

# Coming to a forest near you?



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# Outline

Other forest pests concerns on the horizon

Preface: Stress from forest condition

- Animal damage
- Climate Change
- Gold spotted oak borer (San Diego & Riverside)
- Shot hole borer (Los Angeles)
- Laurel wilt (Southeast U.S.)



Increasing stand density

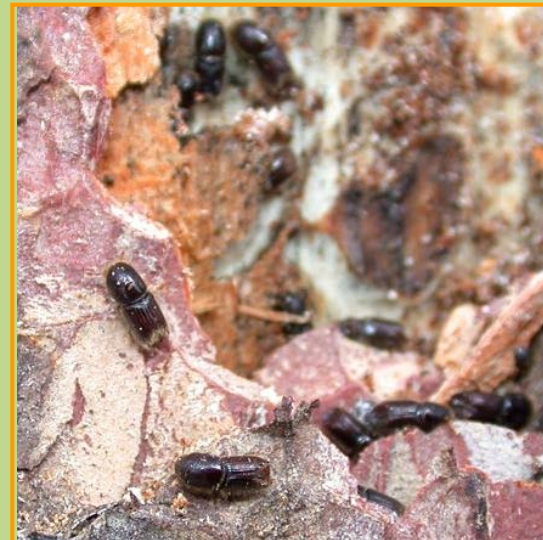
Fire suppression

Altered species composition



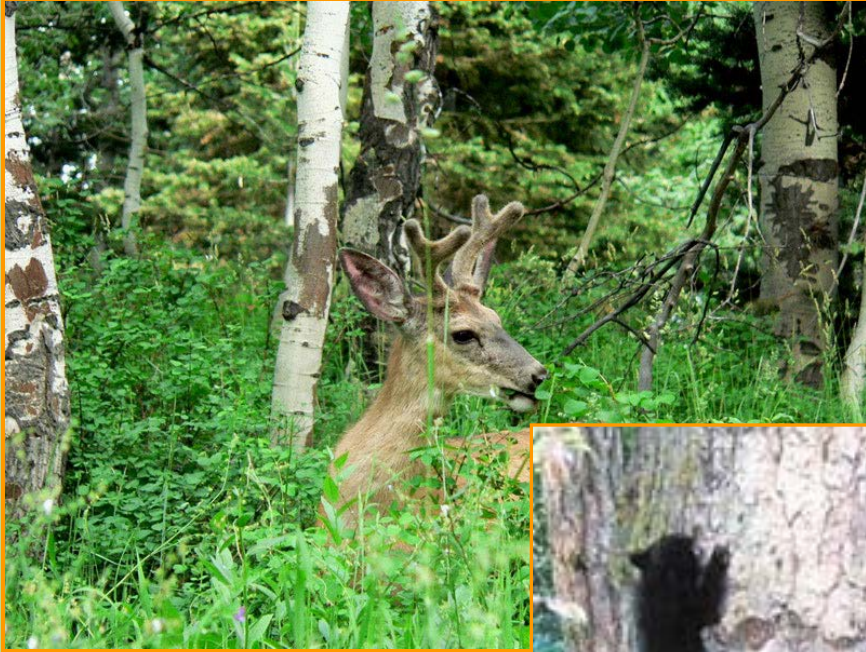
Root disease,  
Dwarf mistletoe,  
Beetles

