chapter 5, Page 238, Lines 21-29:**	(Need justification for first statement. The last statement is very important and would be improved with an example, like the importance of the timing of breeding of the seabird Cassin's Auklet with productivity peaks in central California (Sydeman et al. 2006)).	Agreed	Information and citation added to revised text. "Additionally, warmer temperatures on land surfaces, contributing to low atmospheric pressure combined with ocean heating may contribute to stronger and altered seasonality of upwelling in western coastal regions (Bakun 1990; Snyder et al. 2003). Migration patterns of animals within the California Current (e.g., whiting, sardines, shearwaters, loggerhead turtles, Grey Whales) may be altered to take advantage of feeding opportunities. Recent disruptions of seasonal breeding patterns of a marine seabird (Cassin's Auklet) by delayed upwelling have been reported by Sydeman et al. (2006)."
Public Comment-86	**Chapter 5, Page 238, Lines 39-44:**	(Also Roemmich and McGowan (1995)).		Bullet removed, citation not added.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-87	**Chapter 5, Page 238, Line 46:**	(Need references to key studies: Tidal pools studied along the Monterey coast of California already demonstrate that species abundance and distribution is changing due to climate change. In just six decades, shoreline ocean temperatures warmed by 0.79□ C, cold-water species declined, and warm-water species increased (Sagarin et al. 1999). Similarly, in reef fish assemblages in the Southern California Bight, northern and endemic species declined and southern species increased following the shift to warm water conditions in the late 1970s (Holbrook et al. 1997).)		References & information added to revised chapter.
Public Comment-88	**Chapter 5, Page 239, Line 8:**	(I don't understand or agree with the statement "In the northernmost regions, areas where production is light limited may see higher productivity." This needs an explanation and justification. Also important to include--global declines in net primary production between 1997-2005 were attributed to reduced nutrient enhancement due to ocean surface warming (Behrenfeld et al. 2006)).		Bullet and related information removed in revision.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-89	**Chapter 5, Page 239, Lines 14-19:**	(This section on increasing variability is important and should be combined with the “Surprises” section on page 240 to include observed changes (2005, 2006 examples; finish analysis of 2007 or delete it) and predicted changes (more frequent and severe storms, extreme precipitation events, etc).)		Bullet and related information removed in revision.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-90	**Chapter 5, Page 240, Line 21:**	(Montane ecosystems are a very important example of ecosystems that are sensitive to climate change so I'm glad this is being included. This section could be improved by presenting a review of predicted changes in addition to the review of observed changes. Predicted changes are mentioned only briefly on page 242 lines 1-5.)	More information on montane systems is provided in section 5.9.10 Particularly Sensitive Areas.	These environmental changes are resulting in the disappearance of glaciers in most montane areas around the world. The changes in patterns and abundance of melt water from these glaciers have significant implications for the sixth of the world's population that is dependent upon glaciers and melting snowpack for water supplies (Barnett et al. 2005). Plant and animal communities are also affected as glaciers recede, exposing new terrain for colonization in an ongoing process of succession (e.g., for spider communities, see Gobbi et al. 2006). One group of organisms whose reproductive phenology is closely tied to snowmelt is amphibians, for which this environmental cue is apparently more important than temperature (Corn 2003). Hibernating and migratory species that reproduce at high altitudes during the summer are also being affected by the ongoing environmental changes. For example, marmots are emerging a few weeks earlier than they used to in the Colorado Rocky Mountains, and robins are arriving from wintering grounds weeks earlier in the same habitats (Inouye et al. 2000). Spe

