SAFEGUARDING WILDLIFE FROM CLIMATE CHANGE

Quick Guide to Vulnerability Assessment

Global warming is already disrupting the natural ecosystems on which both people and wildlife depend. The fate of our wildlife and wild places will depend on steps we take now to help them survive in the face of a changing climate. **Vulnerability assessment** is a tool for determining which of our species and ecosystems are likely to be most severely affected by climate change. Understanding vulnerability to shifts in climate provides key insights for developing adaptation strategies designed to safeguard our natural heritage.

Many coastal habitats are vulnerable to sea-level rise and other climate change effects.

WHAT IS VULNERABILITY TO CLIMATE CHANGE?

Plant and animal species—"wildlife" in the broadest sense—vary widely in how they are likely to respond to changes in temperature, precipitation, and other factors brought about by global warming. Vulnerability to climate change refers to the likelihood that these climate-induced shifts will have an adverse impact on a given species, habitat, or ecosystem. More vulnerable species and systems are likely to experience greater impacts from climate change, while less vulnerable species and systems will be less affected, or may even benefit.

A KEY TOOL FOR ADAPTATION PLANNING

With the impact of climate change on our wildlife and natural ecosystems becoming increasingly evident, wildlife and natural resource managers are now confronting the difficult task of re-envisioning conservation for a changing world. Preparing for and responding to the impacts of global warming—**climate change adaptation**—is fast becoming an overarching framework for conservation and wildlife management planning. Adaptation planning, in turn, depends on a sound understanding of how our changing climate is likely to affect wildlife and their habitats—critical information provided by vulnerability assessments.

Vulnerability assessments are a key tool for adaptation planning, and an essential first step as states begin the task of updating their wildlife action plans to take climate change into account. By detailing the ecological impacts and implications of climate change on our wildlife, vulnerability assessments can help managers:

- identify those species and systems most likely to be in need of conservation actions as a result of climate change;
- develop adaptation strategies tailored for managing species and habitats in greatest need;
- foster collaboration at statewide and regional scales by providing a shared understanding of impacts and management options; and
- allow scarce resources for wildlife conservation to be allocated efficiently in the face of climate change.

COMPONENTS OF VULNERABILITY

Vulnerability consists of two basic elements, ***sensitivity*** and ***exposure***. Sensitivity is a measure of whether and how a species or system is likely to be affected by a given change in climate. Exposure is a measure of how much of a change in climate a species is likely to experience.

Fish such as trout and salmon thrive in cold water and are particularly sensitive to increases in water temperature.

As an example, fair-skinned individuals usually are more sensitive to sunburn than those with deeper skin tones. However, depending on one's exposure to UV rays (e.g., hours in the sun or strength of the sun's rays), most anyone can suffer a sunburn. Vulnerability—in this case to sunburn—is a function of both sensitivity and exposure. Assessing vulnerability thus entails analyzing both the inherent sensitivity of a species or system to likely climate change effects, as well as the likely magnitude or degree of exposure to those effects.

ASSESSING SENSITIVITY

The sensitivity of a species, habitat, or ecosystem to climate change reflects the degree to which that organism or system is susceptible, either directly or indirectly, to those changes. For example, a cold-water trout species living at the upper end of its temperature threshold would be highly sensitive to increases in water temperature. Many aspects of a species' life history make it more or less sensitive to climate change. For example, is the species:

- physiologically sensitive to changes in temperature or precipitation?
- found in habitats likely to be significantly affected by climate change?
- closely tied to one or more disturbance regimes (e.g., fire, floods) likely to be altered by climate change?
- limited in its ability to disperse?
- highly dependent on specialized habitats, on certain other species, or on the timing of ecological events?

There are several approaches to answering these and other pertinent questions regarding sensitivity. The answers can be derived from a variety of sources including literature searches, expert opinion, and models. Various types of models can be used including population models, energetics models, correlative "climate envelope" models, and dispersal models.

