

**Response to ACSERAC Recommendations**  
**on**  
*Synthesis and Assessment Product 4.4: Adaptation for Climate-Sensitive Ecosystems  
and Resources*

**Charge Q1. To improve the effectiveness of the review of adaptation options by the chosen six federally owned and managed lands and waters, the Committee recommendations were to: (1) make clear why these six management systems were selected, and why others were not (BLM and DoD lands, for example), (2) begin the report with a synthesis of the various adaptation approaches discussed in the underlying chapters, and (3) summarize information by major ecosystem type since many ecosystems occur in more than one management system.**

We agree with the Committee that better clarification is needed for why these six management systems were selected and others were not. We have (1) added text to the Introduction and the Executive Summary to explain that this report is not meant to be exhaustive of all types of Federal lands, but is meant to cover enough types of management systems to provide useful insights to other federally and non-federally managed lands and waters. We believe that we have satisfied this goal with the choice of these six management systems and that although other large federally managed systems are not included, insights gained from these six systems may be applied to them.

The Executive Summary has been rewritten to (2) summarize the themes brought out in the Synthesis Chapter, as drawn from across the management system chapters, rather than retaining the original organization of summarizing each management system chapter individually. In the current Summary, we include a synthesis of the various adaptation approaches discussed in each management system chapter, as the Committee recommended. However, we do not (3) provide a summary of information by major ecosystem type because the level of effort required to this in the timeframe available is not possible and because the current organization of this information is the most useful for managers. The current organization of this report by management system establishes the necessary context of desired ecosystem conditions and natural resource management goals to provide managers with an understanding of how climate change may affect those goals and the diverse adaptation options available to address potential impacts. An ecosystem cross-cut of this same information would be beneficial, though not necessary, since this current organization meets the goals of the report to provide managers with as useful as possible a review of the state of knowledge of adaptation options.

**Charge Q2. To improve the usefulness (and clarity) of the information in the management system chapters, the Committee recommended the following: (1) add opening summaries to all six of the management system chapters, (2) add short introductions to the case studies to clearly state the purpose of the specific studies and the lessons to be drawn, (3) standardize the conclusions sections and ensure that they are informative rather than broad-brush statements, (4) ensure precise use of terminology across chapters and avoid “buzzwords”, (5) give added attention to scaling from local issues to landscape-level management, and (6) ensure that the information is presented in an accessible form for multiple target audiences.**

We agree with the Committee’s recommendations and have done the following: (1) We added opening summaries to each of the management system chapters, using a similar style across chapters. (2) We developed case study summary boxes for each chapter that use a common format and provide bulletized information on each case study, including why the case study was chosen, the management context, key climate change impacts, adaptation options that may be implemented, and conclusions/lessons learned. The full case studies have been moved to an appendix within SAP 4.4. (3) While we did not impose standardization of the conclusion sections on the author teams, some conclusions sections have been modified where necessary to make them as informative as possible (see Appendix A for individual Management System Chapter modifications and responses to Federal Advisory Committee recommendations).

In response to the Committee’s concern about (4) the use of “buzzwords” in SAP 4.4, we made sure that each chapter uses the same definitions for terms such as ecosystem management, biodiversity, resilience, and adaptive management. Where terms are critical to an understanding of how to respond to climate change, those terms are explained fully and used consistently across chapters, as defined in the glossary.

With respect to the Committee’s recommendation (5) about scales of management, each chapter discusses as fully as necessary both local- and landscape-level management. For some chapters, this required no changes, and for others, some modifications were made (see Appendix A for individual Management System Chapter modifications and responses to Federal Advisory Committee recommendations). The chapters also discuss the necessity of developing partnerships with others across state and federal agencies to adaptively manage at the landscape level, but the details of those working relationships will depend on specific circumstances and are not elaborated on in the chapters. Whether working at larger scales with other partners or working at smaller scales within single systems, methods to prioritize resources will be necessary. Each chapter recognizes this need, and where appropriate, mentions such a need to set priorities based on some method of triage, but the details of how this might be done are not within the scope of this report.

We agree with the Committee that (6) the two primary target groups for the information in this report are managers on the ground and administrators and planners. With that in mind, we re-wrote the Executive Summary to target the second audience – policy makers – and provide them with key, policy-relevant insights and lessons learned. More technical information for the manager target audience that was previously in the Executive Summary is now provided in chapter summaries at the front of each chapter.

