

Lecture 4:
Mechanisms of Influence: Basic ecology

Climate Change Ecology
Geography 404
Jeff Hicke

Climate Change Ecology Prof. J. Hicke

Environmental Gradients
Different plants have different climate factors

Figure 2 consists of four subplots (a, b, c, d) showing the probability of occurrence for two plant species across different climate variables. Subplot (a) shows *Pinus ponderosa* response to Summer precipitation (mm), with a unimodal curve peaking at approximately 20 mm. Subplot (b) shows *Pinus ponderosa* response to Mean annual temperature, with a unimodal curve peaking at approximately 5°C. Subplot (c) shows *Pseudotsuga menziesii* response to Growing degree days, with a unimodal curve peaking at approximately 3000 GDD. Subplot (d) shows *Pseudotsuga menziesii* response to Frost-free days, with a unimodal curve peaking at approximately 150 days. A caption for Figure 2 states: "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." The source is cited as McKenzie et al., 2003.

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Environmental Gradients
Range and density

The map shows the geographic range of western bluebirds in British Columbia, Canada. The range is indicated by a shaded area, and the population density is shown by a color gradient from light purple (low density) to dark purple (high density). A legend on the right indicates density levels: 0 (lightest), 1-2, 5, 10, 20, and 50 (darkest). A small illustration of a bluebird is shown in the top right corner. A caption below the map states: "FIGURE 1.12 The range and population density of western bluebirds (birds) in western British Columbia. Population density is greatest in central and northern parts of the geographic range (after Bjerkh, 1974; Brown and Gibson, 1992)." The source is cited as McKenzie et al., 2003.

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Temperature

Animals: Temperature effects on distributions




FIGURE 3.6 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, 1995).


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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/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

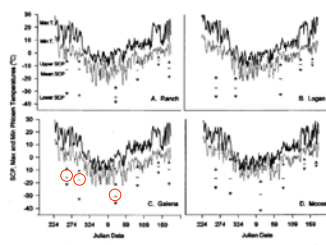


Fig. 9. Maximum and minimum phloem temperatures (°C) at 4 sites (A, B, C, D) in 1995-1999 with the mean (---) and range (---) of measured larval supercooling points (SCP) (°C).

Bentz and Mullins, 1999

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Temperature

Animals: Temperature adaptations to heat

Shelter

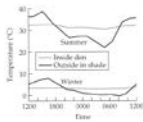



FIGURE 3.18 Temperatures inside and outside the den of a shaded rodent woodrat (*Neotoma ciorensis*) and a deep crack between large boulders in the high desert of southeastern Utah during midsummer and midwinter. Because the den (where the animal spends most of its time) experiences much less variation than the macroclimate outside, it affords vital protection from stressful high and low temperatures in summer and winter, respectively. (After Brown 1964.)



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

Lomolino et al. 2006

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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 hatching 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 32°C	Shade (75%)	Sun
	<i>Geopemys ewaldensis</i>					
Male	210	0	75	0	180	4
Female	0	211	0	65	0	121
?	23	26	38	44	181	74
	<i>Geopemys pseudogeographica</i>					
Male	175	4	43	0	35	1
Female	0	147	0	43	0	19
?	49	81	20	24	10	25
	<i>Geopemys geographica</i>					
Male	58	0			37	8
Female	0	88			0	15
?	24	31			12	36
	<i>Chersophrys picta</i>					
Male	81	0				
Female	0	81				
?	21	20				
	<i>Trionyx spiniferus</i>					
Male	33	27				
Female	34	24				
?	16	35				

Implications of global warming?

Bull and Vogt, 1979

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