An Overview of Climate, Climate Change and Forest Insects and Pathogens

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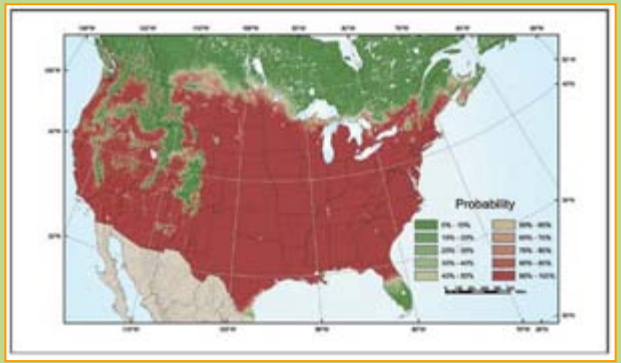
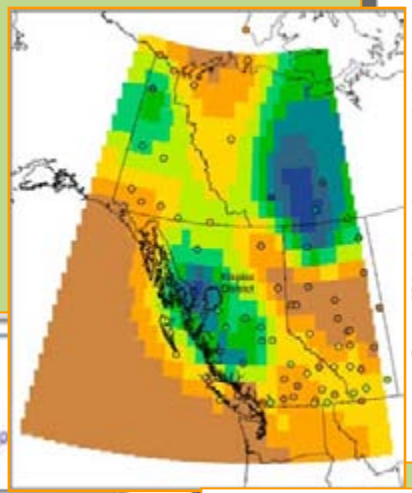
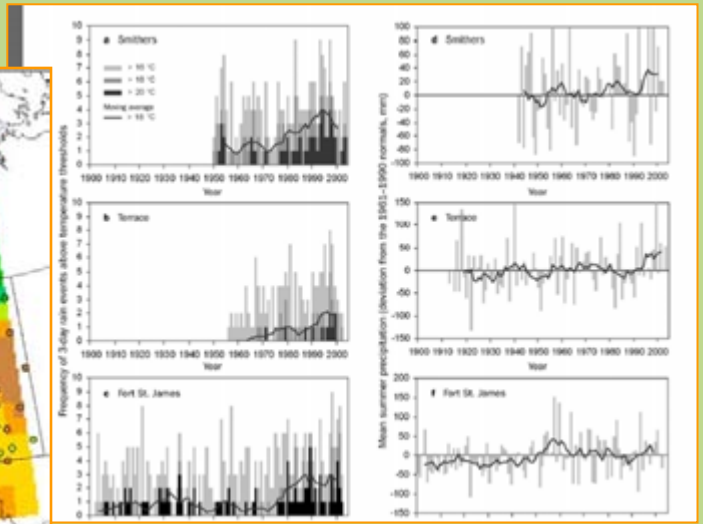
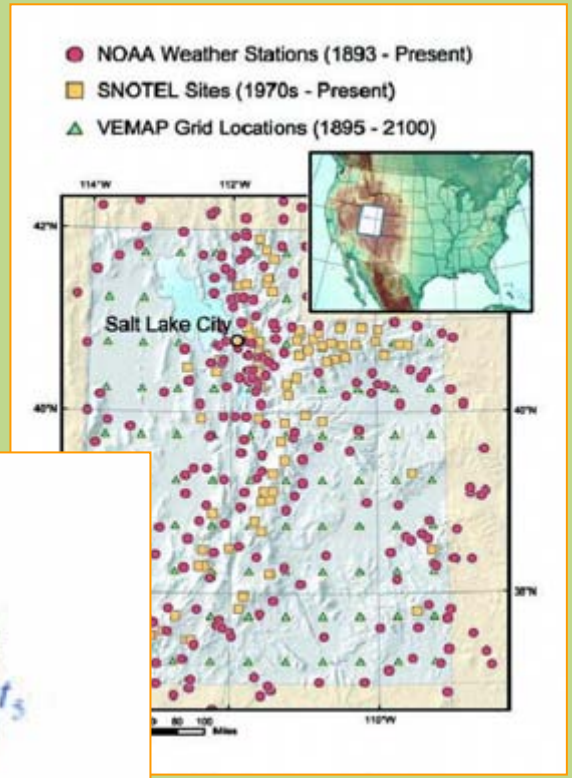
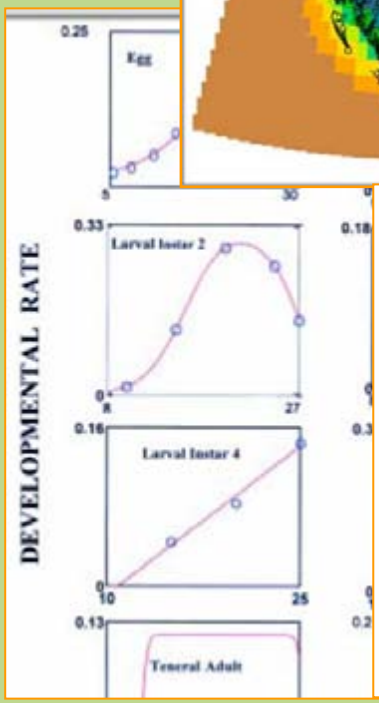
Forest insect and pathogen relationships to climate are extremely complicated