See Appendix A for individual Management System Chapter responses to Federal Advisory Committee recommendations.

**Charge Q3. With respect to the case studies, the Committee recommended that they be shortened considerably and include a greater emphasis on the reason the case study was chosen and the lessons learned about adaptation in that location.**

As mentioned above, we developed case study summary boxes (of 1.5 pages or less) for each chapter that use a common format to document the approach and the lessons learned from each one. Those boxes include brief, bulletized information on the following: why the case study was chosen, the purpose of each case study, the management context, key climate change impacts, adaptation options that may be implemented, and conclusions/lessons learned. The full case studies have been moved to an appendix in SAP 4.4.

**Charge Q4. The Committee recommends that the structure of the Synthesis chapter be altered to include an introduction and clear articulation of the chapter's goal and common themes drawn from the rest of the report.**

The Committee was concerned about the need to orient the reader to the purpose and information presented in the Synthesis chapter because of the likelihood that it may be the only chapter read by certain audiences. With this concern in mind, the Synthesis chapter now includes a Summary similar to each of the Management System chapters. In addition to the summary, it also (1) provides more information on decision making under uncertainty with respect to ecosystem management, and (2) a more complete explanation of the technical merits of current management approaches and options, and their usefulness with respect to adapting to climate change. Monitoring was given even greater emphasis as a synthetic theme, as were options that address non-climate objectives and climate change impacts simultaneously. It was also emphasized in this chapter as well as the Executive Summary that this report is anticipated to be only the beginning of an ongoing effort to further our knowledge about how to adapt effectively to the consequences of climate change.

Because the Executive Summary was greatly shortened and now summarizes the Synthesis chapter, the Synthesis chapter was kept as the final chapter to the report. The underlying chapters provide the data that inform the Synthesis chapter, and therefore conceptually the Synthesis chapter belongs most appropriately at the end. While the Management System chapters did not explicitly use the Synthesis chapter as a guide for revising their chapters, themes that appear in the Synthesis were brought out more clearly in the chapters, and terminology common to the Synthesis was used in the chapters to make the link clear between the underlying material in the chapters and their appearance as specific themes in the Synthesis.

**Charge Q5. The Committee recommended that the Authors make more clear the main conclusions, key concepts, and recommendations across management systems and ecosystem types.**

We agree that the main conclusions and key concepts across management systems need to be clearer. Therefore, the Executive Summary was rewritten to provide the most important conclusions and concepts up front and as quickly and succinctly as possible. We did not provide a summary of the state of knowledge for ecosystem responses to climate change and the potential consequences of neglecting to adapt to predicted ecosystem responses to climate change. The addition of this information would be impractical and unnecessary for three reasons: (1) it would cause SAP 4.4 to almost double in length, (2) it is already the focus of SAP 4.2 (observed and projected changes to land and water resources and biodiversity) and SAP 4.3 (threshold changes in ecosystems), and (3) it goes beyond the scope of SAP 4.4 that is intended to cover management options as a response to climate change impacts.

**Charge Q6. The CCSP guidelines on characterizing confidence levels for proposed adaptation approaches would benefit from providing a review of the rationale used in preparing certainty and levels of confidence statements.**

We agree that the characterization of confidence levels needs to be done in a more systematic manner, with greater explication by the authors as to how they determined their characterizations. To that end, the method for characterizing levels of confidence was redesigned (see Appendix B for the directions and template used by the authors), and the characterization exercise was repeated following this new method. The Authors' explanations of how they made their determinations of confidence will be provided to the reader in an appendix to SAP 4.4. The sections on uncertainty in the Introduction, Executive Summary, and Synthesis chapters have been revised to clarify how the confidence levels were obtained and, in the Synthesis chapter, to discuss the new results. In this report, treatment of confidence follows the IPCC guidelines for the IPCC 5<sup>th</sup> Assessment Reports. For SAP 4.4, this involves characterization and communication of confidence through two separate but related elements. The first element is the amount of evidence available to support the determination that the effectiveness of a given adaptation approach is well-studied and understood (high or low). The second element is the level of agreement or consensus within the scientific community about the different lines of evidence on the effectiveness of that adaptation approach (high or low). Thus, each of the synthetic adaptation approaches drawn from across the chapters of this report is assessed and given a ranking of "high" or "low" for each element (amount of evidence and amount of agreement).

