

Project Title: “Applying Vulnerability Assessment Tools to Plan for Climate Adaptation: Case Studies in the North Pacific LCC”

Project Category: Cross-Ecosystems

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Partners: Elizabeth Gray, The Nature Conservancy, Seattle, WA; J. Michael Scott, USGS and University of Idaho, Moscow, ID; Brad McRae, The Nature Conservancy, Seattle, WA; Leona Svancara, Idaho Department of Fish & Game, Boise, ID; Rocky Beach, Washington Department of Fish & Wildlife, Olympia, WA; Regina Rochefort, National Park Service, Sedro-Woolley, WA; Dan Siemann, National Wildlife Federation, Seattle, WA. Anticipated contributions: all partners named above have developed the climate change vulnerability assessment approach, and will help guide the selection of specific case study areas.

Project Summary: This project will apply the results of an on-going climate change vulnerability assessment to the management of two complex landscapes. The vulnerability assessment project team will work with managers, land-owners, and conservation practitioners to explore 1) how downscaled climate datasets, modeled vegetation changes, and information on estimated species sensitivities can be used to develop climate change adaptation strategies, and 2) how model results and datasets can be made more useful for informing the management of species and landscapes. To accomplish these two goals, we will prepare datasets and model outputs for two landscapes—potentially, the Willamette Basin landscape in Oregon, and the protected areas network in British Columbia, Canada—and hold workshops with stakeholders in both regions.

Project Need:

Over the last 100 years, average annual global temperatures have risen 0.7 °C (IPCC 2007). This trend in warming is projected to continue into the future and will likely be accompanied by changes in precipitation patterns. Global average surface temperatures are projected to rise between 1.1 and 6.4 °C by 2100 (IPCC 2007). Although projected changes in precipitation are less consistent, the Pacific Northwest of the United States is projected to experience wetter winters and drier summers.

There is ample evidence that recent climatic changes have altered ecological systems, producing shifts in both the timing of ecological events and the distribution of species (Walther et al. 2002, Parmesan and Yohe 2003, Root et al. 2003, Parmesan 2006). The ecological impacts of projected climatic changes are expected to be greater than those recorded in the past century in extent and magnitude (e.g., Thomas et al. 2004). To successfully protect biodiversity, conservation planning and management strategies must account for the effects of climate change.

One of the first steps towards developing strategies to address climate change is to understand how and to what degree ecological systems and species will be vulnerable to projected changes. The Pacific Northwest Climate Change Vulnerability Assessment is an ongoing effort to provide such an understanding for the systems and species of the northwestern United States and southwestern Canada. The assessment is a joint effort of the Universities of Washington and Idaho, The Nature Conservancy, USGS, National Wildlife Federation, and

Idaho, Washington, and Oregon state wildlife agencies, and is being led by a team that includes Dr. Lawler (PI of this proposed project). The project has several major components:

1. Building an on-line database to document the inherent sensitivities of the species and systems of the Pacific Northwest to climate change (currently being populated with information for over 300 species and many terrestrial, freshwater, and marine systems).
2. Developing multiple downscaled climate datasets for projected future climates in the Pacific Northwest to roughly 1-km resolution.
3. Projecting changes in vegetation. Vegetation changes are being modeled mechanistically using the Lund Potsdam Jena dynamic global vegetation model (Sitch et al. 2003) and correlatively using machine-learning and statistical approaches.
4. Projecting potential changes in animal species distributions. The project will use a combination of correlative and mechanistic models to project potential shifts in species distributions in response to forecasted climatic changes.

There is clearly a need for this type of information to inform management and planning in the face of climate change. However, perhaps an even more critical need than the data themselves is an understanding of how to use those data to develop management plans and climate-adaptation strategies. Here we propose to integrate knowledge of projected climate impacts into land- and wildlife-management and conservation planning by working with managers, business- and land-owners to apply the results of the Pacific Northwest Climate Change Vulnerability Assessment to planning efforts in two areas within the North Pacific LCC: the Willamette Basin landscape, and the British Columbia protected areas network.

This project will also address the need to develop climate, land-cover, and other datasets that are useful to managers. In the process of applying the results of the regional vulnerability assessment to the two case study areas, we will determine how the different assessment products can be made more relevant for answering management questions and making business decisions, and answer the call for a more integrative role for research scientists in resource management (Lach et al. 2003).

Objectives: This project directly supports the LCCs' objective to produce decision support tools, systems, and science applications for focused resource conservation. The overarching goal of this project is to inform on-the-ground management and planning with data and tools for assessing climate vulnerability. More specifically, the project has two main objectives. These are to work with stakeholders to determine:

1. How downscaled climate datasets, modeled vegetation changes, and information on estimated species sensitivities can be used to develop climate-change adaptation strategies; and
2. How model results and datasets can be made more useful for informing management of species and landscapes in a changing climate.

Methods: We will work with managers, business- and landowners, and conservation practitioners to use the results of a regional climate change vulnerability assessment to develop conservation and management plans that take climate change impacts into account. The process will have four steps.

