

Climate Change Impacts on . . .

Forests,



Agriculture, and

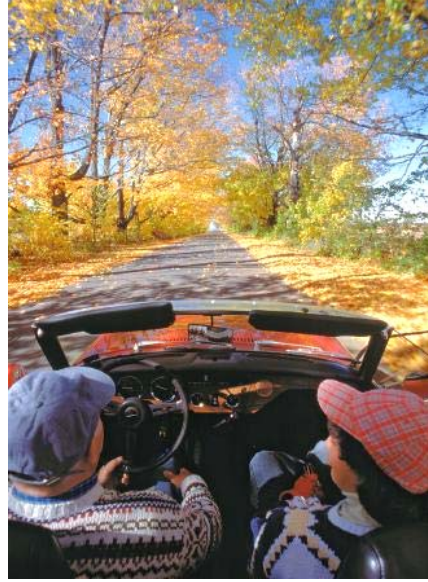


Invasive Species



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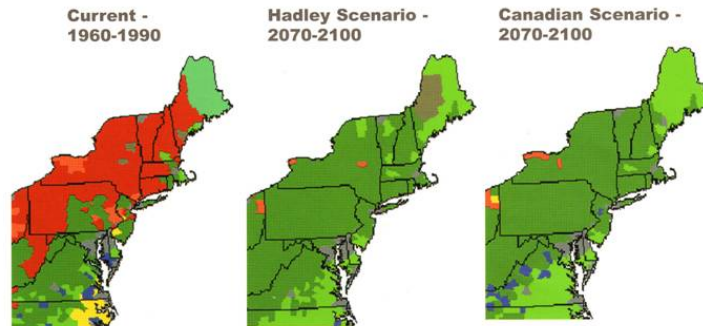
Climate change and ecosystem “services”



Projected Shifts in Tree Species

Dominant Forest Types

- White-Red-Jack Pine
- Spruce-Fir
- Longleaf-Slash Pine
- Loblolly-Shortleaf Pine
- Oak-Pine
- Oak-Hickory
- Oak-Gum-Cypress
- Elm-Ash-Cottonwood
- Maple-Beech-Birch
- Aspen-Birch
- No Data



Source: Melillo J et al. and US Global Change Research Program. 2000. Climate Change Impacts on the United States. Cambridge University Press. Cambridge, UK. p. 45.



Climate change will alter the palette of crops we can choose from, and pose new challenges for farmers, land managers, policy-makers

**Some crops may
have already
benefited from
warmer winters, . . .**



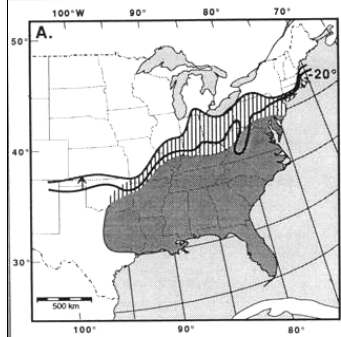
(less vine and root damage
in European wine grapes)

**while for other crops
there is evidence of
reduced yields following
warmer winters.**



(inadequate “winter chill” period, and
poor fruit development in apples)

Warmer winters and invasive weeds: potential shifts in -20 C (-4 F) isocline



Kudzu in North Carolina



Kudzu in New England??

Source: Sasek and Strain. 1990. *Climatic Change* 16:31-51

Invasives and Biodiversity

-Invasive species are typically very good at migrating (e.g., seed dispersal), and establishing and dominating in new locations

-Rare or endangered species are often poor at migrating, and/or adapting to change

Marginally over-wintering insects will benefit Examples: flea beetle, corn earworm

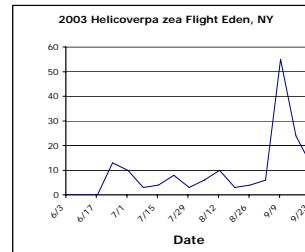
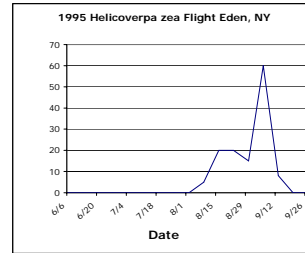
Flea beetle



A vector for Stewart's Wilt



Corn earworm



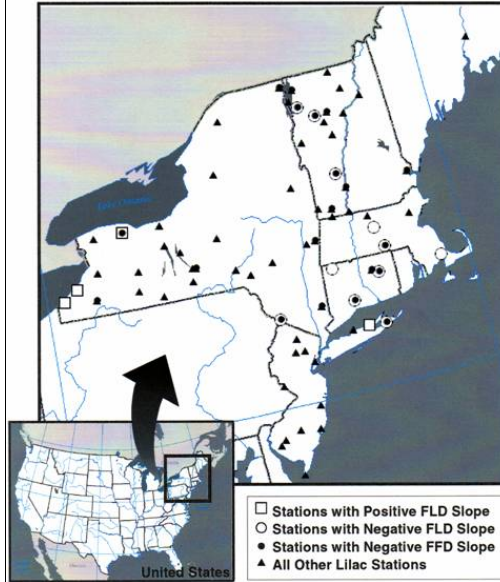
Source: A. Seemann, NY Integrated Pest Management Program; data are from pheromone traps in Eden, NY

The average of monthly temperatures in December, January, and February is used to predict the severity of Stewart's wilt the following growing season. Warmer average temperatures allow higher winter survival for the flea beetle vector. Left photo is a corn plant infected with Stewart's wilt, right photo is the corn flea beetle vector.