The Authors' explanation of how they determined their confidence for each adaptation approach includes what they considered related to: (1) peer-reviewed and gray literature; (2) data and observations; (3) model results; and (4) their experience, including their experience in the field, their analyses of data, and their knowledge of the performance of specific adaptation options under each type of adaptation approach. Each adaptation approach was evaluated for its effectiveness at achieving increased resilience in the near term and any non-technical or non-ecological considerations were excluded.

**Charge Q7. The Committee recommends that EPA be clear about (1) why their stakeholder involvement was limited and (2) the implications of a relatively narrow stakeholder involvement process so as not to alienate potential readers.**

We agree that the discussion of stakeholder involvement in SAP 4.4 might lead the reader to believe that a comprehensive process was used to engage all interested and relevant parties to participate in the development of SAP 4.4. So as not to mislead the reader, we added text in the section on stakeholder engagement to make clear that the initial planning of SAP 4.4 involved engaging a narrowly-defined targeted group of expert stakeholders to review the substance of the report. Small groups of no more than 20 people from the fields of adaptation science and resource management were asked to provide comments to the authors of the report on its content through participation in the series of six workshops. We also included in the Acknowledgements section of each Management System chapter the list of those individuals that were invited to the initial workshops, as well as those that attended, along with the organizations they represented. At each workshop, chapter lead and contributing authors presented draft information on their chapters and case studies and incorporated the expert input into their revisions. We also made clear in the Introduction that beyond the narrowly defined group of expert “stakeholders” we engaged in the workshops, a broader array of relevant stakeholders were invited to contribute to the shaping of this document through a public review process. Feedback was received from non-governmental organizations, industry, academia, state organizations, and private citizens as well as federal government representatives. That feedback resulted in significant changes to this report.

## **Appendix A – Chapter-Specific Responses to ACSERAC Comments**

### **National Forest Chapter**

The chapter revision has included text addressing missing concepts on the genetics in silvicultural treatments, recognizing timber harvesting as a stressor, the use of natural fire regimes, and the putative values of connecting landscapes. The interacting consequences and complexity of mitigation techniques has been addressed in several sections. The committee noted that the Chapter focused entirely on forestland and the revision has broadened the ecosystems mentioned in the text as well as expanded the management options beyond those specific for forests.

The Committee pointed out that although the National Forest System was selected as a unit of focus for sensitive ecosystems, information from other agencies (BLM, DOD, tribal lands) was not included. The objective of selecting NFS as well as the other federally managed lands described in this report was to give a sense of how particular land management goals might be affected by climate change where those goals were clearly articulated, as they are for federal lands. Other federal lands such as those managed by BLM, DOD, etc. and tribal lands may or may not have climate change objectives that are similar to the NFS. We have revised the text to acknowledge the need for the USFS to interact with these other agencies where NFS lands are adjacent or intermingled with lands that they manage or, for example, where the USFS needs to coordinate with the BLM on mining. Although the discussion of adaptation approaches or particular management recommendations in the chapter (e.g., fire) likely has relevance for other federal lands (e.g., those managed by BLM) we have not specifically highlighted the relevance.

Using an administrative unit for case studies was acknowledged by the Federal Advisory Committee as one way to give credit to agencies and stakeholders for the difficult task of integrating climate change into an adaptive process. Given that the objective of this report was to explore how the agency might adapt to climate change, highlighting the administrative structure in which adaptation will likely take place provided a context for some of the adaptation challenges. We agree that this approach does not lessen the validity of ecosystems as an integrating unit.

The case study sections have been revised to have a common format across all chapters and shortened to highlight lessons learned. The Committee suggested that the case studies would benefit by some examples of anticipatory options for extreme events such as fire or hurricanes as well as descriptions of management activities that have not been successful accompanied by an explanation of their failure. We had recognized the need for anticipatory options in the public comment version and have revised the text to add some anticipatory options for fire. At this point, adaptation actions on the ground are limited; however, we agree that sharing the success or failure of adaptation options would be critical to facilitate a learning environment and have included that point in the revision of the chapter.