Step 1 is to finalize the selection of two case study areas. Here, we have proposed to use two landscapes as case studies—the Willamette Basin, and the British Columbia protected areas network. These potential case studies are described below. However, the final decision on

whether to use these two areas or others as cases studies will be made after consultation with the partners listed above and the staff of the North Pacific LCC to assure that these studies will provide the greatest benefit to the largest number of partners.

Potential Case Study 1: The **Willamette Basin** in Oregon has extensive agriculture and residential development in its valley floor, bounded on either side by the mostly-forested Cascade and Coast Mountain ranges. A number of previous studies have examined the potential impacts of land-use change on vertebrates, as well as strategies to maintain both economic returns and species conservation (Polasky et al. 2005, Polasky et al. 2008), but what has been missing so far is incorporating an assessment of climate change vulnerability in this area.

Potential Case Study 2: The **British Columbia Parks and Protected Areas network** includes a large number of protected areas extending from the U.S.-Canada border north into B.C. Conifer forests of various types are the dominant land cover (including subalpine and alpine habitats) as well as alpine meadows at higher elevations. One key question for this case study is how a *network* of protected areas does or does not provide protection opportunities for plant and animal species in the face of projected shifts in climate and vegetation types. Identifying potential sites of climate refugia could be one outcome of the case study (Stevens 2007). Projections of changes in tree mortality and fire frequency will take ecological as well as economic importance (Spittlehouse 2008).

Step 2 in the project will be to tailor vulnerability assessment outputs and tools to the needs of the specific case studies, both in terms of the spatial extents of the two areas and the specific species and systems in the two regions. This step will require discussions with our case-study partners to identify their specific management objectives and data needs for addressing climate-adaptation planning.

Step 3 in the project will be to design and hold workshops with managers, landowners, and conservation practitioners from each region. These will be one- to three-day workshops in which the research team works with the stakeholders to interpret the results of the vulnerability assessment in light of their specific management needs. The workshops will result in draft Climate Adaptation Plans that provide guidance for land and wildlife management in the region in the face of climate change. In addition, the workshops will highlight ways in which the outputs of the vulnerability assessment can be modified to be of more use to stakeholders (e.g., additional bioclimatic variables that can be calculated and mapped, specific measures of uncertainty or variability in climate factors, landscape pattern analyses or assessments).

Step 4 in the project will be to process the results of the workshops. We will work with our partners in the two regions to produce Climate Adaptation Plans. We will also use the information gleaned in the workshops to inform the final analyses and product creation in the vulnerability assessment. In addition, locating case studies in different parts of the North Pacific LCC, and encouraging communication between them, will increase learning opportunities across states and agencies grappling with similar climate-related concerns.

As discussed above, this project leverages the work of the Pacific Northwest Climate Change Vulnerability Assessment project. The vulnerability assessment is funded by the USGS, The Nature Conservancy, the National Parks Service, and the National Wildlife Federation for a total of roughly \$1.1M. These climate adaptation case studies would also complement two case studies proposed for the Great Northern LCC, which involve different partnerships, and arid, mostly shrubland landscapes, but using the same approach. Dr. Lawler is involved with all of these efforts and can help facilitate synergies among them.

Deliverables:

We will produce a Climate Adaptation Plan for each of the two case-study regions. These plans will provide general and specific guidance for the management of the species and systems in each region in light of projected climatic changes and impacts. We will also produce a list of specific recommendations for refinement of the vulnerability assessment products and tools, and identify key information needs that will not be met by that assessment. Finally, we will produce a final report for the North Pacific LCC as well as one or more published manuscripts describing the process and the lessons learned. These specific deliverables will be submitted by December 2012, as shown below:

	<i>Task</i>	<i>Dates</i>
Step 1	Finalize case study selection: Communicate with North Pacific LCC coordinators and science staff, Vulnerability Assessment team and advisory board, and potential case study partners	SEP-DEC 2011
Step 2	Tailor Vulnerability Assessment products for the two case study sites:	
	Write out conservation priorities, management objectives, species and ecosystems of interest, and data needs for each case study site. Create custom datasets, GIS layers, maps, and collect additional data for use in each case study site	JAN-APR 2012
	Plan dates and logistics for climate adaptation workshops	FEB-MAR 2012
Step 3	Develop and Hold Climate Adaptation Workshops: Hold workshops in two case study sites and identify individuals participating in Step 4.	MAR-JUN 2012 (or later if requested)
Step 4	Develop Climate Adaptation Plans, recommendations for the Vulnerability Assessment team, and manuscripts:	
	Write climate adaptation plans for each case study site, and recommendations for the VA team, and send drafts to partners for review	JUL-OCT 2012
	Write manuscripts for publication describing the case study process and lessons learned, and send drafts to partners.	JUL-OCT 2012
	Submit final versions of deliverables and final report to North Pacific LCC coordinators	DEC 2012
	Submit manuscripts for publication	DEC 2012-JAN 2013
	Present results and conclusions at scientific meetings	2013

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