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The Heat is On: Climate Change and Agriculture

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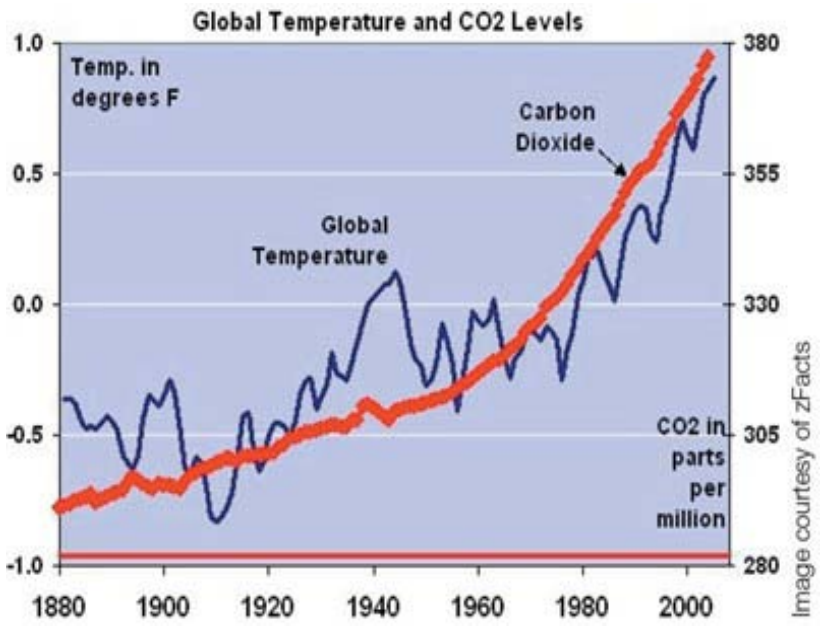
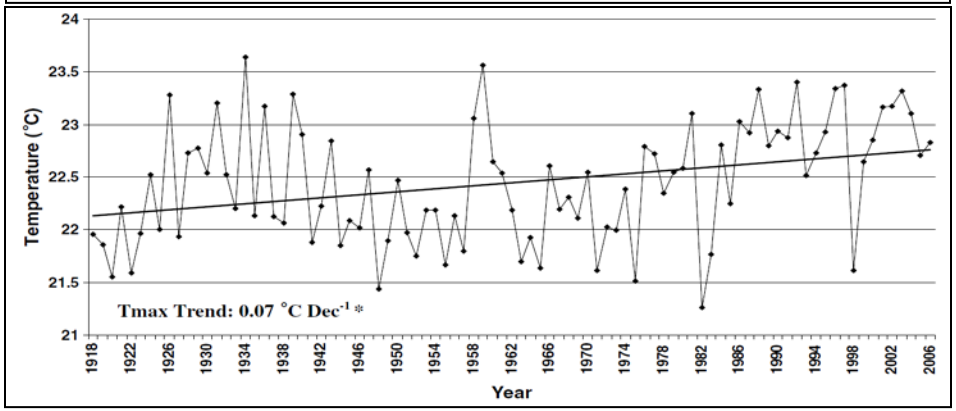
Is the Climate Changing? You Decide!

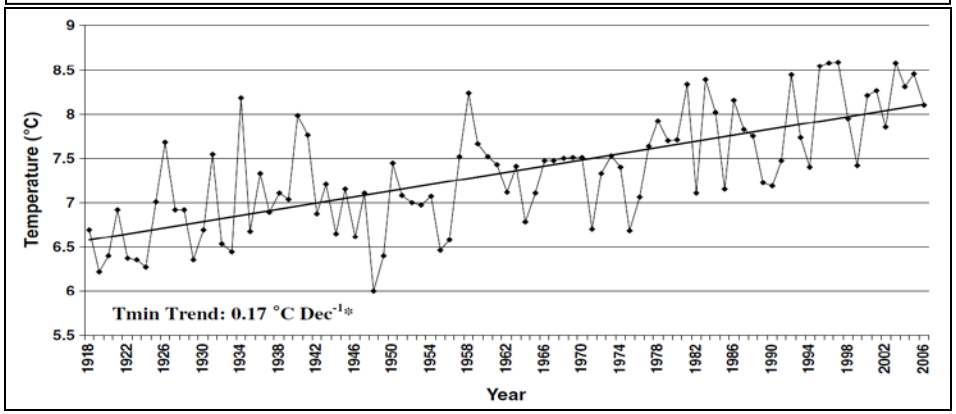
Temperature: Since the Industrial Revolution (1860s) the global average temperature has risen significantly



Annual California Temperature Maximum



Annual California Temperature Minimum



Source: Global Temperature: Zfacts, http://zfacts.com/p/226.html, Accessed 11/8/11

Source: California Temperatures: Cordero et al, Climatic Change, 2011.

