

CHAPTER 1: CLIMATE CHANGE RESPONSE FRAMEWORK OVERVIEW

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Managers currently face the immense challenge of anticipating the effects of climate change on forest ecosystems and then developing and applying management responses for adapting forests to future conditions. The Climate Change Response Framework (CCRF) is a highly collaborative approach to helping land managers understand the potential effects of climate change on forest ecosystems and integrating climate change considerations into management. Since 2009, the CCRF project in northern Wisconsin has worked to bridge the gap between scientific research on climate change impacts and on-the-ground management. Climate change has the potential to affect areas much larger than any single ownership, making multi-institutional efforts and partnerships crucial in addressing climate change. The information and tools developed as part of this project can be applied by forest owners and managers working in a variety of private and public agencies, both within and beyond northern Wisconsin. Currently, the framework is being applied in other locations in the eastern United States through coordinated place-based projects (Northern Institute of Applied Climate Science [NIACS] 2011). In this chapter, we outline this general framework for adapting to climate change. We then describe the application of the framework through project activities in northern Wisconsin and provide background for the subsequent sections of this document.

A Framework for Adapting to Climate Change

From its beginning, the CCRF was conceived as a model for collaborative management and climate change response across large and diverse landscapes that could be employed beyond the original geographic borders of the project (NIACS 2011). With this in mind, the framework represents a broad approach for responding to climate change (Fig. 4) that can be adjusted and applied to other locations and landscapes. The overall process is adaptive and incorporates opportunities for new information, ideas, and lessons learned during the process to be incorporated into the elements and activities.

Identify location, ecosystems, and time frame

The first step in this process is defining the scope of the project: the geographic scale and extent of the analysis area, the ecosystems of interest, and relevant timelines for evaluating available information. The geographic scale at which the project works is very important and needs to be chosen so that an adequate level of detail is available in the assessment stage for later use in management decisions. If the analysis area is too large, the information may be too general and unsuitable for supporting decisions in specific management applications. If the analysis area is too small, however, available information



Figure 4.—The Climate Change Response Framework uses an adaptive management approach to help land managers understand the potential effects of climate change on forest ecosystems and integrate climate change considerations into management.

(e.g., climate projections, impact model results) developed at much larger spatial scales may not be suitable for use at the finer spatial resolution of the area. The location, scale, ecosystems, and time frame identified can be refined throughout the process as needed. For example, the time frame may be influenced by the information that is selected for use in the assessments.

Establish partnerships

Climate change is inherently a cross-boundary issue because all places will be affected in some way, regardless of ownership. Communication and coordination with partners increase the ability of everyone involved to respond to climate change by increasing the amount and accessibility of information and ideas. It is critical to bring key partners into the process as early as possible. Whenever possible, the use of existing partnerships is extremely valuable because it builds upon established relationships and can avoid reinventing the wheel in many situations. However, it is also

very important to look for new partners. Given the broad impacts and importance of climate change, new partners may be available beyond those that are normally enlisted. This step is critical in defining and launching a new project, but never really stops thereafter. A successful effort will draw new partners, who will continue to enrich the skills, creativity, lands, resources, and perspectives available to the project. Profiting from partnerships requires flexibility, continual focus on project objectives and timelines, and excellent communication.

Assess ecosystem vulnerabilities and mitigation potential

Collecting information about projected changes in climate and impacts on ecosystems provides critical information to determine what species, ecosystems, or other features are most vulnerable to the effects of climate change. Likewise, assessing the current amount of carbon and the mitigation potential of the analysis area can provide information for consideration in management decisionmaking. There is no universally accepted process for developing these assessments, and new and different assessments are rapidly being developed (e.g., Byers and Norris 2011, Doppelt et al. 2009, Swanston et al. 2011). *Scanning the Conservation Horizon: A Guide to Climate Change Vulnerability Assessment* (Glick et al. 2011) outlines the elements of a vulnerability assessment and provides examples of possible approaches for creating an assessment. In general, assessments should strive to include both a synthesis of existing information and new information on the ecosystems of interest. Drawing upon partners, especially research partners, is a great way to develop new information. Additionally, a “common-sense filter” should be used to put analyses in perspective. Scientific models or other information used to create new information may not provide a complete picture of on-the-ground realities; input from both scientists and managers can be important in putting scientific results in context.

