## Population Distributions: ecological underpinnings

"Underlying species-environment models is the premise that predictable relations exist between the occurrence of a species and certain features of its environment and that the distributions of species have adaptive significance." (Heglund 2002:35)

"From an evolutionary perspective, where an animal is likely to occur, can be thought of as the result of adaptations to certain biotic and abiotic factors that predispose and animal to occur in one area as opposed to another" (Morrison et al. 1998).

Niche concept:

Grinnell (1917) : physical environment and range (geophysical spatial unit), entire area where animal can occur/survive

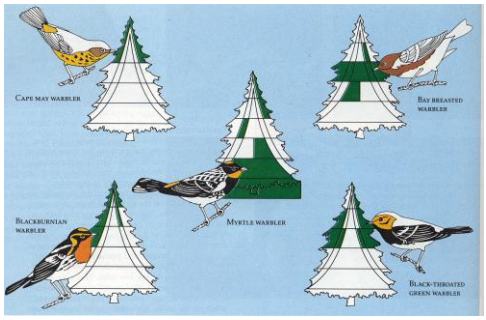
Elton (1927): function, an animals 'occupation' or place in a biotic community

Hutchinson (1957) : n – dimensional hypervolume

## Types of niche

Fundamental: potential niche, in absence of competition and other biotic interactions

Realized : species actual use of resources in a given time and space after competition and biotic interactions




## But… relationships are dynamic

- The environment is dynamic (i.e., changing)
- Site fidelity may prevent immediate response
- Animal's may acclimate producing different responses

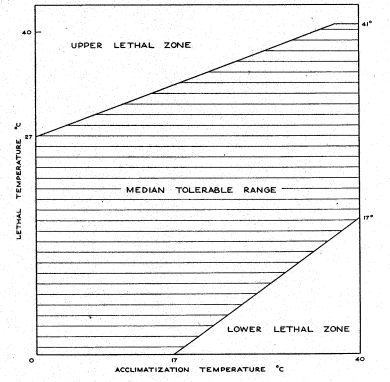



FIG. 6.28.—Showing the median tolerable range of temperature for goldfish and how the lower and upper lethal limits depend upon the temperature to which the fish had previously been acclimatized. (Modified after Fry, Brett, and Clausen, 1942.)

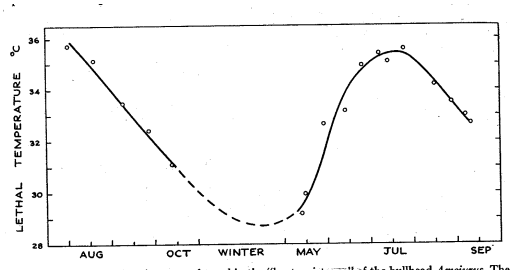



FIG. 6.30.—Illustrating the seasonal trend in the "heat resistance" of the bullhead *Ameiurus*. The ordinate gives the lowest temperature at which just half the sample of fish were dead after an exposure of 12 hours. The fish have clearly become acclimatized to the prevailing temperature of each season. (After Brett, 1944.)

## Limiting Factors

What are they?

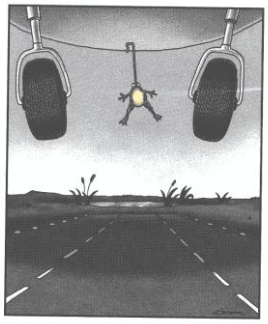
Categories?

Examples?

## Factors that limit distributions

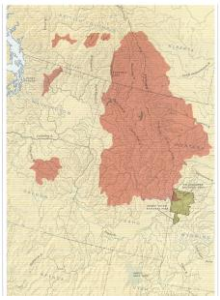
1. Mobility/dispersal
2. Habitat:
   Temperature, moisture, light, oxygen, vegetation, aquatic/lithic substrates
3. Interactions with other animals

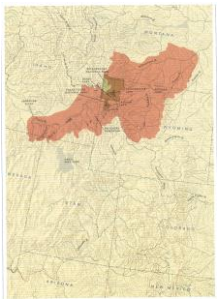
## Limiting factors – dispersal



## Limiting factors – dispersal

(e.g., Westslope and Yellowstone Cutthroat)





## Limiting factors – habitat (abiotic)

## Limiting factors – habitat (biotic)

## Intraspecific dynamics

Ideal free distribution (Fretwell & Lucas 1970)

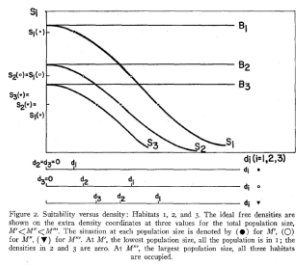


Figure 2. Suitability versus density: Habitats 1, 2, and 3. The ideal free densities are shown on the extra density coordinates at three values for the total population size, $M' < M'' < M'''$. The situation at each population size is denoted by (●) for $M'$, (○) for $M''$, (▼) for $M'''$. At $M'$, the lowest population size, all the population is in 1; the densities in 2 and 3 are zero. At $M'''$, the largest population size, all three habitats are occupied.

## Interspecific dynamics

Competition

*Competitive Exclusion Principle (Gause 1934)* – no two species can fill the same niche (compete for the same resource) for very long. Eventually leads to displacement / partitioning of the shared resource in space or time, or lack of coexistence.

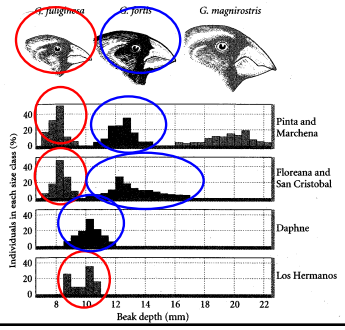
2 types:

Interference

Exploitative

## Interspecific competition

Character Displacement – Darwin's Finches




## Interspecific dynamics

Predation

Prey and/or predators can be influence spatial and temporal distributions of each at different times.

examples?

## A final note: hierarchy of scales