Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II

Public Comment Period & National Academies Review Annotation

The U.S. Global Change Research Program (USGCRP) released the draft Fourth National Climate Assessment (NCA4), Volume II for public comment from 03 November 2017 to 31 January 2018, concurrent with review by a special committee convened by the National Academies of Sciences, Engineering, and Medicine (NASEM, 03 November 2017 - 12 March 2018).

The NASEM panel evaluated the draft NCA4 Vol. II and published a document that captured consensus responses to questions posed within a carefully designed Statement of Task. The final report can be accessed here and an acknowledgment generated by USGCRP leadership here. This memo explains actions taken by the NCA4 Vol. II writing team to accommodate the expert judgment of the committee. In addition to the narrative review provided by the NASEM penal, each chapter writing team considered any chapter-specific line-by-line comments made by the panel, noted edits and rationale, and revise the report. The annotation to these line-by-line comments from the NASEM panel can be accessed here.

A Federal Register Notice publicized the Public Comment Period and a web-based system collected input from the general public and external disciplinary experts. Chapter writing teams considered each comment, noted edits and rationale, and revised the report. The Public Comment Period annotation can be accessed here.

Independent Review Editors (RE) were chosen by the NCA4 Federal Steering Committee from a pool of eternal experts solicited through an open call publicized via Federal Register Notice (20 July 2017 – 08 September 2017). Each chapter was assigned an RE to evaluate author responses to both the NASEM review and public comments, and the revised chapter drafts themselves, to confirm that the chapter writing teams had given due consideration to all review comments prior to submission for final agency review and clearance.

Names and affiliations of participants in the NCA4 Vol. II Public Comment Period were withheld from the authors, Review Editors, Federal Steering Committee, and staff throughout review and revisions. Anonymity helped preserve integrity of the drafting process. During registration, all reviewers consented to have their names associated with relevant comments once the report was published. The full report underwent several additional rounds of review after these responses were generated and, therefore, edits may have been made that are not part of the attributed set of comments included on the following pages.

Comment #	Chapter	Page/Line	Comment	Response
1	General		The intended audience should be more clearly explained in the Front Matter of the draft NCA4 in order to indicate the broad range of possible users of information in the report.	A new paragraph has been added in the "About this Report" section of the Front Matter explaining who the intended audience of the NCA4 is and how we hope it can be used.
2	General		Similar usage of boxes across chapters would improve consistency across the report and provide readers with a clearer understanding of their general purpose.	Boxes serve two general purposes in NCA4 Vol. II: (1) to highlight case studies, and (2) to expand on a certain aspect of the chapter in a manner that complements the traditional chapter text. In the final version, Box Titles will clarify if it is a "CASE STUDY" or some othe title that provides complementary information. We are considering whether different color shading in the final report to differentiate between case studies and other boxes would be useful or confusing. A decision on this will be made before final production.
3	General		Discussion of up-scaling and downscaling within regional scales where data is available would be beneficial.	This is a technical matter that we are reluctant to get in to in this report. Readers are referred to Ch 4 of NCA4 Vol I: Climate Science Special Report: https://science2017.globalchange.gov/chapter/4/), as well as Appendix 3 in this report (Data Tools and Scneario Products) for a more thorough presentation of downscaling techniques.
4	General		The term "stressors" is used throughout the draft NCA4. It would be useful to provide a definition of what it means in the context of this report early in the draft document.	Rather than define all possible terms explicitly in the report itself, we have a included paragraph at the end of the Front Matter that explains how terms used in this report draw from the USGCRP glossary (http://www.globalchange.gov/climate-change/glossary) unless otherwise specified. "Stressors" is defined there as "Something that has an effect on people and on natural, managed, and socioeconomic systems. Multiple stressors can have compounded effects, such as when economic or market stress combines with drought to negatively impact farmers."
5	General		Increased usage of subject headers would help to guide readers through the chapters. This includes noting whether initial paragraphs in each chapter are intended to be a summary or an introduction. Introductions should include references while summaries do not need to include references.	Each chapter has an Executive Summary that summarizes the whole chapter by pulling text from the underlying chapter. A separate Introduction / Background / State of the Sector section is provided for most underlying chapters, as well (Ch. 1 and 2 are some exclusions).
6	General		It is recommended that the Front Matter (or an Appendix) of the draft NCA4 provide information on how regions were determined and note more specifically the differences from the NCA3.	The text just prior to Figure 1 (a map of the 10 NCA4 regions) has been expanded to address how the regions were determined and what the differences are from the NCA3.

Comment #	Chapter	Page/Line	Comment	Response
7	General		The Committee generally found the redundancy within chapters due to repetitious text in the executive summaries, main text, and traceable accounts to be cumbersome. Depending on how the final NCA4 report and derivative products will be structured, the NCA4 authors should consider more concise ways in which to present the material, particularly avoiding duplication between the main text and traceable accounts.	By design, each chapter has an Executive Summary that summarizes the whole chapter by pulling text from the underlying chapter. This is necessary because the only hard copy, printed component of NCA4 Vol II will be the "Report-in-Brief" which will include: (1) Front Matter, (2) Overview, and (3) the Executive Summaries from each underlying chapter. Repetition between the main text and traceable accounts has been reduced as a result of most chapters re-working their Traceable Accounts based on public and National Academies' review. That said, again - by design - Traceable Accounts are there to provide the reader with additional clarity and transparency as to how the authors arrived at the conclusions they did, so by defintiion, some redundancy is
8	General		More information about the public engagement webinars and workshops for individual chapters would be beneficial to include. When was it, to whom, and how was participation solicited?	Additional information about the extent of public engagement is provided in the chapeau to each chapter's Traceable Account (i.e., how was the chapter developed), as well as in Appendix 1 (Process). More information can be found on the USGCRP website here: https://www.globalchange.gov/content/nca4-engagement-activities
9	01. Overview / Executive Summary	P19/L35-P20/L2	The text implies that these water impacts will occur everywhere. It seems important in these high-level messages to acknowledge that there will be regional variation in droughts and floods.	Regional detail on impacts has been added to increase clarity to the reader.
10	01. Overview / Executive Summary	P25/L35	Chapter numbers are incorrect: Chapter 29 is the draft NCA4 mitigation chapter and Chapter 28 is the adaption chapter.	The text has been updated to reflect this suggestion.
11	01. Overview / Executive Summary	P50/L12	The authors should mention that impacts vary by region, sector, and population vulnerability.	A sentence to this effect has been added in Section 1.1.
12	01. Overview / Executive Summary	P50/L20-23	This sentence could also mention carbon capture and use after “including energy efficiency.”	Carbon capture and use at the federal level is not covered in the Mitigation chapter. No change has been made to the chapter in response to this comment.
13	01. Overview / Executive Summary	P19/L22-29	Is “over the coming century” intended to mean the same as “by the end of the century”? It would seem useful to keep the same time frame for both statements.	This text has been eliminated.

Comment #	Chapter	Page/Line	Comment	Response
14	01. Overview / Executive Summary	P24/L10-11	The Committee recommends moving land-management practices to the end of this list of drivers, because it probably has the least impact on wildfires.	The text has been updated to reflect this suggestion.
15	01. Overview / Executive Summary	P24/L23	Change “resemble that” to “resemble those.”	The text has been updated to reflect this suggestion.
16	01. Overview / Executive Summary	P26/L3-14	The upbeat tone of this paragraph sends a message of “We can do it,” which is effective.	No change has been made to the chapter in response to this comment.
17	01. Overview / Executive Summary	P29/L13-14	The graph of percent land area experiencing drought is the only shortterm time series in this figure. Perhaps not surprisingly, it shows lots of variability, but the time series is not long enough to show a climate-driven trend. Can a drought-related parameter with a longer time series be used here instead? Without a longer time series or a clearer trend, this graph really is not informative to this general overview section.	After discussion with the leadership of the USGCRP inter-agency Indicators Working Group (https://www.globalchange.gov/explore/indicators), we agree with this comment that we should aim to include climatological timeseries for each panel of this figure. Unfortunately, the PDSI dataseries does not extend any further back than is presented in this public comment draft. So, we have included a new indicator for drought - Standardized Precipitation Evapotranspiration Index, or SPEI (https://climatedataguide.ucar.edu/climate-data/standardized-precipitation-evapotranspiration-index-spei) - which combines multi-timescales aspects of the Standardized Precipitation Index (SPI) with information about evapotranspiration, making it more useful for climate change studies. Moreover, it is a statistically-based index that requires only climatological information without assumptions about the characteristics of the
18	01. Overview / Executive Summary	P33/L32-33	The Alaska chapter says the climate is warming twice as fast as the global average (not MORE THAN twice as fast). Use the same time interval in the overview chapter as in the Alaska chapter and make sure the message is the same.	The text has been updated to reflect this suggestion.

Comment #	Chapter	Page/Line	Comment	Response
19	01. Overview / Executive Summary	P37/L6-9	The Committee found no statement in the Alaska chapter saying that shellfish populations have been declining for 20 years and recommends the authors check this for consistency.	We note for the Committee that the relevant statement the committee sought was present in the NCA4 Third Order Draft, Chapter 26: Alaska, Key Message #4: "Shellfish populations, an important subsistence and commercial resource along the Alaska coast, have been declining for more than 20 years throughout coastal Alaska, with ocean warming and ocean acidification contributing to the decline (see Marine Ecosystems section)." However, this text has been eliminated in the revised Overview.
20	01. Overview / Executive Summary	P45/L7	The time frame over which 1-4 ft sea level rise is expected is not stated. The RCP scenarios are also not stated. This makes it confusing to relate this statement to Figure 1.4.	The text has been updated to reflect this suggestion.
21	01. Overview / Executive Summary	P49/L33-34	The statement that emissions have stabilized is probably false. The Committee assumes that the authors mean to say that emissions are not increasing as rapidly. This should be clarified	This statement has been eliminated based on recent research as well as the authors' determination that it does not belong in the Overview.
22	01. Overview / Executive Summary	P54/L6	Delete the second occurrence of the word “access” in this sentence.	The text has been updated to reflect this suggestion.
23	04. Energy	P166/L23	High winds can also damage renewable energy generation and oil platforms, in addition to damaging the electricity transmission and distribution as noted here.	We have modified the chapter text to reflect the potential for damage for a range of energy assets.
24	04. Energy	P165/L12	After the sentence about natural gas, there should be a sentence about renewable energy. After this insertion, the sentence “steps are being taken to ensure the safe and reliable” seems abrupt and unconnected to the previous sentence. Another paragraph where DOE’s voluntary partnership is mentioned could be useful. Alternatively, a slight revision could work, such as an addition like, “Many actions are underway across all energy sources to ensure … but much work remains to establish an energy system that can withstand current and future climate change risks.”	We thank the NASEM committee for this thoughful and in-depth comment. We have modified this paragraph in accordance with these suggestions.
25	04. Energy	P171/L2	Maintaining additional natural gas in storage will help prevent against supply shocks and price spikes. Considering supply abundance, most modeling suggests that increased storage is not likely to increase gas or electricity prices.	The relevant sentence has been removed.

Comment #	Chapter	Page/Line	Comment	Response
26	05. Land Cover and Land Use Change	P189/L13	Demand for new settlements can also increase the economic cost of fire damage, as more homes move into wooded areas.	We agree with the reviewers comments, however, the objective of this statement was to illustrate the direct effects and linkage between drivers of LULC change and climate. We have added text on this topic later in the chapter.
27	05. Land Cover and Land Use Change	P189/L25	The authors could also mention policies designed to increase biofuel production.	The text has been updated to reflect this suggestion.
28	05. Land Cover and Land Use Change	P203/L16	It is not clear if the “promotes climate warming” here means that carbon dioxide emissions from deforestation will do this or if regional climates might be influenced through albedo and water and energy fluxes. Evidence presented on page 197, lines 1-10, focuses on local effects.	We added the phrase "through a decrease in carbon sequestration and reduced transpiration" to the end of the sentence. We cite several recent studies that show that carbon sequestration and transpiration in temperate forests promote cooling despite the counteracting effects of relatively forest low albedos.
29	05. Land Cover and Land Use Change	P192/L21-28	This sentence describes approaches to “increasing this carbon storage” and includes in the list of approaches “development of new generation biofuels.” While the other approaches do result in increased carbon storage, there is nothing inherent in increased use of biofuels that will result in carbon storage by themselves, but rather would create more incentive to process and burn biomass. It is suggested that this be deleted from the list.	We agree with the review comment and have removed the discussion about biofuels.
30	05. Land Cover and Land Use Change	P205/L5	The confidence section addresses impacts of climate change on “urbanization in the coastal zone,” but the only substantive text addressing the coastal zone is on page 195 in the draft chapter’s “state of the sector” section, where links to climate change impacts are not made (only land use land cover change is described). It would be useful to make the point, probably in the “state of the sector” section, that the changes that are described for the coastal zone lead to increased impacts.	We agree with this comment and have added a sentence in the Introduction to emphasize the impacts in coastal areas and have also included a reference to the Coastal Effects chapter.
31	05. Land Cover and Land Use Change	P196/L16	A definition for the “business-as-usual scenario” is needed, and/or reference to the description of scenarios in the draft NCA4 Front Matter.	This paragraph has been removed from the chapter in an effort to reduce length.

Comment #	Chapter	Page/Line	Comment	Response
32	05. Land Cover and Land Use Change	P197/L14-23	There is some inconsistency in describing effects of aerosols (page 197, lines 14-15). They do not "reduce surface albedo," but rather they "increase tropospheric albedo." They reduce surface insolation. Lines 21-23 seem to get it right.	Thank you for your attention to detail. We changed surface to tropospheric.
33	05. Land Cover and Land Use Change	P199/L12-14	The expectation of conversion of irrigated agricultural land to dryland (based on the Elliott et al. 2014 reference) is reasonable in the long run (year 2100), but misses the shorter term trend of increased irrigation and the regional differentiation that is likely in these patterns (e.g., Great Lakes versus Great Plains). See Brown, J. F., and M. S. Pervez (2014), Merging remote sensing data and national agricultural statistics to model change in irrigated agriculture, Agricultural Systems, 127, 28-40, doi:10.1016/j.agsy.2014.01.004.	We have incorporated a sentence describing current trends (large increases in irrigated agriculture in the Great Plains (with cross references to the two GP regional chapters) prior to introducing the impacts noted for long-term projections. We included the citation of Brown and Perez (2014) but could not find the (Elliott et al. 2014) reference.
34	05. Land Cover and Land Use Change	P199/L16	The text says, "New policies will" The NCA4 authors do not know what new policies will do and it is not the job of the NCA4 authors to predict them. Policies certainly have affected patterns of agriculture in the past. It is recommended that this be deleted.	We agree with the comment. We have re-worded the sentence to be more clear that the "policies" statement was in reference to recent Energy policies, such as EISA, which have resulted in large changes in land use/cover.
35	06. Forests	P221/L35	Insert "and spring" (revised text would say "winter and spring flooding").	The text has been updated to reflect this suggestion.
36	06. Forests	P222/L10-15	Figure 6.5 is relevant for Pacific Northwest and some forests. Adaptation options to reduce hazardous fuels would not apply to mesic forests that burn infrequently and whose fires would be difficult to manage.	This was revised, as suggested, by revising the figure caption.
37	06. Forests	P223/L6	Add "fiber and wood products, fish and wildlife, and biodiversity" to the list of ecosystem services.	These ecosystem services were included in the text, as suggested.
38	06. Forests	P223/L11-12	Provide a reference for this sentence.	A reference was added, as suggested.
39	06. Forests	P224/L7	Define "large-scale disturbances." Does this refer to area burned or intensity?	The text was revised to clarify spatial and temporal scales.
40	06. Forests	P224/L7-P225/L2	Provide temporal information for "An increase in" and "In recent years."	The text was revised to clarify magnitude and temporal scale.
41	06. Forests	P225/L7	Define the period of "record."	The text was revised to indicate the length of the historical database.
42	06. Forests	P225/L11	Define "were lost."	This was revised to "died".
43	06. Forests	P226/L11	Define "human welfare." Is this same as "human lives" mentioned on page 227, line 17?	This was revised to "human life".

