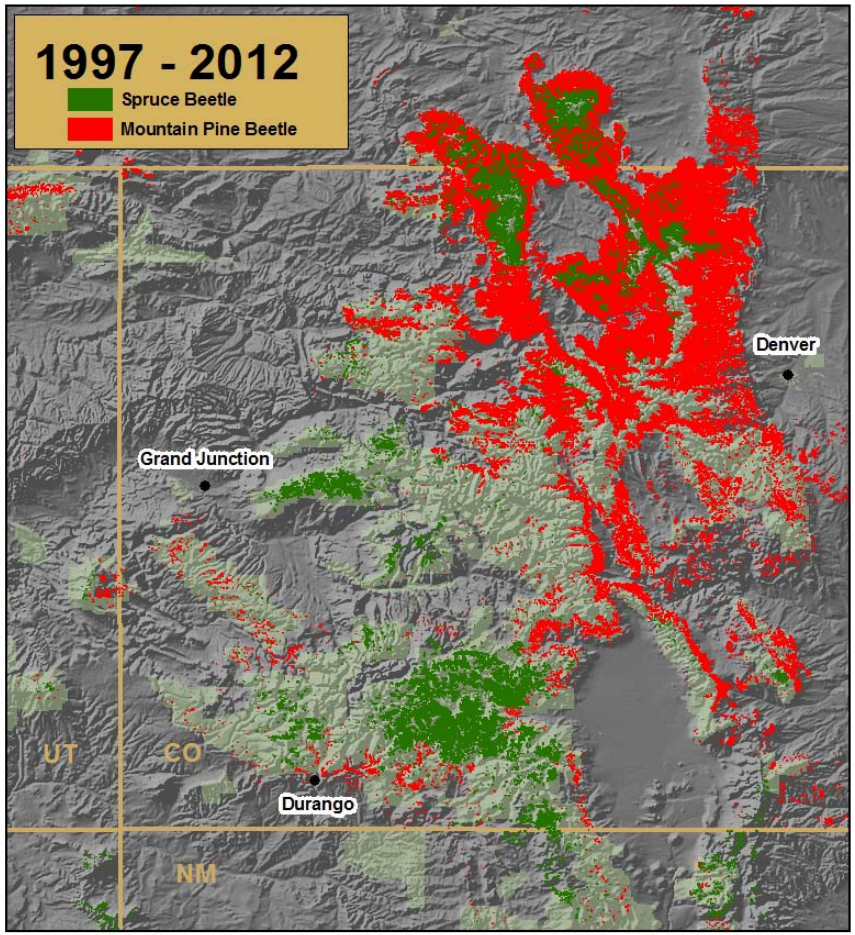
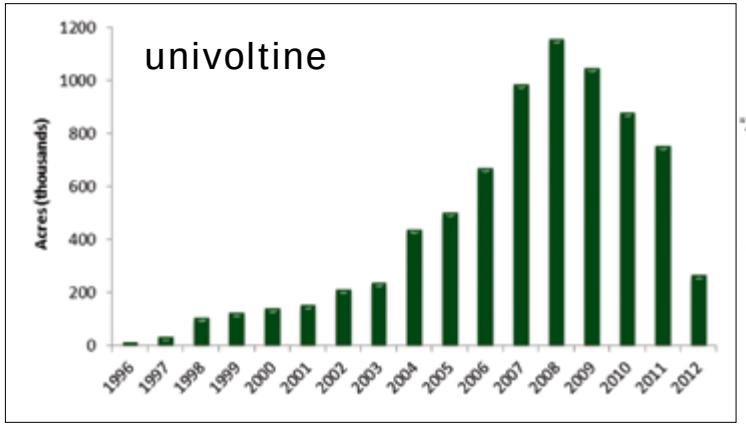
Native Bark Beetles in Colorado: Climate Change Implications



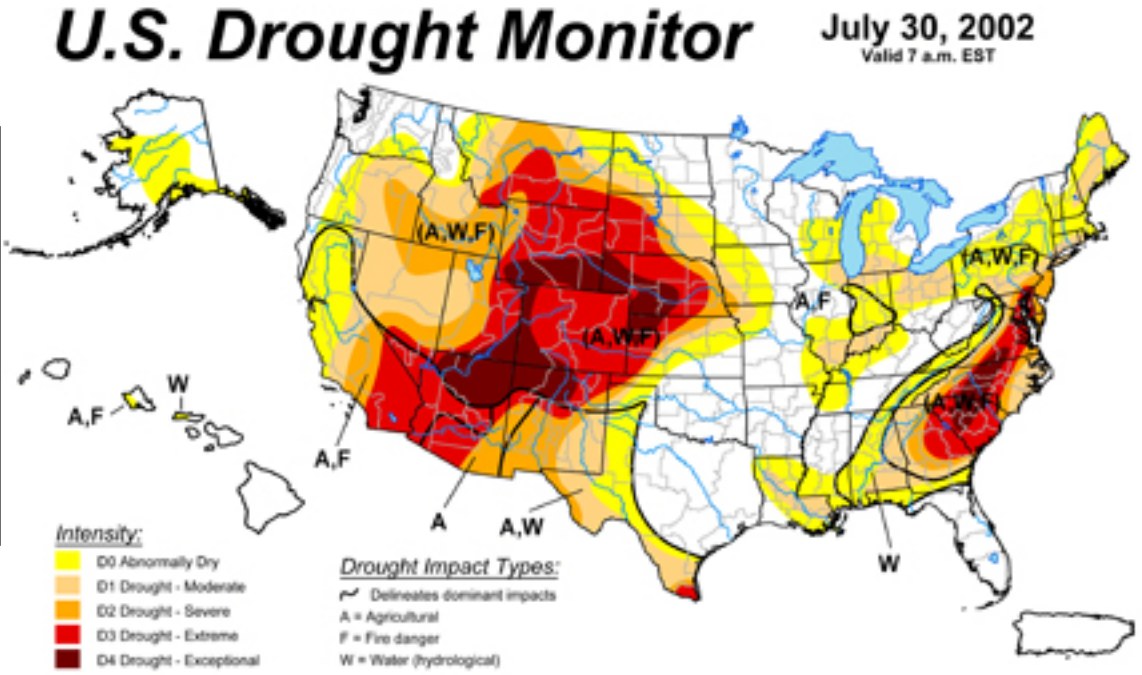
Barbara J. Bentz

Rocky Mountain Research Station
USDA Forest Service, Logan UT
www.usu.edu/beetle

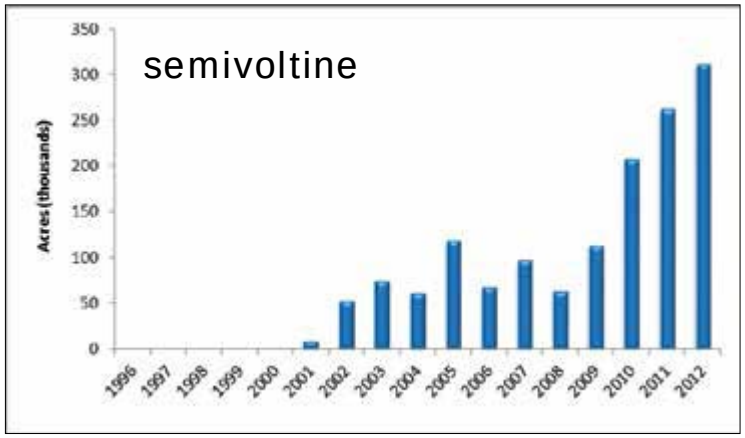
Mountain pine beetle (CO)