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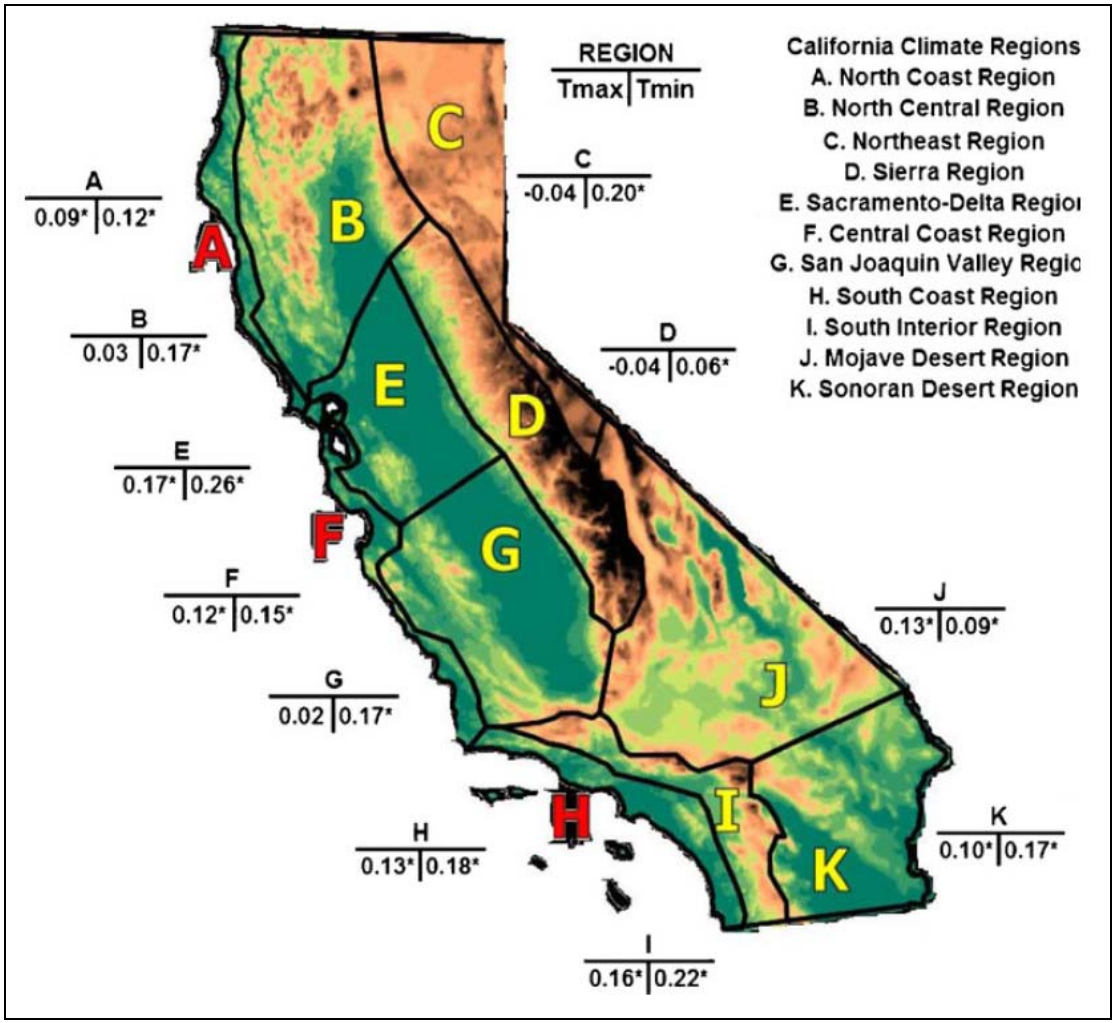
It is Not All Changing the Same?