Comment #	Chapter	Page/Line	Comment	Response
44	06. Forests	P226/L14	Replace “would” by “will” or explain use of conditional tense.	This was revised, as suggested.
45	06. Forests	P227/L13	Define “fire-prone forest ecosystems.” Does this mean they have experienced frequent, low severity fires in the past or that the dominant species have adaptations to survive fires?	This was revised to improve clarity. Fire-prone forests can burn at a range of severities and most have species that have adaptations to survive fires or regenerate quickly
46	06. Forests	P228/L7	Specify the region or forest type where text says “some parts of the western United States.”	The text has been updated to reflect this suggestion.
47	06. Forests	P228/L14	An additional sentence is needed stating that the pattern, extent, and severity of future fires may be constrained by such breaks, provided that fire conditions do not overwhelm these barriers.	This sentence was qualified with the phrase "in some cases" to indicate that the natural fire breaks may not always resist fires.
48	06. Forests	P228/L16-18	This sentence should clarify that prescribed burning in southern forests is an example of fire-prone managed forests.	The text has been updated to reflect this suggestion.
49	06. Forests	P229/L12-17	More context for this sentence is needed. The fire suppression is in what type of forests and what type of insect outbreaks? Define what is meant by “reduced vigor.” Is “plant host” the same as “trees”?	This has been revised for clarity
50	06. Forests	P229/L26	Insert “dry settings such as” so that revised text says “now threatens dry settings, such as the pine barrens of.”	The primary mechanism for the expanding range of southern pine beetles is due to warming, not drought. The suggested revision is not apprporiate.
51	06. Forests	P230/L3	Replace “climate” with “moisture availability.”	The text has been updated to reflect this suggestion.
52	06. Forests	P230/L13	Include recent references in addition to Hicke et al. 2012. See recommended citations at the end of the line comments for this chapter.	Two additional references were added to this sentence.
53	06. Forests	P230/L13-14	This statement needs more explanation on the linkages between local short-term release of carbon dioxide and establishment of native plants.	This sentence was deleted to improve clarity.
54	06. Forests	P230/L19	Where do the mesic forests of the Pacific Northwest and Alaska fit into this scheme of water-limited versus energy-limited forests? Explaining this classification would be helpful.	This sentence was revised to add more details.
55	06. Forests	P230/L22-24	Does “some locations” in this case refer to forests near urban areas? Some specificity is needed.	This was revised to improve clarity.
56	06. Forests	P230/L30-31	This sentence requires more information to explain the drought response of deciduous trees.	This was revised to improve clarity.
57	06. Forests	P230/L36	Define “vegetative” competition.	This was revised to improve clarity.
58	06. Forests	P231/L1	Replace “with” with “as a result of.”	The text has been updated to reflect this suggestion.
59	06. Forests	P231/L3	The text that says “these effects” is an unclear reference.	This was revised to improve clarity.

Comment #	Chapter	Page/Line	Comment	Response
60	06. Forests	P231/L5	Delete the word “margins” and revise text to say “elevation ranges.”	The text has been updated to reflect this suggestion.
61	06. Forests	P231/L20-22	Increased flooding from heavy rainfall events can occur even in the absence of tree mortality. This sentence needs geographic specificity.	This sentence is about the consequence of flooding to forest carbon balances through mortality and transport of forest floor and soil carbon stores. It is not about changes in forest canopy affecting flooding. No change has been made to the text in response to this comment.
62	06. Forests	P232/L3-4	The caption needs more information. What are the colors showing? Cumulative area impacted? What in the figure shows that individual and combined disturbances are important and important in what way?	The caption has been revised with more information and now reads "Cumulative area disturbed on forest land across the conterminous United States, 1984–2014. The small boxes illustrate how disturbances differ regionally." In addition, the colors on the maps are keyed to the disturbance types noted in the map key.
63	06. Forests	P232/L8-9	Explain why future conversion is expected to slow down.	This sentence now reads "Over the last several decades, conversion of forest land to other land uses has contributed to CO2 emissions (Woodall et al. 2015, US EPA 2017) and this trend is likely to continue although this is among the most important sources of unceratinty in the forest carbon sink in the US (Hurtt et al. 2002, Coulston et al. 2015, Wear and Coulston 2015)."
64	06. Forests	P233/L1-2	Since one of the key issues highlighted in this chapter is potential loss of forest land, it might be useful to specify the main processes causing forest loss in western forests. Is it mainly a result of wildfire and insect disturbances or is it human conversion of forest lands to other landcovers? Is it processes similar to those projected to occur, as described in the following paragraph?	This was misstated in the text and the current literature suggests that forest land area has increased in all regions based on contemporary definitions of forest land. The text has been corrected to read "While some individual states have lost forest land, overall each region of the United States (e.g., northern, southern, Rocky Mountain, and Pacific Coast) has gained forest land area over the past 20 years (Oswalt 2014, US EPA 2017).
65	06. Forests	P233/L25	Is there more rain in the spring months as well?	This sentence is just about snowmelt changes, not rainfall; however, spring precipitation is not expected to increse in the Northwest. No change has been made to the text in response to this comment.

Comment #	Chapter	Page/Line	Comment	Response
66	06. Forests	P233/L27-29	Another result is earlier peak runoff in snow-fed headwater streams in the western US. "As a result…flushing of nutrients into streams has decreased." The logic for this is unclear. Do late-melting snowbanks flush more nutrients than the same quantity of runoff caused by winter rains? Is it a difference in the total amount of precipitation and runoff or does the seasonal pattern of runoff influence how much nutrient flushing occurs?	The text has been updated to increase clarity.
67	06. Forests	P233/L33	Define "climate-related changes in forest structure."	This was revised to improve clarity, including some examples.
68	06. Forests	P233/L34-35	Explain that beetle outbreaks and wildfire create forest openings and the resulting increase in surface run-off causes higher water yield.	This was revised to improve clarity, including additional detail.
69	06. Forests	P233/L38	Define "altered."	This was revised to improve clarity.
70	06. Forests	P234/L5	Earlier snowmelt is primarily driven by increased temperatures, not by fires.	This portion of the text was revised considerably to improve clarity and provide additional detail.
71	06. Forests	P234/L6	The word "value" (economic value?) is confusing. Perhaps replace this word with "magnitude."	This was revised to improve clarity.
72	06. Forests	P234/L8	Western should not be capitalized.	The text has been updated to reflect this suggestion.
73	06. Forests	P234/L20	Insert the word "first" (text should say "can first be reduced by").	This was revised, but with slighty different wording than suggested.
74	06. Forests	P234/L21	Replace "in response to the risk" with "to sustain reduced risk."	This was revised, but with slighty different wording than suggested.
75	06. Forests	P234/L23-24	Explain why tree growth, carbon sequestration, and water supply are considered ecological risks. This is unclear.	This portion of the text was revised considerably to improve clarity and provide additional detail.
76	06. Forests	P235/L27-29	Stand reductions to increase forest resistance/resilience to fire, insects, and drought would be effective for some but not all forest types (e.g., mesic forests, high-elevation forests, deciduous hardwood forests). This sentence needs some qualifiers.	This was revised, as suggested, with a qualifier about this being focused on dry western U.S. forests..
77	06. Forests	P236/L3-15	The topic of this paragraph is unclear. Application of what practices and their goal should be restated. Plantation management of tree species is appropriate in forests solely managed for their wood products, but does not cover large tracts of forests on federal lands, which have multiple use mandates. The emphasis on timber extraction is not balanced.	This portion of the text was revised considerably to improve clarity and provide additional detail.

Comment #	Chapter	Page/Line	Comment	Response
78	06. Forests	P236/L20-23	Why does lower forest output lead to lower prices of products? Wouldn't supply-demand relationships lead to the opposite effect?	The referenced text is correct. We believe that the reviewer may misunderstand something about the text or about how markets work. A clarifying sentence was added to improve understanding.
79	06. Forests	P236/L23	The cited Vaughan and Mackes (2015) study reports on a survey of Colorado forestry contractors and does not address timber output versus prices or the efficacy of adaptation treatments and incentives. The point seems counterintuitive and needs more discussion.	This sentence has been revised for clarity.
80	06. Forests	P236/L25	What is "climate-smart" forest management?	This was changed to "climate-informed management," which is a standard term.
81	06. Forests	P237/L2-P238/L6	Where is this photo taken? Describe where beaver reintroduction is underway.	The figure caption was revised to indicate that beaver reintroduction is occurring throughout the Western U.S.
82	06. Forests	P238/L8	More information about the public engagement webinar would be beneficial to include. When was it, to whom, and how was participation solicited?	The text has been revised to provide additional details.
83	06. Forests	P238/L22-24	There is an unclear reference to "severe ecological disturbances" in light of reference to "other disturbances" in next sentence. More specificity or explanation of both types of disturbance is recommended.	This portion of the text was revised considerably to improve clarity and provide additional detail.
84	06. Forests	P238/L24	There is an unclear reference to Hicke et al. 2016. Explain what is meant by "in combination with other disturbances."	This portion of the text was revised considerably to improve clarity and provide additional detail.
85	06. Forests	P238/L25	Abatzoglou and Kolden (2013) should be cited here for western U.S. forests. Abatzoglou, J. T., and C. A. Kolden (2013), Relationships between climate and macroscale area burned in the western United States. International Journal of Wildland Fire 22:1003-1020.	The reference was added, as suggested.
86	06. Forests	P238/L25	Give time frame for phrase "in recent years."	The text has been updated to reflect this suggestion.
87	06. Forests	P238/L32	"Re-burns" have not been mentioned previously, so they should be defined and explained.	This portion of the text was revised considerably to improve clarity and provide additional detail.
88	06. Forests	P238/L32-33	The potential for subsequent fires also depends on fire-fighting and postfire management actions. Discussion of this is recommended.	The text has been updated to reflect this suggestion.
89	06. Forests	P239/L3	This is the first mention of "historical range of variability." It should be defined, referenced and discussed.	This term was deleted, and the text was revised to improve clarity.

Comment #	Chapter	Page/Line	Comment	Response
90	06. Forests	P239/L17-20	Define “gradual climate change” in this paragraph and note that the examples cited come from North America and Europe. This statement should link to Chapter 7, “Ecosystems, Ecosystem Services, and Biodiversity.”	The first two sentences of the paragraph were combined to improve clarity, and the link was added.
91	06. Forests	P239/L23-25	This is an unclear statement. More specificity where the text says “can affect suitable habitat” is needed. Define or replace “elevation range margins” with “elevational ranges” or define “elevation range margins.”	This was revised to improve clarity.
92	06. Forests	P239/L37-39	The cited Caldwell et al. 2016 study is a local study in North Carolina, which attributes lower runoff to a combination of changes to climate, structure, and species composition, not just climate. Reference to Roman et al. 2015 seems inappropriate for this point.	This was revised to improve clarity. Roman et al. (2015) discusses how changing species composition may be affecting drought tolerance as species change.
93	06. Forests	P240/L16-18	Describe the long-term observations (and location) that are referred to here. It is a cryptic point.	This was revised to improve clarity, including additional detail.
94	06. Forests	P240/L33	This citation should say “McCarthy et al. 2006.” Wear and Coulson 2015 seems to be a better citation for this point.	Thank you for the correction. McCarthy et al. 2006 has been deleted and Wear and Coulston 2015 added.
95	06. Forests	P240/L36	Specify the locations (“some locations”) where this may be true.	This was revised to improve clarity, including additional detail.
96	06. Forests	P241/L1-4	This sentence somewhat overstates the conclusion of Kurz et al. 2008, which looks at the loss of carbon from mountain pine beetle outbreaks in British Columbia. It is a single study.	Additional citations have been added which included multiple disturbance types with the same conclusion.
97	06. Forests	P241/L7	It would be helpful to provide some context for this statement as it does not apply equally to all forests (e.g., Pacific Coastal forests, eastern forests).	This text was revised to improve clarity.
98	06. Forests	P241/L35-36	Identify the location of the studies in the Cascades and state the duration of the impact (decreased reflectivity, etc.).	This information is detailed beyond the scope of the chapter. Details are available in the referenced paper.
99	06. Forests	P241/L37	Explain how the conclusions of Luce et al. 2012 were informed by the more recent studies of Gleason et al. 2016 and Cooper et al. 2016. Luce et al. is an older study in a different region.	Luce et al. 2012 covers basin-scale water yield and water yield timing after fire, and it notes a substantial timing change. Gleason et al. 2016 did measurements showing the increase in melt rate tied to increase solar radiation and reduced albedo due to charcoal additions. The Cooper et al. citation is an accident of moving sentences, and does not apply here. It was removed.

Comment #	Chapter	Page/Line	Comment	Response
100	06. Forests	P242/L6-9	There are surprisingly few long-term (tree-ring) studies on carbon dioxide effects on tree growth in older trees. The authors may consider citing Gedalof and Berg (2010). Gedalof, Z., and A. A. Berg (2010), Tree ring evidence for limited direct CO2 fertilization of forests over the 20th century, Global Biogeochemical Cycles, 24(3), doi:10.1029/2009GB003699.	The reference was added, as suggested.
101	06. Forests	P242/L6	Define "altered disturbance patterns." Note that some of the uncertainty comes from the resolution of downscaled climate model projections.	This was revised to improve clarity.
102	06. Forests	P242/L8	This is unclear. What particular future trends in natural and socioeconomic systems are critical?	Some examples were added to improve clarity.
103	06. Forests	P242/L20	The statement of "reduced tree growth and carbon storage observations" needs specific context.	It is unclear what this refers to; authors cannot find this phrase in the chapter. No change has been made to the text in response to this comment.
104	06. Forests	P242/L30-35	This planning effort should be identified by name, location, and the organization doing the planning. The list is too general to be helpful without more information.	These planning efforts are numerous and involve multiple end-users and organizations across the US. Providing a complete list would be exhaustive. Our objective in the text was to state that these efforts are underway and refer the reader to references to describe the approach.
105	06. Forests	P242/L36-P243/L6	This discussion would benefit from literature on fire resilience efforts (i.e., living with fire). The cited Schoennagel et al. 2017 is a good start, but see additional suggestions in the reference list following the line comments for this chapter.	This was revised to provide additional information and Schoennagel reference added.
106	06. Forests	P243/L14	The reference to Worrall et al. (2013) seems inappropriate, since it addresses aspen decline.	The reference was replaced with an appropriate one.
107	06. Forests	P243/L17-18	There is an unclear reference: "more abundant [than what]"?	This was revised to improve clarity.
108	06. Forests	P243/L24	Add "conservation of biodiversity or endangered species" and "protection of plants/places of special importance to indigenous peoples" to the list of specific actions.	"Conservation of biodiversity" was added to the list, as suggested.
109	07. Ecosystems, Ecosystem Services, and Biodiversity	P257/L14	Insert "-" (revised text would say "large marine-ecosystem scales")	We have updated this text so this comment is no longer relevant.

Comment #	Chapter	Page/Line	Comment	Response
110	07. Ecosystems, Ecosystem Services, and Biodiversity	P257/L21- 25	Not all of the topics listed here are discussed in the chapters in the context of the many people, communities, and economies that depend on the services.	We have done a major rewrite of the document to ensure ecosystem services, and the the impact on communities and economies is highlighted throughout the Chapter. In particular, we have worked to connect discussions of ecosystem processes with the impacts on ecosystem services. Where appropriate, we have linked with or referenced other NCA chapters in regard to this issue.
111	07. Ecosystems, Ecosystem Services, and Biodiversity	P259/L4	Delete "_"	The text has been updated to reflect this suggestion.
112	07. Ecosystems, Ecosystem Services, and Biodiversity	P259/L5	The clause ", which include" has an unclear reference. If this is a definition of ecosystems, it should be clearly called out.	We have updated this text so this comment is no longer relevant.

Comment #	Chapter	Page/Line	Comment	Response
113	07. Ecosystems, Ecosystem Services, and Biodiversity	P259/L6	Ecosystem services should be clearly defined.	We have adopted the definition used by the Office of Management and Budget, Council on Environmental Quality, and the Office of Science and Technology Policy in 2015 Memorandum to Federal Agencies as a comprehensive defintion. Daily (1997) attempts to define "ecosystem services" as direct and indirect benefits that humans obtain from nature. In one decade after Daily's publication, there was a risk of double counting in economic valuation and so Boyd and Banzhaf (2007) suggest the term should be restricted to the final benefits obtained by humans. De Groot et al. (2002) laid out a comprehensive concept that integrates information from ecology and economics resulting final goods and services provided by natural and semi-natural systems. The Millennium Ecosystem Assessment (2005) defines underlying ecosystem services, i.e., provisioning services (products obtained from ecosystems, e.g., food, fiber, and water), regulating services (benefits obtained from regulation of ecosystem processes, e.g., climate regulation, flood regulation) and cultural services (non-material benefits people obtain from ecosystems, e.g., recreational, aesthetic and spiritual benefit). However, The Economics of Ecosystems and Biodiversity (TEEB, 2010) defines the term to value biodiversity, considers supporting services as ecological processes, but instead added habitat services as an additional concept. (Birkhofer et al. 2015. Front. Ecol. Evol. https://doi.org/10.3389/fevo.2014.00087)
114	07. Ecosystems, Ecosystem Services, and Biodiversity	P259/L9	The United States is sometimes abbreviated as U.S. and elsewhere it is spelled out. This should be discussed consistently across the chapter (and report).	Acronyms and other standardized formats will be finalized in final production processes for the report.
115	07. Ecosystems, Ecosystem Services, and Biodiversity	P259/L14	Insert "in the future" after "change" so that the text reads, "change in the future still."	We have updated the text to say "the expected consequences of climate change."

Comment #	Chapter	Page/Line	Comment	Response
116	07. Ecosystems, Ecosystem Services, and Biodiversity	P259/L21- 31	By focusing on the "state" of biodiversity and ecosystems, the NCA4 authors place a singular focus on impacts on species, communities, etc. There is virtually no mention of what ecosystem services are likely to be affected, as flows from "stock" (biodiversity and natural ecosystem components) to people, which is the definition of ecosystem services.	We have added references and examples of ecosystem services throughout the Chapter, as well as referencing other examples in the report. Various examples in the text emphasize the status and importance of biodiversity with special reference to species and ecosystem diversity.
117	07. Ecosystems, Ecosystem Services, and Biodiversity	P259/L24	The word "phenology" should be moved to come after "migration."	We have updated this text so this comment is no longer relevant.
118	07. Ecosystems, Ecosystem Services, and Biodiversity	P259/L29- 39	"This" is an unclear reference.	We have updated this text so this comment is no longer relevant.
119	07. Ecosystems, Ecosystem Services, and Biodiversity	P259/L30- 31	Insert "or past response" so that the text reads, "modeling its individual components or past response."	We have updated this text so this comment is no longer relevant.
120	07. Ecosystems, Ecosystem Services, and Biodiversity	P259/L34	Provide a specific example of a shift in phenology and population performance.	We have updated this text so this comment is no longer relevant.
121	07. Ecosystems, Ecosystem Services, and Biodiversity	P259/L35- P260/L1	The cited Cleland et al. 2012, Willis et al. 2010, Chuine 2010, Zimova et al. 2017, are not in the reference list and are inconsistently formatted with other references in the chapter.	We have fixed the references.
122	07. Ecosystems, Ecosystem Services, and Biodiversity	P260/L6	The word "or" should be replaced by "and/or."	The text has been updated to reflect this suggestion.