The Federal Advisory Committee and public comments discussed several topics that cut

across all chapters. The first suggestion was to develop a working or broader definition of *adaptive management* and to carefully review the use of this term. Within the NF chapter, the revision has included the definition as is currently used within NFS and more importantly highlighted areas where adaptive management approaches have been used (Northwest Plan) and are currently being used (Sierra Nevada Forest Plan). Additionally, the challenges of using adaptive management were also included.

The Committee expressed concern about the use and definition of terms such as biodiversity and resilience. In the NF chapter, the revision added a clearer statement of how biodiversity was to be treated and a longer discussion of resilience.

The Committee highlighted the need to add more discussion to two areas: moving from local issues to landscape-level management, and involving stakeholders/cooperators from adjoining state and federal agencies in understanding how to use adaptive management to respond to change. With respect to both concerns, the NF chapter now has more discussion about adaptive capacity and the need to understand the adaptive capacity across the environmental, social, and economic sectors. An understanding of adaptive capacity and a partnership across the public-private spectrum would hopefully lead from local issues to landscape-level (or higher) management.

The Committee also highlighted the challenge that given the number of personnel and level of funding needed to respond to change, there is a need to set priorities for resource use based on some level of triage. The NF chapter had already identified the need to set priorities, and identified the triage approach from the medical environment as one possible priority setting process.

The Committee also noted that there are at least two target groups for which the information will be particularly valuable, namely for managers at the on-the-ground decision level and for administrators and planners. Those in the Congress and higher administrative positions will require yet another presentation and the information presentation and format should be directed toward the needs of these users. This concern has been addressed by the lead authors for the report in restructuring the entire report.

### **National Parks Chapter**

An executive summary was put at the beginning of the Parks chapter to give the key findings from the chapter. Text was added or edited to note the importance of collaboration in adaptation approaches and activities referring to those national parks adjacent to or near other federally managed (BLM, DoD, National Forests, etc.) lands and Tribal lands (see sections of the summary and intro on pages 4-4, 4-25, 4-29, 4-32).

The background discussion of climate change impacts was deleted as recommended because of the general discussion already covered in the Introduction to SAP 4.4.

Reference was made to paleoecological data (see page 4-30), as a long-term perspective on climate variability and change to point managers to important insights.

Many more site-specific examples were added throughout the chapter of the types of actions that could be taken to limit damages from climate change and the types of experiments that could be conducted to find ways of easing the ecological transition to new climate regimes to improve the chapter's usefulness to managers. Also, a paragraph was added that explicitly states the folly of reliance on manuals to determine adaptation options (see p 4-28).

Text was added in the chapter and its summary to make clear those actions that are near, medium, and long term that are either under the control of park managers or that require partnerships with others, support from the public and Congress, and continuing monitoring and research.

Because stressors that come from visitors are more controllable than those that are directly related to changes in climatic conditions, those human-induced stressors have been addressed with added text (see text on p. 4-20 and in the Executive Summary). Text relating to visitor education was also added (see p 4-28).

The discussion of nonnative species and their treatment under changing climatic conditions was expanded to provide a definition of the term (see page 4-14) and to provide much more guidance on when they should be considered invasive and harmful and how to treat them (see p. 4-22).

A short summary of the case study on the Rocky Mountain National Park (RMNP) was written for the chapter and the full case study was moved to an Appendix. In this summary, it now clearly states the purpose of the case study and the major points learned from it. The adaptation approaches mentioned in the full case study that are initiated or planned are provided in the summary to retain the most useful information from the full case study.

Throughout this chapter, references are made to concepts mentioned in the Synthesis chapter using the specific terms developed for the Synthesis chapter to better integrate information within this chapter with other management system chapters and the synthesis.

### **National Wildlife Refuges Chapter**

The chapter makes a recommendation for establishing two new entities: a national interagency climate change council and a national interagency climate change information network. In response to a concern that specific policy recommendations are beyond the scope of this report, we have toned down the "recommendation" to a "suggestion" and eliminated the use of explicit body names.

It was suggested that a chapter summary would be useful at the beginning of the chapter. This has been done, using information originally presented in the Executive Summary and modifying it for consistency with other chapter summaries.