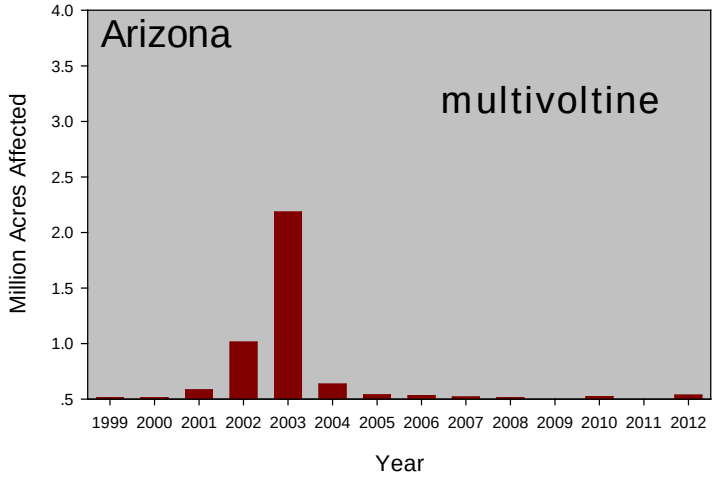
Chapman et al. 2012



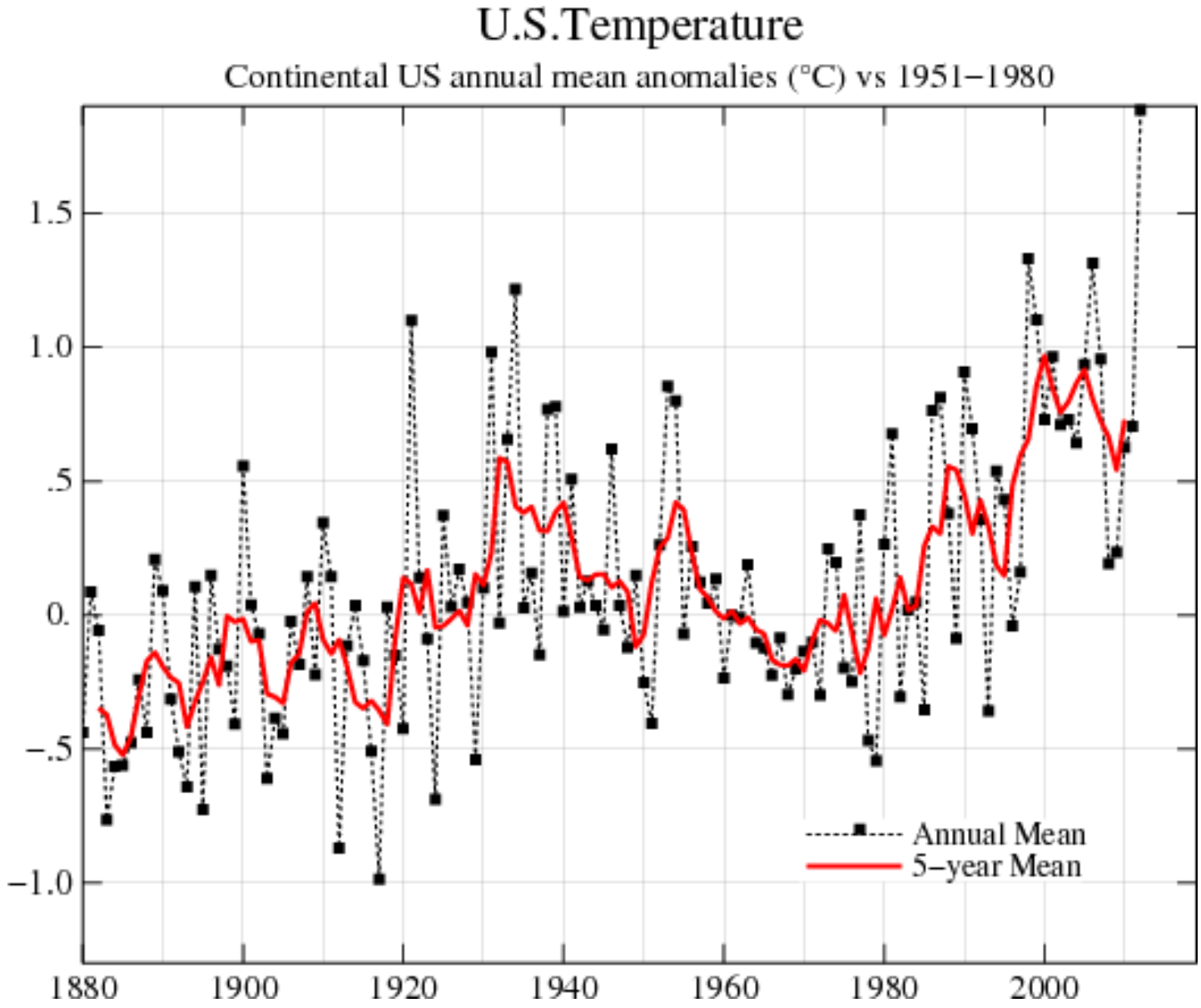
Spruce beetle (CO)



Pinyon Ips



Gaylord et al. 2013



http:data.giss.nasa.gov

Mechanistic Models

Regniere and St. Amant

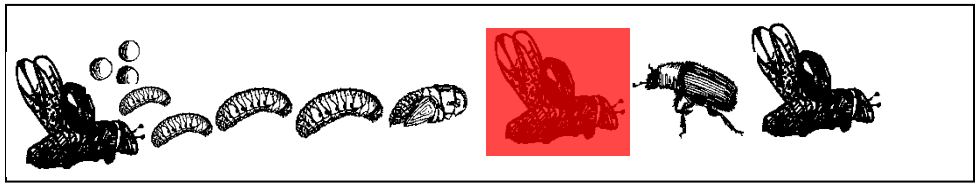
Spruce beetle

Proportion univoltine brood =

f (# hours > 17ºC accumulated after Peak Flight Biofix)

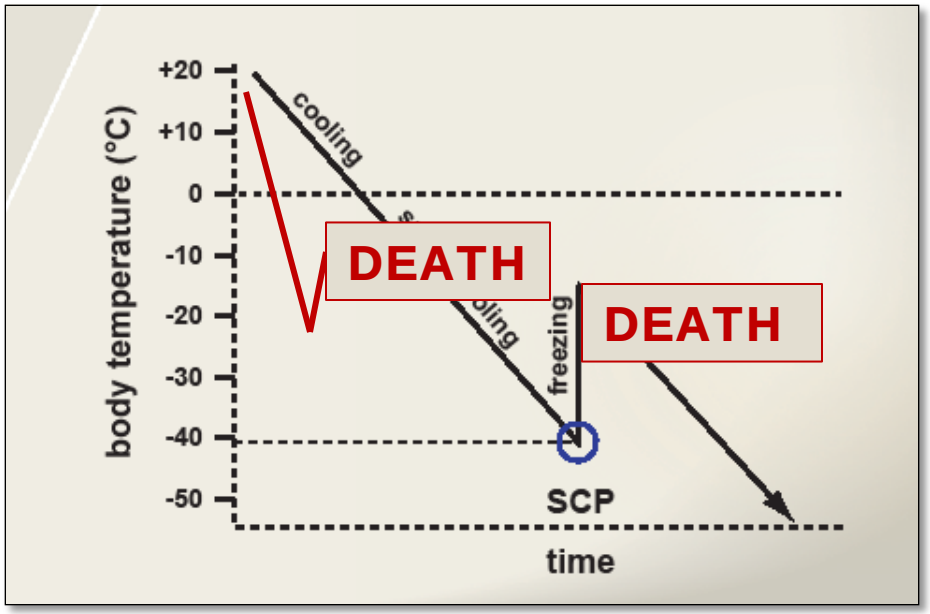
Summer temperatures

Univoltine



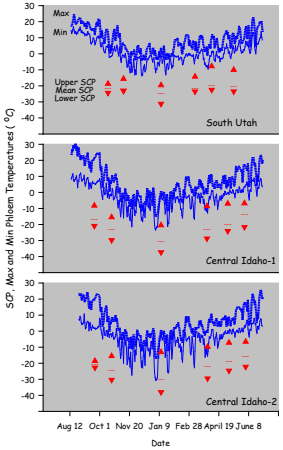
NO-larval diapause YES-adult diapause

(Hansen et al. unpub)