Comment #	Chapter	Page/Line	Comment	Response
123	07. Ecosystems, Ecosystem Services, and Biodiversity	P260/L7-9	Insert a time span of observation for these statements about range changes and provide some specific examples.	Added a time frame. Unfortunately there is not space for specific examples here but there are some highlighted in the figures.
124	07. Ecosystems, Ecosystem Services, and Biodiversity	P260/L10- 12	Range shifts are different among terrestrial species as well, so it is not clear what in this statement is unique to marine plankton.	This statement has been removed.
125	07. Ecosystems, Ecosystem Services, and Biodiversity	P260/L15- 16	This assertion that species will move north and up is too simplistic. Several studies in the western U.S., for example, show complex range changes that best track changes in effective moisture.	The text has been updated to reflect this suggestion.
126	07. Ecosystems, Ecosystem Services, and Biodiversity	P260/L7-8	Over what time have communities shifted ranges? This observation is not helpful without more information about the community, the time span of observation, or the location.	The wording has been changed to clarify.
127	07. Ecosystems, Ecosystem Services, and Biodiversity	P260/L18	This is unclear: “species’ responses” to what? Is this a reference to their range changes?	This wording has been removed.
128	07. Ecosystems, Ecosystem Services, and Biodiversity	P260/L20	Define “other stressors” or remove this phrase if it is covered in the list already.	This wording has been removed.
129	07. Ecosystems, Ecosystem Services, and Biodiversity	P260/L21	It is unclear what is meant by “topography and the interaction of different climate aspects.”	This wording has been removed.

Comment #	Chapter	Page/Line	Comment	Response
130	07. Ecosystems, Ecosystem Services, and Biodiversity	P260/L28- 29	The text needs a time span for “increasing rate of introduction of nonnative species globally.”	We have added "last 200 years" and updated references to included Kolar and Lodge, 2000 AND replace Kovalenko with Havel et al 2015.
131	07. Ecosystems, Ecosystem Services, and Biodiversity	P260/L30	This is unclear: “costs” of what?	We have added "associated with damages caused by non-native species and their control."
132	07. Ecosystems, Ecosystem Services, and Biodiversity	P260/L32	Define “novel communities.”	We have added text to provide additional definition to this term.
133	07. Ecosystems, Ecosystem Services, and Biodiversity	P260/L32- 33	The references provided in support of this point are inappropriate. A specific example is also needed.	While we appreciate this comment, after consideration, the authors disagree with this suggestion. Blois et al specifically mentions the interaction of a non-native scale insect and invasive yellow crazy ant that have dramatically shifted the rainforest ecosystem; Williams & Jackson reviews novel communities of the past and relates them to changes in climate and changes in ranges; added: "For example, range expansion of tropical herbivorous fishes have changed previously kelp-dominated systems into kelp-free sites (Vergés et al. 2016).
134	07. Ecosystems, Ecosystem Services, and Biodiversity	P261/L2	Do the authors mean to say “native species” instead of “existing nonnative species”? This should be clarified.	The text has been updated to reflect this suggestion.
135	07. Ecosystems, Ecosystem Services, and Biodiversity	P261/L10	Suggest replacing “manifested through” with “as evidenced by.”	Text has been modified through public comment edits. This comment no longer applies to the text.

Comment #	Chapter	Page/Line	Comment	Response
136	07. Ecosystems, Ecosystem Services, and Biodiversity	P261/L11- 12	The list is not parallel. It is suggested that “the ecosystem services they support” be replaced with “ecosystem services.”	Text has been modified through public comment edits. This comment no longer applies to the text.
137	07. Ecosystems, Ecosystem Services, and Biodiversity	P261/L12	Instead of stating, “Nationally” it is suggested that “Across the U.S.” be used.	The text has been updated to reflect this suggestion.
138	07. Ecosystems, Ecosystem Services, and Biodiversity	P261/L12	This is unclear: “starting earlier” than when?	Text modified to be "earlier in the year, and as compared to 20th century averages".
139	07. Ecosystems, Ecosystem Services, and Biodiversity	P261/L15- 16	It is unclear what the temporal baseline for this observation is. This should be explained.	This is based on a trend since 1981 and has been modified in the text accordingly.
140	07. Ecosystems, Ecosystem Services, and Biodiversity	P261/L21- 23	Provide an example to support this sentence.	We have added an additional example to support this sentence (McKinney et al 2012), but have placed it within the text of Key Message 2.
141	07. Ecosystems, Ecosystem Services, and Biodiversity	P261/L28	Replace “predators” with “consumers.”	The text has been updated to reflect this suggestion.
142	07. Ecosystems, Ecosystem Services, and Biodiversity	P261/L35	Replace “are able” with “will” in both places.	Text has been modified through public comment edits. This comment no longer applies to the text.

Comment #	Chapter	Page/Line	Comment	Response
143	07. Ecosystems, Ecosystem Services, and Biodiversity	P262/L5-8	Rewrite “stressors increase stress.” Explain how a human-caused stressor “decreases the overall gene pool.” Provide an example.	Text has been modified through public comment edits. This comment no longer applies to the text.
144	07. Ecosystems, Ecosystem Services, and Biodiversity	P262/L6	It is unclear what is meant by “natural systems.”	Text has been modified through public comment edits. This comment no longer applies to the text.
145	07. Ecosystems, Ecosystem Services, and Biodiversity	P262/L13- 16	Provide a specific example for some of these groups.	Text has been modified through public comment edits. This comment no longer applies to the text.
146	07. Ecosystems, Ecosystem Services, and Biodiversity	P262/L16- 19	Provide an example of an evolutionary change in response to climate change.	An example of evolutionary change in response to climate change was added in Key Message 1. Due to the restructuring of the chapter, most examples were moved down to the 4 key messages in order to streamline the state of the sector.
147	07. Ecosystems, Ecosystem Services, and Biodiversity	P262/L20- 24	These two sentences seem contradictory. Evolution will not counteract the negative effects of climate change and evolution will have negative effects. This point needs clarification (and an example).	We removed the sentence regarding negative effects on body size.
148	07. Ecosystems, Ecosystem Services, and Biodiversity	P262/L34	Delete “(.”	The text has been updated to reflect this suggestion.
149	07. Ecosystems, Ecosystem Services, and Biodiversity	P262/L37- 38	It is unclear what “other factors” are. Please specify.	Based on earlier edits and re-orgnaization, this comment is no longer applicable.

Comment #	Chapter	Page/Line	Comment	Response
150	07. Ecosystems, Ecosystem Services, and Biodiversity	P263/L5	Replace ", which has" with ", and this change."	The text has been updated to reflect this suggestion.
151	07. Ecosystems, Ecosystem Services, and Biodiversity	P263/L5	Hyphenate "mid-latitude."	The text has been updated to reflect this suggestion.
152	07. Ecosystems, Ecosystem Services, and Biodiversity	P263/L6-7	This sentence about mixed evidence is cryptic without more information. Also note the time span for decreased productivity (last century).	We have added the following to the traceable accounts: Direct evidence for declines in marine primary production is limited. The suggestion that phytoplankton pigment has declined in many ocean regions (Boyce et al., 2010), indicating a decline in primary production, was found to be inconsistent with primary production time series (McQuatters-Gollop et al. 2011) and potentially sensitive to analysis methodology (Mackas, 2011, Rykaczewski and Dunne, 2011, Boyce et al., 2011). Subsequent work accounting for methodological criticisms still argued for a century-scale decline in phytoplankton pigment but acknowledged large uncertainty in the magnitude of this decline, and some areas with marked increases (Boyce et al., 2014).
153	07. Ecosystems, Ecosystem Services, and Biodiversity	P263/L12	Define the timeframe for "recent observations."	We now note that this inference is supported by satellite-based observations of primary productivity-ice cover relationship over the last 10-15 years.
154	07. Ecosystems, Ecosystem Services, and Biodiversity	P263/L13- 15	For clarity, explain the link between increased productivity and changes in fisheries catch.	We have clarified this text. It now reads: Projections also suggest that changes in productivity will not be equal across trophic levels: changes in primary productivity are likely to be amplified at higher levels of the food web (Chust et al. 2014; Lefort et al. 2015; C. A. Stock, Dunne, and John 2014), for example, small changes in marine primary productivity are likely to result in even larger changes to biomass of fisheries catch (Charles A. Stock et al. 2017).

Comment #	Chapter	Page/Line	Comment	Response
155	07. Ecosystems, Ecosystem Services, and Biodiversity	P263/L20- 24	This statement needs an example. Higher energetic needs would be a direct result of warmer temperatures, drought, and extreme events. This should be factored into this sentence, which focuses only on biotic interactions. Also define “resource mismatches.”	This sentence has been re-written to address this comment. The term resource mismatches is defined at first use in the text above.
156	07. Ecosystems, Ecosystem Services, and Biodiversity	P263/L24- 27	This statement would benefit from an example	We have added example from the referenced paper.
157	07. Ecosystems, Ecosystem Services, and Biodiversity	P263/L38	This last sentence in this paragraph is cryptic. What are the debates? It would be good to cite Barnosky et al. 2017 here. Barnosky, A. D., et al. (2017), Merging paleobiology with conservation biology to guide the future of terrestrial ecosystems, Science, 355(6325), doi:10.1126/science.aah4787.	We have added the suggested reference and added seome examples of debates.
158	07. Ecosystems, Ecosystem Services, and Biodiversity	P264/L5-37	The template is not followed for the Regional Roll-up and the second paragraph is a mish mash of unrelated topics. Some of the statements are questionable (e.g., attributing salmonid declines to climate change versus bears). It is suggested that reference be made to information provided in particular regional chapters. For instance, Tolan and Fisher, 2009 is cited in the draft NCA4 Chapter 23.	We have removed most of the text of the Regional Roll-up and replaced it with a map that contains examples from all of the regions and there are link out to all the regions that contain the specific examples
159	07. Ecosystems, Ecosystem Services, and Biodiversity	P264/L26	Endangered fisheries are the result of land use change as much as climate change.	Thank for the comment. This section has since been revised and the text the comment refers to is no longer present
160	07. Ecosystems, Ecosystem Services, and Biodiversity	P265/L22	Give an example to support this statement about shifts in phenology	We have added an additional example to support this sentence.

Comment #	Chapter	Page/Line	Comment	Response
161	07. Ecosystems, Ecosystem Services, and Biodiversity	P265/L29- 37	This paragraph refers to climate change impacts on ecosystem services, but the information is too general to be evaluated. Some specificity and examples would help.	We have added specific examples of ecosystem services throughout the Chapter and reference or link to other Chapters that discuss ecosystem services (e.g., Ch. 1, 7, 9, 10, 29).
162	07. Ecosystems, Ecosystem Services, and Biodiversity	P266/L6-12	The treatment of U.S. federal agency policies/actions is vague. Provide specific example(s) to make it real for the reader.	We added a new key message focused on adaptation and natural resource management, which includes specific examples of how federal agencies have incorporated climate change into natural resource management
163	07. Ecosystems, Ecosystem Services, and Biodiversity	P266/L8	Insert "," so that revised text would say "food conditions, they."	The text has been updated to reflect this suggestion.
164	07. Ecosystems, Ecosystem Services, and Biodiversity	P266/L23- 38	References on climate resilience should be included here	We added a reference to resilience
165	07. Ecosystems, Ecosystem Services, and Biodiversity	P266/L31	Fix the citation: "Service 2013."	We have fixed this citation.
166	07. Ecosystems, Ecosystem Services, and Biodiversity	P266/L32	The authors should review and consider citing the guidance document, Stein et al., 2014. Stein, B.A., P. Glick, N. Edelson, and A. Staudt (eds.). 2014. ClimateSmart Conservation: Putting Adaptation Principles into Practice. National Wildlife Federation, Washington, DC.	Thank you for the suggestion, we have cited this document.
167	07. Ecosystems, Ecosystem Services, and Biodiversity	P266/L36	Define "holistic ecosystem-based approaches."	We removed this phrase.

Comment #	Chapter	Page/Line	Comment	Response
168	07. Ecosystems, Ecosystem Services, and Biodiversity	P267/L4-5	It is unclear what is meant by “mitigate the harmful impacts of current and future resource management challenges.”	We have changed this sentence to: "Climate change is being incorporated into national and international frameworks that seek to mitigate harmful impacts and interactions with other stressors and address future management challenges"
169	07. Ecosystems, Ecosystem Services, and Biodiversity	P267/L5	The word “agencies” should be in lower case.	The text has been updated to reflect this suggestion.
170	07. Ecosystems, Ecosystem Services, and Biodiversity	P268/L1-2	Cite references for the statement regarding range shift consequences.	We added citations regarding the consequences of range shifts in the range shifts section.
171	07. Ecosystems, Ecosystem Services, and Biodiversity	P268/L28	Insert time span to support “species respond to climate change.”	This wording has been removed.
172	07. Ecosystems, Ecosystem Services, and Biodiversity	P268/L32	Insert time span for “experienced range shifts.”	Time frame has been added.
173	07. Ecosystems, Ecosystem Services, and Biodiversity	P268/L32- 35	Define climate velocity. Also cite Dobrowski and Parks, 2016, for discussion of climate change velocity/exposure in mountainous areas. Dobrowski, S. Z., and S. A. Parks (2016), Climate change velocity underestimates climate change exposure in mountainous regions, Nature Communications, 7, 12349, doi:10.1038/ncomms12349. https://www.nature.com/articles/ncomms12349#supplementaryinformation.	The text has been updated to reflect this suggestion.

Comment #	Chapter	Page/Line	Comment	Response
174	07. Ecosystems, Ecosystem Services, and Biodiversity	P268/L34	Explain why text says “can be greater,” rather than “is.”	The wording has been changed.
175	07. Ecosystems, Ecosystem Services, and Biodiversity	P269/L1-2	The first sentence needs some specific case studies for this to make sense. Provide some direct links to climate change and references to specific documents.	Thanks for the comment, due to changes in this section, this section no longer exists.
176	07. Ecosystems, Ecosystem Services, and Biodiversity	P269/L3	Explain why timber production will shift as a result of climate change.	We have added additional text to clarify this sentence, as well as a reference.
177	07. Ecosystems, Ecosystem Services, and Biodiversity	P269/L5-6	Define “tragedy of the commons,” which will likely be unfamiliar to a general audience.	We have clarified this phrase.
178	07. Ecosystems, Ecosystem Services, and Biodiversity	P269/L7-9	This statement would benefit from an example and reference to regional chapters that discuss Indigenous issues.	We have moved this text to the traceable accounts for KM3 and added a link to the Indigenous peoples chapter.
179	07. Ecosystems, Ecosystem Services, and Biodiversity	P269/L8	Delete “both.”	The wording has been changed.
180	07. Ecosystems, Ecosystem Services, and Biodiversity	P269/L8-10	More citations should be provided to support this sentence. There are more recent papers than Graves, 2008 and ones that cover full breadth of statement.	We have also provided a link to the Indigenous peoples chapter.

Comment #	Chapter	Page/Line	Comment	Response
181	07. Ecosystems, Ecosystem Services, and Biodiversity	P269/L15	Provide an example of "climate-induced phenological change" to support this sentence.	Added a 1-sentence example as suggested.
182	07. Ecosystems, Ecosystem Services, and Biodiversity	P269/L20- 24	This interesting observation about migratory birds needs a time span for the data.	We have included a time span for the referenced paper.
183	07. Ecosystems, Ecosystem Services, and Biodiversity	P269/L24- 25	It is unclear what is meant by "sufficiently advance migratory phenology."	Additional text has been added to clarify this phrase.
184	07. Ecosystems, Ecosystem Services, and Biodiversity	P269/L30	Provide an example of altered pollinator-prey relationships.	The text has been updated to reflect this suggestion.
185	07. Ecosystems, Ecosystem Services, and Biodiversity	P269/L35	It is unclear what a "climatological expectation" is and what the time frame for this observation is.	We have modified the text and included a time frame for this reference.
186	07. Ecosystems, Ecosystem Services, and Biodiversity	P270/L4	Define "standing genetic diversity."	We have clarified this phrase.
187	07. Ecosystems, Ecosystem Services, and Biodiversity	P270/L5	This is unclear: "more gradual" than what?	We have clarified this text.

