Climate and Biomes

How will organism distributions shift under climate change?

Terms: biome, PET, AET, ecotone, microclimate

A. Biomes
B. Climate diagrams
C. Microclimate
D. Ecotones

II. Organism adaptations and tolerance

Terms: Adaptation, fitness, tradeoffs, genotype, phenotype, ecotype, plasticity, homeostasis, feedbacks

A. Adaptation
B. Homeostasis
C. Law of Tolerance, acclimatization

Tropical rain forest

Biomes

Major **ecosystem types** characterized by dominant vegetation and climate

Tropical dry forest

What are they?

Tropical rain forest
Tropical dry forest
Tropical savanna
Desert
Mediterranean woodland and shrubland
Temperate grassland
Temperate forest
Boreal forest
Tundra

Savanna

Desert

Temperate forest

Temperate rain forest

Grassland

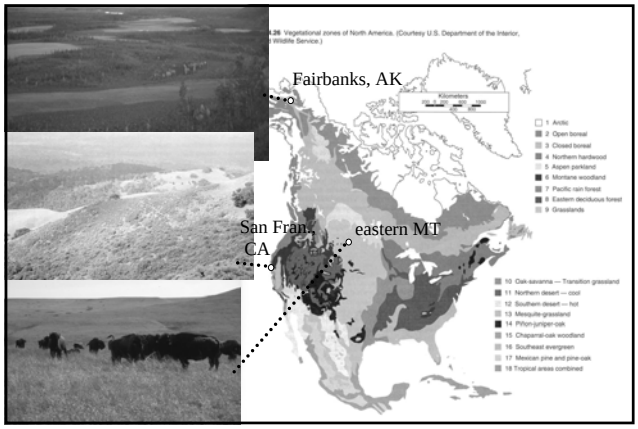
Shrub steppe

Desert

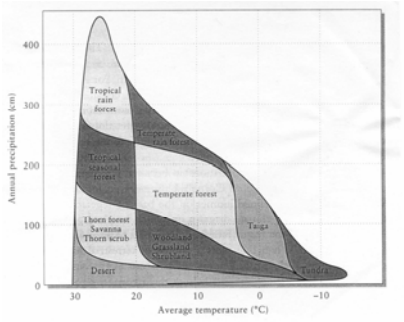
Tundra

Boreal forest

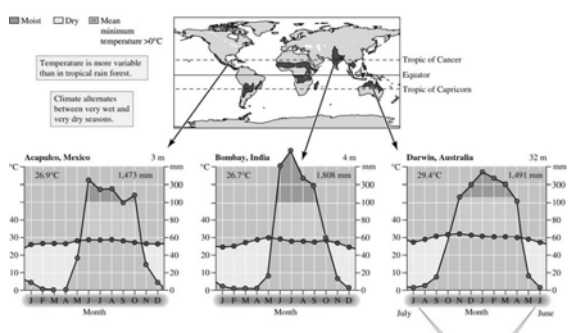
Tundra



Biomes:
Temperature and moisture dependence

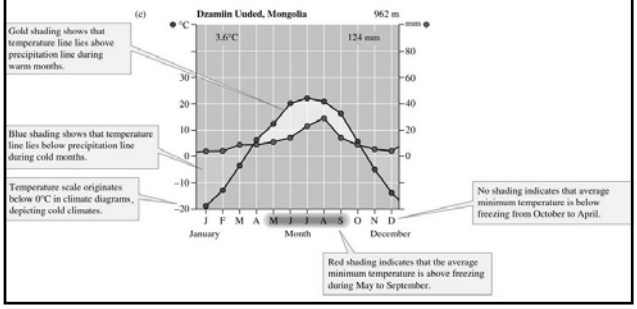


(Ricklefs 2001)

