

Forest Management and Climate Change: A Synthesis of Genetic and Silvicultural Options for the Western U.S.

*Glenn Howe¹, J. Bradley St.Clair², Paul Anderson², Jeff DeBell³,
Sara Lipow⁴, David Harry¹, Marilyn Cherry¹, and Doug Maguire¹*

¹Dept of Forest Science, Oregon State University; ²U.S. Forest Service, Pacific Northwest Research Station;
³Washington Dept of Natural Resources; ⁴Oregon Dept of Forestry

I. Abstract.

We propose to evaluate how climate change will affect forest trees in the western United States, and then recommend genetic and silvicultural options for maintaining the adaptability, productivity, and value of western forests under a range of climate change scenarios. Specifically, we propose to (1) develop a multi-disciplinary taskforce of forest managers, forest geneticists, tree breeders, silviculturists, and tree physiologists; (2) conduct a literature review and problem analysis that will (i) describe how trees are likely to respond to alternative climate change scenarios, (ii) evaluate potential genetic and silvicultural options for dealing with climate change, and (iii) develop a strategic plan for filling important information gaps; and (3) implement an outreach education program to inform forest managers and policy makers about the potential effects of climate change and their forest management options. ***Our overall goal is to provide public and private forest landowners with science-based management options suitable for meeting diverse management objectives under alternative climate change scenarios.***

II. Background.

The Intergovernmental Panel on Climate Change (IPCC) projects that global average surface temperatures will rise about 1.8 to 4.0°C during the 21st century (Table SPM.3 best estimates; http://www.ipcc.ch/WG1_SPM_17Apr07.pdf). Furthermore, confidence is increasing on regional-scale projections of changes in temperature, precipitation, climatic extremes, wind patterns, and ice. Adaptability, which refers to the ability of forest trees to tolerate abiotic and biotic stresses such as cold, drought, insects, disease, and fire, has both genetic and environmental components which can be altered via forest management. The genetic contribution can be influenced positively or negatively depending on which seed source is used for reforestation, whereas the environmental component can be altered by silvicultural treatments such as thinning and fertilization. Because populations of forest trees are genetically adapted to their local climates, adaptability may decline as climates change, whereas short-term productivity may increase or decrease depending on location. Furthermore, because climate change may increase fires, droughts, and pests, changes in silvicultural prescriptions may be desirable. Our problem analysis will address these and other questions, and then develop recommendations for forest managers, policy makers, and scientists in public agencies, forest industry, and non-governmental organizations (NGOs). For example, should we change seed zones and breeding zones to prepare for climate change? Should breeding programs focus more heavily on other traits such as drought hardiness? Should we be thinning forests earlier and more heavily? What new knowledge will be most important for making wise forest management decisions in the future?

III. Deliverables (see *Proposed activities* for more details).

1. Taskforce deliverables

- **Coordinated, multi-disciplinary research and technology transfer.** We will help coordinate the climate change activities of industry-university forestry cooperatives (e.g., PNWTIRC, NWTIC, CIPs), state agencies (e.g., ODF, WDNR), federal agencies (e.g., USFS PNWRS, USFS WWETAC, BLM), universities (e.g., OSU), and others (e.g., NGOs).

2. Literature review and problem analysis deliverables

- **Scientific literature review and problem analysis** on forest management and climate change.

- **Recommendations for forest landowners**, including decision-support tools that will describe management options for meeting a range of management objectives under alternative climate change scenarios.
- **Strategic plan for filling important information gaps.**

3. *Outreach and education deliverables*

- **Web portal** for practical information on forest management and climate change that is relevant and accessible to forest landowners, including web-based decision-support tools that will allow managers to evaluate genetic and silvicultural options for meeting a range of management objectives under alternative climate change scenarios.
- **Expert list** for information on forest management and climate change (i.e., web-accessible list of technical expertise and contact information for members of the climate change taskforce).
- **Fact sheets** on forest management and climate change. The problem analysis will be distributed as a series of fact sheets, with each fact sheet focusing on a separate problem analysis sub-topic.
- **Problem analysis for forest landowners** (downloadable publication).
- **Speaker's Bureau presentations** that will be added to OFRI's collection of PowerPoint presentations (with associated notes).
- **Workshops** to inform outreach and education specialists on genetic and silvicultural options for adapting to climate change (i.e., to "train the trainers").