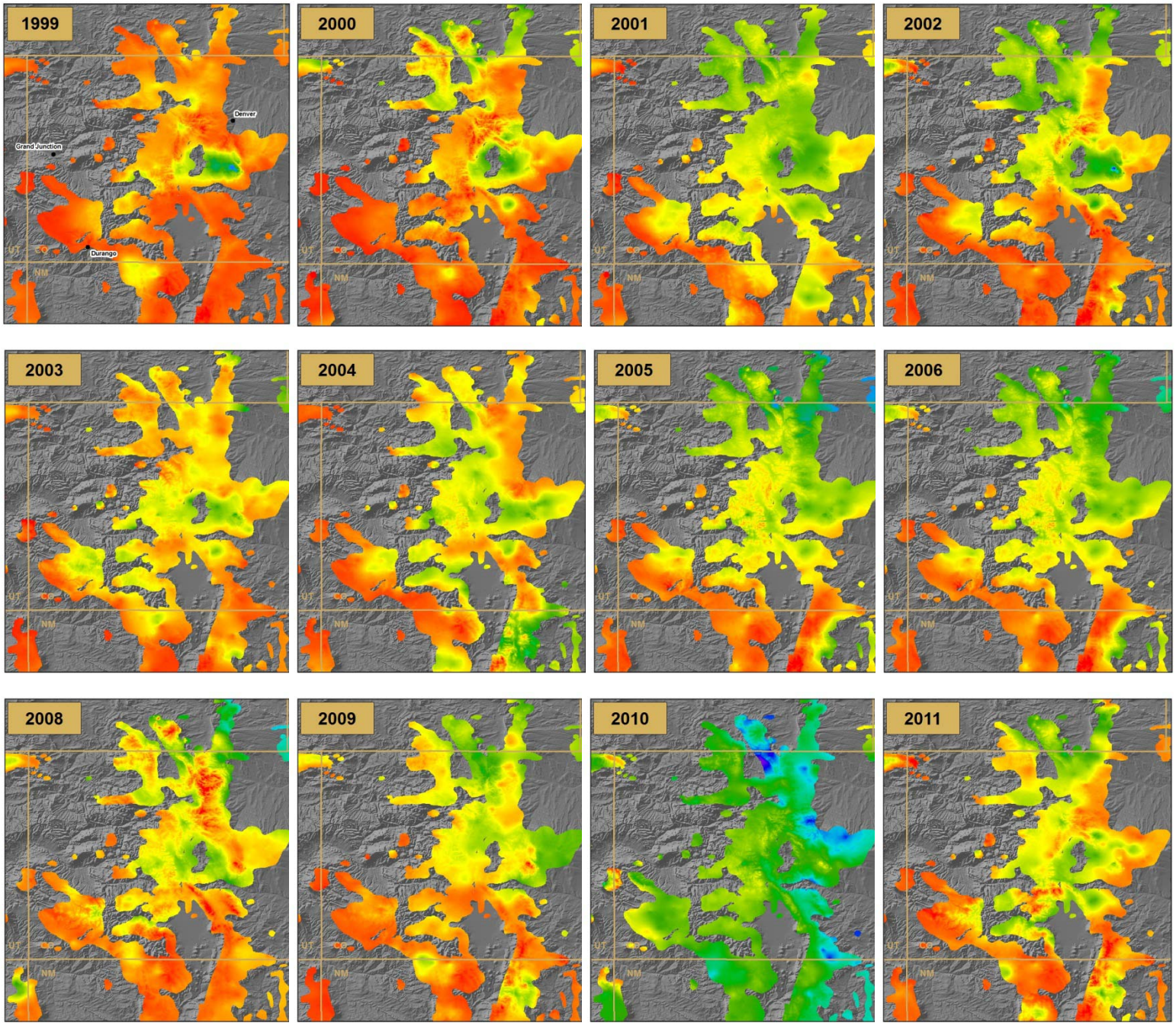


Mountain pine beetle mortality due to cold temperatures.

Winter temperatures



Bentz and Mullins 1999, Regniere and Bentz 2007

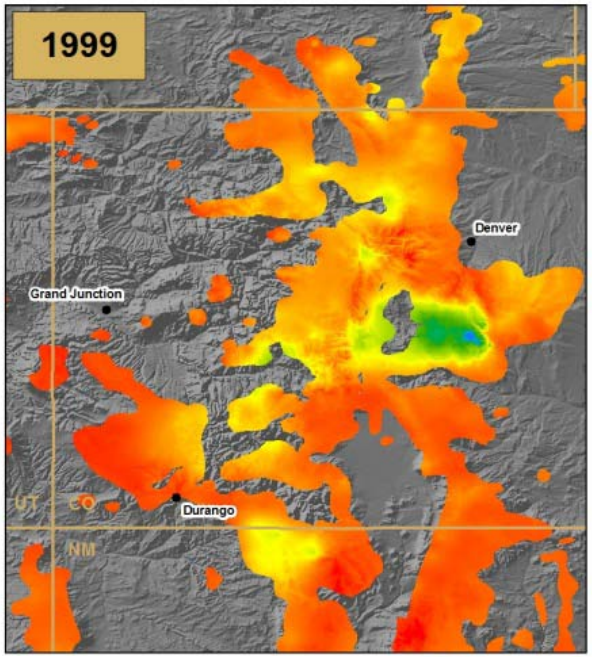


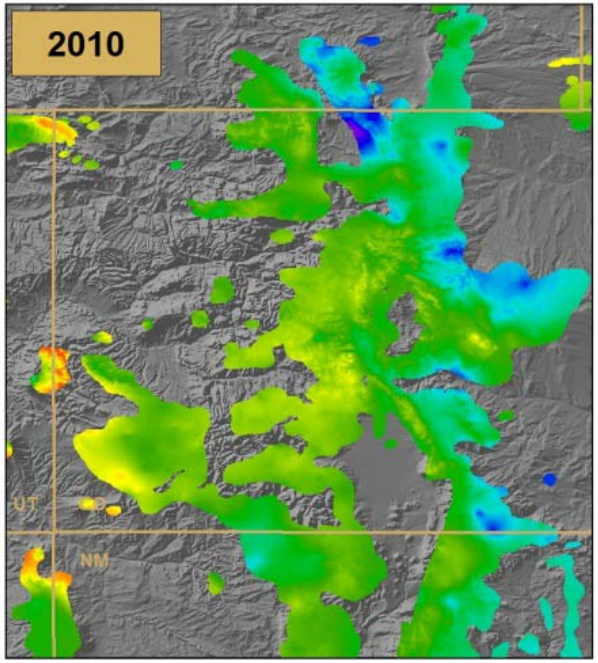
MPB
Probability survival
f(cold tolerance)
by attack year