ASSESSING EXPOSURE

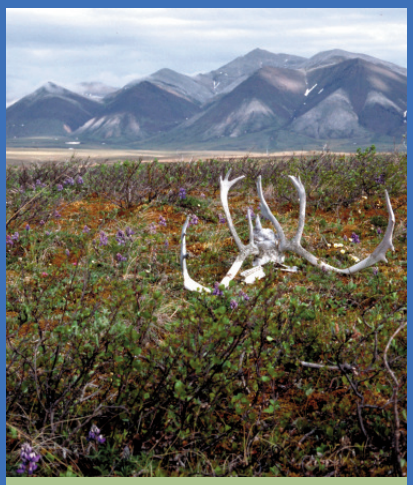
Exposure refers to the amount of climatic or environmental change that a species, habitat, or ecosystem is facing. Assessing exposure entails projecting future climatic conditions, preferably with a focus on those with ecologically relevant effects (e.g., extremes in summer temperature or onset of ice-break-up). Types of information useful for assessing the potential exposure of a species or a system to climate change include:

Climate Change Projections ~ Assessments can take advantage of summarized regional trends (e.g., average temperatures projected across a region) or more geographically explicit data from downscaled-climate projections derived from general circulation models (GCMs) or regional climate models (RCMs).

Historic Climate Trends ~ As with the stock market, although past performance is no guarantee of future results, past climate trends offer useful predictors of future change. Historic climatic trends are often available for a region as weather-station data or modeled grids of temperature and/or precipitation.

Projected Habitat Changes ~ Many models can be used to simulate habitat changes in response to altered climates, such as dynamic global vegetation models, forest gap models, correlative "climate envelope" models, hydrologic models, sea-level rise projections, and fire models.

Expert Opinion ~ In many cases, downscaled climate data and vegetation-model projections will be unavailable or too expensive to develop. In these instances, expert opinion can be useful for assessing the likelihood of how future local climates will reflect regional projections or how habitats will change. Expert opinion should be accompanied by an estimate of certainty and description of the assumptions, evidence, or reasoning underlying the opinion.



The arctic is experiencing extremely rapid warming, exposing many of its species and habitats to unprecedented levels of change.

TEN TIPS FOR CLIMATE CHANGE VULNERABILITY ASSESSMENTS

There is no single best approach to assessing wildlife vulnerability to climate change. Assessments can focus on plant and animal species, habitats, or ecosystems, depending on the specific needs of the wildlife or resource managers. Assessments can be quantitative, qualitative, or both. They can vary considerably in their level of detail, scale, and scope, depending on factors such as data availability, levels of funding, and time constraints, as well as the particular conservation goal or goals of concern. And they can consider one or more scenarios of future change. Indeed, there is no "one-size-fits-all" method for conducting vulnerability assessments; the approach taken will depend on user needs and other considerations.

Based on a review of many of the existing assessments of wildlife vulnerability to climate change that have been carried out or are underway, we have identified the following ten tips for conducting wildlife and ecosystem vulnerability assessments.

1. Begin with a clear understanding of user needs.
Why is the assessment needed (e.g., updates of state wildlife action plans, refuge or national forest planning), and how will it be used?

2. Determine the target of the assessment.
Will the assessment address species, ecosystems, habitats, specific sites (e.g., wildlife refuges, state parks), or some combination of these targets?

3. Determine the spatial and/or temporal scale of the assessment.
What will the geographic extent of the assessment be? What is the ideal spatial and temporal resolution for climate, vegetation, ecosystem, or species data? What is the level of specificity or precision required in the results?

4. Design assessment products with stakeholder input.
What types of products will be most useful to intended users? Will maps, lists, rankings, tables, or some combination of products be most useful?

5. Collaborate with regional experts.
Who in the region (or nationally) has expertise in climate change, vegetation, hydrological, fire, or sea-level modeling, and knowledge of the species, habitats, or ecosystems? Can they provide data or advice on obtaining appropriate data?

6. Build from existing efforts.
Use other assessments as models and sources of relevant information. For instance several states (e.g., Massachusetts, Nevada, New York, Virginia, Washington) are undertaking wildlife vulnerability assessments.

7. Weigh budget and time constraints when selecting tools and methods.
Carefully consider the level of specificity needed when selecting tools and methods. Some modeling approaches take considerable time, funding, and expertise to run and apply.

8. Understand, describe, and if possible quantify the uncertainties in the results.
Where are the key uncertainties in the results? Are there particular results relatively robust to uncertainties in, for example, precipitation projections?

9. Design the assessment so it can be easily repeated.
Ideally, updated climate and climate-impact projections can be applied to an existing assessment framework and new results easily generated.

10. Share the information about your process and results.
Sharing information and results can help eliminate duplication of efforts and can foster collaboration across states and institutions.

Assessing the vulnerability of species such as American pika involves consideration of their sensitivity to changes in climate, and the likely degree of exposure to those changes.

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