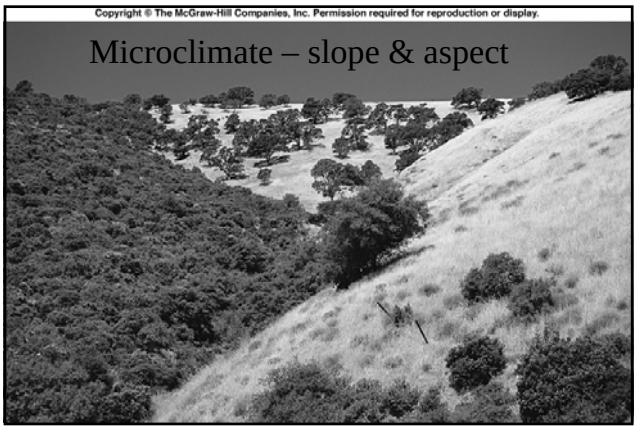


Tropical dry forest

Cold desert

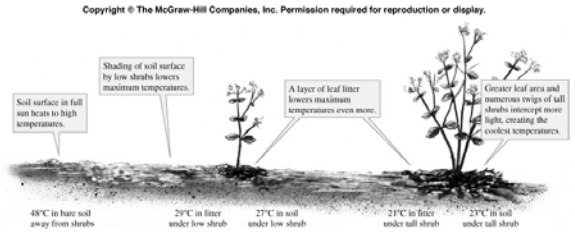


Climate diagram



Microclimate – slope & aspect

Microclimate – canopy cover



II. Organism adaptations and tolerance

Terms: Adaptation, fitness, tradeoffs, genotype, phenotype, ecotype, plasticity, homeostasis, feedbacks

A. Adaptation

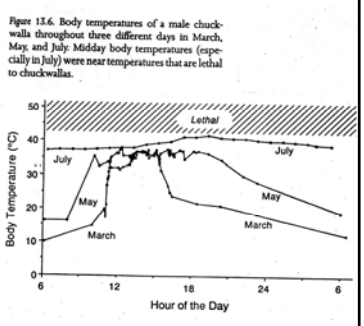
B. Homeostasis

C. Law of Tolerance, acclimatization

Ecotones

Tolerance – effects of environmental change?

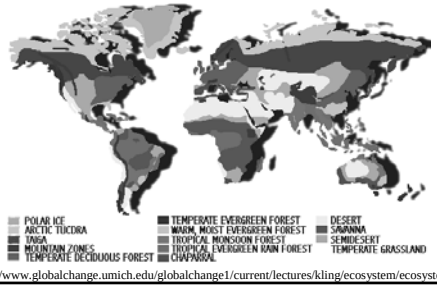
Chuckwalla, Valley of Fire



http://www.richard-seaman.com/Reptiles/Usa/Nevada/ValleyOfFire/

Biome distribution

What will happen with climate change?
Will species shift together?
Will some species not be able to shift?



http://www.globalchange.umich.edu/globalchange1/current/lectures/kling/ecosystem/ecosystem.html

Adaptation

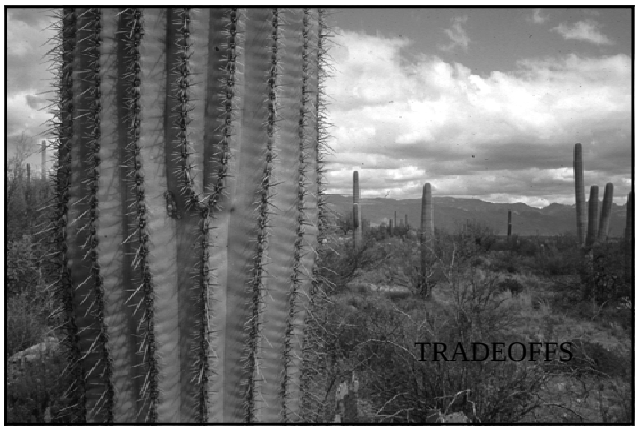
Any heritable behavioral, morphological or physiological trait

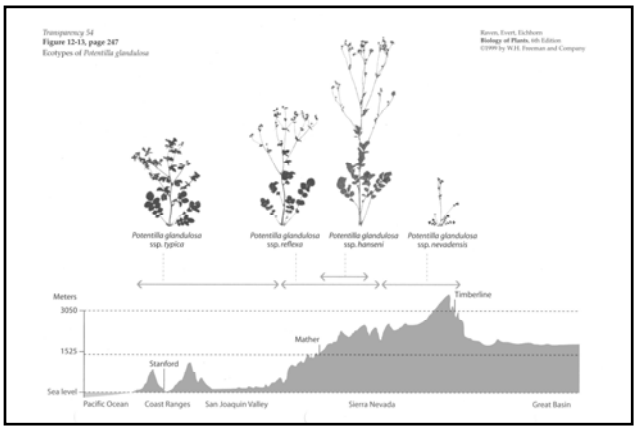
that maintains or increases the fitness of an organism

under a given set of environmental conditions.