D. Conklin, USFS





# Animal Damage



Aspen Photos:  
USFS



Photo: Sean Matthews



Photo: Emily Gumon



Photo: Las Pilitas Nursery



# Climate Change. Drought stress! Lack of water! Fire!

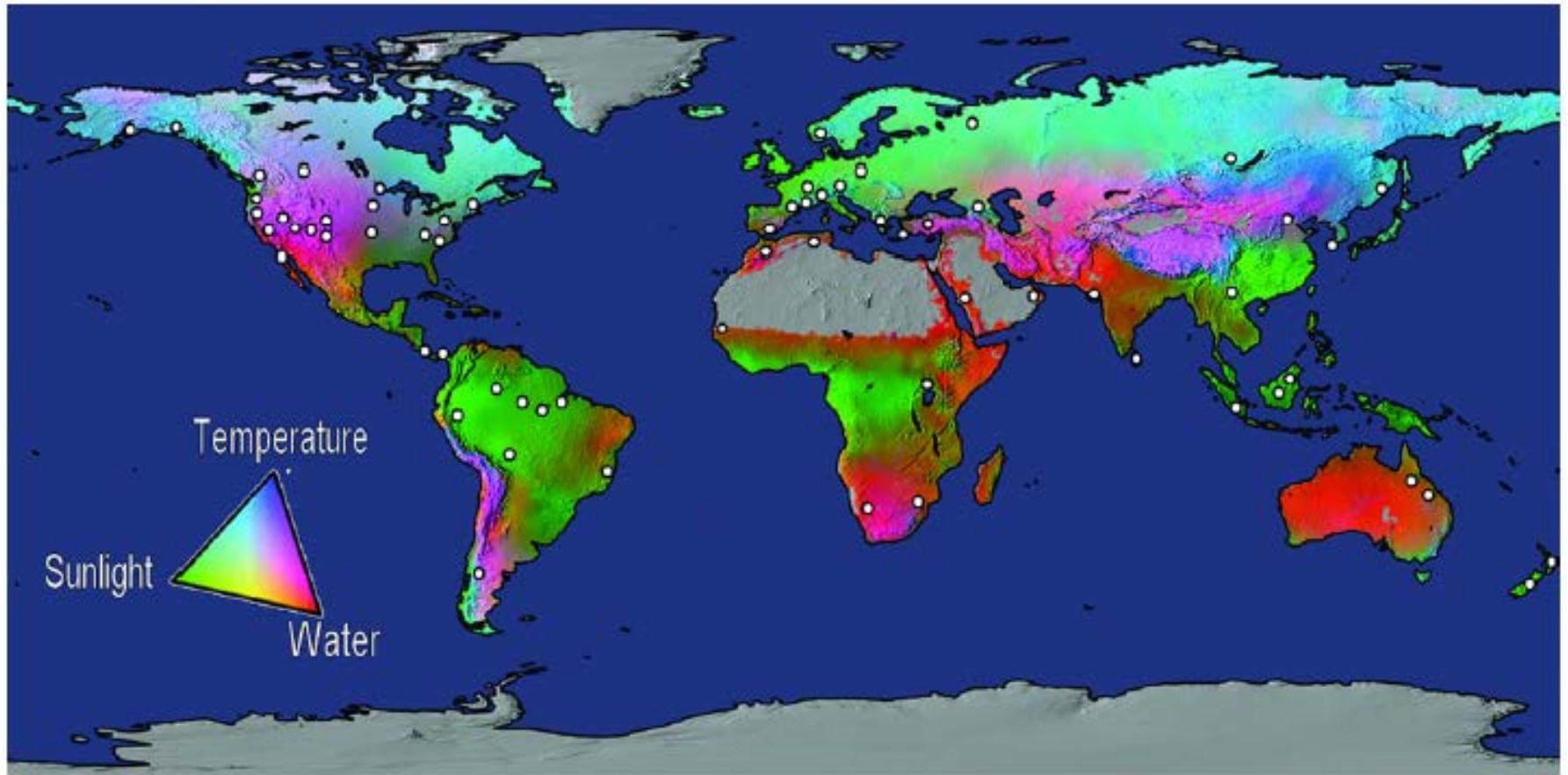


New Mexico News and Views



Photo Credit: CBS News

# Locations of increased forest mortality due to drought & high temperatures



C. D. Allen et al. 2010. A global overview of drought and heat-induced tree mortality reveals emerging climate change risks for forests. *For. Ecol. Manage.* 259: 660–684.



# 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



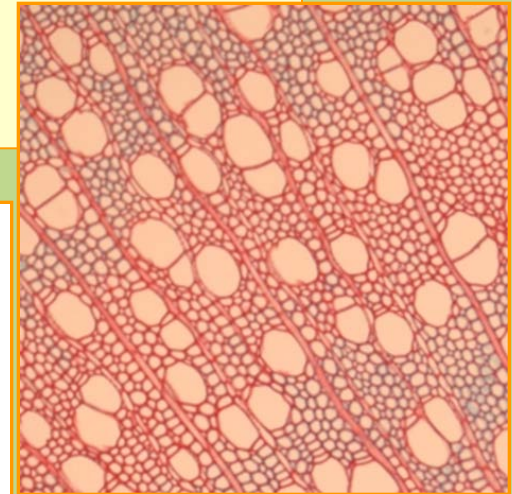
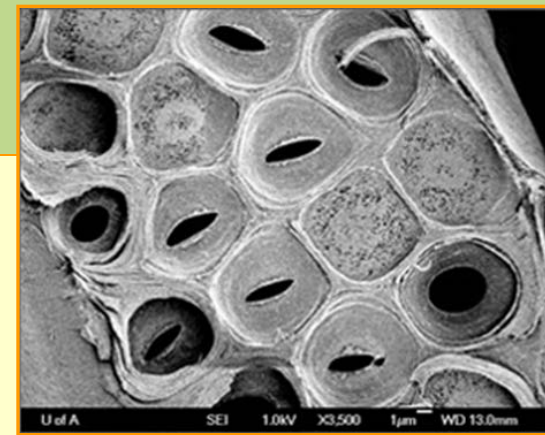
# Why do trees die after drought?