IV. Proposed activities.

1. Develop a multi-disciplinary taskforce to coordinate climate change activities. We will develop a multi-organizational, multi-disciplinary team of forest managers, forest geneticists, tree breeders, silviculturists, and tree physiologists to guide the problem analysis and outreach education activities. This team will coordinate research, outreach, and education on forest management in relation to climate change among industry-university forestry cooperatives (e.g., PNWTIRC, NWTIC, CIPs), state agencies (e.g., ODF, WDNR), federal agencies (e.g., USFS PNWRS, USFS WWETAC, BLM), universities (e.g., OSU), and others (e.g., NGOs). A provisional team has already been assembled (Western Forests Climate Change Task Force; <http://www.cof.orst.edu/cof/fs/wfcctf/people.htm>).

2. Synthesize relevant literature and conduct a problem analysis. The taskforce will conduct a scientific literature review and problem analysis that will (1) describe how trees are likely to respond to alternative climate change scenarios in the next 100 years, (2) evaluate potential genetic and silvicultural options for dealing with climate change, and (3) develop a strategic plan for filling important information gaps. We will assess **how climate change will affect forest trees**: What climatic changes are projected for the western U.S.? How do these projections vary among climate models? How will these changes affect the adaptability and productivity of forest trees over the next 100 years? Furthermore, we will develop a mechanism for updating and revising these projections as we learn more about climate change in the future.

After considering the effects of climate change, we will provide **recommendations** to forest managers and specialists (e.g., forest geneticists, tree breeders, silviculturists, forest health specialists) about how to adapt to any adverse effects that are identified. We will examine what **genetic and silvicultural options** are available to prepare for climate change. In addition to the questions raised in the *Background*, we will ask questions such as: Which seed sources and silvicultural practices are best suited to future climates? How can we monitor forests to identify emerging problems and respond to them quickly? How will stand and individual-tree growth projections change in future climates? Can we incorporate climatic variables into the growth models commonly used by forest managers? Should we begin actively managing protected areas (i.e., areas that could become increasingly maladapted in the future)?

We will also develop a **strategic plan for filling important information gaps** that will identify the new knowledge needed to make wise forest management decisions in the future, the activities needed to fill these gaps, and how these activities can be funded. This strategic plan will also identify the people who are working on relevant climate change issues to foster collaboration and minimize duplication of efforts.

3. Outreach and education. The outreach and education program will help the contributing organizations and their stakeholders understand climate change issues and management options for maintaining healthy forests. The taskforce will develop and maintain a **web portal** that will serve as a clearinghouse for current information on climate change and its potential effects on forest trees that is relevant and accessible to forest landowners, including links to other climate change research and outreach activities in the region (e.g., OFRI and USFS web sites). Information from the literature review and problem analysis will be added to this web portal as it becomes available (see IV.2., above). The web portal will also include an **expert list** of technical expertise and contact information for members of the taskforce that can be used by forest landowners to obtain information on specific topics of interest.

We will publish articles, develop presentations, and offer workshops for land managers, policy makers, scientists, and the public. At the end of the project, the scientific literature review and problem analysis will be published as a **problem analysis for forest landowners**, a document written specifically for forest landowners that will be accessible via the internet. To inform forest managers as quickly as possible, we will initially distribute this problem analysis as a series of **fact sheets** that focus on specific problem analysis sub-topics. We expect to distribute at least four of these fact sheets each year. Fact sheet information will also be developed into **Speaker's Bureau presentations** (i.e., content slides and notes) that will be added to OFRI's collection of PowerPoint presentations. We will work with OFRI communication specialists to modify these presentations to the desired audiences, and will conduct **workshops** to teach outreach and education specialists about genetic and silvicultural options for adapting to climate change (i.e., workshops to "train the trainers").

V. Project organization.

1. Personnel. A post-doctoral scientist will be hired to serve as the taskforce Director for two years. A taskforce Steering Committee of three people will guide the activities of the Director. The Steering Committee will consist of Glenn Howe (OSU; physiological genetics and tree breeding), Brad St.Clair (USFS; genecology, seed zones and breeding zones), and Paul Anderson (USFS; silviculture and physiology). The Technical Committee, which will ultimately consist of one representative from each contributing organization, will help set taskforce priorities and provide technical expertise on forest management activities. Currently, the Technical Committee consists of representatives from organizations that have already contributed, plus organizations that are likely to contribute:

Advisory Group (Advisory Group members are also members of the Technical Committee).