Source: California Temperatures: Cordero et al, Climatic Change, 2011

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Climate Change Uncertainties Could Bring Too Much of a Good Thing

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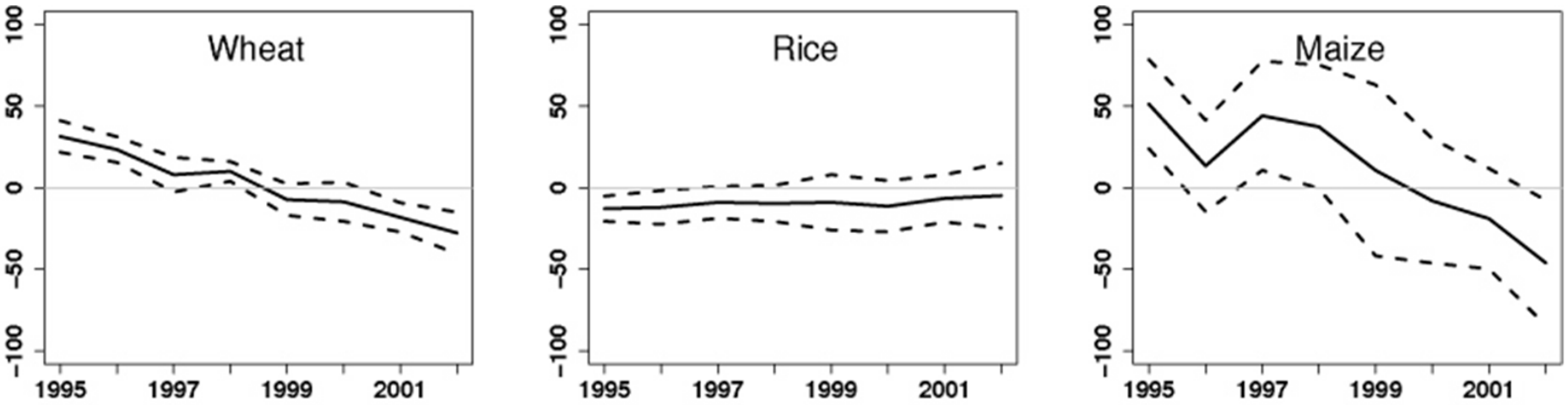
Relationship of Temperature and Crop Yield

Yield Impact of Climate Trend Since 1981 (kg ha^{-1} yr^{-1})



Source: Lobell and Field, Environmental Research Letters, 2007

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Winter Wheat

(CV Mercia Temperature and CO2 Response)

Yield Component	Ambient T 350 CO2	Ambient T 700 CO2	+ 7 F 350 CO2	+ 7 F 700 CO2
Grain Yield (g/m2)	1173	1361	957	1087
mg/grain	41.4	39.0	49.9	54.5