Comment #	Chapter	Page/Line	Comment	Response
188	07. Ecosystems, Ecosystem Services, and Biodiversity	P270/L6-9	This observation suffers by the lack of specific examples. How is adaptation to climate change identified?	Thank you for this comment, however, we have provided several examples of specific adaptation (or lack thereof) to climate change elsewhere in the text. In addition, a full treatment of how evolutionary adaptive responses are identified, as opposed to plastic responses, is outside the scope of this chapter.
189	07. Ecosystems, Ecosystem Services, and Biodiversity	P270/L10	Replace “other non climate-related stressors” with “non-climatic stressors” and define this term.	We have deleted "other" before non-climate stressors and added an example of one.
190	07. Ecosystems, Ecosystem Services, and Biodiversity	P270/L11	Replace “predictions” with “projections.” Specify the critical climate variables (see draft NCA4 Chapter 2).	We have changed this to "projections."
191	07. Ecosystems, Ecosystem Services, and Biodiversity	P270/L20	Define “communities.” In this case, does this refer to human communities?	The text has been updated to reflect this suggestion.
192	07. Ecosystems, Ecosystem Services, and Biodiversity	P270/L21	Replace “communities” with “economies.”	The text has been updated to reflect this suggestion.
193	07. Ecosystems, Ecosystem Services, and Biodiversity	P270/L22	Explain: “economically vulnerable to what,” and how does this limit their response?	We have added "e.g., low population density, low median income, reduced tax revenues)" and replaced "and therefore have limited ability…" with "and therefore have limited resources and ability…"
194	07. Ecosystems, Ecosystem Services, and Biodiversity	P270/L23	Provide an example of an invasive species that is having an economic impact in the face of climate change.	We have added the text: "For example, the invasive cheatgrass (Bromus tectorum) is predicted to increase in abundance with climate change throughout the American West, increasing the frequency of major economic impacts associated with management and rehabilitation of cheatgrass-invaded rangelands (Roberts 1991; Reeves et al 2018)."

Comment #	Chapter	Page/Line	Comment	Response
195	07. Ecosystems, Ecosystem Services, and Biodiversity	P270/L25- 27	The two economic statistics are nonparallel, so it is difficult to compare them.	We have replaced current text with "Ecological and economic costs of invasive species are substantial, with global costs of invasive species at over $1.4 trillion annually (Burgiel et al. 2014). Annual economic damages from climate change are complex and are projected to increase over time across most sectors that have been examined (e.g., coral reefs, freshwater fish, shellfish; see Figure 29.2 of NCA4 Chapter 29)."
196	07. Ecosystems, Ecosystem Services, and Biodiversity	P270/L28- 37	This section would benefit from a case study under the key message	Based on earlier edits and re-organization, this comment is no longer applicable.
197	07. Ecosystems, Ecosystem Services, and Biodiversity	P270/L28	Insert "-" (revised text would say "land-use change").	We have hyphenated land-use change.
198	07. Ecosystems, Ecosystem Services, and Biodiversity	P270/L29	Insert "ecological" so that revised text states "ecological communities."	This change has been made throughout the document to better highlight when referring to ecological and human communities
199	07. Ecosystems, Ecosystem Services, and Biodiversity	P270/L32	It is unclear what is meant by "behavioral mechanisms."	More detail has been added to increase clarity.
200	07. Ecosystems, Ecosystem Services, and Biodiversity	P270/L33	It is unclear what is meant by "specific traits."	More detail has been added to increase clarity.

Comment #	Chapter	Page/Line	Comment	Response
201	07. Ecosystems, Ecosystem Services, and Biodiversity	P271/L3	Clarify: “major outbreaks” of what?	The text has been updated to reflect this suggestion.
202	07. Ecosystems, Ecosystem Services, and Biodiversity	P271/L5-7	It would be useful to provide an example of how novel species are making the noted changes.	The text has been updated to reflect this suggestion.
203	07. Ecosystems, Ecosystem Services, and Biodiversity	P271/L9	This sentence seems out of place.	Based on earlier edits and re-organization, this comment is no longer applicable.
204	07. Ecosystems, Ecosystem Services, and Biodiversity	P271/L13- 23	These two sentences make no sense and do not follow each other.	The wording has been changed for clarity.
205	07. Ecosystems, Ecosystem Services, and Biodiversity	P271/L24	Explain “advanced modeling techniques.”	We have added text to clarify this reference to statistical modeling.
206	07. Ecosystems, Ecosystem Services, and Biodiversity	P271/L28	Monitoring should be included as a shortcoming and critical need.	We have added additional text and a reference to describe the need for improved monitoring.
207	07. Ecosystems, Ecosystem Services, and Biodiversity	P271/L29	It is unclear what “under” means.	We have clarified this text.

Comment #	Chapter	Page/Line	Comment	Response
208	07. Ecosystems, Ecosystem Services, and Biodiversity	P271/L36	Insert space between “variation” and “(Jeong.”	We have inserted a space.
209	07. Ecosystems, Ecosystem Services, and Biodiversity	P272/L3	It is unclear why there is a long list of citations here.	Thank you for the comment. We have determined that these references sufficiently support the text, and serve to point readers to more detailed information.
210	07. Ecosystems, Ecosystem Services, and Biodiversity	P272/L5	What is the demonstrated “uniquity of local adaptation” that is referred to? This is important and more detail should be provided.	We have clarified this text.
211	07. Ecosystems, Ecosystem Services, and Biodiversity	P272/L8	What is the year of the publication?	We have corrected the date.
212	07. Ecosystems, Ecosystem Services, and Biodiversity	P272/L8	Explain the two case studies.	We have provided additional details for the relevant example.
213	07. Ecosystems, Ecosystem Services, and Biodiversity	P272/L10	For the phrase, “involved changes in the timing of migration,” what time period is being discussed?	This phrase refers to the annual timing of migration; we have clarified the text to reflect this.

Comment #	Chapter	Page/Line	Comment	Response
214	07. Ecosystems, Ecosystem Services, and Biodiversity	P272/L13	The use of the term “novel” is used differently here than the rest of the text-here it refers to invaded areas. The term should be used consistently, or clearly defined when used differently.	We have replaced "There is some uncertainty in knowing how much an introduced species will impact a novel environment although there are methods available for estimating this risk (Andersen et al. 2004, Koop et al. 2012)." with "There is some uncertainty in knowing how much a non-native species will impact an environment if and when it is introduced, although there are methods available for estimating this risk (Andersen et al. 2004, Koop et al. 2012).
215	07. Ecosystems, Ecosystem Services, and Biodiversity	P272/L13	Provide an example of how available methods have been used to estimate risk.	We have added the following text: For example, the U.S. Departement of Agriculture conducts Weed Risk Assessment (U,S. Department of Agriculture, 2016) and the U.S Fish and Wildlife Service publishes Ecological Risk Screen Summaries (https://www.fws.gov/fisheries/ans/species_erss_reports.html)
216	07. Ecosystems, Ecosystem Services, and Biodiversity	P272/L14	What are the emerging technologies noted here?	We have added "New technologies, such as genetic engineering, environmental DND (eDNA), improved detection via satellites and drones offer promise to fight invasive species (U.S. Department of the Interior 2016b)"
217	07. Ecosystems, Ecosystem Services, and Biodiversity	P272/L17	Define “novel sectors and livelihoods.”	We have edited the text: "Novel approaches to both invasive species management and mitigation or adapting to climate change could create novel sectors and livelihoods", to "New technologies and novel approaches to both invasive species management and mitigation or adapting to climate change could reduce negative impacts to livelihoods, but there is some uncertainty in whether or not the application of new technologies can gain social acceptance and practical applications.
218	07. Ecosystems, Ecosystem Services, and Biodiversity	P272/L21	Provide an example of how novel ecosystem transitions may result. The paleoecological literature might be helpful in this regard.	We have added reference to Blois et al 2013 which demonstrates novel communities dominated by generalists following climate driven mass extinctions of specialists.
219	07. Ecosystems, Ecosystem Services, and Biodiversity	P272/L28	It is unclear how the references are related to the sentence.	References have been reorgainzed around specific examples and statements.

Comment #	Chapter	Page/Line	Comment	Response
220	07. Ecosystems, Ecosystem Services, and Biodiversity	P272/L36	This text repeats line 20-24 but with different references.	The text has been updated to reflect this suggestion.
221	07. Ecosystems, Ecosystem Services, and Biodiversity	P273/L18	There are no case studies to demonstrate how well natural resource management and adaptation strategies are working now or need to be refined in order to work better.	We have added a case study from the Caribbean chapter to the traceable accounts, and a case study from the Midwest chapter to the main text. We have also added a few sentences in the main text about limitations to current adaptation measures and barriers to implementating climate-smart management approaches.
222	07. Ecosystems, Ecosystem Services, and Biodiversity	P273/L27- 28	Define “seed sourcing” and “assisted migration” for a general audience	We have linked these terms to the glossary.
223	07. Ecosystems, Ecosystem Services, and Biodiversity	P273/L31- 32	No case studies are provided in the text to support this statement.	There is not enough room to provide examples in the text but some examples are highlighted in the figures.
224	07. Ecosystems, Ecosystem Services, and Biodiversity	P273/L32- 35	The statement would be strengthened with some examples.	There is not enough room to provide examples in the text but some examples are highlighted in the figures.
225	07. Ecosystems, Ecosystem Services, and Biodiversity	P274/L3	Vermont grassland systems are human-created landscapes. What is their value for biodiversity or conservation? Describe the likely phenological shifts related to climate change.	This example is intended to describe ways in which phenology & phenological research can support improved management and conservation outcomes. It is beyond the scope of this example to describe biodiversity value of grassland ecosystems. We have, however, modified the text to make the purpose of this example more clear.
226	07. Ecosystems, Ecosystem Services, and Biodiversity	P274/L5	Replace “has” with “have.”	The text has been updated to reflect this suggestion.

Comment #	Chapter	Page/Line	Comment	Response
227	07. Ecosystems, Ecosystem Services, and Biodiversity	P274/L15- 17	This reference to resistance/resilience is not well discussed in the key message section and should be clarified. How is resistance/resilience with respect to climate change defined and what are the compromises posed by invasive species?	We have changed "Reducing the impact of invasive species can build ecological, social, and economic resistance/resilience to climate change. Early detection and rapid response is much more effective than control once established (U.S. Department of the Interior 2016a)." to "EDRR is much more effective than control once an invasive species is established (U.S. Department of the Interior 2016a). The current U.S. National Invasive Species Council Management plan (National Invasive Species Council, 2016) recognizes the stressors of land use and climate change and calls for an assessment of national EDRR capabilities.
228	07. Ecosystems, Ecosystem Services, and Biodiversity	P274/L20- 23	This long list of citation needs some examples in order for the reader to understand the state of uncertainty and the potential for large changes in this regard.	We have revised the text to more clearly associate the sources of uncertainty with specific references.
229	07. Ecosystems, Ecosystem Services, and Biodiversity	P274/L25	What is the reference to “recent” here? Some of the citations go back to before the NCA3, so they are no not new in relation to the development of this draft fourth assessment.	We have added "within the last 10 years" after recent to clarify the time frame.
230	07. Ecosystems, Ecosystem Services, and Biodiversity	P274/L35	Plans for state and public-private partnerships should be discussed	We have included a discussion of partnerships as well as an example in the main text of key message 4.
231	07. Ecosystems, Ecosystem Services, and Biodiversity	P275/L14	It is unclear why is the word “could” is used here.	We have replaced "could" with "can."
232	09. Oceans and Marine Resources	P332/L19-20	A reference and some elaboration is needed on the statement that ocean acidification or low oxygen events can lead to technological adaptation.	The development of the technology to monitor and manage water chemistry in shellfish hatcheries is one of the clearest examples in the literature. We cite the Barton et al. 2015 paper in Oceanography in both the main text and the traceable accounts.

Comment #	Chapter	Page/Line	Comment	Response
233	09. Oceans and Marine Resources	P334/L5	The population and percentage value listed differ slightly from that provided in the draft NCA4 Chapter 8. The chapters should report the information using the same values for consistency.	This issue was raised in our public comments and has been corrected.
234	09. Oceans and Marine Resources	P334/L25-37	Why are no new references on ocean acidification since theNCA3 cited? The discussion is basic information, rather than new data on the status or trends.	We agree that this is not new information for chemical oceanographers; however, they are not the main audience for the NCA. The author team decided that it was necessary to provide an overview of the basics of ocean acidification, both to help non-specialists interpret our subsequent text and to clarify the terminology that we will be using.
235	09. Oceans and Marine Resources	P335/L7-10	A reference is needed for the “dead zone” in the Gulf of Mexico.	We have added references to Rabalais et al. (2007), CENR (2000) and, Cai et al. (2011).
236	09. Oceans and Marine Resources	P336/L4	Burrows et al. (2014) would also be an appropriate reference to include here. Burrows, M. T., et al. (2014), Geographical limits to species-range shifts are suggested by climate velocity, Nature, 507(7493), 492-495, doi:10.1038/nature12976.	The text has been updated to reflect this suggestion.

Comment #	Chapter	Page/Line	Comment	Response
237	10. Agriculture and Rural Communities	P373/L27-P375/L5	Adaptation through land-use change is acknowledged as an option (page 375, line 5), but not addressed with any specific examples. Consider including one or more of the following instances where more detail or examples could be helpful: (1) page 375, where the need for adaptation in the long run should be more strongly stated (Pugh et al., 2016), (2) page 373, line 27 and page 374, line 1, the amount of cropland in 2012 was down substantially from the 1950s (Brown et al., 2005) in response to change markets, technology, and policy. Less productive areas that have been abandoned could be brought back into production as an adaptation measure, though new ownership and land-use/livelihood patterns may reduce the capacity for reversion to agriculture as patterns of productivity change. Loss of cropland to urbanization, for example, limits reversion to cropland. (3) Paragraph beginning on page 375, line 16, Paragraph addresses adaptation by a variety of means, but not by land-use change. Retirement of agricultural land or conversion to pasture at the productivity margins is a form of adaptation that has been happening over centuries. As noted above, it may be the key form of adaptation necessary in the long run. This will have significant effects on rural communities (both those where cropping declines and those where it increases). Evidence from econometric studies could be included, such as Burke and Emerick (2016), Feng et al. (2015), and Burke and Emerick (2016) (cited in draft chapter). (4) Address bioenergy and bioenergy with carbon capture as mitigation options and the additional interconnected stresses a massive scale up in bioenergy for mitigation would likely cause. See new citations at the end of	We have added the Pugh et al, 2016 and Brown et al. 2005 references and expanded the discussion of dynamic land use change, including linking to an excellent example given in Table 27.3 and Figure 27.3. Space does not allow specific examples nor the role that climate change, markets, and policy play in land use change. Bioenergy section was added. Additionally, bioenergy land use and some of the complexities of cascading effects onto rural communities has been added to a new research needs section.
238	10. Agriculture and Rural Communities	P373/L12-16	Remove “Food service, eating and drinking places,” “Food and beverage stores,” and “Textile, apparel, and leather manufacturing” from Figure 10.1. Their magnitude and distant relevance to the chapter (i.e., these are largely urban enterprises) distract from the message.	The authors have retained the figure as is to communicate the scope of the linked agriculture and food system which it is important for readers to understand.

Comment #	Chapter	Page/Line	Comment	Response
239	10. Agriculture and Rural Communities	P374/L6-11	It is true and well-documented that agriculture has become more efficient over the last few decades. However, consider following up the statement about reducing agricultural and environmental footprint with a comment about some of the remaining major environmental footprint issues to be addressed (e.g., eutrophication in Great Lakes and the Gulf of Mexico).	Two sentences are added to the section mention GHG emissions and eutrophication concerns.
240	10. Agriculture and Rural Communities	P375/L16-P376/L9	The comment about the effectiveness of existing adaptation strategies given continued productivity growth does not consider the possibility that growth could have been much faster with even better adaptation. Given the concurrent trends of continuous equipment/genetic improvements, which were not designed as climate mitigation strategies, it is probably not safe to assume from the last couple of decades of increasing productivity that the sector is particularly skilled at climate change adaptation already.	The section has been modified slightly. The authors do not imply that adaptation has eliminated impacts of climate change nor address what productivity iincrease might have been without climate change. However, agriculture has a long history of adaptation and adoption of new technologies to address changing conditions, of which climate stressors are a key driver of agricultural systems and productivity. Implicitly, and often explicitly, new technologies are addresseing productivity and environmental challenges posed by climate.
241	10. Agriculture and Rural Communities	P375L13-15	Challenges to food security should acknowledge changing diets along with population growth as drivers of this challenge.	We agree that changing diets are another driver for this food security concern. We have modified the sentence and added two additional references (Hallström et al., 2015 and Harwatt et al., 2017).
242	10. Agriculture and Rural Communities	P376/L6-9	Research needs are referenced here, but few other places in the chapter. It would be highly valuable to comment more systematically on views of what the key research challenges are (related to this chapter's scope) in the next few years, as appropriate for inclusion in this draft report.	A brief discussion of emerging issues and research needs was added.
243	10. Agriculture and Rural Communities	P376/L35-P377/L5	Mention of increasing irrigation as possible adaptation should reference observed increases, while also acknowledging the importance of water resource limitations in the future, as the text does. Data from Brown et al. 2014 could give a sense of scale. Also, acknowledge the regional variability of resource limitations (some basins are in much better or worse shape than others).	A citation Brown and Pervez (2014) is added to the text.
244	10. Agriculture and Rural Communities	P377/L27-P378/L7	Consider adding a comment on yield quality in addition to quantity, e.g., nutritional quality of crops under climate change scenarios. This may qualify as an emerging topic to watch. The draft NCA4 Chapter 23 cites Myers et al. (2017) on this.	"Quality"was added to the sentence. Also, the need for better understanding of climate change impacts on quality is including in section on emerging issues and knowledge gaps.

