Outline

What is known: tree mortality, forest insects, diseases & climate change?

- DROUGHT!! What happens to trees after drought?

- Resources on climate change and forest insect and diseases

- Western Region Tribal IPM Workgroup

Discussion, comments, questions
– What’s happening in a forest near you?
Increasing stand density
Altered species composition
Root disease, Dwarf mistletoe, Ips beetles
Fire suppression

D. Conklin, USFS
How will forests respond to climate change?

Warming will

- decrease snowpack,
- cause earlier snowmelt,
- increase summer evapotranspiration,
- increase the frequency and severity of droughts,
- increase risk of frost injury
- change germination time
- change time of bud set and bud break

Fire! Drought stress! Lack of water!
Locations of increased forest mortality due to drought & high temperatures

Why do trees die after drought?

Aspen - Hydraulic damage persisted in dying trees

Deterioration- 9 years post stress.

Also + insects and pathogens (secondary organisms)

Similar findings for pinyon (Mueller, 2005)


Photo Credit: Palvcova, Univ of Alberta & astate.edu
In areas where drought occurred
- More trees die in fires!

Recent physiological evidence show that both drought and heating from fire can impair xylem conductivity.

Warming may also increase forest fire severity (number of trees killed) independent of fire intensity!!


Photo Credit: Windandsong.com; duke.edu
Good news. Some trees use less water with high CO$_2$

- increase in water-use efficiency in temperate and boreal forests of the Northern Hemisphere over the past two decades
- increasing photosynthesis, net carbon uptake, and decreasing evapotranspiration.


Photo Credit: Chris Vogel, NY Times
Manage water for forest health!

Mulch
Thinning and species selection
Soil conservation
Irrigation

Water for fish? Water for farms? Water for city people?
Water for the forest?

Resources: Literature Review and Risk Assessment

• Pathogens (fungi) reproduce quicker than trees

• Drought stress! Triggers fungi

• In warmer and drier climates – root diseases are predicted to cause the most mortality and growth loss
Resources

Pacific Southwest Research Station

Research Topics

Climate Change, Mitigation, and Adaptation Science

Main Topic | Climate Change | Ecosystem Effects | Carbon Cycle | Mitigation & Adaptation Strategies

Annotated Bibliography of Climate and Forest Diseases of Western North America

The Forest Service PSW Research Station and Western Wildland Environmental Threat Assessment Center maintain an annotated bibliography of research on forest pathogens and climate. Citations and summaries for over 500 records of journal articles and working papers are retrievable by author, topic, species, or geographic area. Each search will produce an annotated bibliography of all citations matching user specifications. The bibliography focuses on Western North American forest pathogens but some articles from other geographic areas are also included.

Download a printable version of all records in the bibliography (pdf 1.3 MB)

If you have questions or publications that need to be added contact afranked@fs.fed.us.

Search Filter - Leave all fields blank to see all records. The more information entered, the narrower the results. Entering Jones Smith in the Author field will select a record only if both Jones and Smith were authors. Selecting Subject "Rust" and Tree "Pinus" selects only records that contain both.

Select by Author:
(Leave blank for all authors.)

Select by Title:
(Leave blank for all titles.)

Limit to this Subject Area:
(Leave blank for all subjects.)

Limit to this Tree Species:
(Make no selection for all species / no preference.)

Limit to this Geographic area:
(Make no selection for all areas / no preference.)

Limit to this type of climate change:
(Leave blank for all change types.)

Your current selection(s)

Results 1-20 of 576

Ogren, E.J; Nilsson, T.J; Sundblad, J.G. 1999. Relationship between respiratory depletion of sugars and loss of cold hardness in coniferous seedlings overwintering at...

www.fs.fed.us/psw/topics/climate_change/forest_disease/
Climate change and forest diseases

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As climate changes, the effects of forest diseases on forest ecosystems will change. We review knowledge of relationships between climate variables and several forest diseases, as well as current evidence of how climate, host and pathogen interactions are responding or might respond to climate change. Many forests can be managed to both adapt to climate change and minimize the undesirable effects of expected increases in tree mortality. We discuss four types of forest and disease management tactics – monitoring, forecasting, planning and mitigation – and provide case studies of yellow-cedar decline and sud
Conifer bark beetles mortality in the western US, 1997-2009

<table>
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<th>State</th>
<th>Acres</th>
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<tr>
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<tr>
<td><strong>TOTAL ACRES</strong></td>
<td><strong>41,722,000</strong></td>
</tr>
</tbody>
</table>

Credits: USFS. 2011. Western Bark Beetle Strategy
Roundheaded pine beetle, *Dendroctonus adjunctus*

Mexican pine beetle, *Dendroctonus mexicanus*

Southern pine beetle, *Dendroctonus frontalis*

Mountain pine beetle, *Dendroctonus ponderosae*

Carbon. Beetles cause forest to go from sink to source.

Western Region Tribal Integrated Pest Management Workgroup

Mission: Protecting tribal natural and cultural resources through understanding.

Forest health –
Invasive species –
Weeds? Insect outbreak?

Nina Hapner, Kashia Band of Pomo Indians;
Janice Alexander, UC Cooperative Extension, Marin County;
Carla Thomas, UC IPM Center, UC Davis
Susan Frankel, USDA – Forest Service, Berkeley, CA

Photos: L.L. George; Hearst Museum, from Bowcutt
Acknowledgements

USDA Forest Service,
Pacific Southwest Research Station
and the Western Wildland Environmental Threat Center (WWETAC)
Foe for a particular species?

Chestnut blight, Dutch Elm Disease, White Pine Blister Rust – Invasives!!
What is the role of fungi?  Permian times
Global fungal apocalypse??

Shaper of life? Warm-blooded mammals evolved to defend against fungal infections

Can we predict the role of plant pathogens 1 million years from now?

Fungi
200,000 species known to be plant pathogenic
1.5 million fungal species – total

Oomycetes – *Phytophthora* species
Bacteria
Viruses
Nematodes
Parasitic plants
Abiotic injury – freeze, sunscald, hail damage
Sudden Aspen Decline - Severe drought in 2002

Photos: James Worrall, US Forest Service, Rocky Mountain Region
Pinon Juniper mortality

Photos: USDA-FS, Carsen NF, Craig Allen, USGS
Aspen

Bronze poplar borer
*Agrilus liragus*

Aspen habitat to decrease by 10% to 40% by 2030 (Rehfeldt, Ferguson, and Crookston 2009).

Cytospora Canker

Photos: Forestryimages.org
Aspen - Browse

Photos: USFS