Winter snow cover, soil biological processes, and nitrogen cycling



**Plants are blooming earlier:
NE Lilac Phenology Network**



Compared to 1960s:

Lilacs: 4 days earlier

Grapes: 6 days earlier

Apples: 9 days earlier

**(Source: Wolfe et al. 2005.
Internat J. Biometeorology
49:303-309)**

Moderate high temperature stress effects on quality



Control (82/71 F) Seeded fruit



Tipburn



Heat stress (90/79 F)
undeveloped flowers



Blossom end rot

Heat Stress and Livestock



→ Avg annual economic losses of \$24.9 million per year for NY
(Source: S. Pierre et al. 2003. J. Dairy Sci 86:E52-77)

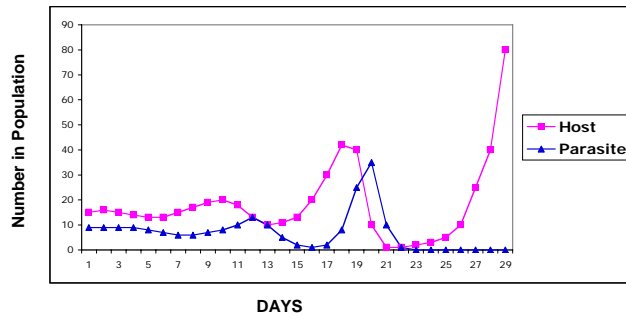
→ In hot summer of 2005, NY dairy farmers reported 8-20%
reductions in milk production, and increased costs for cooling
(Source: L. Chase, Prof. Animal Sci. Cornell Univ.)

This is another way to control heat stress.

How will climate change affect the synchrony between organisms?



Plants and pollinators?



Natural enemies of insect pests?

**Climate change uncertainties:
it could bring too much of a good thing**



Duke FACE (“Free Air CO2 Enrichment”) Facility

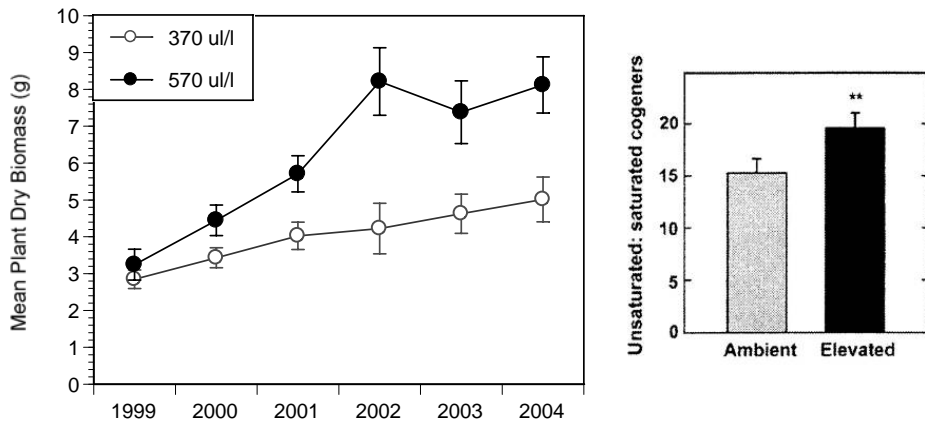


While there are positive aspects to rising CO₂, not all plants are equally desirable.



Poison ivy at Duke FACE ring.

Poison ivy plants grow faster and are more allergenic at elevated CO₂



Source: Mohan et al. 2006. Proc. Nat. Acad. Sci. 103(24): 9086-9089.

CO₂ and Round-up

Ambient CO₂

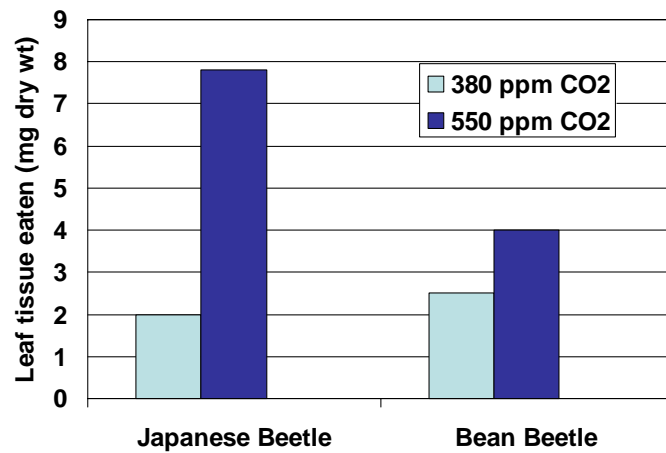
Future CO₂



Increasing CO₂ reduces herbicide efficacy.

(Source: Ziska et al. 2004 *Weed Sci* 52:584-588; Ziska et al. 1999. *Weed Sci* 47:608-615.)

Leaf-feeding insects may do more damage in a high CO₂ world



Data are from soybean FACE field facility (Univ. of Illinois).

Source: Hamilton et al. 2005 *Environ. Entomology* 34:479-485

Concluding Remarks

- **Some crops, and opportunistic farmers who grow them, may benefit from increasing CO₂ and a longer growing season, BUT...**
- **Invasive insect, disease and weed pests are likely to benefit most from climate change, leading to increased pesticide and herbicide use**
- **Many crops that currently drive the region's ag economy, and the dairy industry, will be at risk.**
- **Many small family farms could lack the capital to adapt, or may not be able to develop new markets for new crops**

Concluding Remarks (cont.)

- **Plants and other living things are responding to rising CO₂ and climate change in our region NOW**
- **The fabric of our forests will be forever changed**
- **Climate change will tend to exacerbate loss of endangered species and biodiversity in some ecosystems**

Wishing you a “normal” and peaceful winter