Comment #	Chapter	Page/Line	Comment	Response
245	10. Agriculture and Rural Communities	P377/L29-31	"The demand for higher crop productivity under climate change has contributed to advancements in crop genetics in recent years." Do the provided references support this? Robust crop breeding programs certainly are a mechanism for continually adjusting crop genetics to recent weather conditions and thereby ought to help agriculture progressively adjust to some types of climate change. And, in some cases, breeding programs have more directly targeted traits that help with drought resilience, etc., as noted in the text. But that is different than climate change adaptation being a direct motivator of recent crop genetic advancements.	We agree that one of the references was not entirely appropriate for this sentence in the chapter. We have modified the sentence to indicate that crop researchers are, in fact, breeding in anticipation of environmental challenges due to climate change. We have also removed the Jiao et al. reference and added a more appropriate Watson et al., 2018 reference
246	10. Agriculture and Rural Communities	P377/L1-5	This statement is probably true without climate change also-recharge is not keeping up with withdrawals in a lot of places. Climate change might accelerate this, but the chapter needs to recognize the baseline.	We have modified the sentence to indicated withdrawals exceed recharge, and climate change places additional challenges on the resource.
247	10. Agriculture and Rural Communities	P378/L20-P379/L6	There may be somewhat of an overemphasis of the chapter text on irrigation as measured by the amount of text in the chapter devoted to this relative to U.S. acreage percentage using irrigation. Maybe it is an appropriate ratio based on economic importance? If so, the authors could state the outsized economic importance of irrigated acres. Either way, it is not clear that it is appropriate to have the sole case study box in this section to be about groundwater-fed irrigation of High Plains row crops.	A paragraph has been added to the Case Study to provide economic importance of this region.
248	10. Agriculture and Rural Communities	P378/L20-P379/L6	"[T]he Ogallala aquifer is a nonrenewable resource." This requires more qualification, as there is a major difference in conditions from north to south across the aquifer. Groundwater recharge rates in the northern portion are quite high and approximately capable of sustaining current irrigation rates (although river flows have suffered). As recent supporting evidence, groundwater levels in Nebraska recovered well following the record drawdowns during the 2012 drought year. In contrast, the central and southern portions have low recharge and should mostly be considered non-renewable resources.	A sentence is added to focus our discussion on southern and central portion of the Ogallala aquifer.
249	10. Agriculture and Rural Communities	P378/L8-9	Define "climate-smart agriculture" and reference the origin of this term.	A reference has been provided.

Comment #	Chapter	Page/Line	Comment	Response
250	10. Agriculture and Rural Communities	P381/L33-38	Clarification is needed in the statement about migration of the feeding industry. Is the expectation that industry in the southern Great Plains and Atlantic coastal plain will contract towards the northern Great Plains and upper midwest? Is there a reference describing the current trend?	A citation has been provided but space limits preclude addition of details and all of the multiple issues in addition to climate change that would play into migration of a major business investment.
251	10. Agriculture and Rural Communities	P381/L25	“Similar arguments” is too vague of a reference. To what arguments does it refer?	We have replaced "similar arguments can be made" with "heat stress losses affect."
252	10. Agriculture and Rural Communities	P382/L21-39	The nutrient loss pathway discussion focuses on erosion, but leaching (with or without tile drains) is another major loss pathway. The word leaching does not appear in the chapter. Relatedly, the combination of warmer springtime soils and increased rainfall intensity would seem to have the potential to increase nitrogen leaching under U.S. row crops, potentially reversing a trend of increasing nitrogen use efficiency over time in the sector. The cited Rosenzweig et al. 2014 paper mentions nitrogen losses as potentially exacerbating yield reductions. Pesticide leaching is also a risk. Consider adding comments on these mechanisms. A related point is that agronomic management practice shifts that are designed to mitigate climate impacts could also unintentionally exacerbate downstream impacts, for example, adding more fertilizers to insure against the yield losses described by the Rosenzweig et al (2014) citation included in the draft NCA4, could potentially add to waterway discharges if they are not coupled with precision application technologies or similar.	Leaching has been added to the Key Message. A water quality section was added to focus on nutrient and sediment loadings by erosion and leaching. However, considering the page limit, we did not provide detailed discussion of any one pathway.
253	10. Agriculture and Rural Communities	P383/L5	“[S]uch declarations” are not defined. A reference is provided in the traceable accounts (see the reference to “billion dollar natural disasters” on page 390, line 1), but it is unclear if they are referring to the same thing. More explanation is needed.	The two sentences were referring to the same severe storms and disasters, but the sentence in the text was eliminated during revision and remains in the traceable accounts.
254	10. Agriculture and Rural Communities	P383/L4-8	This paragraph seems out of scope since it is not focusing on agricultural and rural communities.	A portion of this paragraph (out of scope) was deleted and the remainder of the paragraph, now in KM2, more appropriately introduces the section on flooding related to agriculture.
255	10. Agriculture and Rural Communities	P384/L23	This is confusing wording. Change to “ are less likely to exist and more loosely enforced.”	The text has been updated to reflect this suggestion.

Comment #	Chapter	Page/Line	Comment	Response
256	10. Agriculture and Rural Communities	P385/L38	"TPF" should be "TFP."	The text has been updated to reflect this suggestion.
257	10. Agriculture and Rural Communities	P386/L8-14	Is the moisture/fire relationship for the period 1600-1800 safely applicable to the 2000s given all the land use and land cover differences?	Given the few such analyses and the causal link between lack of moisture and fire risk, readers may find this useful but shortened discussion.
258	10. Agriculture and Rural Communities	P386/L8-14	Evidence for the fire prevalence impact on agriculture and how economically impactful it is should be added.	Evidence provided by Donovan et al. (2017) was added, indicating 400% increase in the grassland area burned in the Great Plains from 2005-2014, relative to 1985-1994.
259	10. Agriculture and Rural Communities	P386/L8-14	The cited Margolis et al. 2017 is locally focused on northern New Mexico. Additional references to support the statement more broadly would be beneficial.	There is a lack of reviewed literature on climate change impacts on grassland fire risk which is the focus of Margolis et al., 2017 paper. The Donovan et al. 2017 paper provided additional information for the Great Plains grasslands.
260	10. Agriculture and Rural Communities	P386/L16	Dai and Zhao 2017 may have found positive trends in drought indices (not negative, as stated). It is suggested that the authors revisit this literature and confirm/correct.	We have reworded the Traceable Account as follows "WATER - Dai and Zhao (2017) quantify historical trends in drought based on indices derived from the self-calibrated PDSI and Penman-Monteith potential evapotranspiration index. For greater reliability they compare these results with observed precipitation change patterns, streamflow and runoff in three different periods; 1950-2012, 1955-2000, and 1980-2012. They indicate that spatially consistent patterns of drying have occurred in many parts of the Americas, pan evaporation is slightly negative or small positive trends exclusive of 1950-1980 and that drought has been increasingly linked to increased vapor pressure deficits since th 1980s.
261	10. Agriculture and Rural Communities	P387/L27-P388/L14	Consider separating and making explicit the main types of research evidence about climate change impacts on crops. For example, (1) observational field studies, (2) experimental field studies, and (3) modeling studies. Also consider citing by name an example from each, such as the cited Hatfield et al. 2017 and several Lobell studies for (1), free air carbon dioxide experiment (FACE) studies for (2), the Agricultural Model Intercomparison and Improvement Project (AGMIP) for (3).	We agree that a many types of research are required to address the the complex suite of direct, indirect, and cascading impacts of climate change on crop productivity, as well as livestock productivity, human and livestock health, and environmental footprints and ecosystem services that derive from agricultural lands. We have cited findings from observational, experimental, and modeling studies. However, we have chosen not to re-organize, as the section is already organized based on the various types of impacts, and we feel that this is valuable to the anticipated audience for this report.

Comment #	Chapter	Page/Line	Comment	Response
262	10. Agriculture and Rural Communities	P390/L7-13	This section justifies comments on mitigation capabilities but not on the impacts themselves.	We have added impacts of decreased soil carbon on hydrologic function to this section.
263	10. Agriculture and Rural Communities	P402/L7-10	This reference is used four times in the chapter and is a link to a nontechnical overview. Reference to the full work should be included	Citation is now Malcolm et al. (2012), the full ERS Report No. 136 from which the article was developed.
264	12. Transportation	P451/L1	It would be more appropriate to say that transportation is "A" not "THE" backbone, along with communications and energy.	The text has been updated to reflect this suggestion.
265	12. Transportation	P451/L19	The transportation system is "INTERdependent with" other systems, not just dependent upon.	The text has been updated to reflect this suggestion.
266	12. Transportation	P452/L5	The notion of "a new transportation paradigm" is raised, but is not defined. Do these new approaches (transit-oriented development (TOD), autonomous vehicles, and shared mobility) actually constitute a new paradigm?	The text has been updated to reflect this suggestion.
267	12. Transportation	P452/L34	The NCA4 authors should check on whether the state of the science indicates that there is too much uncertainty in forecasts about the levels of the Great Lakes to say that lower levels WILL limit boat traffic.	The text has been modified to discuss extremes and reference to the Midwest chapter.
268	12. Transportation	P456/L1-3	This is a theoretical statement about heat impacts. This is a well-known process to be sure, but it would be strengthened with empirical observations of the effect.	This is how pavement design is conducted in standard practice. We have determined no change is needed.
269	12. Transportation	P460/L9	Examples of resiliency measures that have or could be taken should be provided. This is not obvious from the text.	The text has been updated to reflect this suggestion.
270	12. Transportation	P468/L28	"[C]omprise" should be "compromise."	The text has been updated to reflect this suggestion.
271	12. Transportation	P468/L37	It would be useful to relate the physical effect of buckling at >90 degrees to the number of projects days under the scenarios.	We have added material and referenced back to the CSSR where more appropriate.
272	12. Transportation	P470/L11- 15	Empirical and modeling evidence seems to be slim for this "high confidence." Presumably, high confidence could be based on engineering studies, but it would be stronger with observations and models.	Confidence level was adjusted.
273	12. Transportation	P470/L32	This statement about low-income people being less likely to evacuate comes from another assessment report. The primary evidence should be provided.	The text has been updated to reflect this suggestion.
274	12. Transportation	P471/L1	The meaning of "broad constituencies in suburban areas" is vague and requires clarification.	This text has been removed in subsequent revisions.

Comment #	Chapter	Page/Line	Comment	Response
275	12. Transportation	P471/L9-10	Why give examples of Colorado and Iowa? In what way are they representative?	This text has been removed in subsequent revisions.
276	15. Tribal and Indigenous Communities	P548/L26-33	The introduction in general, and this paragraph in particular, would benefit from references to support these statements. If this initial section is intended as an overview summary rather than an introduction, a heading should be added to indicate this. It is an opportunity to inform the general readership of the NCA4 about publications that document the important points raised in the introduction. For example, literature that documents increased rates of mood and anxiety disorders is needed. This statement is repeated in the "results" (draft NCA4 page 555, lines 32-34). Do the NCA4 authors intend this to be a finding of the assessment (in which case, page 555 and the associated key message is a good place to present it) or as background (in which case, the introduction would be the better place)? Other more general statements have been well documented in the literature, which	The reviewer is referencing the Executive Summary (ES) that was added to the beginning of each chapter of the draft NCA4. Across all of the chapters, the ES sections will be pulled into a separate section that will serve as the overall ES for the report. The format of the ES is that it pulls directly from each underlying chapter text and does not include references because these are present in the underlying chapter. No changes were made because the ES intentionally repeats/summarizes the content presented in the chapter.
277	15. Tribal and Indigenous Communities	P548/L34-37	See previous comment #274. Additional references that would allow readers to further explore the content of this paragraph are needed.	The reviewer is referencing the Executive Summary (ES) that was added to the beginning of each chapter of the draft NCA4. Across all of the chapters, the ES sections will be pulled into a separate section that will serve as the overall ES for the report. The format of the ES is that it pulls directly from each underlying chapter text and does not include references because these are present in the underlying chapter. No changes were made because the ES intentionally repeats/summarizes the content presented in the chapter.

Comment #	Chapter	Page/Line	Comment	Response
278	15. Tribal and Indigenous Communities	P552/L3-7	Key Message 1 is important. However, with a superficial reading, it would seem to apply to non-tribal as well as tribal entities. The logic would be more compelling if the chapter explained why these vulnerabilities are often greater for tribal than for non-tribal entities. Text that references Figure 15.2 might be an appropriate place to make these explanations. Box 15.1 does a good job of providing these types of explanations with respect to social determinants of indigenous health.	Key Message 1 as well as the associated text have been revised extensively to specifically highlight factors that make Indigenous peoples and tribal entities particularly vulnerable to climate change. Additional text with associated references point to climate impacts specific to the livelihoods and economies of Indigenous peoples (federally recognized and non-federally recognized). Additional text also includes the impact of past and ongoing federal oversight (unique to federally-recognzied tribes) which inhibits the capacity of tribes to freely and effectively adapt to climate change. We have incorporated text expanding on the infrastructure challenges portrayed in Figure 15.2 and updated the figure's caption to more clearly link infrastructure deficiencies to increased vulnerability to climate impacts. Challenges faced by non-federally recognized tribes are addressed in the State of the Sector and in the text for Key
279	15. Tribal and Indigenous Communities	P555/L6	Replace “that can that” with “that can.”	The text has been updated to reflect this suggestion.
280	15. Tribal and Indigenous Communities	P555/L38-P556/L3	This section needs citations and more thorough explanation.	This section has been reworked to clarify how climate change can lead to mental health impacts and several new citations have been added.
281	15. Tribal and Indigenous Communities	P556/L4-11	This paragraph does a good job of providing citations for each key statement.	Thank you! The Chapter Authors appreciate this comment.
282	15. Tribal and Indigenous Communities	P558/L2-7	This is an excellent example of the types of statistics that are valuable to present in the report.	Thank you! The Chapter Authors appreciate this comment.
283	15. Tribal and Indigenous Communities	P559/L5-7	The NCA4 authors should be a bit more explicit about these issues. It seems like an important point, but it is so general that it does not provide a lot of insight. Is this because the governance issues are so heterogeneous from place to place that one cannot generalize, i.e., that greater future assessment will be necessary to make progress, or is it that the authors chose not to provide the details?	We strengthened language and added examples, including one from a new citation to clarify this issue. The examples include the limitations of existing governing structures in coordinating relocation efforts, the limitation of disaster recovery grants to address local recovery needs, and the inadequacy of many funding streams to address the unique conditions and statuses of tribal communities (e.g., the "scoring" system for grants).

Comment #	Chapter	Page/Line	Comment	Response
284	15. Tribal and Indigenous Communities	P547-563	General comment: The chapter is clearly written and addresses the important climate change impacts on indigenous peoples in a rigorous fashion. In some instances, the same points are made in the introduction and results, making it unclear which aspects are part of this assessment and which are general background. The inclination is to suggest general background papers be cited in the introduction and that the results focus on evaluation of papers which bring new information to this assessment. See also comment #274.	The chapter text has been revised extensively throughout to include more background information in the introductory State of the Sector section on the unique aspects of Indigenous vulnerability regarding limits to self-determination related to historical and ongoing federal oversight of federally recognized tribal reservation resources and related property rights institutions. However, in Key Messages 1 and 3, the authors determined that it was important to also address these points and provide more detail that was specific to implications of this unique aspect of vulnerability for economic self-determination and adaptive capacity. The authors do not view the Key Message sections as separate "results". The State of the Sector section is still part of the overall "assessment" of the literature, it just serves more as introductory framing for the chapter while the Key Message sections go into more detail on three main themes that have not been discussed in as much detail in previous assessments.
285	15. Tribal and Indigenous Communities	P550/L7	The term “federally recognized Tribes” appears without definition or characterization of important distinctions regarding legal/policy standing and political relationships with other groups of indigenous peoples, non-federally recognized tribes, state recognized tribes, and other groups of self-recognized peoples. It is recommended that the term be defined.	The text has been revised as suggested.
286	15. Tribal and Indigenous Communities	P550/L9	This characterization of the trust responsibility is misleading. The trust responsibility has two major components: (1) fiduciary obligations of the U.S. as trustee for management of the Indian estate, the funds and resources entrusted to its care; and (2) the duty to support tribal self-determination and role in the American system of governance. What is described as “trust responsibility” is in fact a policy recognition that federally recognized tribes are political sovereigns that are to be treated in accordance with protocols appropriate for government-to-government relations. There are several statutes and policies that describe responsibilities for interacting with tribal governments, including consultation on matters that affect their rights and interests.	The text in the State of the Sector section and in Key Message 1 pertaining to trust responsibility has been revised, and in some cases expanded with associated references, to clarify trust responsibility.