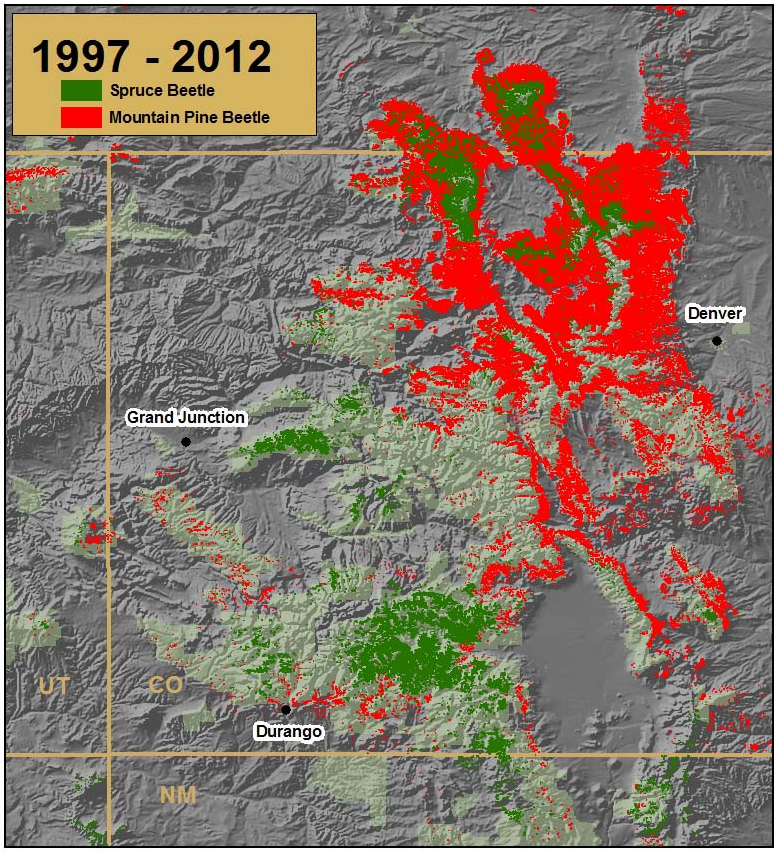
Winter temperature

See Bentz et al. 2010

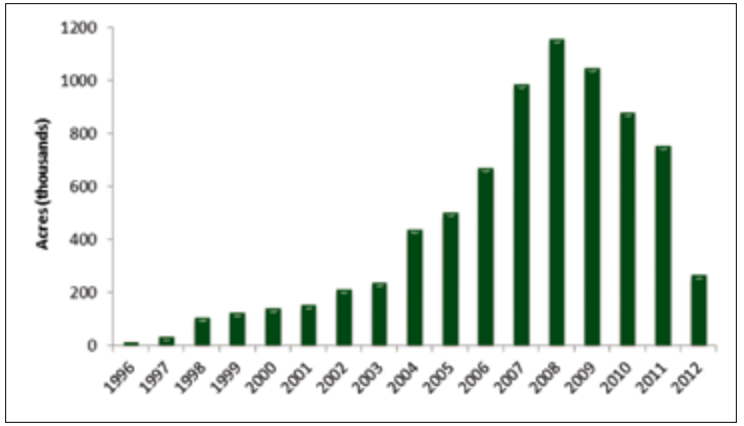
Mountain pine beetle



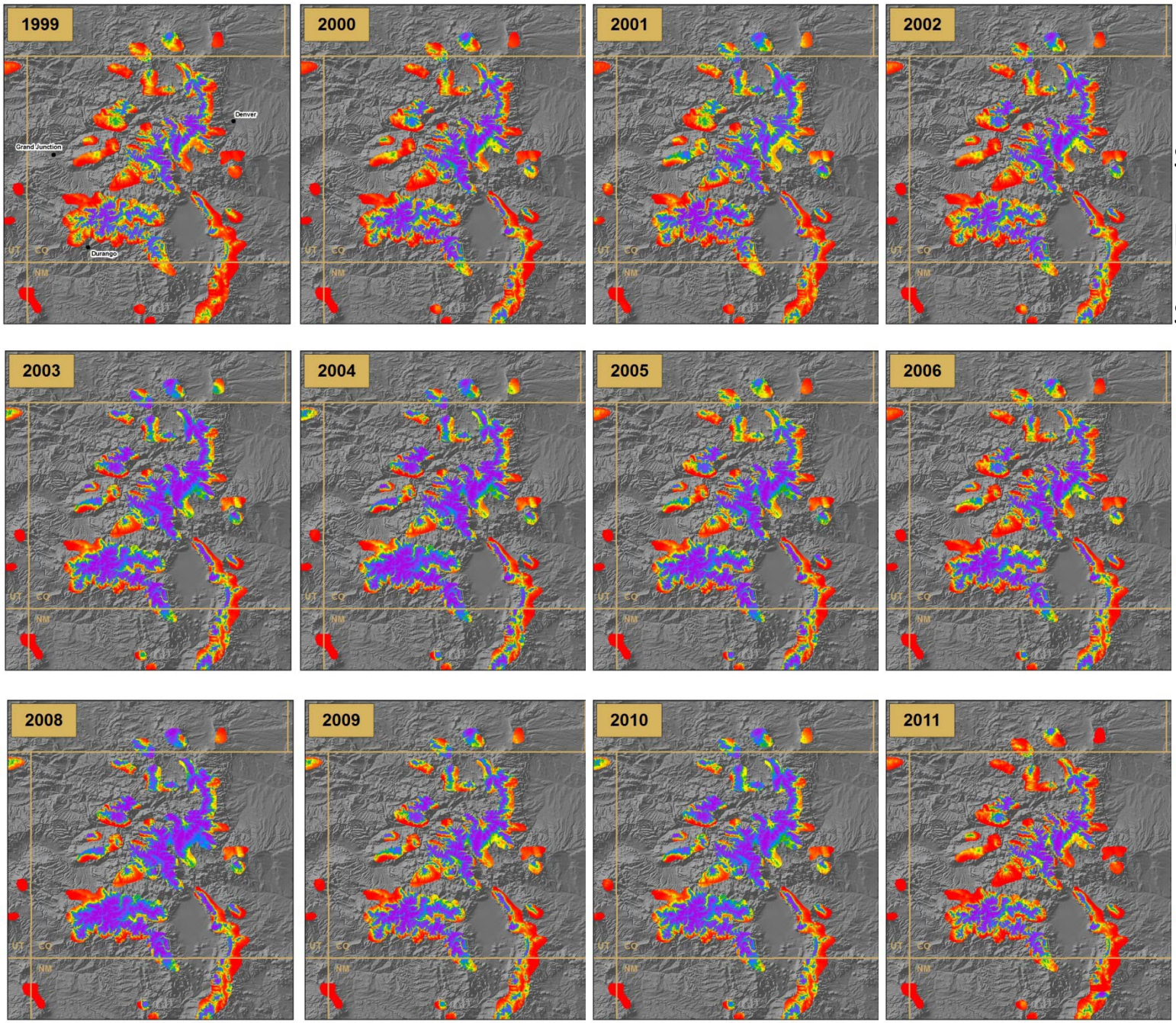




Mountain pine beetle (CO)



http://csfs.colostate.edu/pages/common-insects.html

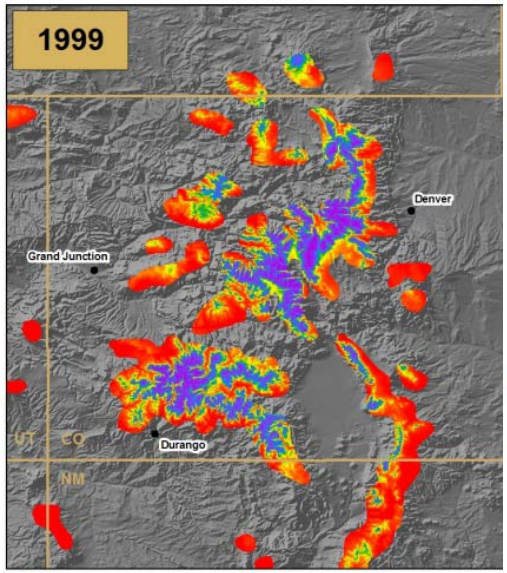


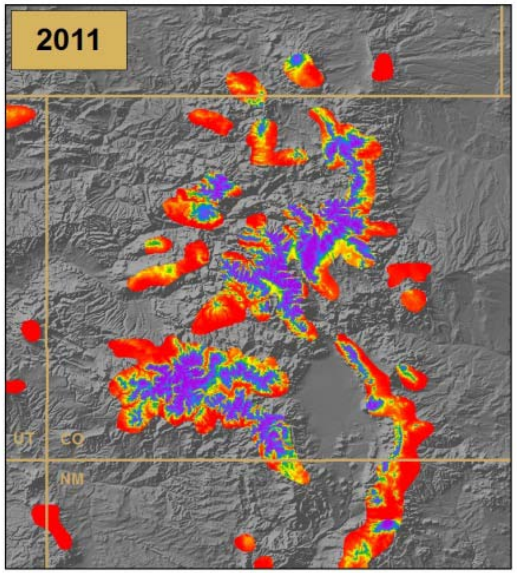
Spruce Beetle
Proportion univoltine
by attack year