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-91	**Chapter 5, Page 242, Line 6:**	(Section 5.6.2 on polar bears is an important section but would be better placed in the context of the Arctic as a particularly sensitive ecosystem. I recommend moving the short Arctic section on page 230 to the Sensitive Ecosystems section and presenting a more detailed analysis of physical changes in the Arctic and the observed and predicted impacts to artic species. For example, according to the IPCC and ACIA (2004), arctic average temperature has risen at almost twice the rate as the rest of the world in the past few decades: In Alaska and western Canada, winter temperatures have increased by as much as 3-4° C (5-7°F) in the past 50 years. Over the next 100 years, under a moderate emissions scenario, annual average temperatures are projected to rise 3-5°C (5-9°F) over land and up to 7° C (13°F) over the oceans. Winter temperatures are projected to rise by 4-7°C (5-9°F) over land and 7-10°C (13-18°) over the oceans. (ACIA 2004). There has been a dramatic loss of sea ice, widespread melting of glaciers, rapid melting of the Greenland ice sheet, and r	Agreed	Polar Bear information moved to Arctic Sea-ice Ecosystems, Section 5.9.11

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-92	**Chapter 5, Page 242, Line 6:**	(The recent USGS reports on projected impacts to polar bear populations must be added to this section. The USGS conducted polar bear population modeling based on 10 climate models chosen from among 20 available because they did the best job of simulating current ice conditions and would thus be expected to most accurately simulate future ice conditions. The USGS used the Intergovernmental Panel on Climate Change ("IPCC") A1B "business as usual" scenario of future emissions to run the climate models. Amstrup et al. (2007) project that two-thirds of the world's polar bear populations will be extinct by 2050, including all of the bears in Alaska. Polar bears may survive in the high Canadian Archipelago and portions of Northwest Greenland through the end of this century. However, their extinction risk is still extremely high: over 40% in the Archipelago and over 70% in Northwest Greenland (Amstrup et al. 2007: Table 8). Moreover, the USGS emphasizes repeatedly that because all of the available climate models have to date underestimated the actual observed sea-	Agree	The USGS study is cited in the revision, as are a number of other new citations.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-93	**Chapter 5, Page 247, Lines 37-42:**	(Instead of simply stating that the National Research Council released recommendations for future measurements, it would be more helpful to briefly state the relevant highlights of these recommendations in terms of how monitoring systems can be improved for detecting impacts of climate change on biodiversity.)	A good recommendation, but with space at a premium in this report, we leave it to readers to use the citation to find the information they are most interested in.	No change.
Public Comment-94	**Chapter 5, Page 247, Lines 44-46:**	(This paragraph would be more useful if the authors made recommendations, based on their varied experiences and knowledge base, on the adequacy of existing monitoring systems. The other chapters have managed to do this. The importance of long-term datasets that capture changes in climate and biological variables and that cover broad spatial scales (i.e. CalCOFI program) should be emphasized.)	Agreed	Section 5.8 provides greater background information on existing monitoring systems, as well as citations that readers can use to track down further information.
Public Comment-95	**Chapter 5, Page 250, Line 6:**	(The major findings and conclusions will hopefully be more comprehensive once Chapter 5 is improved. Some points result from incomplete analyses and aren't that useful.)	Yes	The major findings and conclusions have been expanded in the latest chapter revision.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-96	**Chapter 5, Page 255, Lines 34-39:**	(The first sentence is not supported by information provided in this section and should be deleted. To my understanding, there are data on mismatches in phenology between plants and pollinators, and if there is another area where data are lacking, specify and justify.)	The chapter is clear that there are documented mis-matches between pollinator activity and plants. However, the overarching conclusion is that existing operational monitoring systems do not capture this level of biological detail still holds.	This chapter has been updated and revised to support this sentence mentioned in this comment. We can think of the monitoring systems that have been used to evaluate the relationship between changes in the physical climate system and biological diversity as having three components. • There is a plethora of species-specific or ecosystem-specific monitoring systems, variously sponsored by the U.S. federal agencies, state agencies, conservation organizations, and other private organizations. However, in very few cases were these monitoring systems established with climate variability and climate change in mind. • Augmenting the monitoring systems that make routine measurements are a set of more specific research activities that have been designed to create time-series of population data, and associated climatic and environmental data. • The third component is spatially extensive observations derived from remotely sensed data. These are primarily focused on land-cover, and thus are a good indicator of the major single driver of changes in biodiversity patterns, or on esti