Comment #	Chapter	Page/Line	Comment	Response
287	15. Tribal and Indigenous Communities	P550/L15-22	Consider relocating this paragraph to the start of the Executive Summary.	The author team has decided not to relocate or copy this text from the State of the Sector section into the Executive Summary because the Executive Summary will become part of a standalone Executive Summary for the whole NCA4 report. Due to space limitations, we had to focus the Executive Summary text on summarize the Key Messages of the chapter, and do not have space to include comparison of this chapter to the Third National Climate Assessment.
288	15. Tribal and Indigenous Communities	P551/L13-14	Figure 15.1 does not reflect “models of adaptation,” but rather indicates locations of tribal involvement in climate change initiatives.	Figure 15.1 indicates tribal resilience actions across the Nation which have been categorized into five broad types. These five types have been listed in the text and included in the Figure's legend under "Resilience Actions". To make this more clear, text in these lines has been changed to "types of adaptation projects."
289	15. Tribal and Indigenous Communities	P551/Figure 15.1	Adaptation is not well covered in the web links provided in this figure. The first web link simply refers back to this draft NCA4 chapter; the second and third web links describe climate impacts but say relatively little about ongoing adaptation activities.	This comment refers to the interactive Figure 15.1, which is designed to be embedded in the online version of the Chapter for Figure 15.1. There may have been a temporary technical issue if the reader could not click on the interactive map. The user may zoom to better select a single Tribe or group, and the resulting popup will show multiple results, if more than one action is included for the community at that location. There are over 800 adaptation actions in this interactive figure. In addition, the figure caption provides links to the Institute for Tribal Environmental Professionals' Tribal Profiles of climate impacts and adaptation activities and the Climate Resilience Toolkit case studies. These links include a wealth of information on impacts and recent adaptation activities, including case studies.
290	15. Tribal and Indigenous Communities	P551/L16	The word “cumulatively” should be “collectively.”	The text has been revised as suggested.

Comment #	Chapter	Page/Line	Comment	Response
291	15. Tribal and Indigenous Communities	P551/L19-20	It is recommended that the last sentence be deleted because it serves little substantive purpose. Although islands are depicted in Figure 15.1, the chapter text does not substantively discuss many of the unique issues faced by indigenous peoples in these locations.	This statement (on the high concentration of adaptation actions in the North West) has been moved from the text to the caption as a description and link to the North West Regional chapter. Regarding the comment on islands, the authors' intent was to acknowledge the presence and unique impacts and actions underaken by Indigenous peoples across the Nation, including those from the Pacific and Caribbean. In some cases, while peer-reviewed literature may be lacking for specific regions, the authors decided to be inclusive and include these populations in the general statements regarding Indigenous peoples in the regions. The authors now note that literature on the Indigenous peoples of the Caribbean is currently sparse and thus quantifying risk is challenging. Despite this gap, the authors cite three papers (Gould et al. 2015, David-Chavez 2018, and Sterling et al 2017) and have included additional text and cross-references to Chapter 27, Hawai'i and the Pacific Islands and Chapter 20, Caribbean Island to better specify content on island peoples. In addition, Key Message 2 now includes an example from the Republic of the Marshall Islands.
292	15. Tribal and Indigenous Communities	P552/L15	Change “comprise” to “contain.”	Key Message 1 text has been revised extensively in response to public comments and "comprise" is no longer part of the current text.
293	15. Tribal and Indigenous Communities	P552/L15	The validity of this statement is questioned here. No source for this statistic is presented. Most tribal hatcheries do not produce fish that are not listed under the ESA.	Due to extensive revisions to Key Message 1, this sentence was deleted from the previous draft.
294	15. Tribal and Indigenous Communities	P553/L7	Authors should consider citing Parsons et al., 2017. Parsons, M., C. Brown, J. Nalau, and K. Fisher (2017), Assessing adaptive capacity and adaptation: insights from Samoan tourism operators, Climate and Development, 1-20, doi:10.1080/17565529.2017.1410082.	After input from other reviewers and much deliberation, the author team has decided to remove the sentence and section to which the commenter is referring. We have, however, included citations to the article by Parsons et al. throughout Key Message 1 as well as the State of the Sector section.

Comment #	Chapter	Page/Line	Comment	Response
295	15. Tribal and Indigenous Communities	P553/L14	There are not just regulatory responses and impacts on arts and crafts income. Failure to enforce laws and regulations (e.g., clean air and water, energy efficiency), conflicting missions among fragmented agencies, failure to allow for traditional uses and management practices, etc. affect availability (access, abundance, and productivity) of many resources for food security, subsistence, medicines, and commercial and ceremonial use.	The section of Key Message 1 has been revised extensively since this review was conducted and the commenter's overall point that there are not just regulatory responses and impacts on arts and crafts income has been incorporated and an example included. The authors agree with the wide variety of impacts relating to failure to enforce laws and reglations and diverse agency missions, however, given space constraints we did not include these factors.
296	15. Tribal and Indigenous Communities	P553/L23-30	The pervasive role of federal agencies and persistent remnants of paternalistic policies are embodied in the manuals, rules, and regulations. These policies and procedures that are relied upon to administer fiduciary trust responsibilities are major barriers to adaption and development of tribal resources/economies. See Energy Act, NIFRMA, Indian Ag Act, etc. Additionally, note persistent poverty, lack of infrastructure, and isolation (e.g., 14% lack access to electricity (Energy Information Administration), and only a small percentage have access to broadband internet.	Key Message 1 (KM1) has been revised extensively since this review. See new lanaguage throughout KM1 on "trust doctrine", federal policies, pervasive role of federal agencies, and court decisions concerning land and other natural resources. In addition, text has been added discussing poverty and infrastructure deficiencies and the rural nature of many tribal communities.
297	15. Tribal and Indigenous Communities	P555/L5	This discussion would benefit from references to environmental/climate justice to address disproportionate distribution of impacts to economically disadvantaged and populations of color.	This chapter has been extensively edited to include more explanation and citations supporting the environmental /climate justice issues affecting tribes and Indigenous peoples that have, in part, evolved over the past two plus centuries stemming from the effects of colonialism and federal trust doctrine. We have included a number of new citations related to environmental justice (EJ) in the text box on social determinants of health and health disparities in Key Message 2. In addition, the authors have added new text describing how many EJ and public health studies in the literature do not fully account for the uniqueness of Indigenous peoples in terms of how they define and value non-physiological aspects of health including cultural, spritiual, and community aspects.
298	15. Tribal and Indigenous Communities	P555/L19	The word “undermine” should be changed to “alter.” These relationships are not limited to humans and animals, but to all aspects of the environment, plants, water, soils, air, etc.	The text has been revised as suggested.

Comment #	Chapter	Page/Line	Comment	Response
299	15. Tribal and Indigenous Communities	P555/L23-31	An aspect of climate change which is important, but not directly covered, involves scarcity of resources and competition, not just among indigenous peoples' communities, but also as a result of recreational and commercial use of these resources by a growing population. Additionally, trespassing on tribal lands, environmental degradation, and some reserved rights to areas off reservation are also affected.	The authors agree that there are non-climatic factors such as competition for resources and population growth that can lead to environmental degradation that affects tribal lands and resources; however, given space limitations in the chapter, we cannot comprehensively tackle all of the suggested topics. We have included expanded text in Key Message 1 about water rights that discusses scarcity and competition (increasing regional demands for water). We have also included off-reservation resource rights under Key Message 3 as one of the contextual factors that affect how tribes and Indigenous peoples plan for and adapt to climate change.
300	15. Tribal and Indigenous Communities	P556/L11	Impacts also accrue to traditions and practices, not just to sacred sites.	We have now included reference to climate impacts to traditional/cultural practices througout this Key Message 2 text, and as one of the aspects of values-based Indigneous understandings of health that are not always accounted for Western science approaches to quantifying and analyzing health.
301	15. Tribal and Indigenous Communities	P556/L27	The discussion of adaptation is overly broad. Consideration should be given to the utility of distinguishing between different types of adaptation experienced by indigenous peoples. Certainly the ability to adapt to changing natural environments over millenia of pre-European contact, when indigenous communities were much more mobile within ancestral territories, differs markedly from the trauma of populations devastated by disease and forced adaptation to changes in natural and political environments resulting from the imposition of Western political, legal, and economic systems of property ownership, dispossession, relocation, and assimilation policies. These challenges differ markedly from those being faced today by indigenous peoples as they strive to contend with the necessity to deal with the pace and intensity of adaptation, preparation, and mitigation measures needed to respond to climate change. The ability of indigenous peoples to anticipate and respond to climate change is affected by economic, political, and legal considerations that severely constrain their abilities to consider and undertake alternative actions.	We have added language to the text for Key Message 3, including highlighting the severity of structural obstacles to adaptation and limited access to traditional territories and the mobility associated with that access. The removal of indigenous peoples from their homelands is discussed in the Displacement and Relocation section of text for Key Message 3. We emphasize that there is a history of knowledge and capacity in confronting environmental changes that offers indigenous communities strengths in adapting to climate change, but at the same time, these strengths are severely constrainted by current socio-political, economic, and legal contraints imposed on them.We have also added language in the first paragraph that identifies the pace of climate change.

Comment #	Chapter	Page/Line	Comment	Response
302	15. Tribal and Indigenous Communities	P556/L36	Revise text to say “multi-generational accumulation and transfer of knowledge.”	We have edited this sentence to include reference to "multi-generational" but the suggested phrase was not included in its entirely because the author team was aiming to keep the already long sentence as concise as possible.
303	15. Tribal and Indigenous Communities	P557/L25	It is recommended that “within recognized areas where reserved hunting, fishing, gathering, and trapping rights can be exercised” be added.	We have made edits based on this suggestion.
304	15. Tribal and Indigenous Communities	P557/L25	A major impact that is not mentioned is reduced abundance and productivity due to environmental degradation and development that affect ecological processes.	We agree that plant and animal species abundance and productivity are impacted by environmental degradation and land-use development in addition to the impacts from climate change. However, the chapter and NCA4 report as a whole are meant to provide a high-level synthesis of the main themes and findings from the literature. Space is limited and the author team has deliberated and agreed on the most relevant information and illustrations to include. Because the sentence focus is on ecological impacts of climate change, we have chosen not to include this level of background information about non-climate stressors.
305	15. Tribal and Indigenous Communities	P557/L38	Should section 1110 of the Sandy Recovery Improvement Act or Stafford Act be referenced?	We have provided citations to section 1101 of the Sandy Reocvery Improvement Act, replacing the Norton-Smith reference.
306	15. Tribal and Indigenous Communities	P558/L2-7	“President” should be capitalized.	The text has been revised as suggested.

Comment #	Chapter	Page/Line	Comment	Response
307	15. Tribal and Indigenous Communities	P558/L20-25 & P559/L17-28	clarified. Rather than "frameworks"—whatever those might be—three larger problems are apparent: (1) the difficulty of maintaining community/cultural continuity of place and environment for communities under relocation; (2) the lack of resources to support physical relocation, including aspects of governance—taxation, regulation, etc.; and (3) the impacts on the communities and environments receiving relocated communities.	(1) We have added text and a citation acknowledging the difficulty in maintaining community/cultural continuity, pointing out that there is a lack of replicable models for accomplishing cultural continuity in the context of relocation. (2) We stregthened language and added examples from a new citation to clarify this issue, including the limitations of existing governing structures in coordinating relocation efforts, the limitation of disaster recovery grants to address local recovery needs, and the inadequacy of many funding streams to address the unique conditions and statuses of tribal communities (e.g., the "scoring" system for grants). (3) The authors discussed this issue at length and decided not to include this point in the chapter. We did not find much literature on this topic that related specifically to tribal communities or Indigenous populations. Therefore, even though this issue has been brought up in other contexts, we did not think the literature at this
308	21. Midwest	P844/L8-15	The chapter should address (at least major categories of) adaptation in the agriculture sector.	This suggested material is already present in the section on adaptation at the end of the KM1 narrative.
309	21. Midwest	P850/L1	The impacts of transitions from an extreme drought year to an extreme flood year are mentioned, but no information is provided on whether this is expected in the future. Will there be more, fewer, the same, or is it unknown? If it is unknown, it seems unnecessary to mention the impact.	We are not aware of any literature that specifically identifies drought years following flood years. However, it does fall under the realm of future increases in flooding and agricultural (i.e., summer) drought. Furthermore, as the Loecke et al reference points out, this phenomenon has been observed in recent years and represents a major challenge if this pattern continues.
310	21. Midwest	P851/L6-7	It would be useful to comment on increasing irrigation use in some parts of the region.	A comment on increasing acreage under irrigation in the northern Midwest, and irrigation as an adaptation option in areas with coarse soils has been added under the adaptation section.
311	21. Midwest	P857/L1515	Climate factors interact with one another and they interact with land use land cover patterns. This should be noted.	We determined that it would make the text overly complex for the reader to insert the land cover component in the same sentence, so we have expanded and reframed the rest of the paragraph a bit to better capture this idea of multiple levels of interaction.

Comment #	Chapter	Page/Line	Comment	Response
312	21. Midwest	P863/L29-P864/L1	The implication is that decreasing lake levels can be expected. The evidence is not clear on this. Of course, if they do decrease, there will be increasing shipping costs. It would be more appropriate to say something about the science of whether or not we can expect them to decrease. Reduced ice cover is more clear.	The science of lake level changes is discussed five paragraphs earlier. We have revised the sentence to read "While the most recent research (Lofgren and Rouhana 2016) underscores the great uncertainty in future lake levels, (Millerd 2011) showed that scenarios of decreasing lake levels will increase shipping costs even if the shipping season is longer, or lower ice cover could increase the damage to coastal infrastructure caused by winter storms (Howk 2009; Forbes et al. 2002). "
313	21. Midwest	P887/L19- 20	Provide references for the following claim: “It is clear, however, that flood frequency on major rivers in the Midwest has increased in recent decades.”	Three references have been added.
314	22. Northern Great Plains	P916/L15	“[G]eographical migration of agricultural practices” seems like jargon. Clarification on what exactly this means is needed.	We have replaced "geographical migration" with "regional shifts."
315	22. Northern Great Plains	P917/L12	The Northern Great Plains extends to Wyoming and Montana and significantly wetter conditions are not forecasted for the western parts of these states.	This is correct. No edits have been implemented in response to this comment.
316	22. Northern Great Plains	P919/L1-7	It would be helpful to show other basic climate projections for the region (seasonal/annual temperature, seasonal/annual precipitation projections).	We revised the chapter to include a new figure - a map of the region. This map includes callouts that illustrate key cliamte projections (and impacts and responses) across the region.
317	22. Northern Great Plains	P921/L2	These three geographic features should be shown on a map and there should be some identification beyond these features. The three features are also not clearly identified in the text (Red River Valley, Upper Missouri River Basin, and the third being the mountains of Wyoming and Montana?).	We revised the chapter to include a new figure - a map of the region. This map includes callouts that illustrate key geographical features (elevation gradients/vegetation distribution) across the region.
318	22. Northern Great Plains	P921/L11	Define “alpine water dynamics.” Is this precipitation in headwater systems?	The text has been adjusted to clarify.
319	22. Northern Great Plains	P921/L18	This is a very sparsely populated region.	This is correct. No edits have been implemented in response to this comment.
320	22. Northern Great Plains	P921/L18- 23	The NCA4 authors should mention dryland wheat production in Montana. The reference to arid to semiarid climate of this region requires some climate information.	We have added mention of dryland agriculture in this region. Since the terms "arid" and "semiarid" are already-defined terms, we haven't revised to include climate information here.
321	22. Northern Great Plains	P921/L21	Delete “.”	The text has been adjusted accordingly.
322	22. Northern Great Plains	P921/L22	It is unclear what is meant by the “western portion of the region,” but it is managed for agriculture, forestry, grazing, and recreation.	We now mention forestry explicitly. We now have created a map that indicates land cover, illustrating gradations across the region.

Comment #	Chapter	Page/Line	Comment	Response
323	22. Northern Great Plains	P921/L35	Insert “-” such that revised text says “long-term.”	The text has been adjusted accordingly.
324	22. Northern Great Plains	P922/L12	The statement that it is among the most arid in the Nation should be supported with some precipitation data and an identification of what area is referred to specifically.	A reference has been added: "e.g. less than 10% of regional precipitation reaches streams and the Missouri River (Hoerling et al., 2016), "
325	22. Northern Great Plains	P922/L24	Delete “a” so that text reads, “representing new and unprecedented.”	The text has been adjusted accordingly.
326	22. Northern Great Plains	P922/L25	Is this a reference specifically to Glacier National Park?	This is not a reference specific to Glacier National Park. However, to be consistent w/ the FAQ chapter, we ensured that the data were consistent within the report. The FAQ section IS specific to Glacier National Park.
327	22. Northern Great Plains	P922/L35	Add Montana to the list.	The text has been adjusted accordingly.
328	22. Northern Great Plains	P924/L11	In Figure 22.2, an explanation is needed for why Snow Water Equivalent for Average March is used instead of the usual April 1 Snow Water Equivalent.	We revised the caption text to explain this more clearly.
329	22. Northern Great Plains	P925/L5	Explain “high degree of variability.” Does this mean annual, seasonal, or spatial? Not only is the variability high, but the uncertainty is also high.	We inserted "interannual" to clarify. Since the point of this sentence is putting small forecast changes in context of large interannual variability, we don't think it's necessary to point out the large uncertainty in those forecasts.
330	22. Northern Great Plains	P925/L8-9	Delete “in the future.”	The text has been adjusted accordingly.
331	22. Northern Great Plains	P925/L15	These projections also apply to the northwestern portion (i.e.,northern Montana).	This is correct. No edits have been implemented in response to this comment.
332	22. Northern Great Plains	P925/L17	Replace “which” with “and projected changes.”	The text has been adjusted accordingly.
333	22. Northern Great Plains	P925/L19	In addition to agriculture and energy production, the should be expanded to include human health, streamflow and temperatures, snow melt, fires, etc.	The text has been adjusted accordingly.
334	22. Northern Great Plains	P925/L24	Nebraska has more humid-continental climate than where? Does this statement apply year-round or to seasonal climate conditions?	This sentence has been deleted.
335	22. Northern Great Plains	P925/L25- 26	Does this statement about reservoir and groundwater storage apply everywhere in the region or only in the eastern part?	The previous sentence was deleted and it is now clear that this applies across the region.
336	22. Northern Great Plains	P927/L7	It is unclear what is meant by “essential vegetation heterogeneity.”	This phrase has been deleted.