Compile adaptation strategies and approaches

A wealth of information is available on the adaptation of forests to the effects of climate change, as well as on the potential for forests to mitigate greenhouse gases. However, most of this information is very broad and not directly applicable at scales most relevant to land managers. Re-examining the breadth of adaptation strategies being discussed in scientific and management communities within the specific context of the analysis area and its ecosystems will help identify an array of strategies that are the most relevant for local land managers. This comprehensive array of strategies and approaches does not focus on a particular land use or management goal, but instead serves as a “menu” from which managers can select actions based on their management needs for a particular situation. In fact, some strategies may be mutually exclusive in a given place, but can be applied simultaneously in different places across the landscape according to management goals and ecological considerations. Integrating local vulnerabilities with a menu of adaptation approaches can help managers devise the most realistic adaptation tactics for their needs.

Plan and implement at appropriate scales

After considering management goals and local vulnerabilities, and then choosing adaptation strategies and approaches, land owners and managers can devise adaptation tactics that are best suited to their needs and constraints. Just as there is a menu of adaptation strategies and approaches, additional tactics may be created to increase the range of choices under consideration. The implementation of some tactics may be considered practicable and appropriate in some ownerships, but not in others. Even within an ownership, some tactics may be deemed fully practicable and even necessary in the long term, but too risky or uncertain in the near term. Implementation of adaptation

tactics will vary widely across ownerships and through time in the same way that a wide variety of tactics is currently applied in forest management.

Integrate monitoring and evaluate effectiveness

Monitoring is a critical step to evaluate whether management actions are effective in responding to climate change and reducing the vulnerability of ecosystems to changes that are occurring. As with implementation, the ways in which monitoring is implemented and monitoring results are evaluated and incorporated into management will depend upon land managers’ particular decisionmaking processes and plans. Results from monitoring can be integrated throughout this framework to refine individual steps. For example, monitoring results may be able to provide more detail on the vulnerability of ecosystem components to specific climate change impacts, and this information could be included in relevant assessments.

Applying the Framework in Northern Wisconsin

The CCRF was developed to synthesize information on climate change to help forest owners and managers incorporate climate change considerations into land management planning and activities. The CCRF project underway in northern Wisconsin is the result of a substantial collaboration among multiple organizations, with the Chequamegon-Nicolet National Forest (CNNF) playing a critical role as an initial test-bed for this project. In this section, we describe the application of the framework in northern Wisconsin, including activities and products developed as components of the project.

Early in the process, we identified flexibility and communication as critical features in the project. Allowing for a certain amount of flexibility gave us the opportunity to make needed adjustments

and capitalize on opportunities as they arose. We developed robust and productive communication avenues between the major partners and communicated frequently with potential users. Ultimately, however, we identified the need for much stronger and earlier outreach to potential users of the products.

Identify location, ecosystems, and time frame

Although the CCRF was catalyzed by the Forest Service’s interest in gaining information and insights about how to respond to climate change, we determined at the outset of the project that it would be critical to work beyond National Forest boundaries. Climate change will affect forests regardless of ownership boundaries, and information and tools designed to support informed responses to climate change within the CNNF are relevant to all land managers in northern Wisconsin.

We defined this project’s area of interest, the “analysis area,” as the portion of Wisconsin that is within Ecological Province 212 (Fig. 5; ECOMAP 1993). This area of Mixed Laurentian Forest, generally referred to as northern Wisconsin in this document, has ecological, political, and social significance. A time frame of approximately 100 years for the assessments was identified based on the majority of information that is available on projected climate change impacts. Additional time frames may be evaluated in subsequent versions of the assessment.

The ecological emphasis of the project is forested ecosystems. Forests are the primary land use in northern Wisconsin, covering 46 percent of the area (Wisconsin Department of Natural Resources 1998). Other ecosystems and methods of assessment may be added to the project in the future. For example, a watershed vulnerability assessment project that is