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-97	**Synthesis, Page 261, Line 19:**	(The overarching conclusions section does not present a sufficient summary of the magnitude of current climate change or projected climate change as detailed in the IPCC Fourth Assessment report. This conclusion should acknowledge the magnitude of climate change predicted for the next decades and throughout this century that are outlined in the "robust findings" for global and regional projections outlined in the Technical Summary (Solomon et al. 2007) and detailed in the IPCC Fourth Assessment report. Throughout this report (including the introductory sections), there is not sufficient analysis of how the range of physical changes projected by the IPCC for this century will affect biodiversity, land resources, water resources, and agriculture.)	Yes	The chapter is now clear in its main findings in each section that current impacts have been well documented, and where projections have been done, their potential magnitude is discussed, if that information has appeared in the literature.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-98	**(Chapter 5) References:**	ACIA. 2004. Impacts of a Warming Climate: Arctic Climate Impact Assessment. Cambridge University Press, Cambridge, UK. Amstrup, S. C., B. G. Marcot, and D. C. Douglas. 2007. Forecasting the Range-wide Status of Polar Bears at Selected Times in the 21st Century. U.S. Department of the Interior and U.S. Geological Survey, USGS Science Strategy to Support U.S. Fish and Wildlife Service Polar Bear Listing Decision, Reston, Virginia. Beever, E. A., P. E. Brussard, and J. Berger. 2003. Patterns of apparent extirpation among isolated populations of pikas (Ochotona princeps) in the Great Basin. Journal of Mammalogy 84:37-54. Behrenfeld, M. J., R. T. O'Malley, D. A. Siegel, C. R. McClain, J. L. Sarmiento, G. C. Feldman, A. J. Milligan, P. G. Falkowski, R. M. Letelier, and E. S. Boss. 2006. Climate-driven trends in contemporary ocean productivity. Nature 444:752-755. Bindoff, N. L., J. Willebrand, V. Artale, A. Cazenave, J. Gregory, S. Gulev, K. Hanawa, C. Le Quéré, S. Levitus, Y. Nojiri, C. K. Shum, L. D. Talley, and A. Unnikrishnan. 2007. 2007: Observations:	Reference list acknowledged.	Some of listed references added to content.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-99	**Chapter 5, Pages 1-37, Lines All:**	The chapter does not address impacts of climate change on several major taxa in any meaningful way. Other than polar bears and seals, discussion of climate change impacts to mammals is limited to a few paragraphs. There is no discussion of impacts to freshwater fish. There is no discussion of impacts to reptiles. Discussion of impacts to amphibians is limited to a few paragraphs. There is no discussion of impacts to non-migratory birds. Other than butterflies, there is no discussion of impacts to insects or other invertebrates outside of marine environments unless they are pest species. The discussion of impacts to plant biodiversity is minimal, outside of discussion of invasive species. The lack of meaningful coverage of these major taxa that occur in the U.S. and are major components of biodiversity in this country represents a major deficiency in this document that severely limits its usefulness for estimating effects of future climate change on these systems and resources, a stated primary goal of the SAP 4.3 document. The final report needs to address impacts to these taxa i	As mentioned by the reviewer, many of these ecosystems are covered in other chapters.	Chapter greatly revised to cover a broader spectrum of taxa, however, there are inevitably some topics that have not been explored. Sections on amphibians and mammals, and plant communities are greatly expanded. Treatment of insects other than butterflies and pest species is still limited, although this is in part a reflection of the available literature. Space constraints in the assessment preclude a full treatment of all possible taxonomic groups.