Aspen - Hydraulic damage persisted in dying trees

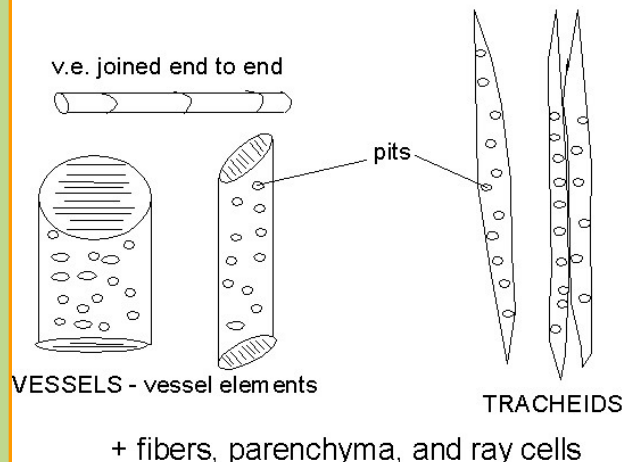
Deterioration- 9 years post stress.

Also +insects and pathogens (secondary organisms)

Similar findings for pinyon (Mueller, 2005)



## COMPONENTS OF XYLEM



Anderegg, W.R.L., Plavcová, L., Anderegg, L.D.L., Hacke, U.G., Berry, J.A. & Field, C.B. (2013). Drought's legacy: multiyear hydraulic deterioration underlies widespread aspen forest die-off and portends increased future risk. *Glob. Change Biol.*, 19, 1188–1196.



# Conifer bark beetles mortality in the western US, 1997-2009

## ACRES BY STATE

Arizona	2,343,000
California	5,528,000
Colorado	6,637,000
Idaho	5,177,000
Montana	6,166,000
Nebraska	30,000
Nevada	1,302,000
New Mexico	1,830,000
Oregon	3,000,000
South Dakota	473,000
Utah	1,960,000
Washington	3,622,000
Wyoming	3,654,000
TOTAL ACRES	41,722,000



# Stress!!



# 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!!

van Mantgem PJ, Nesmith JC, Keifer M, Knapp EE, Flint A, Flint L. 2013. Climatic stress increases forest fire severity across the western United States. Ecology Letters. Jul 22. doi: 10.1111/ele.12151.





# Manage water for forest health!

Mulch

Thinning and species selection

Soil conservation

Irrigation



Water for fish? Water for farms? Water for city people?  
Or – water for the forest?

Photo credit : TNC

Gordon E. Grant, Christina L. Tague, and Craig D. Allen 2013. Watering the forest for the trees: an emerging priority for managing water in forest landscapes. *Frontiers in Ecology and the Environment* 11: 314–321

Photo credit : TNC

# 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



Photo: Craig Allen, USGS

Chumua, D.J., P.D. Anderson, G.T. Howe, C.A. Harrington, J.E. Halofsky, D.L. Peterson, D.C. Shaw, and B. St. Clair. 2011. Forest Responses to climate change in the northwestern United States: Ecophysiological foundations for adaptive management. *Forest Ecology and Management*. 261: 1121-1142



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

nature

International weekly journal of science

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## Letter

*Nature* **452**, 987–990 (24 April 2008) | doi:10.1038/nature06777; Received 9 December 2007; Accepted 29 January 2008

## Mountain pine beetle and forest carbon feedback to climate change

W. A. Kurz<sup>1</sup>, C. C. Dymond<sup>1</sup>, G. Stinson<sup>1</sup>, G. J. Rampley<sup>1</sup>, E. T. Neilson<sup>1</sup>, A. L. Carroll<sup>1</sup>, T. Ebata<sup>2</sup> & L. Safranyik<sup>1</sup>

1. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, Victoria, British Columbia, V8Z 1M5, Canada
2. British Columbia Ministry of Forests and Range, Victoria, British Columbia, V8W 9C2, Canada