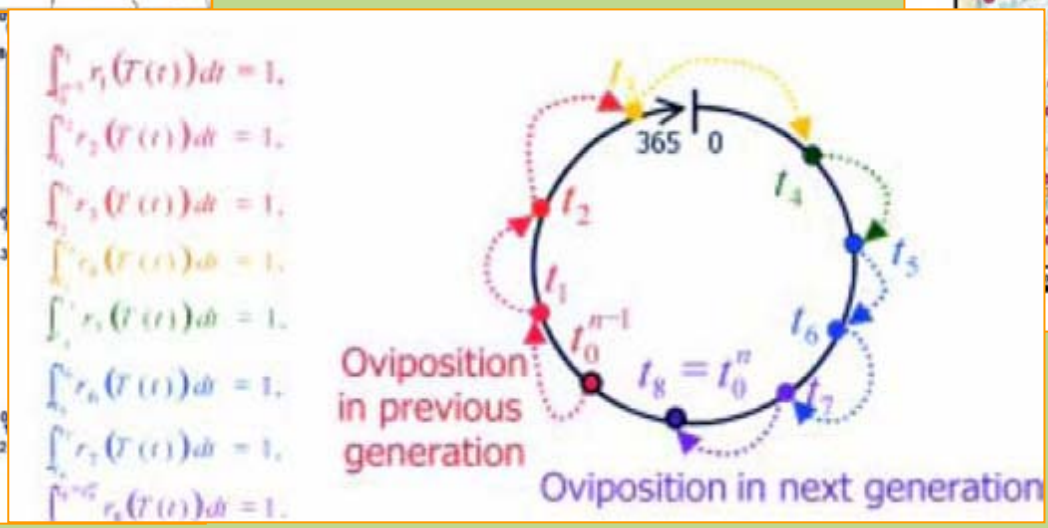












A simple approach to forest insects and pathogens response to climate change

How are stand structure and ecology influencing forest health conditions?

What forest insects and pathogens are active in the ecosystem?

What forest insects and pathogens are present at low levels?

What changes are occuring in your local weather pattern?

What impacts are those changes having in the environment?

How will those changes affect forest insect and disease conditions?

Changes influencing forest insect and disease conditions

Phenology/Synchrony

Extreme weather

Changes in snowpack

Drought

Warmer winters

Changes in precipitation pattern

Seasonal adaptation

Jason Delport

Mtn Pine Beetle and White Pine Blister Rust in Whitebark Pine Ecosystems

Photos: Northwest Habitat institute, KCET-TV, Bugwood, National Parks Conservation Assoc.

Adaptive Seasonality
Mountain Pine Beetle ~ Whitebark Pine

Jesse Logan and others, USDA-FS, Rocky Mtn Research Station (retired)

Observation: Expansion of MPB mortality in whitebark pine ecosystems.

Cause: 2 Cº temperature rise since the mid-1970s is allowing for mass beetle attack in areas that were previously too cold. The warmth allowed the mpb to complete its lifecycle in one year (down from 2).

Logan JA and Powell JA. 2001. Ghost forests, global warming, and the mountain pine beetle. *Am Entomol* 47: 160–73

Petit C. 2007. In the Rockies, Pines Die and Bears Feel It. New York Times. Science TImes. Jan. 30, 2007

Mountain Pine Beetle in BC and Alberta

Area Infested: 9.2 million hectares

Volume Infested: 582 million cubic m

3 million dead trees in Alberta

$200 million in 01/07 – Fed. MPB prog.

Source: The State of Canada's Forests. 2007 Annual Report.

Mountain

Pine Beetle

BC Ministry of Forests photos

Red band needle blight in BC
Dothistroma septosporum

Lodgepole pine
mortality in a mature stand, trees about 65 years old

Photo: Woods, BC Ministry of Forests

Change in rain pattern

Red band needle blight in BC, *Dothistroma*

Alex Woods and others, Ministry of Forests, British Columbia

Observation: Unprecedented mortality of mature lodgepole pine trees and increased defoliation in plantations.

Cause: Increase in warm, summer rains.