Source: Mitchell et al. 1993. Plant, Cell and Environ. 16:521-529

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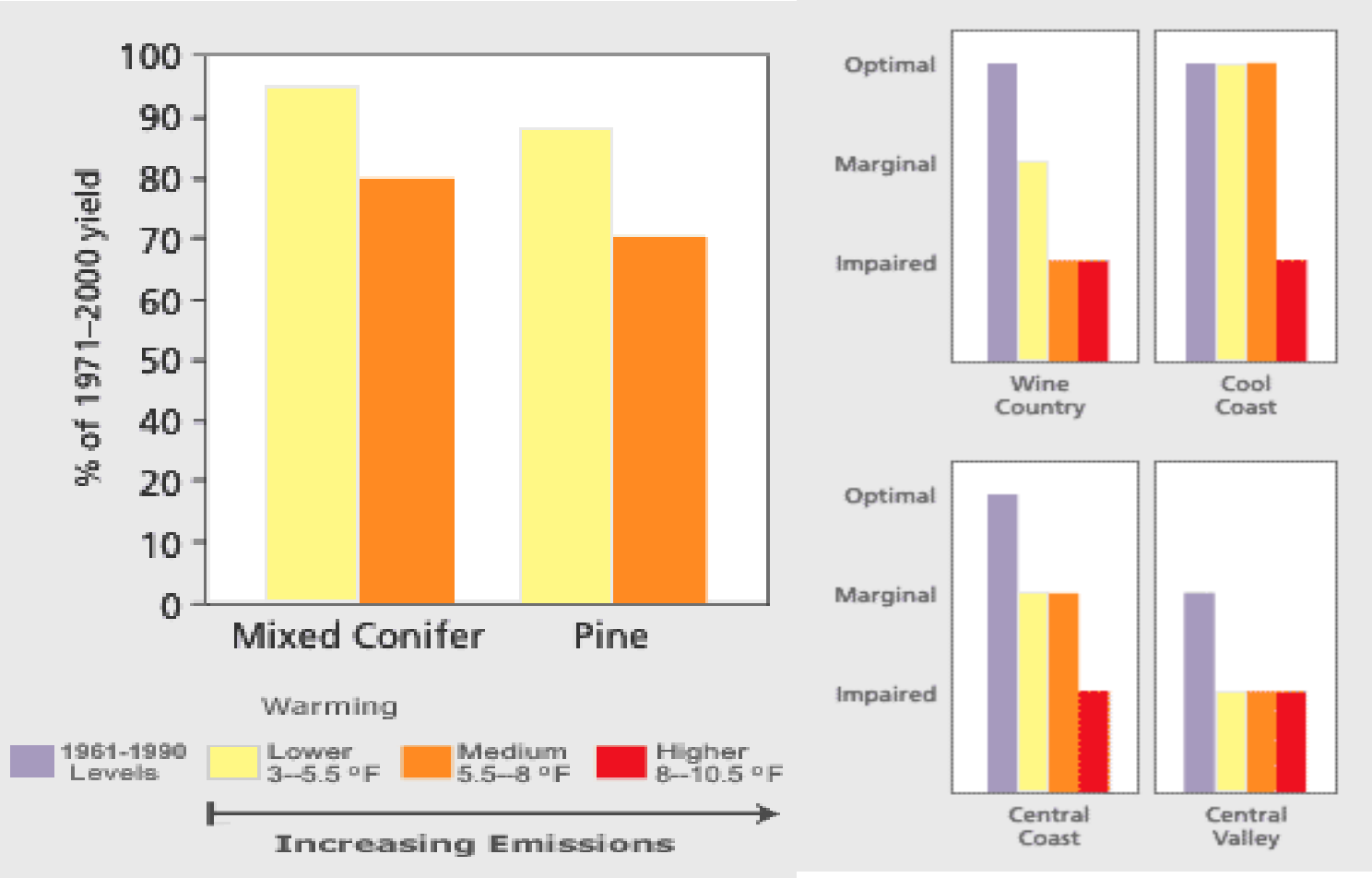
California Examples
Sierra Nevada Forest and Wine Regions



Sources: Forestry: Battles, 2008, Climatic Change. Wine: Hayhoe, 2007.