The FACA recommended that all chapters be made conceptually consistent with the



Synthesis. It is already consistent where it should be. No more consistency was imposed (as a command decision) since the Synthesis chapter conceptually draws from and synthesizes information from the underlying chapters, not the other way around. The themes in the Synthesis chapter emerged from a reading of all the Management Systems chapters.

Another recommendation was to include greater consideration of anticipatory management and making optimal use of current best management practices. The NWRS is particularly well-suited to do this, thus implementing a “no regrets” policy. Anticipatory management and optimal use of current best management practices is stressed in this chapter already. No change is necessary.

Another concern was that the chapter needs to be clear that the audience for needed policy changes is at the regional and national level. The level and extent of detail in the text should be calibrated to what will be critical to those decision-makers. We added an explicit target audience phrase on p. 5-6 and edited the paragraph there for internal consistency.

It was also noted by the FACA that the case study was an interesting selection. Although there was only one selected, it covers a very large footprint. However, there was concern that some critical insights for adaptation were missed. It was suggested that some of the concern could be attenuated if the “lessons learned” from the case study were given greater emphasis through use of a text box for greater emphasis. We have worked to highlight the lessons learned in the “box” that replaces the case study section in the report.

To ensure consistency between what refuge managers can do and how the approaches are summarized in Table 9.4, the table was edited.

It was stated that the chapter needs greater clarity about how the NWRS should address range shifts in the context of invasive species, i.e., how non-native species should be handled if they are in a refuge as a result of range shifts. The chapter talks about assisted dispersal in addressing range shifts but this leaves out natural dispersal. We clarified the native/non-native issue and expanded the text in the sections related to this concept.

Finally, the FACA stated that there is an inconsistency in the chapter that should be corrected. The second paragraph of Sect 5.1.4.5 (p. 5-10) discusses using historic conditions as a benchmark for success. The next paragraph states that the policy does not insist on a return to historical conditions but to use them as a frame of reference for understanding successional shifts (p.5-11). Then the second take-away message (p. 5-63) is worded as if historical conditions are, in fact, the management target. These appear to be in conflict. The committee agrees with the frame-of-reference use for historical conditions, but suggests that this point be clearly described and that recommendations be consistent with current policy. In response to these concerns, we edited the first and third paragraphs to ensure internal consistency.

## **Wild and Scenic Rivers Chapter**

For the most part the FACA comments were quite complementary and brief for the WSR chapter. There was some need expressed to both expand on the management options and to better link those to the text. Thus a new table was developed that replaced the old Box 6.5 (which was criticized by the panel). This new Box summarizes the types of adaptation options and directly ties to sections in the text.

There was a little concern that some of the suggestions for options could not be accomplished by WSR managers. This is fully recognized by the authors but it is clearly stated that these actions should be considered by working with those (e.g., dam managers, local land owners) who do have the appropriate power. Many or most WSRs will *never* be protected from climate change impacts if actions outside of federally-owned lands are not taken. This is in part because many WSR designations are in watersheds that are somewhat developed.

The Conclusions have been re-written as requested and the language concerning very clear statements about the need for proactive management has been added.

## **National Estuaries Chapter**

We responded to specific issues raised about the National Estuaries Chapter and to relevant generic issues raised about the entire 4.4 product and its Executive Summary.

- (1) We appreciate the compliments on our writing and then, armed with good will and pride, considered the suggestion made to prioritize our Conclusions. We decided that our Conclusions section has several attributes that make prioritization inappropriate. First, the Conclusions are prepared in its beginning as an organized series of points, each leading logically and stepwise to the next. Thus, this portion has its own organizational structure for which prioritization simply does not make sense. Second, we break our Conclusions up subsequent to this logical series into several categories (Management Response vs. Research Priorities, which we organize into separate sections (Conceptual Gaps in Understanding; Data Gaps; Governance Issues; Tool Needs; and Education)). Each of these sections speaks to largely separate audiences, and in that sense the relevant conclusions do not lend themselves well to prioritization because different agencies must respond. In other words, although some issues may be more urgent than others, it is not unreasonable to expect progress on all fronts because in general different groups are responding. Prioritization could actually be counter-productive if it was used to allow one agency of group to avoid doing their part. However, to be true to the spirit of this suggestion, and to respond to another recommendation of the FACA panel, we did prepare an Abstract (Summary) of about 3 pages, in which the most important conclusions are identified and stressed.
- (2) We were pleased to make the addition of extensive comments about the importance of state programs under CZMA, including especially local land-use planning, to implementation of management adaptations to climate change. We added an entirely new section (7.3.3.4) in which to present this program and its role. In addition, we made mention later in the text in presenting management adaptations where the

CZMA plays a useful role. In so doing we cited and incorporated conclusions of the CSO report provided in one public review.