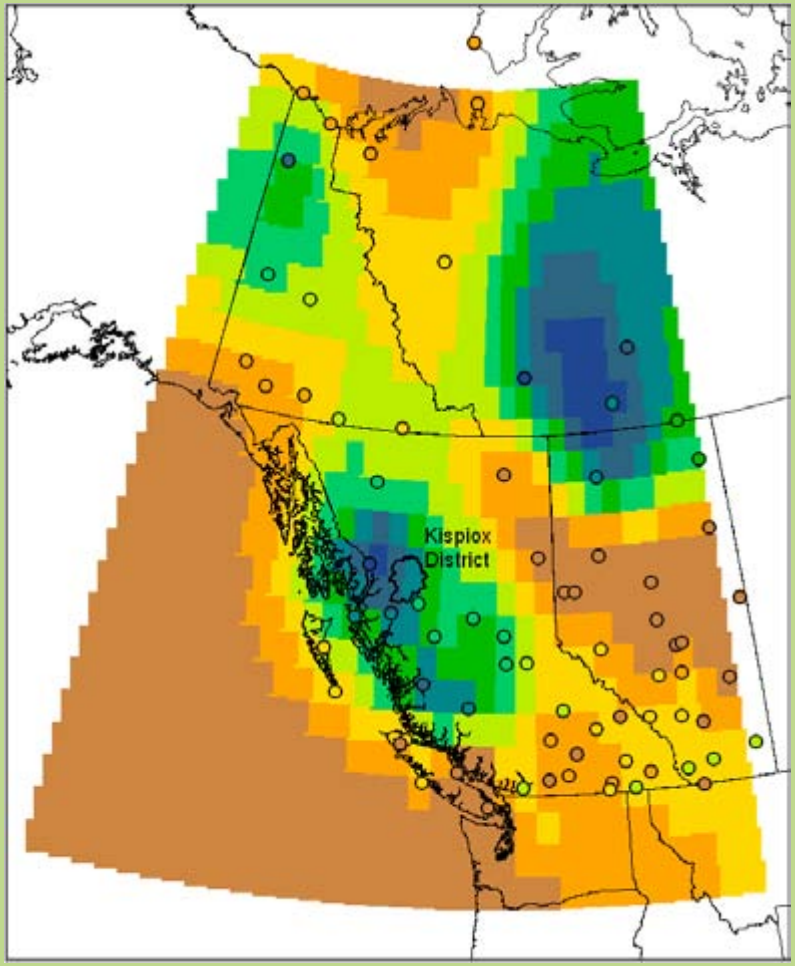
Climate records show that the trend in summer precipitation exceeded the natural fluctuation in local climate.

Woods A, Coates KD, and Hamann A. 2005. Is an unprecedented Dothistroma needle blight epidemic related to climate change? BioScience 55 (9): 761-769