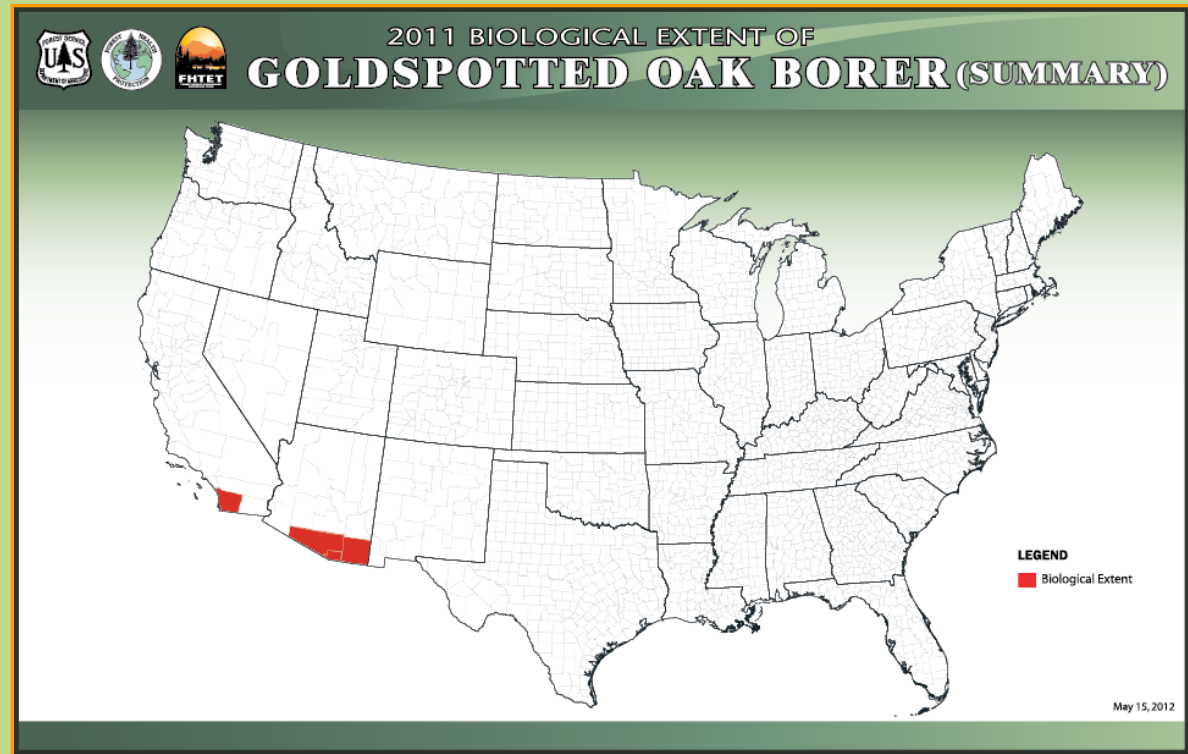
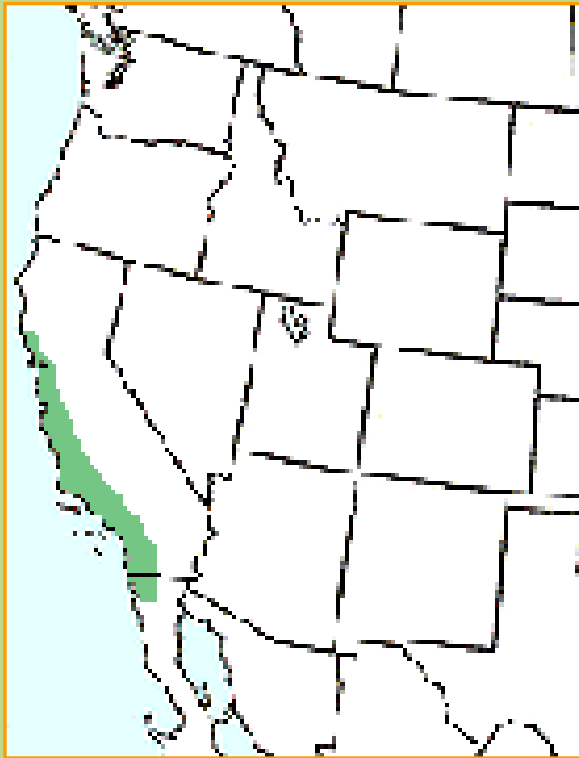
Kurz, W. A., C. C. Dymond, G. Stenson, G. J. Rampley, A. L. Carroll, T. Ebata, and L. Safranyik. 2008. Mountain pine beetle and forest carbon feedback to climate change. *Nature* 452:987–990.

# Gold spotted oak borer, *Agrilus auroguttatus*



Coast live oak in San Diego and Riverside Counties





- Range of coast live oak
- Range of gold spotted oak borer?



# Laurel Wilt – Threat to California Bay Laurel

Redbay ambrosia beetle,  
*Xyleborus glabratus*

*Raffaelea lauricola*



Credit: UC Riverside, Center for Invasive Species Research



# Shot hole borer



## Shot Hole Borer (*Euwallacea* sp.) and Fusarium Dieback (*Fusarium* sp.)

- Los Angeles and Orange Counties
- Hosts: Coast live oak, box elder, avocado, big leaf maple, California sycamore and more



# Acknowledgements

USDA Forest Service,  
Pacific Southwest Research Station