Comment #	Chapter	Page/Line	Comment	Response
337	22. Northern Great Plains	P927/L19	A more detailed discussion of producer decision-making would be helpful, since climate change is only one factor. Refer to Whitlock et al. 2017 provided in the references at the end of this chapter review and the draft NCA4 Chapter 5 for a start.	We have revised this section to expand a little bit on producer decision-making, adding insights from Whitlock et al. (2018).
338	22. Northern Great Plains	P927/L28	Provide information about summer precipitation.	We revised this sentence to provide more information.
339	22. Northern Great Plains	P927/L28	This paragraph should also cite the increase in extreme precipitation events. For example, a study of hail: Brimelow et al. 2017. Brimelow, J. C., W. R. Burrows, and J. M. Hanesiak (2017), The changing hail threat over North America in response to anthropogenic climate change, Nature Climate Change, 7(7), 516-522, doi:10.1038/nclimate3321.	We now cite Brimelow et al. (2017).
340	22. Northern Great Plains	P927/L30	Insert "(."	The text has been adjusted accordingly.
341	22. Northern Great Plains	P927/L34-P928/L17	These projections do not apply to the entire Northern Great Plains region, which extends to western Montana. The authors need to be geographically specific. Item 1 should provide a season. Item 6 does not apply to the western region, where livestock will experience greater stress as a result of late-season drought and high temperatures.	We revised this sentence to provide more info, including within-region specificity
342	22. Northern Great Plains	P928/L29	Consider changing "would" to "will."	The text has been updated to reflect this suggestion.
343	22. Northern Great Plains	P928/L30	Define "sustainability" in this case, or replace with "resilience."	The text has been updated to reflect this suggestion.
344	22. Northern Great Plains	P929/L19	Explain the Collaborative Adaptive Rangeland Management experiment and how it relates to The Nature Conservancy's Matador Ranch.	We revised the text to more cleary distinguish these two projects.
345	22. Northern Great Plains	P929/L25	The phrase: "under each which were used" is awkward and should be reworded.	We rephrased this sentence to clarify.
346	22. Northern Great Plains	P930/L8	To clarify, $4.9 billion was spent in the Northern Great Plains states?	This sentence has been revised to make it clearer that $4.9 billion was spent in 2011 on these recreational activities in the five Northern Great Plains states.

Comment #	Chapter	Page/Line	Comment	Response
347	22. Northern Great Plains	P930/L28	More regional citations that should be reviewed/cited include: Al-Chokhachy, R., D. Schmetterling, C. Clancy, P. Saffel, R. Kovach, L. Nyce, B. Liermann, W. Fredenberg, and R. Pierce (2016), Are brown trout replacing or displacing bull trout populations in a changing climate?, Canadian Journal of Fisheries and Aquatic Sciences, 73(9), 1395-1404, doi:10.1139/cjfas-2015-0293. Giersch, J. J., S. Hotaling, R. P. Kovach, L. A. Jones, and C. C. Muhlfeld (2017), Climate-induced glacier and snow loss imperils alpine stream insects, Global Change Biology, 23(7), 2577-2589, doi:10.1111/gcb.13565. Muhlfeld, C. C., R. P. Kovach, L. A. Jones, R. Al-Chokhachy, M. C. Boyer, R. F. Leary, W. H. Lowe, G. Luikart, and F. W. Allendorf (2014), Invasive hybridization in a threatened species is accelerated by climate change, Nature Climate Change, 4(7), 620-	We have reviewed the suggested literature. Regarding Al-Chokhachy et al. (2016), the topic of rising stream temperatures and its impacts on native versus introduced trout species was highlighted in NCA3, which we were charged with avoiding overlap in NCA4, so we have chosen not to cite it. Regarding Giersch et al. (2017), we already cite a closely related paper (Hotaling et al. 2017), which we feel has broader relevance to a general public audience. Regarding Muhlfed et al. (2014), this issue is sufficiently relevant to the general public (anglers) and not strongly highlighted in NCA3; therefore, we have inserted a new sentence citing them.
348	22. Northern Great Plains	P930/L29	This line needs a citation to support the content.	A citation of Tonkin et al. (2018) has been added to support this statement.
349	22. Northern Great Plains	P931/L10	Insert "the" so the text reads, "last day of the snow." Do not capitalize spring.	The text has been adjusted accordingly.
350	22. Northern Great Plains	P932/L5-9	Other initiatives should be mentioned such as the Greater Yellowstone Coordinating Committee (representing all federal agencies in the Greater Yellowstone Area) that has several climate-change related initiatives, and Crown of the Continent Partnership, which similarly, is looking at climate change impacts on headwater streams.	The website content for the Greater Yellowstone Coordinating Committee's subcommittee on "Climate Change Adaptation" has not been updated since 2015. So it is unclear if this group is still actively meeting. The Crown of the Continent Partnership has been actively meeting, so we have referenced them in a new sentence: "The Crown Adaptation Partnership—a transboundary team of scientists and resource managers from the United States, Canada, and Tribes/First Nations—is collaborating on climate-change adaptation strategies across multiple jurisdictions to enhance resiliency of the Crown of the Continent Ecosystem in northern Montana, southwestern Alberta and southeastern British Columbia
351	22. Northern Great Plains	P932/L22	This should say "northern and eastern Montana"	The maps of prairie potholes we have seen show a very restricted distribution, only in far nothern MT. Therefore, we haven't revised this text.

Comment #	Chapter	Page/Line	Comment	Response
352	22. Northern Great Plains	P933/L77	Table 22.3 should include information from Montana, which represents about 30% of the prairie pothole region.	The study from which Table 22.3 is adapted (Wright and Wimberly 2013) unfortunately does not include Montana in their analysis, so we are unable to fill the table in with directly comparable information. Instead, we inserted a new row in Table 22.3 for MT indicating "not available", with a footnote stating: "Wright and Wimberly (2013) did not include Montana in their analysis, so comparable statistics are not available. See Lark et al. (2015, doi:10.1088/1748-9326/10/4/044003) and Wright et al. (2017, https://doi.org/10.1088/1748-9326/aa6446) for map-based estimates of grassland conversion in Montana, from 2008-2012, though not specifically for the Prairie Pothole Region." Regarding the statement "Montana represents about 30% of the prairie pothole region", this estimate depends heavily on the map used to delineate the PPR. According to the US Fish & Wildlife Service's definition, Montana comprises about 18% of the US portion of the PPR (see Table 2 of https://www.fws.gov/wetlands/Documents/Status-and-Trends-of-
353	22. Northern Great Plains	P936/L6	Stating “things” is not very specific. It is suggested that this be changed to “initiatives” or “programs.”	The text has been adjusted to clarify.
354	22. Northern Great Plains	P936/L8-19	The authors should mention that the largest emitters of greenhouse gases in this region are coal-fired power plants and that Wyoming and North Dakota are the highest emitters of greenhouse gases per person in the nation.	This is true, but we have chosen not to revise this text for two reasons. First, this level of detail seems to be beyond the scope of this work, which is focused on climate change impacts (not drivers). Second, it's not clear that attributing all of those power plant emissions to those states is reasonable (they're exporing electricity). Rather than elaborate on this topic, we've left the text as-is.
355	22. Northern Great Plains	P937/L8-12	A description of Department of Energy (DOE) supported efforts for carbon capture and sequestration should be described.	Since the focuse of this assessment is climate change and climate impacts, we have chosen to devote only a small amount of text to efforts to mitigate GHG emissions. Thus we have not revised the text to address this DOE project.
356	22. Northern Great Plains	P938/L7	Why use “some” if they are “among.” Delete “some.”	The text has been adjusted accordingly.
357	22. Northern Great Plains	P938/L13	It is unclear what the difference is between climate and seasonality changes. Is this meant to say changes in annual and seasonal climate?	We revised this sentence to clarify

Comment #	Chapter	Page/Line	Comment	Response
358	22. Northern Great Plains	P938/L18- 21	This sentence is poorly written. Rewrite for clarity and parallelism. Suggested edit: “changes in hydrology, phenology, availability of traditional plant-based foods, bear migration and hibernation cycles, as well as the health of [whitebark?] pine? There is also a mismatch between traditional stories of past climate and current climate conditions.”	We reorganized this sentence to make it clear.
359	22. Northern Great Plains	P938/L22- 25	These are general statements (e.g., no salmon in this region), where more specific examples would be helpful.	The citations contain region-specific examples, which we've listed in this section. There are introduced salmon in lakes in the region. It may be that the reviewers concluded that these were not regional specific examples because of this confusion about salmon.
360	22. Northern Great Plains	P938/L24	Delete “,”.	The text has been adjusted accordingly.
361	22. Northern Great Plains	P938/L31	State which language is quoted.	We have added text to clarify that this is a Lakota phrase.
362	22. Northern Great Plains	P938/L33	There is a misspelling of the word "Because."	The text has been adjusted accordingly.
363	22. Northern Great Plains	P939/L3	Replace "were" with "was."	The text has been adjusted accordingly.
364	22. Northern Great Plains	P939/L9	Provide more specificity for the statement “changes to temperature and water cycles.”	This text was revised to add specificity.
365	22. Northern Great Plains	P939/L10	It is suggested that “increasing livestock stress” be added to the list.	The text has been adjusted accordingly.
366	22. Northern Great Plains	P940/L6	Provide more specificity for “projected to damage infrastructure.” What types of climate change, for what infrastructure, and where is this happening?	The text has been revised to be more specific
367	22. Northern Great Plains	P940/L22	Define "colonial/postcolonial."	We haven't defined these terms, but have added text to this sentence to make the definititions clear.
368	22. Northern Great Plains	P940/L30	There is a misspelling of the word "Dakota."	The text has been adjusted accordingly.
369	22. Northern Great Plains	P942/L9	The term “South-central should be in lower case, as in “south-central” or “south central.”	The text has been adjusted accordingly.
370	22. Northern Great Plains	P942/L15	Delete “,”.	The text has been updated to reflect this suggestion.
371	22. Northern Great Plains	P942/L24	There should be no capitalization of the word “chokecherry.”	The text has been adjusted accordingly.

Comment #	Chapter	Page/Line	Comment	Response
372	22. Northern Great Plains	P942/L30	There should be no capitalization of the word “olive.”	The text has been adjusted accordingly.
373	22. Northern Great Plains	P943/L3-5	For Figure 22.6’s caption, there should be no capitalization of the word “olive.”	The text has been adjusted accordingly.
374	22. Northern Great Plains	P943/L3-5	This inset is very hard to evaluate. What is the current distribution of Russian olives and what do the colors and the scale mean? The warm colors may suggest that there is a projected decrease in Russian olives to many readers.	We revised this figure to use a high-contrast color scheme and to clarify the scale.
375	22. Northern Great Plains	P945/L10	Explain why there are no authors from Montana, SouthDakota, North Dakota or Wyoming. This does not seem like appropriate representation for a regional assessment and this will reduce its creditability among stakeholders.	There are a few factors that led to the chapter having no authors from Montana, South Dakota, North Dakota, or Wyoming. We approached potential co-authors from all of these states. Some agreed to contribute but were eventually unable to. Others were not able to contribute from the start. We believe that the author team is highly qualified, capable, and knowledgeable of the region. We engaged stakeholders through the region at our stakeholder workshop. We strongly believe that this chapter will be widely perceived as highly credible. We now mention this in the traceable accounts.
376	22. Northern Great Plains	P945/L36	Replace “montane west” with “western mountains.”	The text has been adjusted accordingly.
377	22. Northern Great Plains	P946/L10	In addition to year-to-year variability, there is increased seasonal variability. See the draft NCA4 Chapter 2 and the Montana Climate Assessment (Whitlock et al. 2017 in the reference list at the end of this chapter’s line comments).	We have revised this sentence to point out the uncertainties in changes in within season variability, citing Whitlock et al. (2018).
378	22. Northern Great Plains	P946/L29	Specificity is needed as not all parts of the region will show an increase in productivity.	We revised this text to clarify that yield increases are forecast for the nothern portion of the region.
379	22. Northern Great Plains	P946/L30	What weeds in particular are competitive? Greater specificity is needed.	We revised this sentence to be more specific.
380	22. Northern Great Plains	P946/L36	It would be helpful for a call-out of these particular studies, especially those studies specific to the Northern Great Plains.	These studies refer to the Northern Great Plains.
381	22. Northern Great Plains	P947/L15	The reference to "geographical migration of agricultural practices and enterprises" is part of Key Message 2, but it is not discussed.	The key message text is consistent each time a key message is presented (in the executive summary, in the body of the chapter, and in the traceable accounts section). Geographical migration of agricultural practices is discussed in the body of the chapter.
382	22. Northern Great Plains	P947/L36- 37	This sentence is awkward and needs greater clarity.	This sentence was re-written to improve structure and clarity.

Comment #	Chapter	Page/Line	Comment	Response
383	22. Northern Great Plains	P948/L5-6	Agricultural land-use change is not a function of climate change. A more nuanced discussion of this point and the factors that shape land- use decisions is needed.	This sentence was revised to to acknowledge that agricultural land-use change is a function of climate change and other complex economic forces. A more nuanced discussion is already provided in the chapter's main text.
384	22. Northern Great Plains	P948/L14	What is more important for skiing is that climate change will shorten the ski season, which has economic consequences for the skiing industry.	We revised the last sentence in the paragraph to include this point.
385	22. Northern Great Plains	P948/L18	This list should mention the impacts affecting cold-water fisheries, e.g., more invasive species, warmer water temperatures, and lower flow.	This is not meant to be an exhaustive list, but to illustrate a key point. There are many other, related issues that could be included that we have chosen not to include. For this reason, we have not added this to the list.
386	22. Northern Great Plains	P948/L24	In addition to disease, upriver movement of warm-water fish and displacement of cold-water species should be mentioned.	Like the previous comment, this list was not meant to be exhaustive, but to illustrate that some of what we know is based on information collected in other regions. Thus we have not revised this sentence.
387	22. Northern Great Plains	P949/L10	There are not only climate-induces changes to agricultural land-use, but also changes to the wetlands themselves through late-season drying, early snowmelt, etc.	We have not revised this because the logic is now clarified due to revisions made in response to previous NAS and other comments.
388	22. Northern Great Plains	P949/L16	Replace "is" with "are."	We think this should remain "is."
389	22. Northern Great Plains	P950/L10	Specific examples, or at least references, are needed here.	We have revised this sentence to include specific info from these reports
390	22. Northern Great Plains	P950/L22	This is the first reference to the Columbia River Basin, which represents a very small part of the Northern Great Plains region.	This is just an example of related information. We have revised the text to clarify.
391	22. Northern Great Plains	P950/L27- 28	This sentence about biofule production is very cryptic. Whatother biofuels are used? Specify some of the climate change impacts.	This sentence was re-written to improve specificity and clarity.
392	22. Northern Great Plains	P951/L32	It would be helpful to list state-level climate assessments for additional information.	There are two comprehensive state climate assessments. We now cite both of those.
393	23. Southern Great Plains	P966/L30	Brimelow et al., 2017 should be cited for hail threat. Brimelow, J. C., W. R. Burrows, and J. M. Hanesiak (2017), The changing hail threat over North America in response to anthropogenic climate change, Nature Climate Change, 7(7), 516-522, doi:10.1038/nclimate3321.	This reference was added to the main chapter text rather than to the Executive Summary.
394	23. Southern Great Plains	P970/L33-P971/L4	Add references to statements in the last two paragraphs of the box regarding changes to projected frequencies and intensities.	Added (Kossin et al 2013) as the reference and added the word "global" to be consistent with the reference.

Comment #	Chapter	Page/Line	Comment	Response
395	23. Southern Great Plains	P971/L7	The time span for this observation needs to be stated.	The text has been updated to reflect this suggestion.
396	23. Southern Great Plains	P973/L22-38	The paragraph on the drought in 2011-2015 and its resulting economic impacts is an interesting one, but the text is not currently clear about what the intended takeaways are: (a) an indicator of the kinds of things we expect to increase in frequency in the future with climate change, (b) an episode that is attributable to climate change, or (c) other? Please specify. Also, consider this as a potentially suitable case study box.	Text indicating the increasing frequency of resource contention in the future was added to this section.
397	23. Southern Great Plains	P973/L28	Replace "coal plant" with "coal-fired power plant."	The text has been updated to reflect this suggestion.
398	23. Southern Great Plains	P974/L2-P975/L4	The main point of this box is not clear. Is this intended to just point out an example where climate early warning information exists? It would be a more powerful example if a successful utilization of this information by a stakeholder could be described.	Text denoting early warning language was added, as well as a linkage to how stakeholders apply this information.
399	23. Southern Great Plains	P977/L18	Insert "that" so the text reads, "role that climate."	The text has been updated to reflect this suggestion.
400	23. Southern Great Plains	P978/L34	The Oklahoma Mesonet is referenced here. In general, the three states comprising this region have very good state/local monitoring systems, which, in some ways, have been a model for other regions. Consider mentioning climate monitoring investments in the region in the context of either trend identification or adaptive capacity-building.	A paragraph was added that outlines the importance of the Mesonets to the region, and a graphic depicting station locations will be added as well.
401	23. Southern Great Plains	P979/L6	Replace "Nation" with "the U.S."	The text has been updated to reflect this suggestion.
402	23. Southern Great Plains	P980/L21-32	The Box 23.4 discussion on the El Paso desalination plant is quite limited and its takeaways are not clear. How much are costs reduced relative to seawater desalination given the brackish waters? Also, consider revising the box title since the desalination plant is being discussed as one mechanism in a broader suite of methodologies for achieving water security.	The text has been updated to reflect this suggestion.
403	23. Southern Great Plains	P982/L12-15	Whooping cranes vulnerabilities being used as an example of species range changes should be referenced in the draft NCA4 Ecosystems chapter (Chapter 7) if discussed here.	This issue was discussed with the Ecosystems chapter for their possible inclusion in their chapter.