2002
Photo: Woods, BC Ministry of Forests

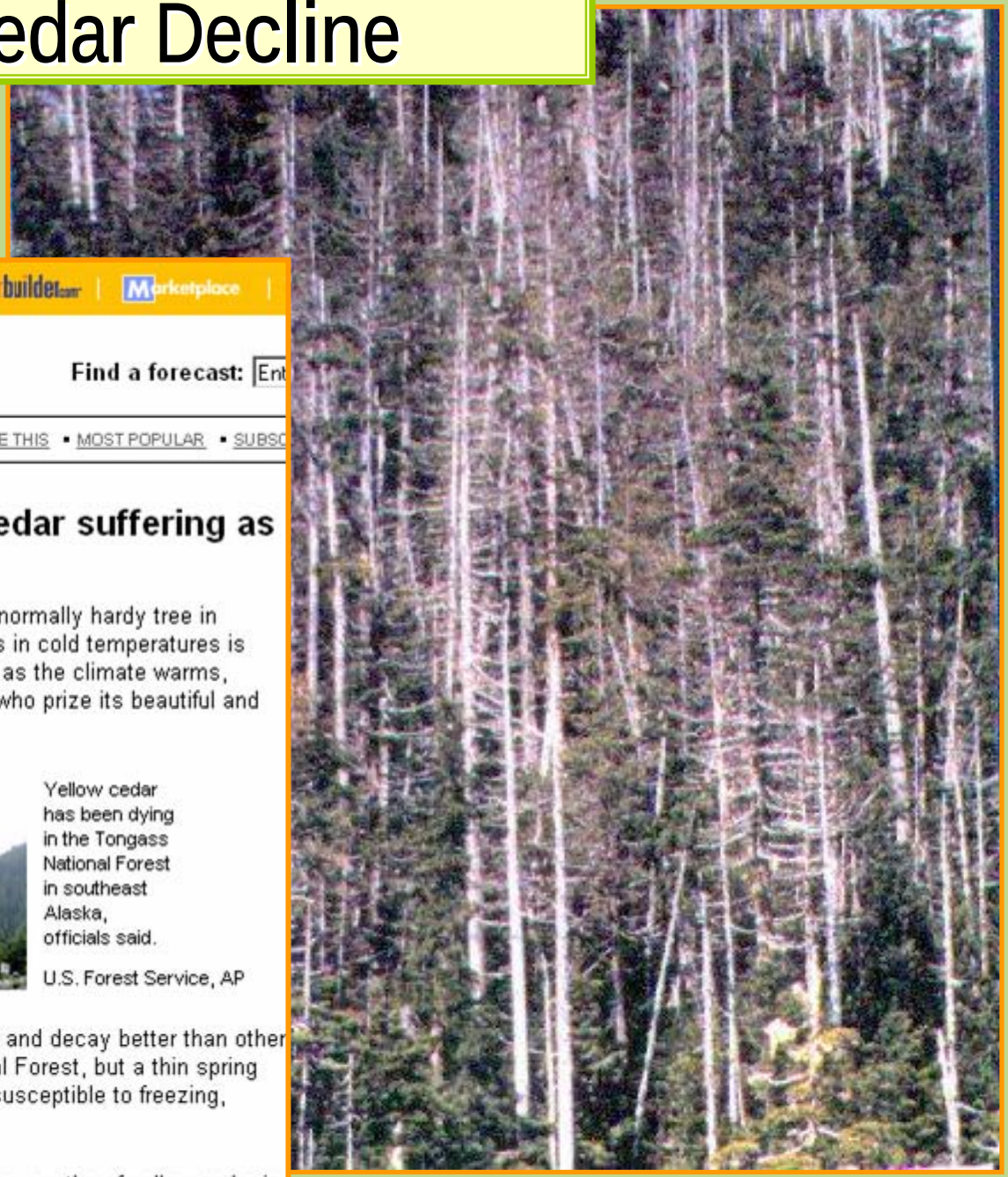
Photo: D. Weaver

Observed changes in mean summer precipitation between 1960-1991 normal and 1998-2002 average



- Pronounced increase in mean summer precipitation in study area
- Spatial match to area with greatest infection is striking

Alaska Yellow Cedar Decline



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Alaska's yellow cedar suffering as climate warms

JUNEAU, Alaska (AP) — A normally hardy tree in southeast Alaska that thrives in cold temperatures is dying out in lower elevations as the climate warms, worrying carvers and others who prize its beautiful and durable wood.

Yellow cedar has been dying in the Tongass National Forest in southeast Alaska, officials said.

U.S. Forest Service, AP

Yellow cedar staves off bugs and decay better than other trees in the Tongass National Forest, but a thin spring snowpack has left its roots susceptible to freezing, scientists said.

For more than a century, large swaths of yellow cedar in

Reduced Snowpack
Alaska Yellow Cedar Decline

Paul Hennon and others, USDA-FS PNW and FHP, Juneau

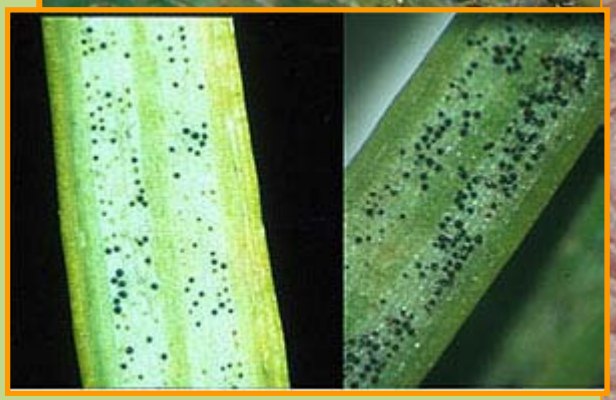
Observations: Continued increase in Alaska yellow-cedar mortality. Mortality is in expanding centers. Problem is correlated with areas with reduced snowpack.

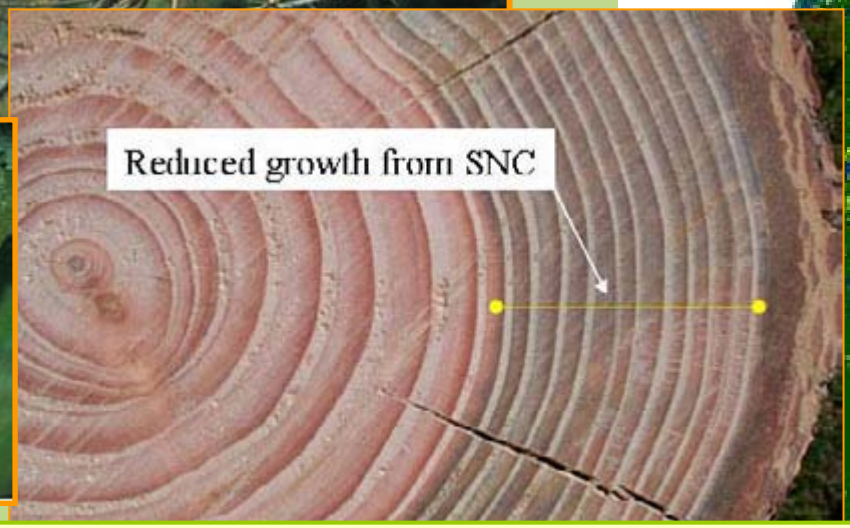
Cause: Earlier snow melt exposes shallow fine roots to colder temperatures often resulting in freeze injury. Root damage leads to tree death.