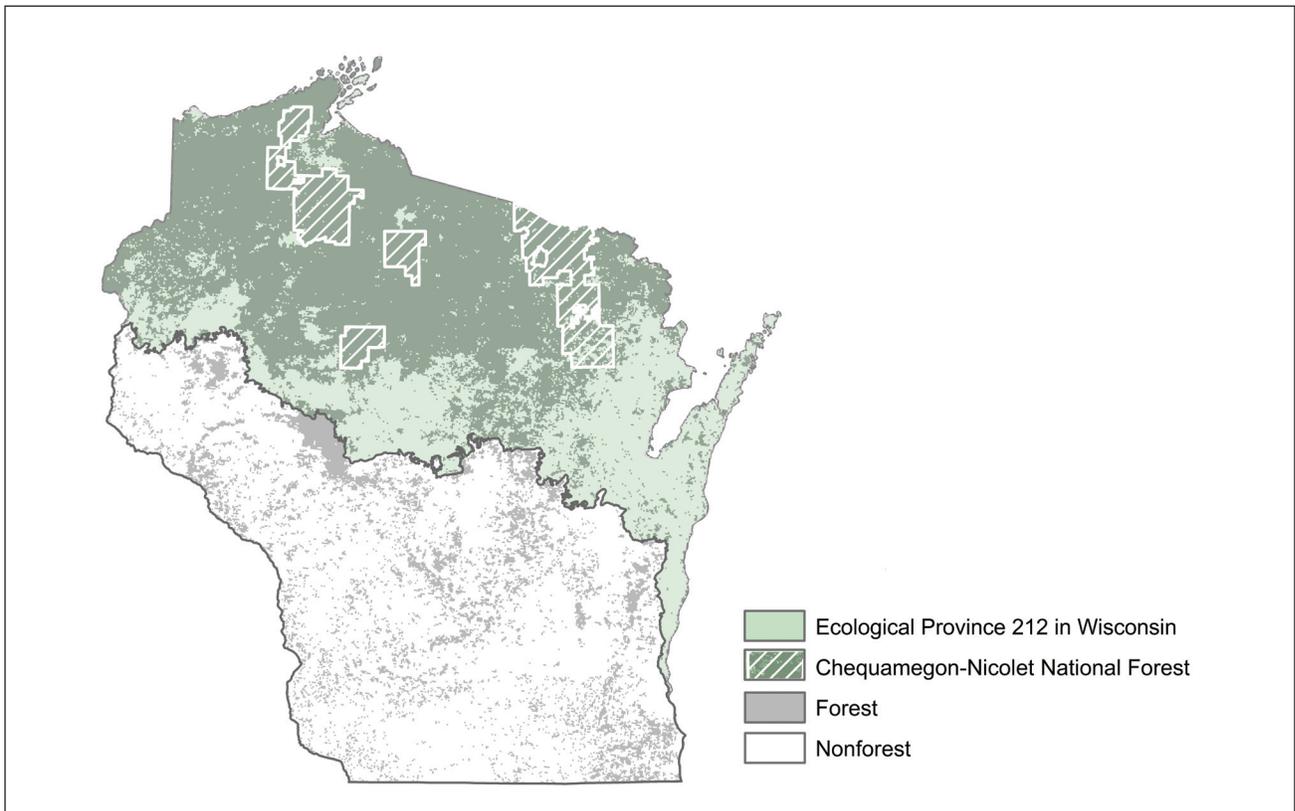


Figure 5.—The analysis area is the portion of Ecological Province 212 (Mixed Laurentian Forest) within Wisconsin.

occurring at the CNNF may help to expand the scope of future versions of the vulnerability assessment.

Establish partnerships

We sought to bring in a variety of partners early in the project. This included the Forest Service Northeastern Area, State and Private Forestry, which strongly encouraged expanding partnerships and was instrumental in bringing in additional landowners and stakeholders. The Wisconsin Department of Natural Resources and the Wisconsin Initiative on Climate Change Impacts (WICCI) were also engaged as key partners very early. Coordination between our project and the Forestry Working Group of WICCI also allowed each group to focus on different regions of the state in pursuit of similar goals.

The Shared Landscapes Initiative was a fundamental component for establishing communication and partnerships across a broad spectrum of forest land owners, managers, and the general public. The purpose of this effort is to foster dialogue about climate change, ecosystem response, ecosystem management, and cooperative activities among these different groups. Working with the Northeastern Area and the CNNF, we hosted a Shared Landscapes Initiative workshop in northern Wisconsin in February 2010. More than 70 people attended the workshop, and the Initiative currently includes more than 30 organizations and individuals that represent federal, state, other public, tribal, and private interests. A Shared Landscapes Work Group was established to maintain communication within the Initiative and facilitate creation of cooperative projects and products.



Photo by Maria K. Janowiak, U.S. Forest Service and Northern Institute of Applied Climate Science

Trees surrounding the edge of a small wetland in northern Wisconsin.

We also expanded partnerships within the scientific community by hosting a Climate Change Science Applications and Needs workshop in April 2010. This workshop brought together more than 50 participants, including scientists from northern Wisconsin, the Great Lakes, and elsewhere in the United States. Participants discussed science needs, applications of science, and climate change monitoring in northern Wisconsin. Workshop participants were invited to join a Climate Change Science Roundtable, whose members have contributed to the scientific review of project documents. As the project itself continues to evolve, the Roundtable is expanding to provide climate-related scientific information and perspective to the Shared Landscapes Initiative. Many of the ideas and conversations from this workshop, Roundtable discussions, and follow-up engagement with workshop participants were incorporated into other aspects of this project, including the assessments and this document.