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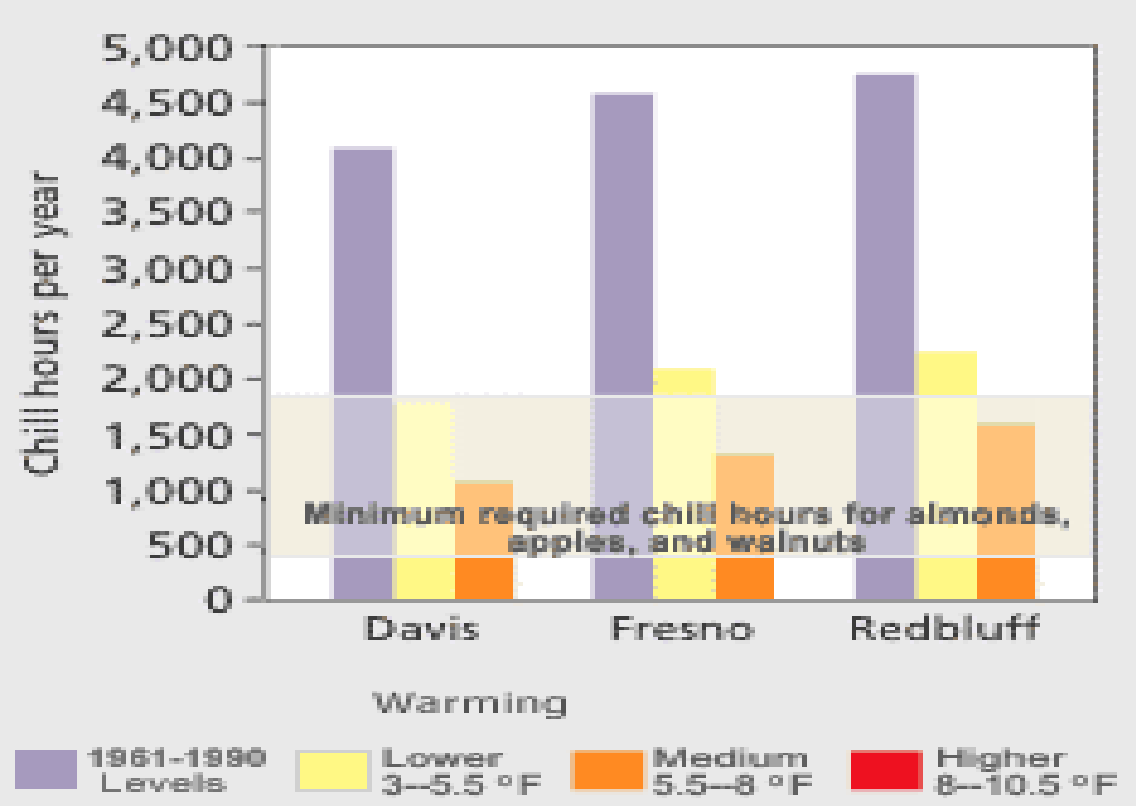
No Chill Hours- Less Walnuts, Almonds, ….



Source: Baldocchi, 2008, Climatic Change 87:S153-166

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How About the Happy Cows?

Heat Stress and Livestock

Optimum temperature for milk production by dairy cattle is 40 – 75 F

	Temp (F) for onset of stress	
RH (%)	Moderate	Severe
30	80	110
50	78	102
70	75	96
90	73	91

Source: Chase, Heat Stress in Cattle, 2006, http://www.climateandfarming.org/clr-cc.php, Accessed 11/8/11