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-100	**Chapter 5, Pages 1-37, Lines All:**	The draft of Chapter 5 presented for public comment is incomplete in many important respects, as evidenced by the lack of a list of references, missing citations, numerous headings without any body text, and notations added e.g. "<INCOMPLETE>". Submittal of a substantially incomplete draft for public comment renders informed public participation difficult, and impossible for those sections that are missing. Without a list of references, there is no way for the public to evaluate the studies upon which the document is based. If the missing sections are written after the public comment period has ended, and are subsequently published in the final document, the sections will have been written and published without the opportunity for public comment. This is clearly inappropriate, and contrary to the spirit of the SAP guidelines which specify that the documents be produced with full public participation. For these reasons, the draft should be completed and resubmitted for public comment at a future date, prior to completion of the final draft.	Changes to the review process are not within the discretion of SAP 4.3's authors, but are decided instead by CCSP.	The revised document is complete in the sense that all the elements in the outline have been covered. Text is fully referenced, and a complete reference list accompanies the revised text. This level of review of both text and citations far exceeds any other sort of publication (e.g., peer reviewed journals) and thus the authors feel that the current draft is now responsive to the concerns of the commenter.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-101	**Chapter 5, Pages 1-37, Lines 11-13:**	This statement would be clearer if an explanation for the 90% decline in flycatcher populations was stated, rather than implied.	Agreed	Added: Many migratory birds, especially short-range migrants, have adapted their timing of reproduction to the timing of the food resources. A careful examination of food resource availability relative to spring arrival and egg-laying dates will aid in the understanding of impacts of climate change. There is a suite of responses that facilitate an adaptive phenological shift; a shift in egg-laying date or a shift in the period between laying of the eggs and hatching of the chicks. In a long-term study of the migratory pied flycatcher (*Ficedula hypoleuca*), researchers found that the peak of abundance of their food resource (caterpillars) has advanced in the last two decades and, in response, the birds have advanced their laying date. In years with an early caterpillar peak, the hatching date was advanced and clutch sizes were larger. Populations of the flycatcher have declined by about 90 percent over the past two decades in areas where food for provisioning nestlings peaks early in the season, but not in areas with a late food peak (Both 2006).

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-102	**Chapter 5, Page 2, Line 39**	This section should be expanded to include evolutionary changes associated with climate change impacts. Bradshaw and Holzapfel (and others) have documented climate change-induced evolutionary changes in insects, with Bradshaw and Holzapfel's study specifically addressing mosquitoes found in the U.S.	OK	Chapter greatly revised to cover a broader spectrum of taxa.
Public Comment-103	**Chapter 5, Page 5, Line 40**	This a very large range (30-75 %) for species migrating northwards, and it would be helpful to explain why there is such a large variance across studies, if the reasons are known or suspected.	Information taken from current literature.	No change made.
Public Comment-104	**Chapter 5, Page 7, Line 25**	Section missing. This section should be completed, and a completed draft resubmitted for public comment. There are a number of articles published regarding the presumed extinction of the Golden Toad (Bufo periglenes), which is discussed on Page 13, Lines 39-41.	OK	Chapter revision resulted in some sections being eliminated; this section has been deleted, however relevant information has been incorporated into the Amphibians section, 5.2.2.4.
Public Comment-105	**Chapter 5, Page 7, Line 27**	Section missing. This section should be completed, and a completed draft resubmitted for public comment.	Changes to the review process are not within the discretion of SAP 4.3's authors, but are instead decided by CCSP.	Chapter revision resulted in some sections being eliminated; this section has been deleted, however relevant information has been incorporated into the Amphibians section, 5.2.2.4.
Public Comment-106	**Chapter 5, Page 7, Line 30**	Major section missing. This section should be completed, and a completed draft resubmitted for public comment.	Noted.	The Climate Change Drivers section has been eliminated in current chapter.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-107	**Chapter 5, Page 7, Line 32**	Major section incomplete. This section should be completed, and a completed draft resubmitted for public comment. Additional ecosystem services such as hunting, seed dispersal, fuel, fiber, pharmaceuticals and other products should be included. A number of services are mentioned in Section 5.7, and impacts to them should be discussed here.	Agreed	Section revised. See Section 5.7, Ecosystem Services and Expectations for Future Change.