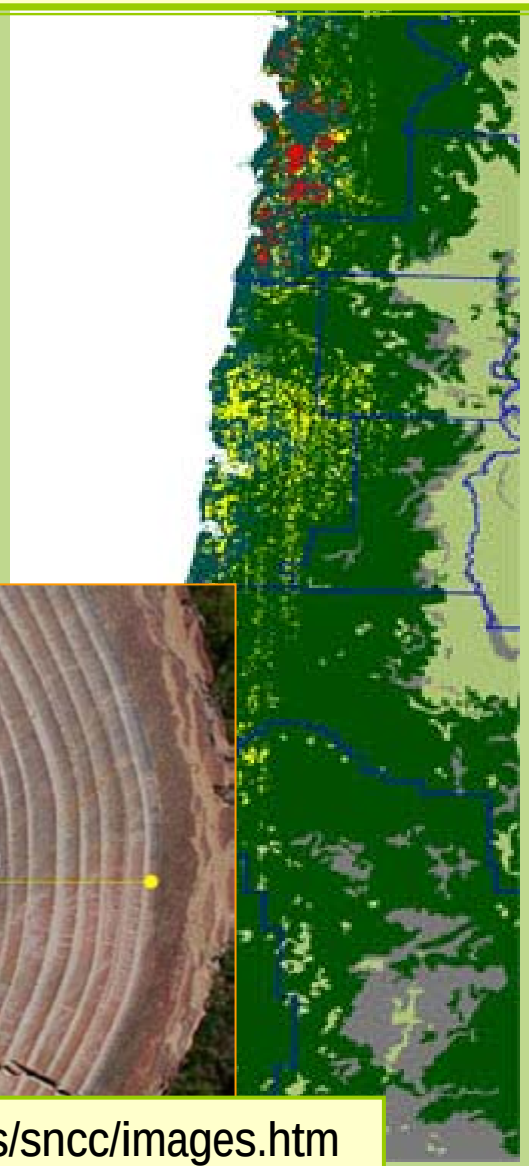
Hennon, Paul E., Shaw III, Charles G. 1997. Enigma of Yellow-Cedar Decline: What Is Killing These Long-Lived, Defensive Trees? Journal of Forestry. 95:12

Hennon, Paul and D'Amore, Dave. 2007. The mysterious demise of an ice-age relic: Exposing the cause of yellow-cedar decline. May 2007. USDA-FS, PNW. Science Findings. Issue 93.