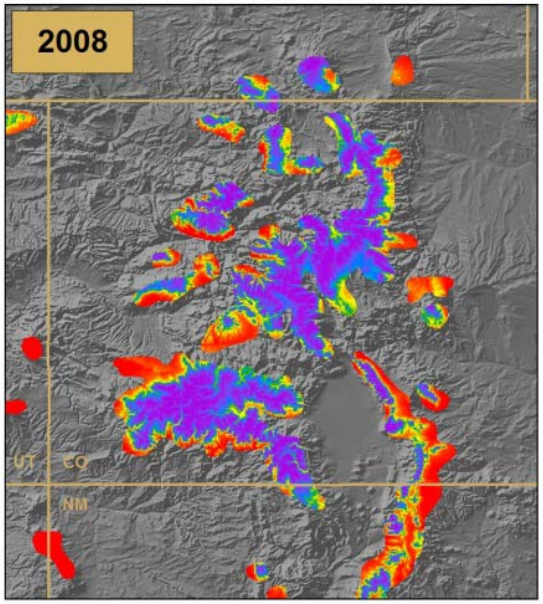
Summer temperature

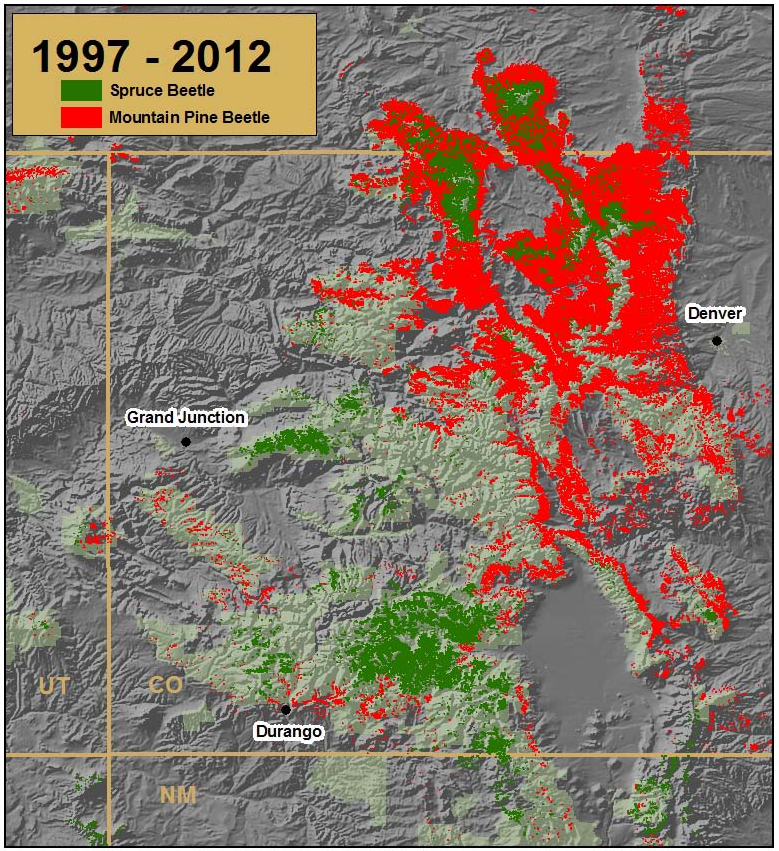
See Bentz et al. 2010

Spruce beetle

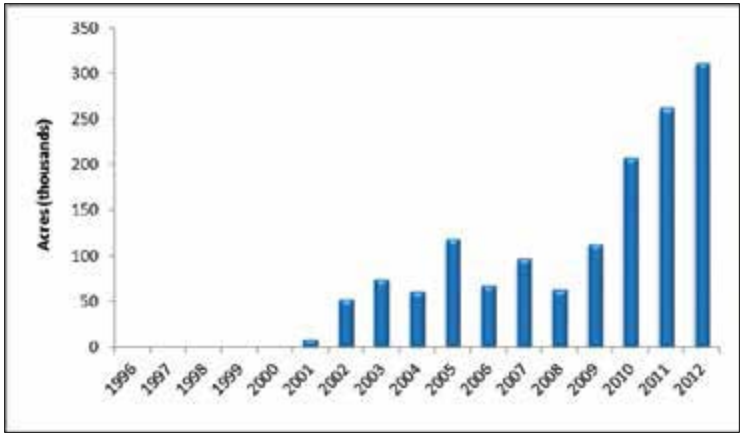








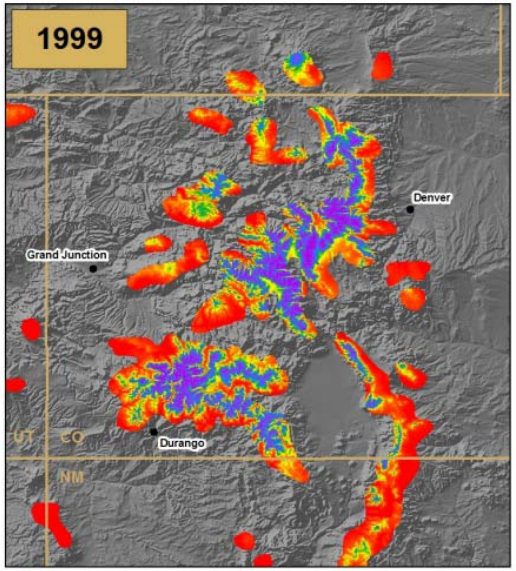
Spruce beetle (CO)