Public Comment-108	**Chapter 5, Page 8, Lines 3-19**	Assuming this section is supposed to present research needs, it should be expanded to include monitoring studies, as discussed on Page 27.	OK	Monitoring studies overview provided in Section 5.8, Adequacy of Observing Systems
Public Comment-109	**Chapter 5, Page 30, Lines 1-3**	Several sections missing. These sections should be completed, and a completed draft resubmitted for public comment. Plant monitoring systems should be included under a separate heading, as should monitoring for fish, invertebrates (other than butterflies), etc.	OK.	Missing sections updated in revision; see Section 5.8, Adequacy of Observing Systems

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-110	**Chapter 5.6.2 entire sec:**	There are many uncertainties associated with predictions of climate change both globally and regionally that the report fails to consider. For example, the projections of future sea ice seem to be based on extrapolations of recent decadal trends, an approach that may not be valid. Recent Arctic warming may be more pronounced than changes in the global mean due to the Pacific Decadal Oscillation, Arctic Oscillation, and North Atlantic Oscillation all being in their up phases (with increases in winds and temperature in the Arctic) for the past 15 years (www.tcsdaily.com/article.aspx?id=030705C, Hurrell, 2006; Laxon et al. 2003; Maslanik et al., 1996; Omstedt and Chen, 2001; Rigor et al., 2002). These patterns are cyclic and will be reversing over coming decades. In addition, models suggest that the Arctic may be more sensitive to solar influences than the global climate, and that recently there has been increased warming in the Arctic due to solar influences (Soon, 2005; Svensmark, 2006). This solar influence is unlikely to continue recent directional trends. Therefore it is not vali	The assertion that studies about sea-ice extent are based only on extrapolating current trends is not correct. The chapter spends most of its space explaining what the impacts of observed changes have been, and then discusses the potential impacts of modeled changes in ice extent and dynamics, given the recent literature. A detailed exposition on ice dynamics by themselves is beyond the scope of the chapter, and we have abstained from making such predictions, although we note that the commenter's hypothesis about cycles is not currently well-supported in the literature.	No change.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-111		Some variation in Arctic ice may reflect wind-driven changes in the distribution of ice rather than melting of ice. The 2007 UN panel report on climate change reports that “Low-frequency, large-scale modes of atmospheric variability … affect both wind-driving of sea ice and heat transport in the atmosphere, and therefore contribute to interannual variations in ice formation, growth and melt. [ICCP draft report sec 4.4.3.4] Some of the dramatic {ice} decrease may be a consequence of wind-driven redistribution of ice volume over time. [ICCP draft report sec 4.4.3.4]”. Therefore, it is not valid to simply extrapolate recent rates of sea ice decline.	See above. Repeated comment.	No change.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-112		The report relies on general circulation models and their predictions about future climates. It looks as though the report relies primarily on an extreme scenario that is already obsolete. The A2 scenario, which is from the IPCC 2001 report, is the most extreme scenario (warmest) by a factor of 2 compared to the IPCC 2001 mid-level scenario. Further, IPCC's A2 scenario is much lower (much less warming) in the 2007 report (due out in November 2007) and the expected (mid-level) scenario is even lower than this. Thus, the temperatures used as a basis for predictions are at the high end of the 2001 IPCC scenarios by many degrees and are outside the range of IPCC's current scenarios. The report needs to use the most recent UN estimates of climate change, because the science has advanced since 2001. It is also critical that the Service consider important limitations of the IPCC climate scenarios rather than ignoring all criticisms of climate models. Finally, the expected degree of warming being used for forecasts is a critical factor which must be stated quantitatively. Merely pro	The commenter is incorrect on three grounds. One is that we have relied on the published literature in total, and have assessed it generally, and have not picked specific scenarios of change to analyze. More importantly, none of the IPCC scenarios should be thought of as more or less likely than the others - they are illustrative only, so characterizing them as expectations is both technically and intellectually incorrect. Third, the actual increase in radiative forcing is very close to the old IS92a scenario, i.e., it is in fact near the high end of the IPCC family of scenarios over time. This is not directly translated into the most rapid possible temperature increases for a large number of reasons that are not appropriate for this assessment, but are detailed at length in the IPCC Working Group I report.	No change.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-113		Another area of uncertainty is associated with the use of regional projections of climate (either current or future) based on general circulation models. Regional projections often are not reliable. For example, climate models are consistently incorrect when predicting 20th Century values for the Midwest United States (Kunkel et al., 2006) and other particular regions. It is particularly noteworthy that an observed 42 year trend of increasing winter ice thickness and earlier Fall freezeup in Hudson Bay cannot be replicated by climate models and contradicts the assumption that all Arctic ice is melting (Gagnon and Gough, 2006). Thus, the report should not rely on these models without mentioning uncertainties.	The report specifically does not address the entire range of issues associated with regional and global climate modeling. Our conclusions are robust with respect to climate models, however, since they are heavily weighted on actual observations. We have been consistent with other sources in the literature about being appropriately cautious about projections.	