Swiss Needle Cast on Douglas Fir - Oregon Coast







Photos: Swiss Needle Cast Coop http://www.cof.orst.edu/coops/sncc/images.htm

Warm winter temperatures

Swiss Needlecast, *Phaeocryptopus gaeumannii*

Manter, Reeser, Stone and others, OSU

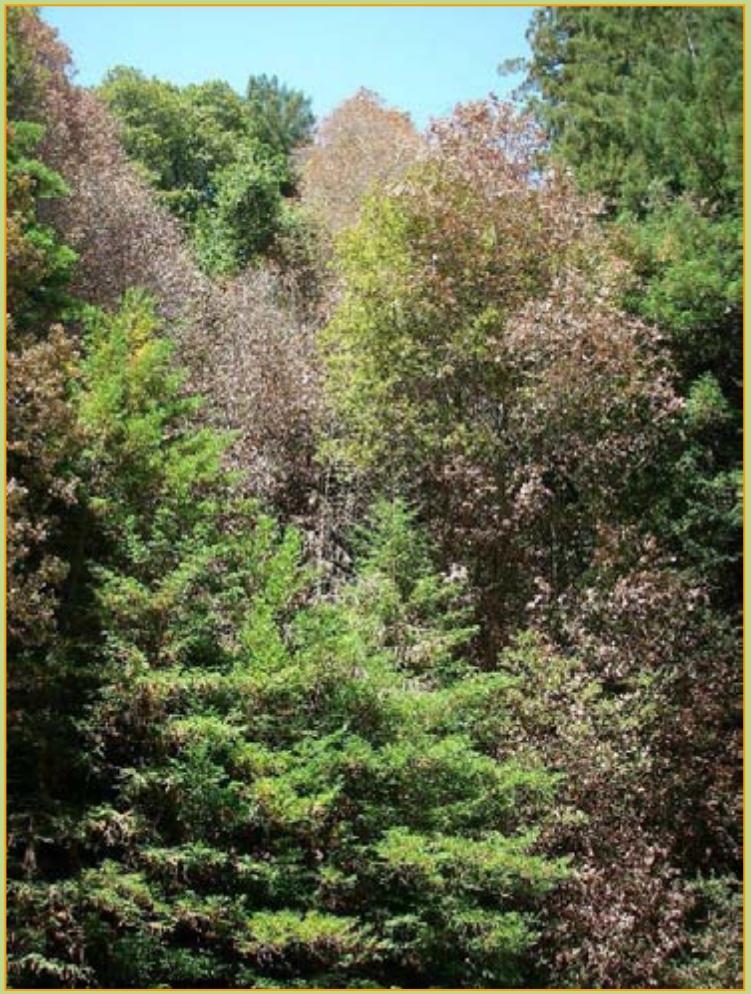
Observation: Swiss needlecast defoliation varies depending on microsite conditions.

Cause: Suprisingly, infection on foliage was negatively correlated with shade and mist and positively correlated with temperature.

Warm winter temperatures favor disease development.

Daniel K. Manter, Paul W. Reeser, and Jeffrey K. Stone. 2005. A Climate-Based Model for Predicting Geographic Variation in Swiss Needle Cast Severity in the Oregon Coast Range. November 2005, Phytopathology Vol. 95, No. 11. 1256-1265

Phytophthora ramorum, Sudden Oak Death



Photos: USDA-FS, FHP; Ian Smith

Extreme Weather
Phytophthora ramorum/Sudden Oak Death

David Rizzo and others, UC-Davis; Jennifer Parke and others, OSU

Observation: Sudden Oak Death mortality appears in wave years and then subsides.

Cause: Heavy rains during warm periods create optimal infection conditions.

Infected trees have reduced capacity to manage water.

Mortality is triggered in years with high temperatures and extended dry periods.

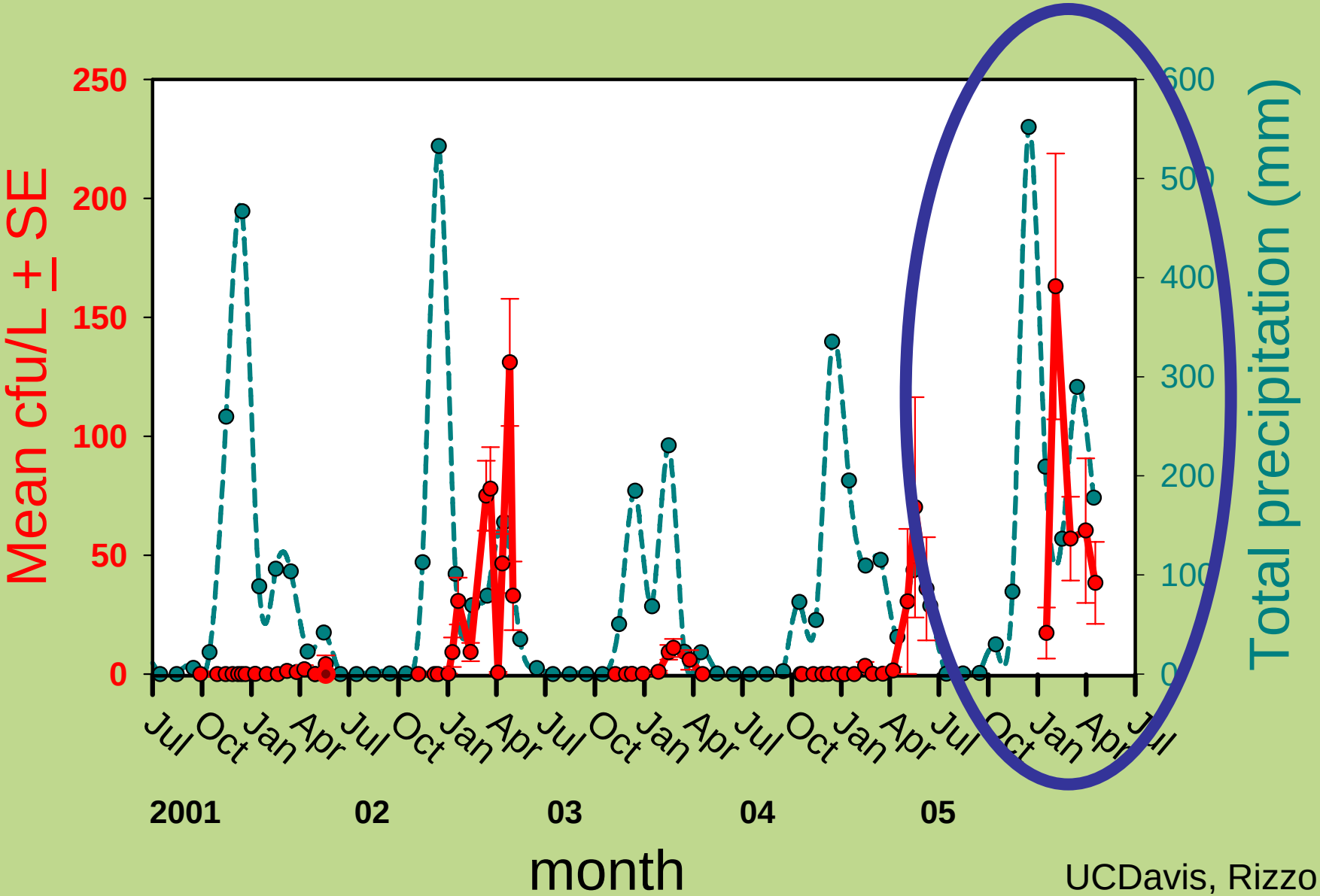
Frankel, S.J. Climate Change's Influence On Sudden Oak Death, PACLIM 2007. May 13-15. 2007, Monterey, CA.