- (3) We agree with and entered all caveats as requested about the use of “adaptive management”, “ecosystem-based management”, and the reliability of biodiversity as a means of providing resilience to climate change. On this last point, we also reflected the uncertainty over effects of biodiversity in our new Confidence Table.
- (4) We added to the Albemarle-Pamlico Estuary case study the explanation for how selection and inclusion of this example highlights important issues developed in our chapter (as presented verbally by Pete Peterson at the review meeting). This case study is also now presented separately from the main text, so its length is no longer an issue.
- (5) We made small modifications in the text where appropriate to utilize the terms describing options for achieving resilience in Table 9.4.
- (6) Finally, we prepared an Abstract, as requested, although it is now termed a “Summary”.

### **Marine Protected Areas Chapter**

For section 8.1 we have modified text, added an example, and deleted text. Section 8.2 develops a series of interrelated topics (ecosystem characteristics/management goals, stressors, management/sensitivity of goals to climate change) that lead to the topic of management options in section 8.3; we modified the text on page 8-15 noted in the comments. We agree that the ecological processes listed in section 8.2.2.1 are not necessarily the most fundamental and modified this list. Further expansion of how range shifts (not warming) may affect the processes is provided in the references cited. Regarding effects of light on bleaching we have modified text, added citations, and added an adaptation option in Box 8.5. Considerable expansion and elaboration of the section on bleaching is not feasible at this stage of completing this "preliminary review;" there are numerous literature citations. There appears to be some confusion about invasive and native species changes/effects and we modified text on this topic. Regarding freshwater influxes and pollution we modified text and suggested a possible solution. We agree that increasing the size of no-take zones is clearly called for. We disagree that engaging stakeholders simply shifts "the onus onto others;" our experience is that MPA managers are held accountable. We agree with other comments about this section and modified text. We added a section on management adaptations to the FKNMS and PMNM case studies.

### **Synthesis Chapter – Response to Federal Advisory Committee Comments**

The synthesis chapter was changed in six substantial ways in response to the review committee’s remarks:

- 1.) The context, role and general intent of the synthesis chapter was laid out in the beginning of the chapter.
- 2.) In several sections greater detail was added—this request for greater detail mirrored some of the comments from the FACA review comments.
- 3.) The papers of Gregory and Arvai were consulted, and used to add greater depth to the

discussion of adaptive management and decision-making under uncertainty.

- 4.) The no-regrets option was given greater emphasis.
- 5.) Prose was added to make clear that the subject of adaptation will require continued attention, and that in no way is this report the "final word".
- 6.) The importance of monitoring was given even more emphasis.

There were, of course, numerous other revisions as well. But the above six modifications represent criticisms raised by the advisory committee that were felt to be especially trenchant and on-target, and hence warranting substantial revisions.

## Appendix B – Directions to Authors and Template for Characterizing Confidence in Response to ACSERAC Recommendations for Charge Question 6

### Directions to Authors for Estimating Confidence

In your judgments of confidence, please consider the following:

- ? Peer-reviewed and gray literature (journal articles, reports, working papers, management plans, workshop reports, other management literature, other gray literature)
- ? Data and observations
- ? Model results
- ? Your own experience, including your experience in the field, your analyses of data, and your knowledge of the performance of specific adaptation options under each type of adaptation approach.

Peer reviewed literature should serve as the primary source considered in your judgments, with minimal reliance on the gray literature, except where no peer reviewed literature are available. Data, observations, model results, and your own experience may be used as secondary lines of evidence. Because promoting resilience may be a management strategy that is useful only on shorter time scales of a few decades, please evaluate each adaptation approach for its effectiveness at achieving increased resilience in the near term. Also, please exclude from your consideration any non-technical or non-ecological considerations, such as how difficult adaptation approaches may be to implement, since these issues are dealt with elsewhere in SAP 4.4.

