How to calculate carrying capacity

1. Sum estimates of regional K.
2. Curve Fitting
3. Assume Single Resource Constraint
4. Reduce Multiple Requirements to one factor
5. Assume Multiple Independent Constraints
6. Multiple Factors and Dynamic Modeling
7. Guess and act like you know what your talking about

Historical development (much abbreviated)
- Malthus
- Condorcet
- Paul Erlich

The axiom of limited returns
Each person can increase K if and only if adequate resources are available to be utilized in new and more efficient ways.

Garden plot analogy

What limits Food production
- Resources?
- Creativity?

Human Carrying Capacity

- Dangers of overshooting
  - Sustainability
  - Ecosystem function
    - Resilience
    - