Climate Change Vulnerability Assessments

Assessing vulnerability to address climate change impacts

Climate change vulnerability assessments (CCVAs) are a key component of how we integrate climate change considerations into management and planning at the USDA Forest Service. CCVAs evaluate the potential impacts of climate change on national forests and associated resources. This evaluation provides an understanding of why a resource is vulnerable and leads to potential adaptation actions to reduce vulnerability. CCVAs deliver conclusions at a scope and scale that is relevant to decision-making, and the process of crafting a CCVA brings together diverse types of science and information and vital partnerships.

What is vulnerability?

Vulnerability to climate change is the degree to which systems are susceptible to, and unable to cope with, the adverse effects of climate change. Although many different conceptualizations of vulnerability exist, in natural resource management, it is often helpful to think of vulnerability as a function of three important components: exposure, sensitivity, and adaptive capacity (Fig. 1).

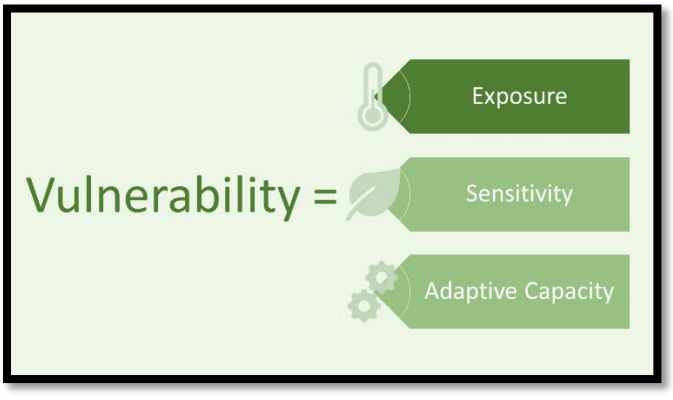

Figure 1. Three components of vulnerability.

Exposure

Exposure is the extent to which climate and climate-related changes may affect a resource or place. Depending on the resource of interest, exposure can include direct effects (increased temperatures, reduced snowfall, more extreme events, sea level rise), and indirect effects (changes in hydrology, vegetation changes, altered disturbance regimes).

Sensitivity

Sensitivity is a measure of how responsive a system or species is to climate change exposure. Sensitivity of species or ecosystems may depend on innate biological and physiological characteristics or specific physical or ecological factors. Different resources can have different sensitivities to the same level of exposure.

Adaptive capacity

Adaptive capacity is the ability of a system or species to cope with change. Adaptive capacity can include the ability of species to physically move to more favorable environments, to adapt to a changing environment, or to evolve to better survive new conditions. Although the natural resource management community generally focuses on the biological or ecological aspects of adaptive capacity, it is also useful to consider how management actions and other human dimensions influence how adaptive capacity is realized.

Assessing vulnerability

Scope and scale

The scope of a CCVA is aligned with one or more resources of interest in management and planning. These targets could include species, habitats, or ecosystems, but could also be focused on watersheds, infrastructure, recreation, cultural resources, or ecosystem services. The geographic

scale of a CCVA is relevant to management of the resource of interest and could focus anywhere from the scale of a watershed to a forest, multiple forests, or a region. CCVAs work best when they are aligned with the scale of a decision-making process, e.g., Forest Plan Revision.

Partnerships and Collaboration

Science-manager partnerships and collaboration ensure that CCVAs incorporate local knowledge and address management needs with the right scope and scale. Collaborations can include decision-makers, planners, and local managers alongside scientists within and outside of the Forest Service. Better outcomes can be achieved when the vulnerability assessment process engages with community members and Tribes who may be affected by climate change impacts to resources. In addition, input from a team of experts with a range of backgrounds and perspectives relevant to the assessment's scope is critical. These partners can include Indigenous knowledge-holders, local managers, and natural and social scientists, among others, to inform expert elicitation of a resource's climate change vulnerability.

Science and information

CCVAs evaluate the vulnerability of important resources through multiple lines of evidence. Climate information that includes historical trends and projected future changes forms the backbone of a CCVA. Vulnerability assessments then provide an evaluation of the potential effects of climate change on different resource areas. This evaluation can be accomplished in many ways, including synthesis of peer-reviewed and grey literature, elicitation from experts with a range of backgrounds and perspectives, assessment of existing ecological response models, or creation of new models that project future ecological condition or describe historical ecological dynamics due to climate change. Vulnerability can be presented as narrative descriptions, rankings, categorizations, or the identification of vulnerable locations. To accommodate uncertainty, when possible, the best practice is to provide projections of future climate and future condition of resources as a range of plausible futures.

CCVAs in the Forest Service

The Forest Service Office of Sustainability and Climate (OSC) developed The Vulnerabilty Assessment Dashboard, an interactive tool that illustrates where CCVAs have been completed across all Forest Service Regions. The Dashboard provides a breakdown of assessments completed by fiscal year, identifies which resources have been assessed, and provides links to CCVAs and other documents. These assessments vary in their scope and scale but have each been integral to recent management and planning.

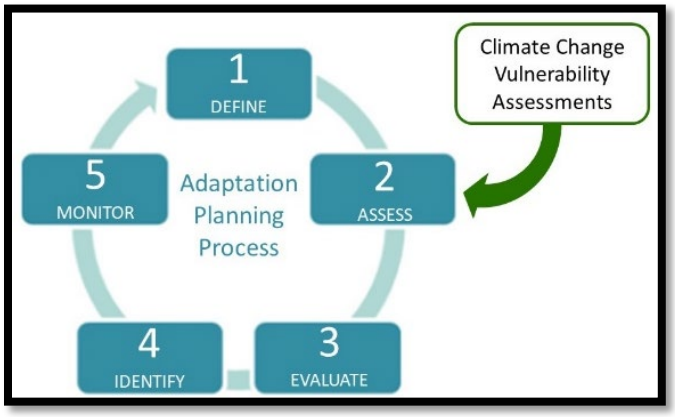

Figure 2. Climate change vulnerability assessments are an integral component of adaptation planning processes.

CCVAs are used in adaptation planning processes at the Forest Service, such as the multi-step Adaptation Workbook, which integrates assessments into management and planning (Fig. 2). Some vulnerability assessments also include descriptions of potential adaptation actions that can be taken to address climate vulnerabilities. These adaptation actions are often developed and selected through collaborative processes and reflect practitioners' input on appropriate management techniques.

For more information on CCVAs, see the guidebooks: Responding to Climate Change in National Forests and Forest Adaptation Resources: Climate Change Tools and Approaches for Land Managers.