For each adaptation approach, you are asked to consider two separate but related elements of confidence. The first element is the amount of evidence that is available (indicating that the topic is well-studied and understood) to assess the effectiveness of a given adaptation approach. The second is the level of agreement or consensus across the different lines of evidence regarding the effectiveness of the adaptation approach. This method for estimating confidence is one of several provided by the IPCC to its authors for the IPCC WG IV reports<sup>1</sup>. *We are asking you to evaluate only those adaptation approaches for which you have adaptation options listed from your chapter (see separate attachment, "Adapt\_Approach.doc", for this listing).* Please consult the tables provided in Adapt\_Approach.doc and then use the template pages below to rank the amount of evidence and level of agreement for each approach as "high" or "low"; this will result in each adaptation approach falling into one of the four quadrants shown below:

		Qualitatively defined levels of understanding	
Level of agreement or consensus	?	High agreement	High agreement
		Low evidence	High evidence
		Low agreement	Low Agreement
		Low evidence	High evidence
		Amount of evidence (theory, observations, models) ?	

<sup>1</sup> Guidance Notes for Lead Authors of the IPCC Fourth Assessment Report on Addressing Uncertainties, July 2005

## Confidence Template for Completion by Authors

### 1. Protecting key ecosystem features

**Description:** focusing management protections on structural characteristics, organisms, or areas that represent important “underpinnings” or “keystones” of the overall system

**Confidence:** is strategic protection of key ecosystem features an effective way to preserve or enhance resilience to climate change?

#### *High/low amount of evidence*

Is this adaptation approach well-studied and understood, or instead is it mostly experimental or theoretical and not well-studied? Does your experience in the field, your analyses of data, and your understanding of the literature and performance of specific adaptation options under this type of adaptation approach indicate that there is a high/low amount of information on the effectiveness of this approach?

High or low evidence?	
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Please convey the amount and type of evidence available that provides support for high/low amount of evidence:

#### *High/low amount of agreement*

Do the studies, reports, and your experience in the field, analyzing data, or implementing the types of adaptation strategies that comprise this approach reflect a high degree of agreement on the effectiveness of this approach, or does it lead to competing interpretations?

High or low agreement?	
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Please convey the information from the different lines of evidence that provides support for the high/low amount of agreement:

## 2. Reducing anthropogenic stresses

**Description:** minimizing localized human stressors (e.g., pollution) that hinder the ability of species or ecosystems to withstand climatic events

**Confidence:** is reduction of anthropogenic stresses effective at increasing resilience to climate change?

### *High/low amount of evidence*

Is this adaptation approach well-studied and understood, or instead is it mostly experimental or theoretical and not well-studied? Does your experience in the field, your analyses of data, and your understanding of the literature and performance of specific adaptation options under this type of adaptation approach indicate that there is a high/low amount of information on the effectiveness of this approach?

High or low evidence?	
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Please convey the amount and type of evidence available that provides support for high/low amount of evidence:

### *High/low amount of agreement*

Do the studies, reports, and your experience in the field, analyzing data, or implementing the types of adaptation strategies that comprise this approach reflect a high degree of agreement on the effectiveness of this approach, or does it lead to competing interpretations?

High or low agreement?	
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Please convey the information from the different lines of evidence that provides support for the high/low amount of agreement:

### 3. Representation

**Description:** protecting a portfolio of variant forms of a species or ecosystem so that, regardless of what climatic changes occur, there will be areas that survive and provide a source for recovery

**Confidence:** is representation effective in supporting resilience through preservation of overall biodiversity?

#### *High/low amount of evidence*

Is this adaptation approach well-studied and understood, or instead is it mostly experimental or theoretical and not well-studied? Does your experience in the field, your analyses of data, and your understanding of the literature and performance of specific adaptation options under this type of adaptation approach indicate that there is a high/low amount of information on the effectiveness of this approach?

High or low evidence?	
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Please convey the amount and type of evidence available that provides support for high/low amount of evidence:

#### *High/low amount of agreement*

Do the studies, reports, and your experience in the field, analyzing data, or implementing the types of adaptation strategies that comprise this approach reflect a high degree of agreement on the effectiveness of this approach, or does it lead to competing interpretations?