Comment #	Chapter	Page/Line	Comment	Response
404	23. Southern Great Plains	P983/L25	Where is the "Texas bay" located? Is this same as the Texas Gulf Coast?	The text has been adjusted to clarify.
405	23. Southern Great Plains	P983/L31	The words "ground water" should be one word: "groundwater."	The text has been updated to reflect this suggestion.
406	23. Southern Great Plains	P986/L45	It is not clear how Phytophthora is influenced by an increase in invasive species. Is this a non-native fungus?	Reviewer is correct. We have double-checked and this fungus is not an issue in TX, OK, KS.
407	23. Southern Great Plains	P990/L29-30	It would be helpful to include more information on the types of individuals that attend the engagement workshop and how they engaged in the process.	This portion of the text has been enhanced to address the reviewer concern.
408	23. Southern Great Plains	P991/L38	The difference between "doctors, academicians, researchers and scientists" is not clear. Please clarify. Are they medical doctors? Are the researchers from federal and state agencies?	The text has been updated to reflect this suggestion.
409	23. Southern Great Plains	P994/L7-8	The description of confidence and likelihood for Key Message 3 makes the point that habitat created by invasive species due to climate changes has improved populations of other species. This may be in reference to increased invasive species following flooding and the increase in detrimental fungal species, but it is not entirely clear. This is mentioned only on page 988, lines 8-12, but the point is not clearly developed and seemed like a minor observation.	The key message and text for Key message 3 were edited in order to address this issue.
410	23. Southern Great Plains	P994/L22-26	The description of evidence base for Key Message 4 makes reference to Chapter 7 on the point of increased microbial and chemical contamination of crops and water in agricultural environments. That message is not currently clear in Chapter 7.	The text has been updated to reflect this suggestion.
411	23. Southern Great Plains	P994/L7-8	Insert "including fungi" at the end of the sentence.	The text has been updated to reflect this suggestion.
412	24. Northwest	P1017/L23-33	Also cite consequences of temperature/range shifts for fisheries (not all are negative-some fish species are/will enter fishing areas where they did not previously occur). See references in the draft NCA4 Chapter 9 and elsewhere.	This topic is covered in the next section of Key Message 1 that focuses on Future Climate Change Relevant to Regional Risks.
413	24. Northwest	P1018/L10	Change "effect" to "affect."	The text has been updated to reflect this suggestion.
414	24. Northwest	P1019/L1-7	Include documented literature on range shift effects on fisheries/management (not just species), e.g., Ianelli et al. 2016 and other references in the draft NCA4 Chapter 9.	We have made modifications throughout this Key Message relating to fisheries, added citations, and also added additional references to specific Key Messages within Chapter 9 to avoid unnecessary duplication.

Comment #	Chapter	Page/Line	Comment	Response
415	24. Northwest	P1020/L18-21	Provide a citation for the good point on variation in adaptive capacity throughout the region.	We have included two citations, Yorgey et al. 2017 and Dalton et al. 2013 to better ground this statement in the literature.
416	24. Northwest	P1025/L20-21	Cite Ianelli et al. 2016 and Seung and Ianelli 2016 in this chapter, which are referenced in the draft NCA4 Chapter 9).	We have cited Lanelli et al 2011, and we have added additional references to Chapter 9. We have reviewed Ianelli et al 2016, and Seung and Ianelle 2016, and have found them to be more appropriately referenced in Chapter 9.
417	24. Northwest	P1026/L28-29	Cite mitigation and other co-benefits from climate-based species/wildlife management as another emerging area.	We have added a sentence on co-benefits of wildlife habitat management with references, including to Ch. 6 Forests.
418	24. Northwest	P1031/L11-12	The text should say “has reduced the impact of sea level rise for some areas in the Northwest.”	After reviewing the public comments submitted on Chapter 24, the reference to Tectonic uplift was removed to avoid confusion, as this process does affect sea level rise equally throughout the Northwest.
419	24. Northwest	P1031/L21-P1032/L2	Include hybrid “green and grey” infrastructure approaches as part of the emerging issues.	We have added a sentence to the Emerging Issues section, along with two examples that illustrate the use of green or green/gray infrastructure to manage floods or stormwater. The use of “green” or hybrid “green and grey” infrastructure (e.g., Kittitas County Flood Control Zone District 2015, City of Portland 2010) solutions that utilize nature-based solutions with more traditional engineering approaches are emerging as a potential adaptation options.
420	25. Southwest	P1088/L8-10	Mention why the significant technology sector in the region cares about climate change (or how climate change affects the sector).	The first paragraph of the background section identifies key resources of the region that are at risk under climate change. All seven key messages relate to the resources here, including the technology sector.
421	25. Southwest	P1088/L17- 18	Water supply varies not only with precipitation, but also with withdrawals/use, as mentioned in the preceding sentence.	The text has been revised. It now reads "Water supplies vary with year-to-year variability in precipitation and water use, but the increasing temperatures brought on by climate change now interact with these factors to reduce the effectiveness of precipitation in replenishing soil moisture and water supplies (Dettinger et al. 2015, McCabe et al. 2017, Udall and Overpeck 2017, Williams et al. 2015)."
422	25. Southwest	P1092/L19- 20	Regarding Oroville Dam spill risks, reduced water supply and maintenance required for aging infrastructure are two risks mentioned in the text. Another major spill risk is the risk to human lives/property/infrastructure from catastrophic failure.	The text has been updated to reflect this suggestion.
423	25. Southwest	P1092/L38	Text should say “rather than being forced to use it immediately.”	The text has been updated to reflect this suggestion.

Comment #	Chapter	Page/Line	Comment	Response
424	25. Southwest	P1094/L2-8	The middle sentences on drought should be rephrased to focus on fire impacts. Start with "forests have dried," driving wildfire increase, and then include an explanation of how droughts have contributed to forest drying.	The text has been updated to reflect this suggestion.
425	25. Southwest	P1094/L21	Text should say "carbon, in California ecosystems."	The text has been updated to reflect this suggestion.
426	25. Southwest	P1098/L36- 37	Text should say "in naturally acidic upwellings."	The text has been updated to reflect this suggestion.
427	25. Southwest	P1099/L3-4	The text needs a citation for the economic risks of ocean acidification to the shellfish industry.	The text has been updated to reflect this suggestion.
428	25. Southwest	P1100/L8	The legend should be consistent with the true color of the temperature line in Figure 25.4. It looks brown in the draft NCA4, but the caption states that it is black.	The text has been updated to reflect this suggestion.
429	25. Southwest	P1102/L2- 13	The paragraph starts with a discussion of how tribes are adapting; the paragraph ends with an example of how vulnerable they are to decreasing water supply. This text needs edits for internal consistency. Perhaps the two points could be merged with other paragraph(s).	The text has been updated to reflect this suggestion.
430	25. Southwest	P1103/L14-15	Briefly state the cause of the increased cost in shifting from hydroelectric to fossil fuels in California (see the cited Gleick, 2015 reference).	The text was clarified to make the cause more apparent.
431	25. Southwest	P1103/L36- 39	This sentence needs editing for length and clarity.	The text was shortened and edited for clarity.
432	25. Southwest	P1104/L8	Text should say "Energy production causes the."	The text has been removed in response to comments.
433	25. Southwest	P1104/L11- 14	This sentence needs editing for length and clarity.	The text has been removed in response to comments.
434	25. Southwest	P1104/L14- 15	What economic damages would carbon emission reductions cut and how? This needs a brief explanation.	The text has been removed in response to comments.
435	25. Southwest	P1114/L21	A citation is needed for the portion of this sentence referring to the increase in flooding. This is the first mention of flooding related to this key message and is strangely stated as part of the documentation in the "drought" key message. More detail on this point can be found in the main text review of this draft NCA4 chapter.	The key message has been revised, as recommended in the main text review. Flooding is included in the key message. There are references in the body of the supporting text.
436	25. Southwest	P1117/L12	An incomplete sentence ends with "to diminishing."	The text has been updated to reflect this suggestion.
437	26. Alaska	P1170/L33-34	There is clumsy wording of the text "qualitative…ecosystems"and is difficult to understand. This differs from many of the relatively simple definitions in the literature.	The text has been modified to make it simpler and also matches similar text reported later in the text.

Comment #	Chapter	Page/Line	Comment	Response
438	26. Alaska	P1170/L37- 39	The range of adaptations that are underway, as stated in this sentence, are not described in the adaptation section of this chapter.	The text has been modified to state that adaptation planning, research and action is underway in Alaska. These include short-term disaster risk management as well as longer-term strategic planning. Additional information has been added to the narrative.
439	26. Alaska	P1171/L2-6	It is unclear how Figure 26.4 relates to the text that precedes or follows it.	For the NCA4, the Executive Summary is intended to repeat material from the chapter itself and it normally contains a figure that the authors felt was important to the chapter. The figure in question however, has been replaced with a new figure.
440	26. Alaska	P1172/L1- 33	Add citations to the introduction.	The authors appreciate this oversight and references have been added to the introduction section
441	26. Alaska	P1174/L8	The text says "(c) same as (c)," but it should say "(d) same as (c)."	The text has been modified to correct this error.
442	26. Alaska	P1174/L29	Do "coastal areas" refer to all coastal areas of the state, including southeastern Alaska?	The text has been modifed for clarity by specifically listing geographic areas as well as including a reference.
443	26. Alaska	P1177/L8	Is it correct that fish feed on pteropods rather than pteropods feeding on fish?	The text has been modified for clarity that the fish are feeding on the pteropods and not the other way around.
444	26. Alaska	P1179/L11	The cited Mann etal.2012 did not discuss shrubs. They talk about the conversion of conifer forests to deciduous vegetation (including shrublands and deciduous forests). They emphasize the importance of aspen forests (not shrublands) as a future state that will become more common. See also comment # 447.	The text has been changed to reflect deciduous vegetation in general (shrubs and trees) and not specifically about shrubs, and other citations have been added.
445	26. Alaska	P1179/L18	What about the effects of permafrost thaw on the water-quality impacts of large mines?	The text has been updated to reflect this suggestion.
446	26. Alaska	P1184/L24	Change"quality"to"air quality."	The text has been updated to reflect this suggestion.
447	26. Alaska	P1186/L30- 32	The same sentence is repeated twice.	The text has been removed in response to comments.
448	26. Alaska	P1196/L2	Is "Arctic ice sheet," meant to be "sea ice"? Clarification is needed.	The text has been updated to reflect this suggestion.
449	26. Alaska	P1196/L34	The conclusion by Mann et al. 2012 referred to changes from conifer to deciduous cover, not changes from forest cover to shrubs, as stated in this sentence (and in an earlier reference to the paper by Mann et al.). The statement that forests are changing to shrublands may be true, but the Mann et al. 2012 reference does not support this statement. See comment #442.	The text has been changed to reflect deciduous vegetation in general (shrubs and trees) and not specifically about shrubs, and other citations have been added.
450	26. Alaska	P1197/L6-8	The sentence "Thermal … regions" seems to have words missing and is unclear.	The text has been modified by inserting "coastal areas" to make the sentence clear.

Comment #	Chapter	Page/Line	Comment	Response
451	26. Alaska	P1201/L1-2	There is a word missing from this sentence.	The text has been modified by inserting "which" to make the sentence clear.
452	Appendix 5: Frequently Asked Questions	P1444/L35- 36	A better topic sentence would be “Additional lines of evidence support the idea that the world is warming.”	The text has been updated to reflect this suggestion.
453	Appendix 5: Frequently Asked Questions	P1445/L7-9	Because the FAQ focus is on how we know the Earth is warming and not why the Earth is warming, reference to human activities being responsible for the warming does not seem appropriate.	The text has been removed in response to comments.
454	Appendix 5: Frequently Asked Questions	P1444/L16	The link included on page 1444, line 16 should be more clearly noted as an external source. As currently written, it gives the impression that it links to Figures A5.1 and A5.2 in the draft NCA4.	The reference was noted as an external source.
455	Appendix 5: Frequently Asked Questions	P1451/L11	The text needs a comma after “heat.”	The text has been updated to reflect this suggestion.
456	Appendix 5: Frequently Asked Questions	P1451/L13	Define the abbreviation GHG before using it (if this line is kept in the text).	The text has been updated to reflect this suggestion.
457	Appendix 5: Frequently Asked Questions	P1453/L2	The word lead “lead” should be changed to “leads” or “must lead.”	The text has been updated to reflect this suggestion.
458	Appendix 5: Frequently Asked Questions	P1447/L17	Insert the word “rapidly” so that it reads “use of coal, oil, and gas has rapidly changed the atmosphere.”	The text has been updated to reflect this suggestion.
459	Appendix 5: Frequently Asked Questions	P1451/L15	The word “similar” should be changed to “similarly,” because the physical mechanism is actually different (greenhouse versus greenhouse gases). Alternatively, the comparison could be omitted.	The word "similar" was changed to "analogous."

Comment #	Chapter	Page/Line	Comment	Response
460	Appendix 5: Frequently Asked Questions	P1459/L13	It would be appropriate to say “very strong regional effects in some areas.”	The text has been updated to reflect this suggestion.
461	Appendix 5: Frequently Asked Questions	P1459/L13- 16	This text is likely too technical for the intended audience and should be revised.	The text has been adjusted to clarify.
462	Appendix 5: Frequently Asked Questions	P1470/L14	The text currently says “scientists compare data.” which could be revised to say “scientists evaluate data.”	The word "compare" was replaced with "evaluate."
463	Appendix 5: Frequently Asked Questions	P1471/L21	Edit text to say “at a given location over periods of multiple years to decades.”	The text has been updated to reflect this suggestion.
464	Appendix 5: Frequently Asked Questions	P1473/L21	The word “arctic” should be capitalized.	The text has been updated to reflect this suggestion.
465	Appendix 5: Frequently Asked Questions	P1475/L36	Insert “noted above” so that the text says “scientific evidence noted above indicates that.”	The text has been updated to reflect this suggestion.
466	Appendix 5: Frequently Asked Questions	P1476/L5	Insert “human-caused” so that the text says “of human-caused global warming on these events.”	The text has been updated to reflect this suggestion.
467	Appendix 5: Frequently Asked Questions	P1476/L12	It is suggested that the words “the severity of” and “some” be added, so that the text reads “global warming has contributed to the severity of some individual weather and climate events.”	The text has been updated to reflect this suggestion.
468	Appendix 5: Frequently Asked Questions	P1476/L15	The text that says “we can model” is jargon. It is suggested that “model” be replaced with “simulate.”	The text has been updated to reflect this suggestion.

Comment #	Chapter	Page/Line	Comment	Response
469	Appendix 5: Frequently Asked Questions	P1477/L3	Insert “human-caused” so that the text says “to detect the influence of human-caused global warming.”	The text has been updated to reflect this suggestion.
470	Appendix 5: Frequently Asked Questions	P1477/L4	Insert “events” so that the text states “and, to a lesser extent, heavy rainfall events, is better at present.”	The text has been updated to reflect this suggestion.
471	Appendix 5: Frequently Asked Questions	P1477/L7-8	It is suggested that the text be changed to the following wording: “ability to attribute how much human-caused global warming contributes to specific weather and climate events.”	The text has been updated to reflect this suggestion.
472	Appendix 5: Frequently Asked Questions	P1477/L12	Insert “human-caused” so that the text says “link human-caused global warming to particular weather and.”	The text has been updated to reflect this suggestion.
473	Appendix 5: Frequently Asked Questions	P1477/L15	Insert “human-caused” so that the text says “while human-caused global warming contributed.”	The text has been updated to reflect this suggestion.
474	Appendix 5: Frequently Asked Questions	P1477/L17	Change the wording to: “activity, but human-caused global warming leads to.”	The text has been updated to reflect this suggestion.
475	Appendix 5: Frequently Asked Questions	P1477/L33	Clarification is needed here. A change in wording to: “exist, only that the data record is not long enough.” is suggested.	The text has been updated to reflect this suggestion.
476	Appendix 5: Frequently Asked Questions	P1488	The intermediate scenario referenced in Figure A5.29 should be consistently labeled throughout the report and FAQs.	The text has been updated to reflect this suggestion.
477	Appendix 5: Frequently Asked Questions	P1488/L16	The text should say “Sea level is expected to continue rising at an accelerating rate this century, increasing the frequency of nuisance flooding, as well as intensifying coastal.”	The text has been updated to reflect this suggestion.