Assess ecosystem vulnerabilities and mitigation potential

We developed the Ecosystem Vulnerability Assessment and Synthesis for northern Wisconsin (Swanston et al. 2011). This assessment describes the contemporary landscape of northern Wisconsin, summarizes projected changes in northern Wisconsin climate at the end of the century, presents results from two vegetation impact models used to project changes in forest composition across a range of potential climates, and assesses the implications of climate change for forest ecosystems in northern Wisconsin. The assessment drew upon and expanded existing scientific examinations of climate change in northern Wisconsin. Downscaled climate projections were readily available from WICCI, and were fundamental to the assessment document and process. Impact models are useful for projecting impacts of climate change on species and ecosystems, but operate under certain assumptions and limitations that contribute to

inherent uncertainty (Swanston et al. 2011, Wiens et al. 2009). For this reason, we used two very different impact models—LANDIS-II (a process model) and the Climate Change Atlas (a species distribution model)—to examine changes to forest ecosystems, and then worked with the results of both models to identify species and ecosystems with greater certainty of future impacts.

A mitigation assessment in preparation will provide information on current carbon stocks in northern Wisconsin and summarize available information on how forest management, land use, and other changes could alter the amount of carbon stored in forests and wood products. It will also contain more detailed results on how carbon stocks may be altered in the future as a result of climate change and forest management. As with the vulnerability assessment, the mitigation assessment will be made publically available in a published format.

Compile adaptation strategies and approaches

We created a set of Adaptation Strategies and Approaches for forests in northern Wisconsin (Chapter 2). These approaches and strategies were synthesized from a broad set of literature and other resources, and refined using feedback from scientists and managers with expertise in regional forest types. Although several documents describing strategies for adaptation have recently been published (e.g., Galatowitsch et al. 2009, Heinz Center 2008, Millar et al. 2007, National Research Council 2010), the vast majority of the adaptation strategies that have been described are general in nature and apply only broadly to many ecosystems and forest types. The central goal in developing our set of strategies and approaches was to focus on a particular location (i.e., northern Wisconsin) and ecosystem (i.e., forests) to provide a relevant and useful list of actions that can be pursued in regional forests. Throughout the development of these actions, we asked ourselves a series of questions to maintain our focus: Within

northern Wisconsin, what are the anticipated effects of climate change? What is an approach for addressing these impacts and helping forests to adapt? How might the use of this approach vary for different forest types?

Plan and implement at appropriate scales

Recognizing that forest owners and managers would ultimately be making decisions on which actions to implement to respond to climate change, we concentrated on developing information and resources that could be used to support these decisions across a variety of land ownerships. We have worked to avoid making recommendations or interfering with existing management planning and decisionmaking; rather, products of the CCRF, including this document, are designed to supplement existing procedures.

Several components of this project can be used to support management decisions for responding to climate change. *The Ecosystem Vulnerability Assessment and Synthesis* (Swanston et al. 2011) provides an extensive description of potential climate change impacts on forests, and additional information that becomes available will be presented in future versions of the assessment. Further, three interrelated chapters of this document help incorporate climate change considerations into management decisions and lead managers toward devising management tactics that can be used to respond to climate change. The Adaptation Workbook (Chapter 3) sets out a process for managers to assess the potential climate change impacts for a management project or issue and then to evaluate the Adaptation Strategies and Approaches that could be used based on their specific management objectives, site conditions, and other factors. Two Illustrations (Chapter 4) provide

examples of how the Adaptation Workbook can be used based on our work with two teams from the CNNF to test and refine the Adaptation Workbook.

Integrate monitoring and evaluate effectiveness

Similar to implementation, necessary and appropriate monitoring will vary by forest owner, site conditions, management objectives, management activities, and relevant time frames. We included monitoring as a vital step within the Adaptation Workbook so that managers will identify what monitoring is necessary to determine whether implemented adaptation actions effectively meet management objectives and adapt forests to changing conditions. It will be beneficial and efficient for monitoring activities to build upon existing efforts when possible (see Appendix 1 for a list of monitoring activities in northern Wisconsin).

Summary

Through the CCRF, we have outlined a general approach for responding to climate change (Fig. 4) that can be adjusted and applied to other locations and landscapes. We have applied this process in northern Wisconsin, and will continue to work with landowners across northern Wisconsin to pursue this process and help forests adapt to the impacts of climate change. At the same time, we have begun extending this project to include all of the Northwoods of Michigan, Wisconsin, and Minnesota, as well as other regions. We recognize that this expanded effort will be able to draw greatly from the work done in Wisconsin, but it will also be different in many ways as we incorporate new partners, work across a larger geographic area, and collaborate with other groups working within different environmental and social systems.