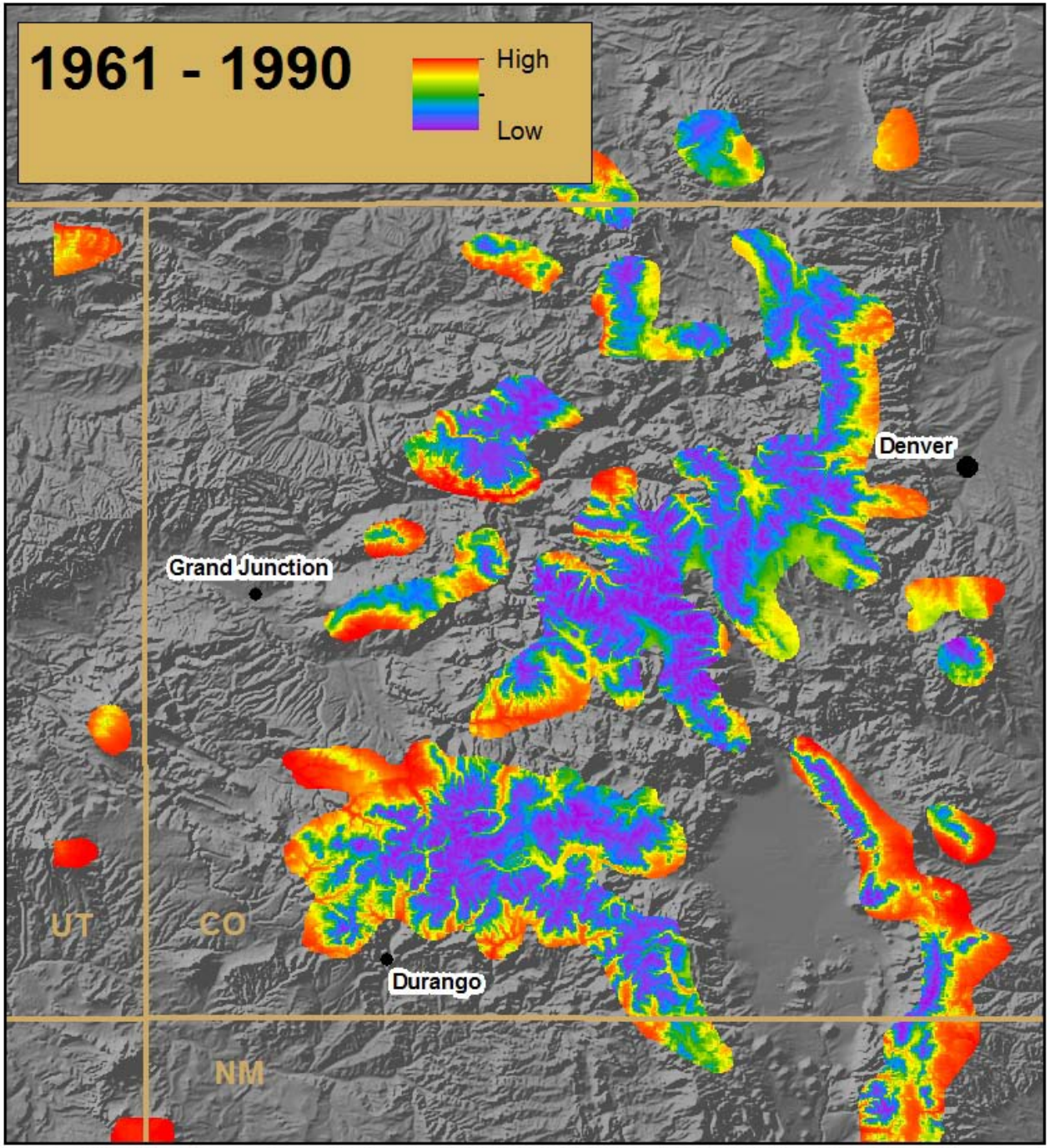


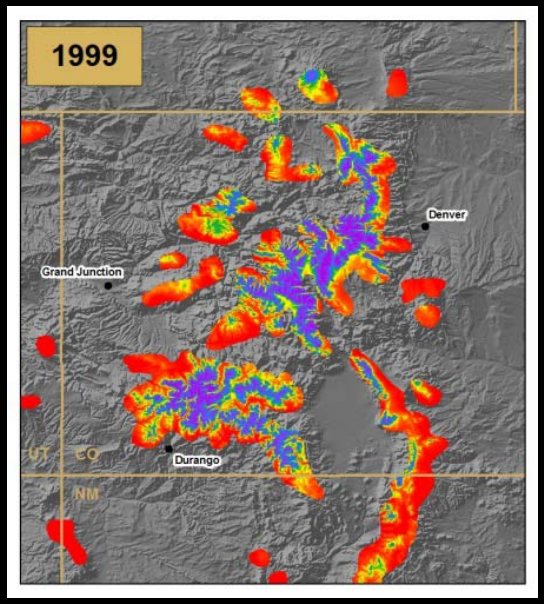
Spruce Beetle
Proportion univoltine

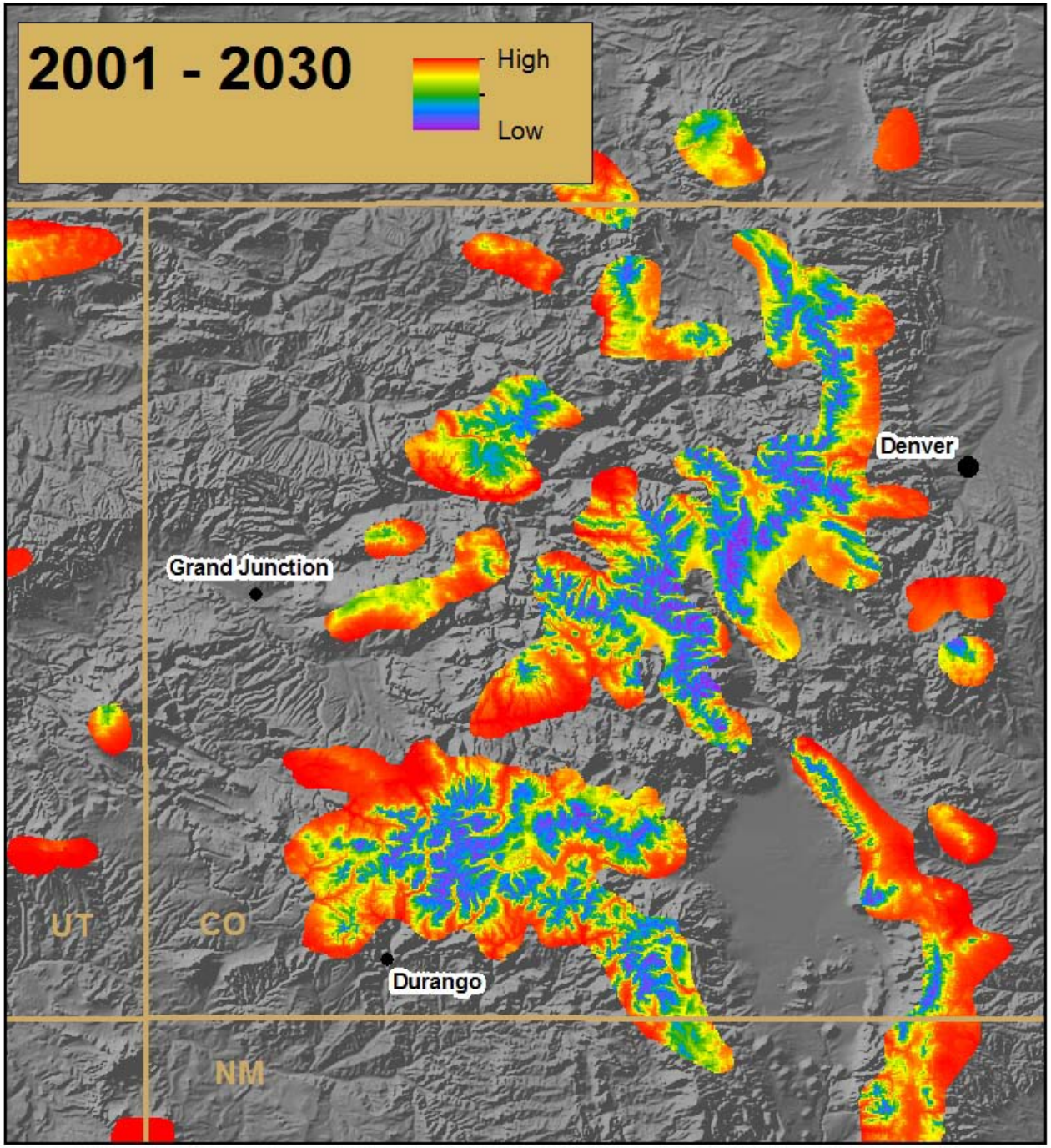
CRCM
IPCC
A2 emissions scenario

See Bentz et al. 2010






1999
Denver
Grand Junction
Durango
UT
CO
NM


2001 - 2030
High
Low
Denver
Grand Junction
Durango
UT
CO
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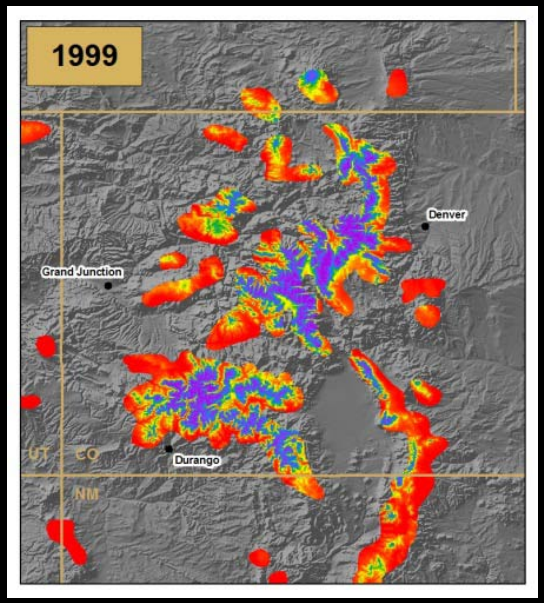
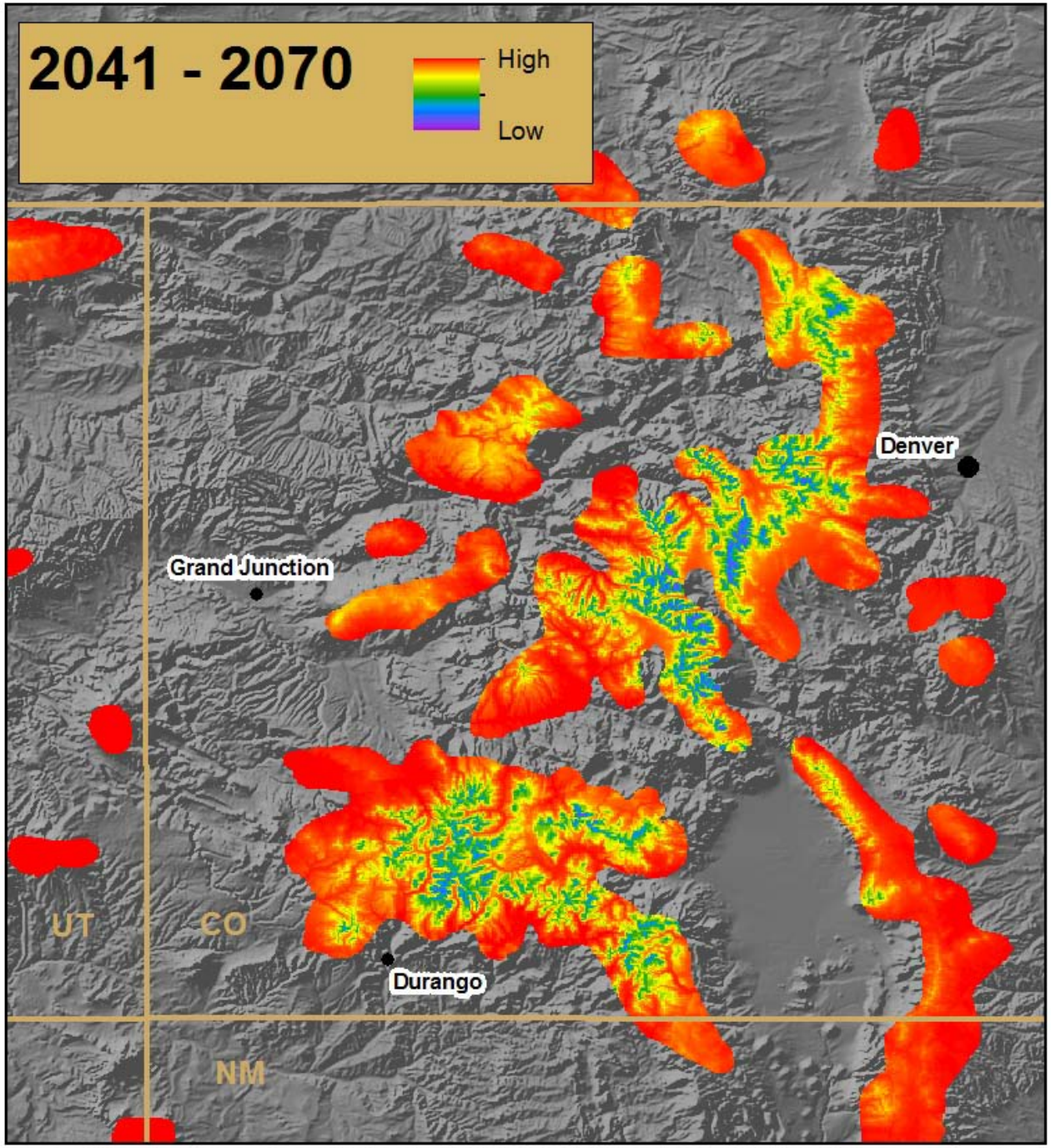
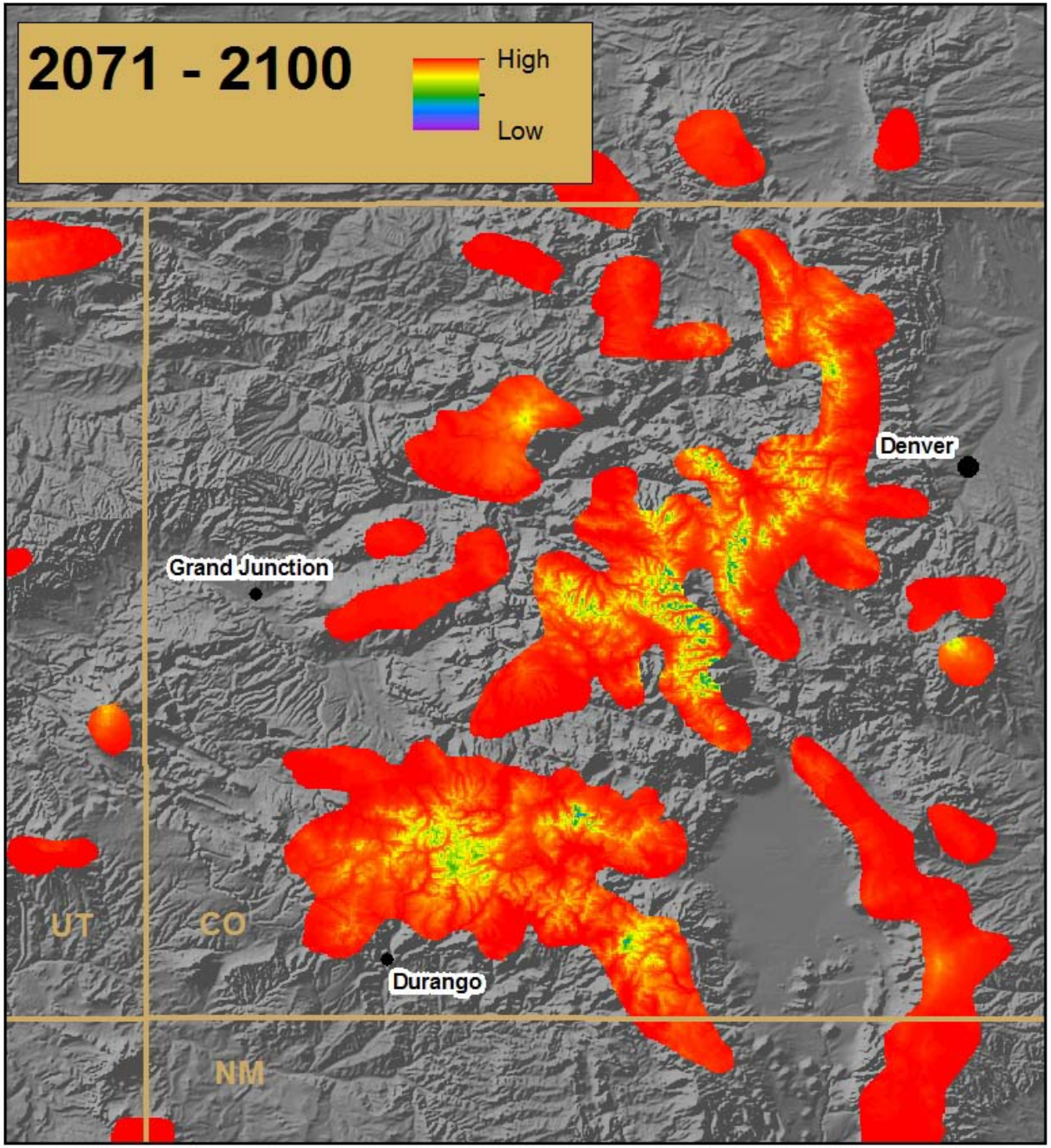