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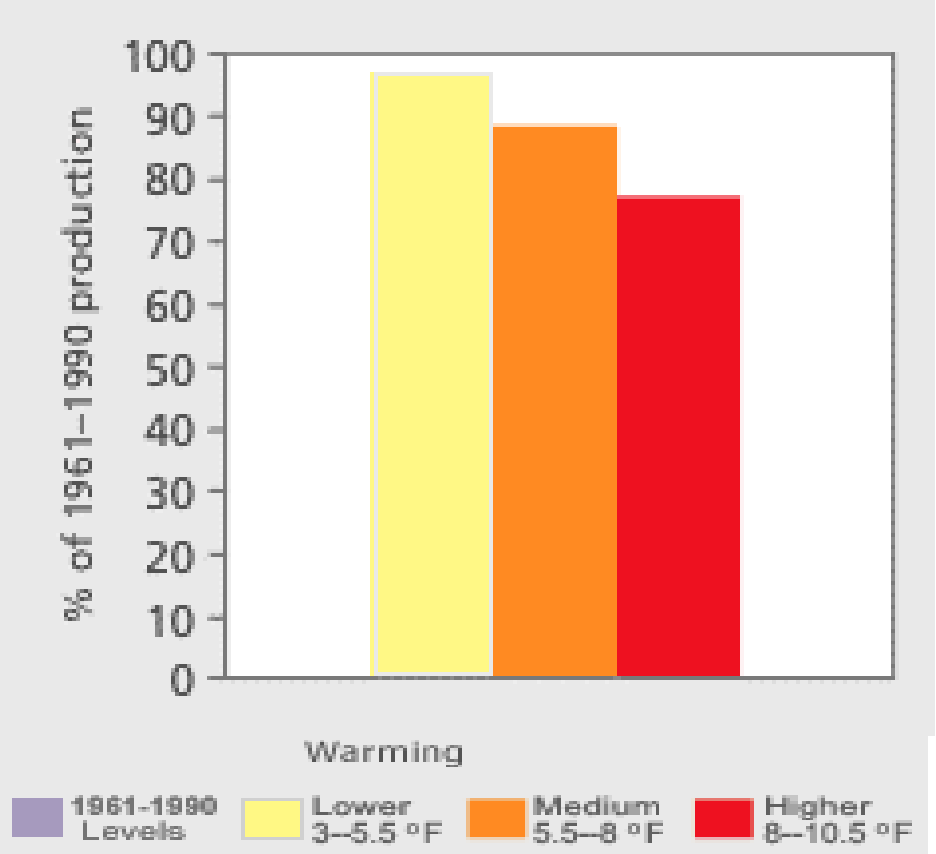
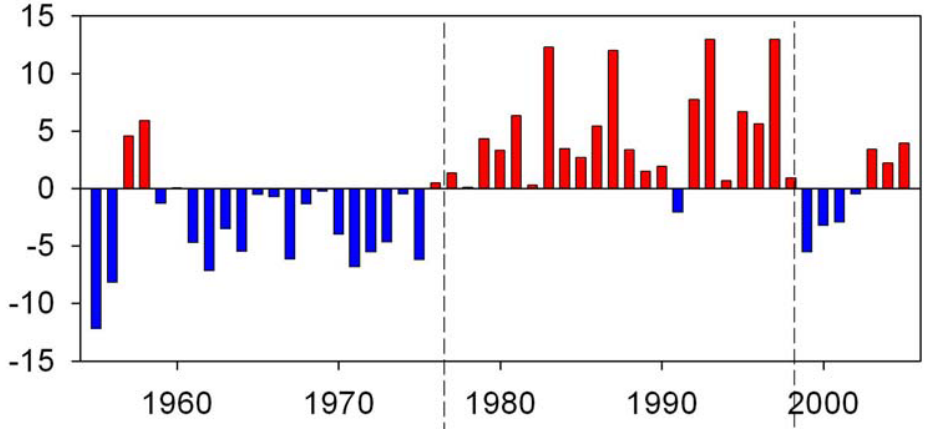
Decreasing Dairy Production 2070-2099



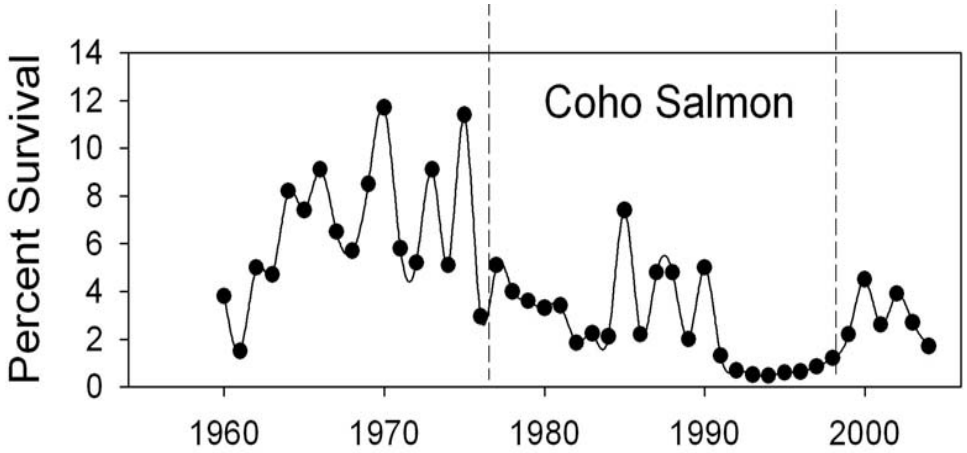
Source: Hayhoe, 2004, PNAS, 101:12422-12427

What About Ocean Products? Effect on Salmon

PDO Index from 1955 to 2005
(Number is calculated from data including sea surface anomalies)



Percent Survival of Hatchery Coho Salmon 1955-2005



Source: *learningcenter.nsta.org*

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Pest Impacts- Example 1
Cotton/Pink Bollworm