Fitness?

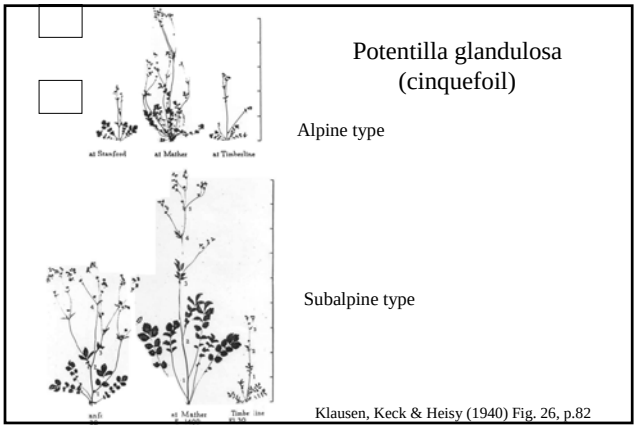
The contribution an organism makes to future generations and the population gene pool.





Genotype
Phenotype
Plasticity
Ecotype

Q for feedback: if two individuals are of the same species, are they genetically identical?



Potentilla glandulosa (cinquefoil)

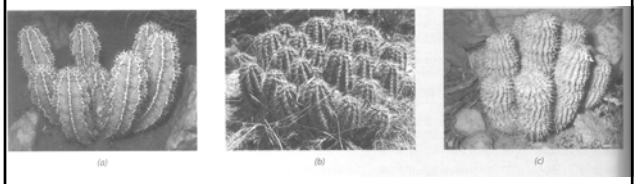
Alpine type

Subalpine type

Klausen, Keck & Heisy (1940) Fig. 26, p.82

Homeostasis
Negative feedbacks
Positive feedbacks

Convergent Evolution



Euphorbia
Euphorbiaceae
Asia & Africa

Echinocerus
Cactaceae
North America

Hoodia
Asclepiadaceae
Asia & Africa

Raven, Evert & Eichorn (2000)

Law of Tolerance

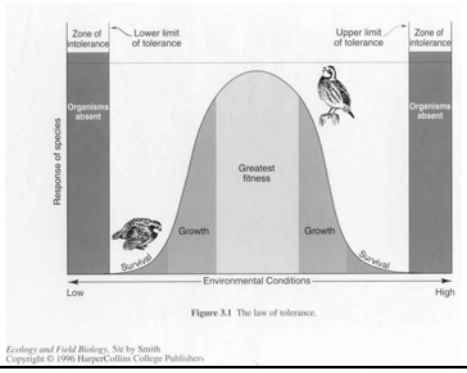


Figure 3.1 The law of tolerance.

Ecology and Field Biology, 5/e by Smith
Copyright © 1996 HarperCollins College Publishers

Acclimation and adaptation

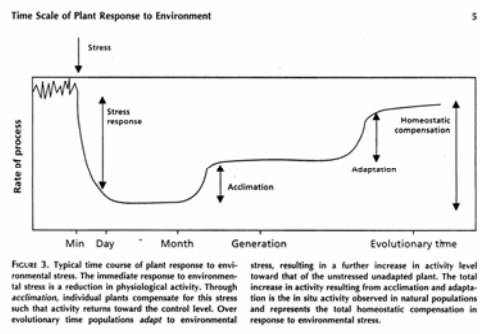


FIGURE 3. Typical time course of plant response to environmental stress. The immediate response to environmental stress is a reduction in physiological activity. Through *acclimation*, individual plants compensate for this stress such that activity returns toward the control level. Over evolutionary time populations *adapt* to environmental stress, resulting in a further increase in activity level toward that of the unstressed unadapted plant. The total increase in activity resulting from acclimation and adaptation is the in situ activity observed in natural populations and represents the total homeostatic compensation in response to environmental stress.