1999
Denver
Grand Junction
Durango
UT
CO
NM


2041 - 2070
High
Low
Denver
Grand Junction
Durango
UT
CO
NM


2071 - 2100
High
Low
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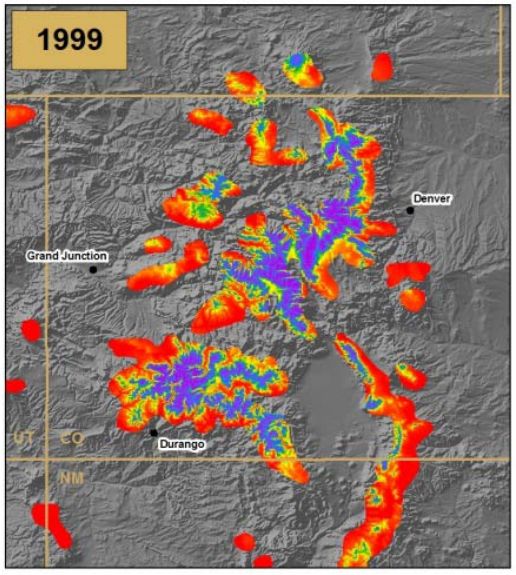
Grand Junction
UT
CO
Durango
NM


1999
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UT
CO
Durango
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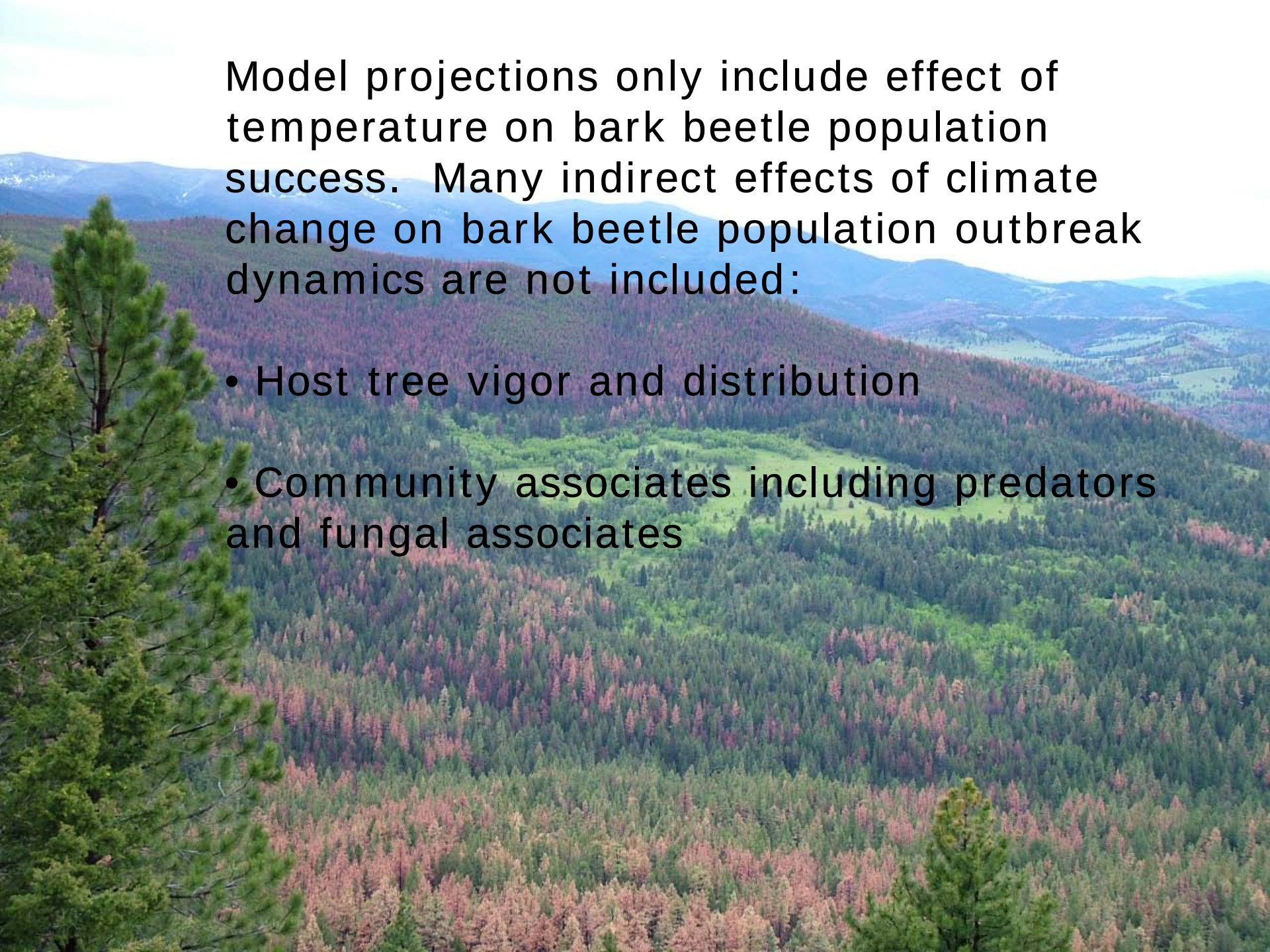
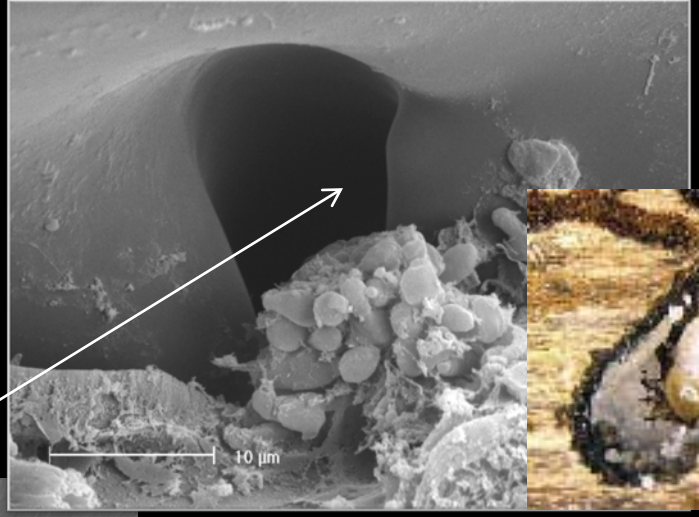
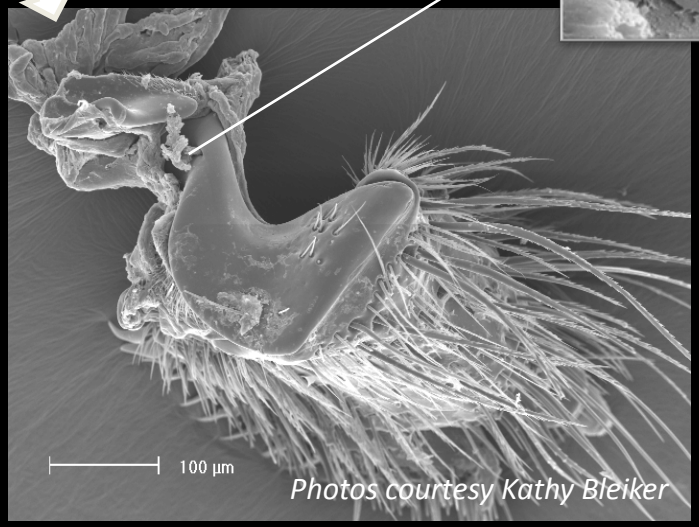