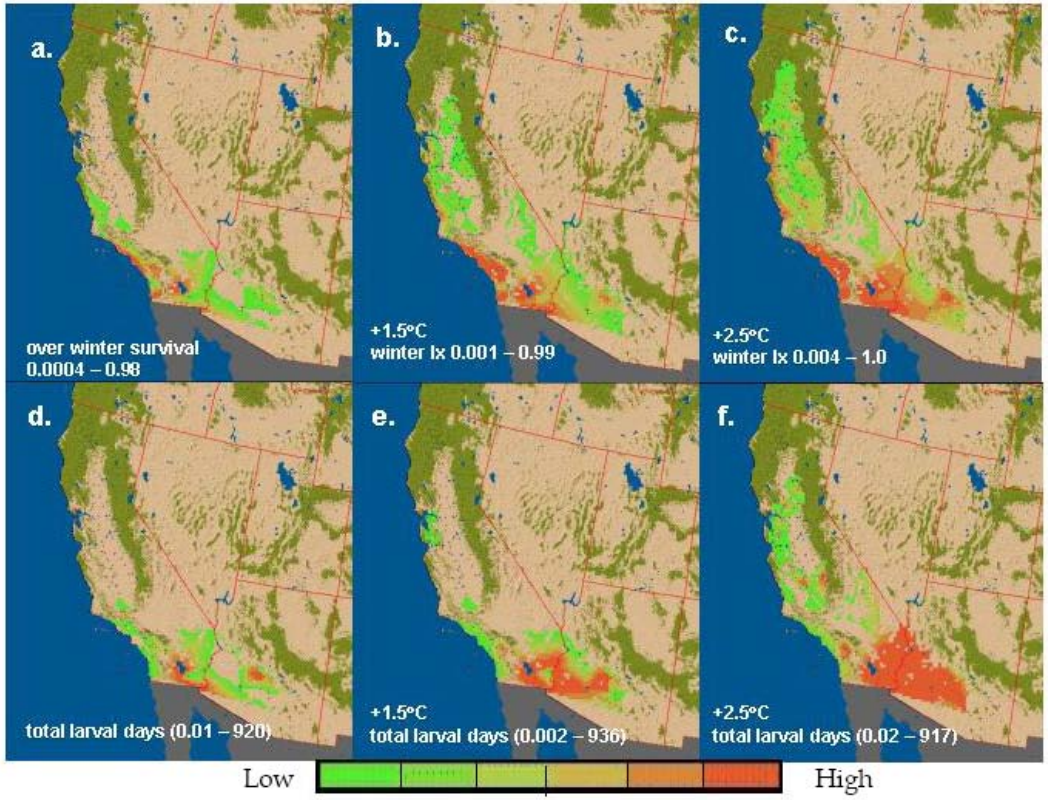

Figure 8. Cotton/pink bollworm (PBW): Predicting areas of favorableness

Source: Guitierrez et. al, White Paper from Climate Change Center
http://www.energy.ca.gov/2005publications/CEC-500-2005-188/CEC-500-2005-188-SF.PDF