- Glenn Howe – OSU, Pacific Northwest Tree Improvement Research Cooperative (PNWTIRC)
- Brad St.Clair – USFS Pacific Northwest Research Station
- Paul Anderson – USFS Pacific Northwest Research Station

Director – Post-doctoral scientist to be hired.

Technical Committee

- Paul Anderson – USFS Pacific Northwest Research Station, Corvallis, OR (contributor)
- Brad St.Clair – USFS Pacific Northwest Research Station, Corvallis, OR (contributor)
- Jeff DeBell – Washington Department of Natural Resources, Olympia, WA (contributor)
- Becky Kerns – USFS Western Wildland Environmental Threat Assessment Center, Prineville, OR (contributor)
- Doug Robin – Oregon Department of Forestry, Salem, OR (contributor)
- Glenn Howe – OSU PNWTIRC, Corvallis, OR (in-kind contributor)
- George McFadden – Bureau of Land Management, Portland, OR (contributor)
- Mike Cloughesy – Oregon Forest Resources Institute, Portland, OR (contributor)
- Vicky Erickson – US Forest Service Region 6, Portland, OR (potential contributor)
- Tom Blush – US Forest Service Region 5 (potential contributor)

We will be soliciting support from additional organizations, including state and federal parks, forest industry, and non-governmental organizations. Other Collaborators will contribute technical expertise in specific areas:

Collaborators

- Glenn Ahrens – OSU Department of Forest Science, Astoria, OR
- Carol Aubry – US Forest Service Region 6, Olympia, WA
- Dominique Bachelet – The Nature Conservancy, Olympia, WA
- Marilyn Cherry – OSU PNWTIRC, Corvallis, OR
- Nick Crookston – USFS Rocky Mountain Research Station
- Peter Gould – USFS Pacific Northwest Research Station, Olympia, WA
- Connie Harrington – USFS Pacific Northwest Research Station, Olympia, WA
- David Harry – OSU Department of Forest Science, Corvallis, OR
- Keith Jayawickrama – OSU Northwest Tree Improvement Cooperative (NWTIC), Corvallis, OR
- Jeremy Littell – University of Washington Climate Impacts Group, Seattle, WA
- Doug Maguire – OSU Center for Intensive Plantation Silviculture (CIPS), Corvallis, OR
- Eric Turnblom – University of Washington Stand Management Cooperative (SMC), Seattle, WA

A list of other potential Collaborators is listed on the web site of the Western Forests Climate Change Task Force (<http://www.cof.orst.edu/cof/fs/wfcctf/people.htm>).

2. Funding. Direct costs for the initial two-year effort are expected to be about \$100K per year, for a total of \$200K, including salary and other personnel expenses (OPE) for the post-doctoral scientist, travel, and other administrative costs for all project activities, including outreach and education.

Expectations for direct contributions are \$10K/year for land management organizations with more than 300,000 acres, and \$5K/year for organizations with fewer than 300,000 acres. We will also seek additional funds from competitive and non-competitive grants and contracts to help support project activities.

Direct funding for the TAFCC.		Funds*		
Source		Year 1	Year 2	Total
Bureau of Land Management		\$10,000	\$10,000	\$20,000
Oregon Department of Forestry		10,000	10,000	20,000
Oregon Forest Resources Institute		10,000	10,000	20,000
USFS Pacific Northwest Research Station		20,000	20,000	40,000
USFS Western Wildland Environmental Threat Assessment Center		10,000	10,000	20,000
Washington Department of Natural Resources		10,000	10,000	20,000
Total committed funds (in bold)		70,000	20,000	90,000
Total expected funds		70,000	70,000	140,000
Funds needed to achieve \$200K target		30,000	30,000	60,000

*Committed funds are shown in bold. Non-committed funds are shown in regular font. Non-committed funds are second year requests that have not yet been allocated by the source organization.

Indirect contributions now include contributions from Oregon State University (salary and OPE for Glenn Howe at 5% time, plus waived overhead), PNWRS (salary, OPE, and overhead for Brad St.Clair and Paul Anderson at 5% time each), and the PNWTIRC (salary, OPE, and overhead for Marilyn Cherry at 1% time).