No change.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-114		Thus, we strongly encourage the authors to acknowledge and quantify uncertainty associated with each type of prediction and for the overall likelihood of predicted events. For example, the report does not demonstrate a quantitative link between amount of sea ice and bear population trends. It is not sufficient to argue that decreased ice means danger in a general way; quantification should be provided. The amount of ice required by the bears, the factors determining habitat quality, and the functional response to habitat area (how many bears as habitat decreases) must be established before extinction risk can be predicted.	IPCC vernacular used to assess uncertainty level.	No change.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-115		It should be noted that Hudson Bay and certain other areas of the Arctic have historically become ice free by August each year and do not refreeze until October (Gagnon and Gough, 2006), yet they have a viable polar bear population. Descriptions of ice loss in the literature convey the impression that polar ice will be virtually eliminated year round during the 21st Century. However, projections actually suggest that only the lowest extent of ice in late summer will become that low. Ice extent in winter is projected to have only minor declines. This period of low ice is only for a month or so, not all year. Thus the question is not whether polar bears can survive with reduced ice cover, but whether they can survive for a month or so with reduced ice cover in late summer. In Hudson Bay and other coastal areas where ice melts the bears spend the warmest months on land. They are able to hibernate during this period, just as other bear species farther south hibernate during winter-time periods of low food supply. Only the small population of bears that spends	OK	The revised report deals with the issue of ice loss (as modeled, not just extrapolated) and all the issues associated with polar bear population decline and possibility of population extinction, which include food supply, ice extent, seasonality, and many other factors. It cites the most recent literature, including the extensive USGS assessment of the species' status.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-116		Many factors, including hunting mortality, may be contributing to changes in polar bear abundance in populations for which declines are reported. Of the five populations deemed to be declining, the Western Hudson Bay, Kane Basin, and Baffin Bay populations have potentially been affected adversely by hunting. The Western Hudson Bay was over-harvested during 1987-2004, which contributed significantly to declines, and sex ratios are now skewed 65:35 M:F (Schliebe et al. 2006: 51-52). In 2005, the IUCN PBSG questioned whether this population continues to be managed based on the best available scientific information (Schielbe et al. 2006: 124). The Kane Basin population also is likely over-harvested and the combined harvest by Greenland and Nunavut hunters is believed unsustainable (Schliebe et al. 2006: 125). Greenland's harvest levels for the Baffin Bay population have increased significantly since 1993 and were particularly high in 2000-2004 (Schielbe et al. 2006: 125). This population also appears to be substantially over-harvested (Schliebe et al. 2006: 55).	Comments noted.	No change.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-117		One of the five populations designated as declining (Southern Beaufort Sea) may not actually be declining. For example, the 1986 population estimate for the Southern Beaufort Sea (1,800) is well within the 95% confidence limits of the most recent (2006) estimate (1,500, 95% CL = 1,000 – 2,000) (Schielbe et al. 2006: 44). Furthermore, population estimation methods appear to have been different between the 1986 and 2006 surveys. Thus, it is inappropriate to suggest that the Southern Beaufort Sea population is declining.	Authors do not suggest declining bear population in Southern Beaufort Sea.	No change

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-118		Interestingly, Schielbe et al. (2006: 126) indicate that “At present, concern exists for potential over-harvest of the [Baffin Bay], [Chukchi Sea], [Kane Basin], and [Western Hudson Bay] populations of polar bears. In other populations like East Greenland and Davis Strait, a high number of polar bears are taken annually despite lack of scientific information about population size. Considerable debate has occurred regarding the recent changes in population estimates and quota increases for some populations in Nunavut (Aars et al. 2006). The question arises whether increasing quotas based on [Inuit ecological knowledge] (and the perception that the populations were increasing because hunters were seeing more bears along the coast) constitutes a ‘sound conservation practice’ and is ‘based on best scientific data’”. Thus, some polar bear populations have clearly been over harvested and steps by the Service and other regulatory agencies to address this issue may help reverse declines in these populations.	Comments noted.	No change.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-119		Of 18 polar bear populations evaluated in the proposed rule, the most recent abundance estimates for only three populations are <5 years old while for six populations the most recent estimate is >10 years old. For five populations, there are insufficient data to estimate population trends and two populations have documented increases. Because the circumpolar population of polar bear (and their prey species) currently appears to be healthy and to occupy the entirety of their historic ranges it would be useful to obtain better and more recent data on status and trends for the global population before proposing this species for listing.	Comments noted. SAP 4.3 does not propose any action, merely evaluates the available literature.	No change.