Rizzo, unpublished data.

Parke, J. L., Oh, E., Voelker, S., Hansen, E. M., Buckles, G., and Lachenbruch, B. 2007. *Phytophthora ramorum* colonizes tanoak xylem and is associated with reduced stem water transport. Phytopathology 97:1558-1567.

Bay Area's string of hot days is longest on record -- odd weather patterns blamed
Glen Martin, Thursday, July 27, 2006. San Francisco Chronicle.

Spores in rainwater 2001-06



UCDavis, Rizzo

Western Spruce Budworm

Photos: Idaho Dpt of Lands, BC Ministry of Forests, USFS FIDL

Phenology/Synchrony - Western Spruce Budworm

Alan Thomson, Pacific Forestry Centre, Victoria, B.C.

Observation: Shift in elevational band of WSB damage.

Cause: Warming winter temperatures on southern Vancouver Island, linked to a rise in sea temperature, promoted earlier larval emergence while the timing of bud flush has remained constant.

Thomson, A.J. Oceans And Climate, And Their Effect On Forest-insect Interactions 2007. May 13-15. 2007, Monterey, CA

Thomson, A.J., R.F. Shepherd, J.W.E. Harris and R.H. Silversides. 1984. Evaluating weather effects on western spruce budworm by analysis of long-term weather records. Can. Ent. 116: 375-381.

Thomson, A.J., J.W.E. Harris, R.H. Silversides and R.F. Shepherd. 1983. Elevation effects on rate of development of western spruce budworm in British Columbia. Can. Ent. 115: 1181-1187.

Thomson, A.J. and S.M. Moncrieff. 1982. Prediction of bud burst in Douglas-fir by degree-day accumulation. Can. J. For. Res. 12: 448-452.

Drought, bark beetles and fire – CA

BREAKING NEWS

The latest on the South Lake Tahoe fire from The Times' staff

Here are the latest developments in the fire at South Lake Tahoe:

--2,000 acres burned

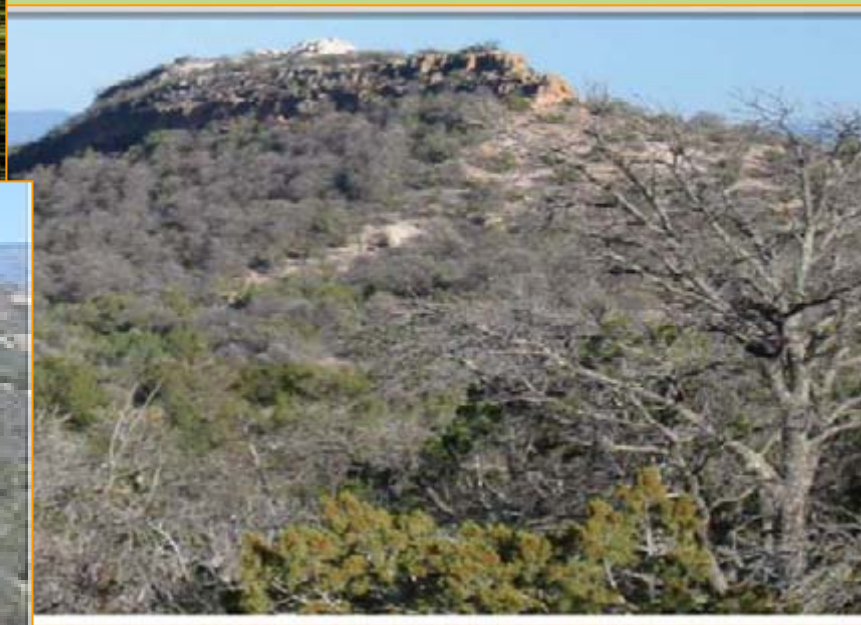
--240 structures destroyed

--No injuries reported

--Much of South Lake Tahoe evacuated

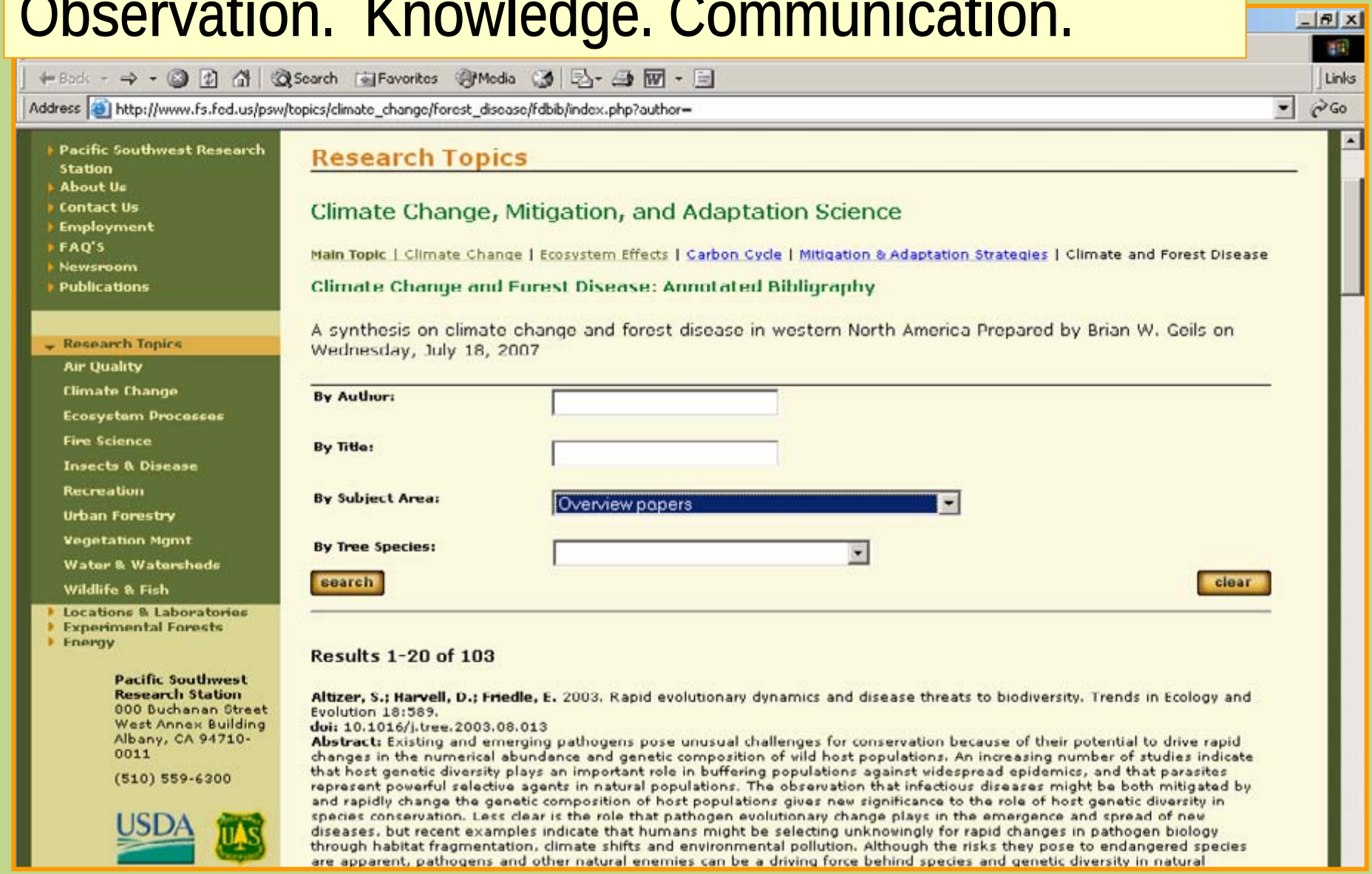
Photos: MAST, CDF

Pinon Juniper mortality in the Southwest



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

How will humans adapt to climate change? Observation. Knowledge. Communication.



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