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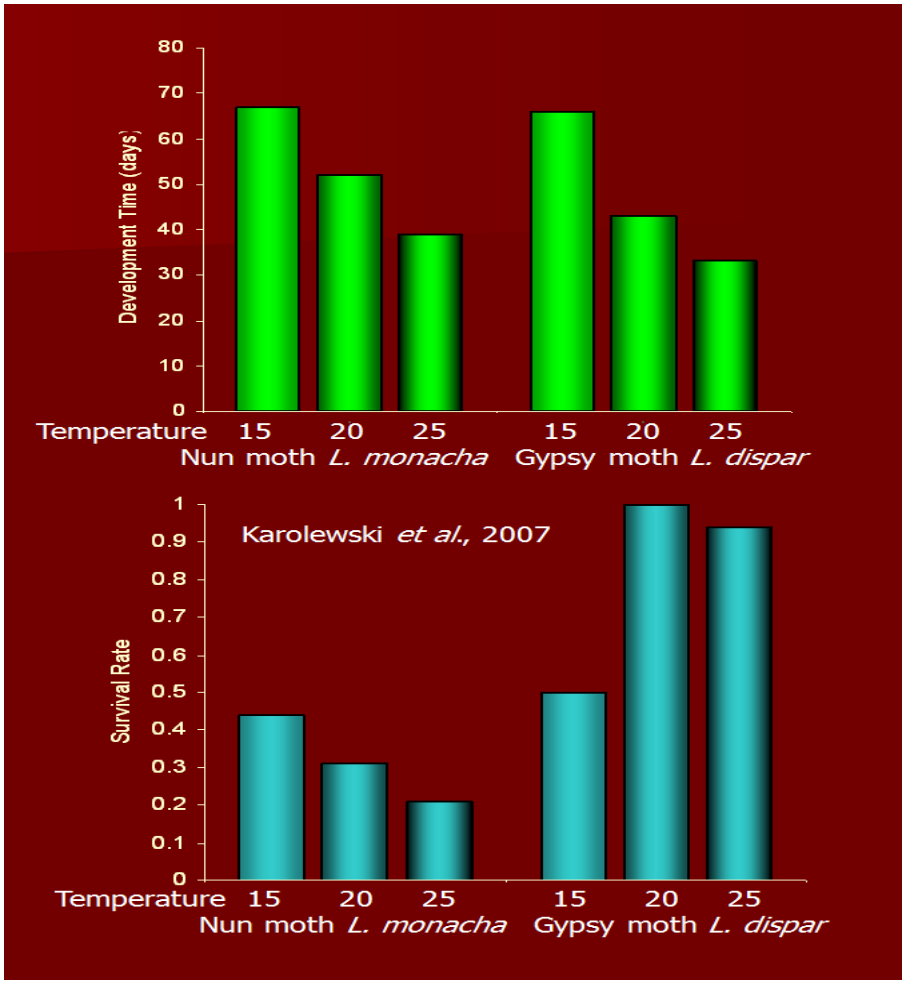
Pest Impacts- Example 2
Gypsy Moth vs Nun Moth



Source: Williams, 2003, Global Change Ecology, 137:114-122

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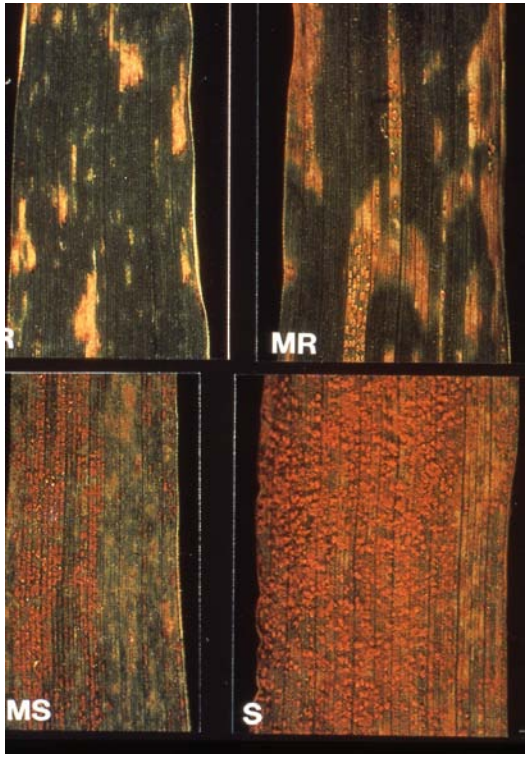
Effect of Climate Change On Crop Disease

- Wheat and oats have been found to be more susceptible to rusts at higher temperatures



Source: Coakley, 1979, Climate Change, 2:33-51

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What is the USDA Natural Resource Conservation Service Doing?

The Natural Resources Conservation Service (NRCS) is focusing global climate change efforts in several areas:

1. Quantifying the effects of conservation practices on greenhouse gas emissions and carbon sequestration;
2. Adaptation strategies in conservation programs to address the effects of climate change on agriculture;
3. Developing and encouraging the use of conservation practices and systems that reduce GHG emissions
4. Developing a climate change adaptation plan and vulnerability assessment
5. NRCS is leading the USDA efforts to develop mitigation and adaptation tools for agriculture
    1. COMET-FARM
    2. COMET-VR 2.0
        1. http://www.comet2.colostate.edu/
6. Online tool to estimate climate benefits of conservation practices

More information:
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/climatechange

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