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-120		The polar bear has experienced and survived natural temperature fluctuations in the past that are noted but not quantified in the report. For example, during the Holocene Optimum (or Hypsithermal) about 6000 to 8000 years ago, the Arctic was at least 2 degrees and perhaps 6 degrees warmer than today for perhaps several thousand years (Andreev et al., 2002; Andreev et al., 2004; Davis et al., 2003; Schirrmeister et al., 2002; Schlütz and Lehmkuhl, 2007; Zhuo et al., 1998), mainly in summer, and ice extent was less. This degree of warming is comparable to or even greater than that projected in the report to occur by 2045. However, the polar bear and their prey did not perish. Thus, historical data suggest that polar bears should be able to withstand the warming predicted in the proposed rule should it occur. In the report it is stated that although polar bears survived past warm periods they are unlikely to do so in the future, but this seems to be based solely on the opinion of 2 authors, and is neither quantified nor defended.	Reference list and comments acknowledged.	**To address these comments**: Adaptive traits reflect selection by past environments, and the time needed to adapt to new environments depends on genetic diversity in populations, the intensity of selection, and the pace of change. Genetic diversity among polar bears is evident in the 19 putative populations, suggesting some scope for adaptation within the species as a whole even if some populations will be at greater risk than others. On the other hand, the nature of the environmental change affecting critical features of polar bears' breeding and foraging habitats, and the rapid pace of change relative to the bears' long generation time (circa 15 years) do not favor successful adaptation. **AND** During previous climate warmings, polar bears apparently survived in unknown refuges that likely included some sea ice cover and access to seals. Within the coming century, however, the Arctic Ocean may be ice-free during summer (Overpeck et al. 2005), and the polar bears' access to seals will be diminished (Stirling and Derocher 1993; Lunn and Stirling 2001; Derocher et al. 2004). As sno

Comment #	Chapter, Page, Line	Comment	Author Response	Changes to Draft
Public Comment-121		**Ref (Craig Loehle):** Andreev, A.A., C. Siegert, V.A. Klimanov, A.Y. Derevyagin, G.N. Shilova, and M. Melles. 2002. Late Pleistocene and Holocene vegetation and climate on the Taymyr Lowland, northern Siberia. Quaternary Research 57:138-150. Andreev, A.A., P.E. Tarasov, V.A. Klimanov, M. Melles, O.M. Lisitsyna, and H.-W. Hubberten. 2004. Vegetation and climate changes around the Lama Lake, Taymyr Peninsula, Russia during the Late Pleistocene and Holocene. Quaternary International 122:69-84. Aars, J., N. J. Lunn, and A.E. Derocher. 2006. Polar bears: Proceedings of the 14th Working Meeting of the IUCN/SSC Polar Bear Specialist Group. 20-24 June, Seattle, Washington, USA. IUCN, Gland, Switzerland. 198pp. Davis, B.A.S., S. Brewer, A.C. Stevenson, and J. Guiot. 2003. The temperature of Europe during the Holocene reconstructed from pollen data. Quaternary Science Reviews 22:1701-1716. Derocher, A. E., N. J. Lunn, and I. Stirling. 2004. Polar bears in a warming climate. Integr. Comp. Biol	Reference list acknowledged.	Derocher, A. E., N. J. Lunn, and I. Stirling. 2004. added