Model projections only include effect of temperature on bark beetle population success. Many indirect effects of climate change on bark beetle population outbreak dynamics are not included:

- Host tree vigor and distribution
- Community associates including predators and fungal associates



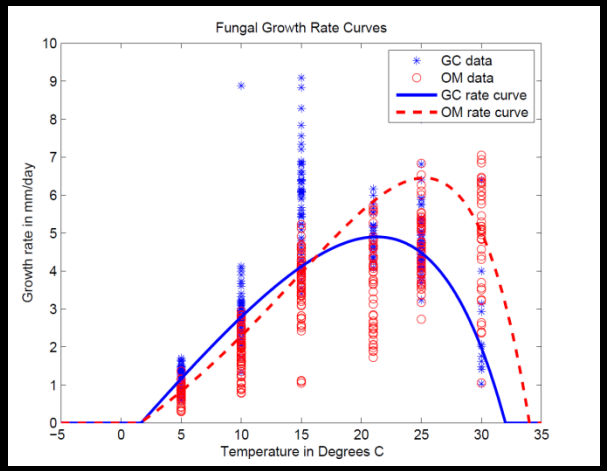
fungi spores



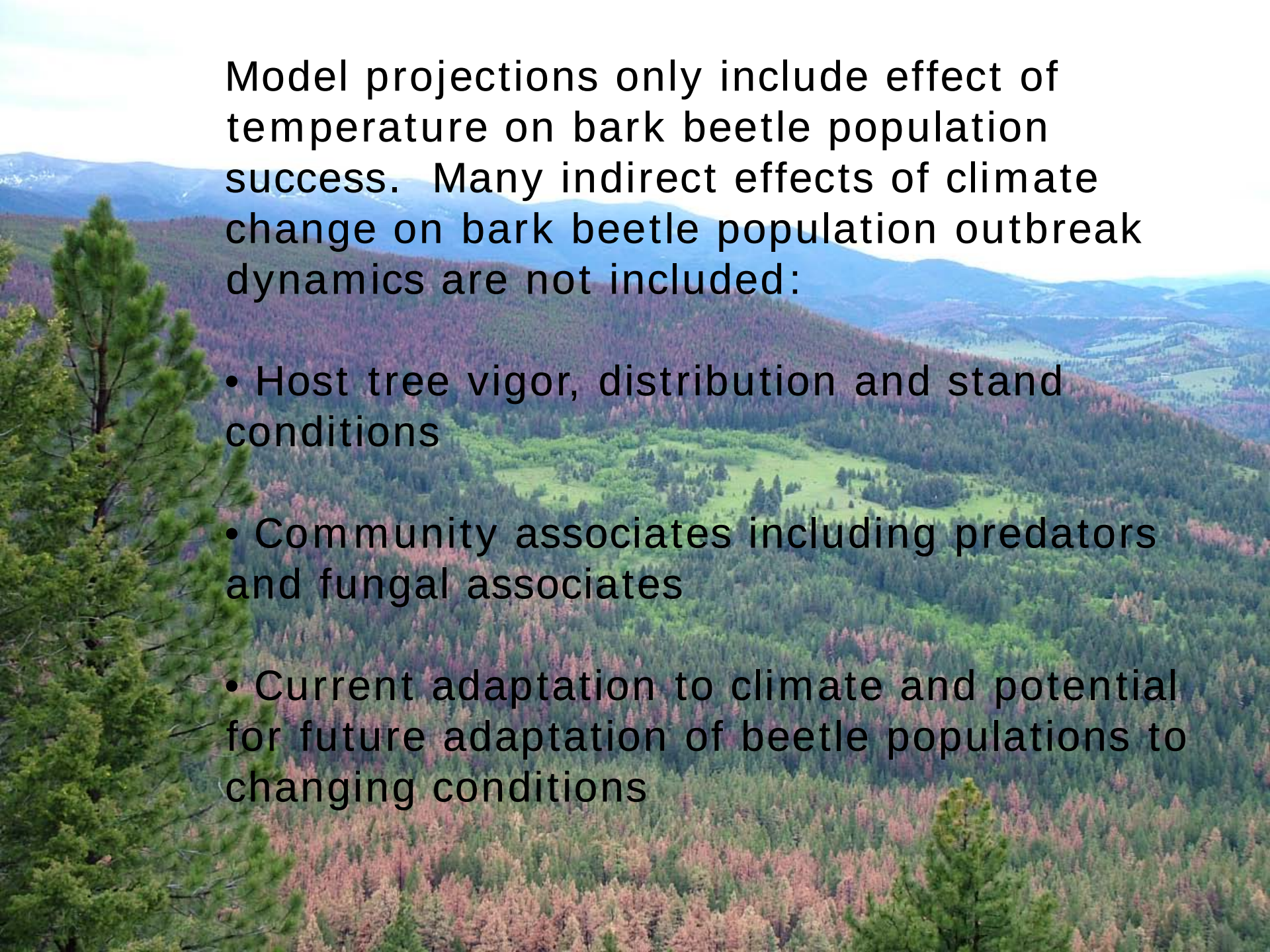
fungi hyphae

‘Blue – staining’ fungi provide vital nutrients to developing mountain pine beetle.

The 2 associated fungi will be differentially influenced by changing temperature.



Addison et al. submitted



Model projections only include effect of temperature on bark beetle population success. Many indirect effects of climate change on bark beetle population outbreak dynamics are not included:

- Host tree vigor, distribution and stand conditions
- Community associates including predators and fungal associates
- Current adaptation to climate and potential for future adaptation of beetle populations to changing conditions

Acknowledgements

National Science Foundation
WHERE DISCOVERIES BEGIN

Natural Resources Canada
Ressources naturelles Canada

USDA FS, Forest Health Monitoring

Utah State University

Rocky Mountain Research Station

Jacques Régnière and Remi St. Amant with the
Canadian Forest Service, Quebec, CA assisted with BioSIM simulations

Jim Vandygriff, RMRS, Logan UT created map outputs