Lecture 4:
Mechanisms of Influence: Basic ecology

Climate Change Ecology
Geography 404
Jeff Hicke

Environmental Gradients
Different plants have different climate factors

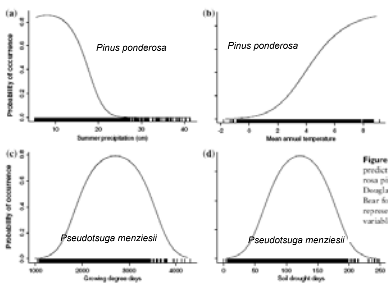
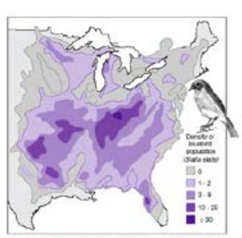


Figure 2 Unimodal/Gaussian responses are predicted by the models. (a) and (b) ponderosa pine on the Wenatchee NF. (c) and (d) Douglas-fir on the Wenatchee and Grizzly Bear forests. Density bands along the *X*-axis represent individual values of the predictor variables.

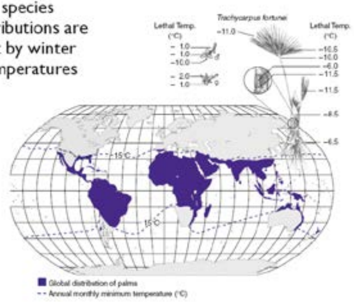
McKenzie et al., 2003

Environmental Gradients
Range and density



Temperature

some plant species distributions are set by winter temperatures



Slide courtesy of C. Still

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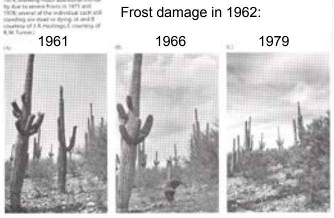
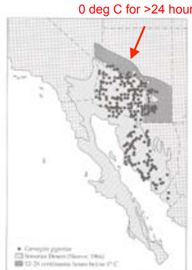
Temperature

Temperature and the saguaro cactus (*Carnegiea gigantea)*

Frost damage in 1962:



0 deg C for >24 hours



Lomolino et al., 2006

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Temperature

other plant species distributions are set by summer temperatures and the length of the growing season

FIGURE 3.4 The relationship between the northern limits of spruce and July temperatures in Canada.

Slide courtesy of C. Still

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Temperature

Animals: Temperature effects on distributions

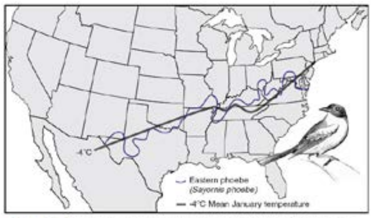

FIGURE 3.8 The relation between January temperature and the northern limits of the eastern phoebe (*Sayornis phoebe*). North of the −4° C January isotherm, the birds cannot obtain food in sufficient quantities to support the metabolic activity required to maintain their body temperature above lethal levels (after Root, 1988).

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Temperature

Animals: Temperature adaptations to cold

Migration

North-south

www.paulnoll.com/Oregon/Birds/Avian-migration.html

Higher-lower

www.oregonzoo.org/Cards/Cascades/elk.roosevelt.htm

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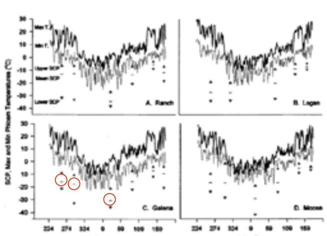
Temperature

Animals: Temperature adaptations to cold

Physiology

Cold hardening of mountain pine beetle

Decrease of supercooling point as winter progresses



Bentz and Mullins, 1999

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Temperature

Animals: Temperature adaptations to heat

Shelter

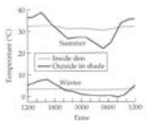

FIGURE 3.18 Temperatures inside and outside the den of a bushy-tailed woodrat (*Neotoma cinerea*) and a deep crack between large boulders in the high desert of southeastern Utah during midsummer and midwinter. Because the den (where the animal spends most of its time) experiences much less variation than the macroclimate outside, it affords vital protection from stressfully high and low temperatures in summer and winter, respectively. (After Brown 1968.)

Lomolino et al. 2006

homepages.gac.edu/~cjgroh/classes/TZPictures.html

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Temperature

Animals: Temperature adaptations to heat

Morphology

“Cool” adaptations to hot conditions

Elephant (*Loxodonta africana*)

fohn.net/elephant-pictures-facts

Chameleons (*Chamaeleo*)

www.african-safari-journals.com/chameleon-pictures.html

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Temperature

Temperature affects sex ratio of turtle hatchlings

Table 1. Sex ratios of hatchling turtles. The question mark indicates sex unknown: infertile, or dead at early stages.

Sex	Experiment 1		Experiment 2		Experiment 3	
	25°C	30.5°C	20° to 30°C	23° to 33°C	Shade (15)	Sun
Graptemys ouachitensis						
Male	210	0	73	0	100	4
Female	0	211	0	65	0	123
?	23	26	38	44	101	74
Graptemys pseudogeographica						
Male	173	4	43	0	35	1
Female	0	147	0	43	0	19
?	49	81	20	24	10	25
Graptemys geographica						
Male	58	0			37	6
Female	0	88			0	15
?	24	31			12	36
Chrysemys picta						
Male	81	0				
Female	0	81				
?	21	20				
Trionyx spiniferus						
Male	33	27				
Female	34	24				
?	16	35				

Implications of global warming?

Bull and Vogt, 1979

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