High or low agreement?	
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Please convey the information from the different lines of evidence that provides support for the high/low amount of agreement:



#### 4. Replication

**Description:** maintaining more than one example of each ecosystem or population within a reserve system such that if one area is affected by a disturbance, replicates in another area provide insurance against extinction and a source for recovery of affected areas

**Confidence:** is replication effective in supporting resilience by spreading the risks posed by climate change?

##### *High/low amount of evidence*

Is this adaptation approach well-studied and understood, or instead is it mostly experimental or theoretical and not well-studied? Does your experience in the field, your analyses of data, and your understanding of the literature and performance of specific adaptation options under this type of adaptation approach indicate that there is a high/low amount of information on the effectiveness of this approach?

High or low evidence?	
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Please convey the amount and type of evidence available that provides support for high/low amount of evidence:

##### *High/low amount of agreement*

Do the studies, reports, and your experience in the field, analyzing data, or implementing the types of adaptation strategies that comprise this approach reflect a high degree of agreement on the effectiveness of this approach, or does it lead to competing interpretations?

High or low agreement?	
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Please convey the information from the different lines of evidence that provides support for the high/low amount of agreement:

## 5. Restoration

**Description:** rebuilding ecosystems that have been lost or compromised

**Confidence:** is restoration of desired ecological states or ecological processes effective in supporting resilience to climate change?

### *High/low amount of evidence*

Is this adaptation approach well-studied and understood, or instead is it mostly experimental or theoretical and not well-studied? Does your experience in the field, your analyses of data, and your understanding of the literature and performance of specific adaptation options under this type of adaptation approach indicate that there is a high/low amount of information on the effectiveness of this approach?

High or low evidence?	
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Please convey the amount and type of evidence available that provides support for high/low amount of evidence:

### *High/low amount of agreement*

Do the studies, reports, and your experience in the field, analyzing data, or implementing the types of adaptation strategies that comprise this approach reflect a high degree of agreement on the effectiveness of this approach, or does it lead to competing interpretations?

High or low agreement?	
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Please convey the information from the different lines of evidence that provides support for the high/low amount of agreement:

**6. Refugia**

**Description:** using areas relatively less affected by climate change as sources of “seed” for recovery or as destinations for climate-sensitive migrants

**Confidence:** are refugia an effective way to preserve or enhance resilience to climate change at the scale of species, communities or regional networks?

*High/low amount of evidence*

Is this adaptation approach well-studied and understood, or instead is it mostly experimental or theoretical and not well-studied? Does your experience in the field, your analyses of data, and your understanding of the literature and performance of specific adaptation options under this type of adaptation approach indicate that there is a high/low amount of information on the effectiveness of this approach?

High or low evidence?	
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Please convey the amount and type of evidence available that provides support for high/low amount of evidence:

*High/low amount of agreement*

Do the studies, reports, and your experience in the field, analyzing data, or implementing the types of adaptation strategies that comprise this approach reflect a high degree of agreement on the effectiveness of this approach, or does it lead to competing interpretations?

High or low agreement?	
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Please convey the information from the different lines of evidence that provides support for the high/low amount of agreement:

## 7. Relocation

**Description:** human-facilitated transplanting of organisms from one location to another in order to bypass a barrier (e.g., urban area)

**Confidence:** is relocation an effective way to promote system-wide (regional) resilience by moving species that would not otherwise be able to emigrate in response to climate change?

### *High/low amount of evidence*

Is this adaptation approach well-studied and understood, or instead is it mostly experimental or theoretical and not well-studied? Does your experience in the field, your analyses of data, and your understanding of the literature and performance of specific adaptation options under this type of adaptation approach indicate that there is a high/low amount of information on the effectiveness of this approach?

High or low evidence?	
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Please convey the amount and type of evidence available that provides support for high/low amount of evidence:

### *High/low amount of agreement*

Do the studies, reports, and your experience in the field, analyzing data, or implementing the types of adaptation strategies that comprise this approach reflect a high degree of agreement on the effectiveness of this approach, or does it lead to competing interpretations?

High or low agreement?	
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Please convey the information from the different lines of evidence that provides support for the high/low amount of agreement: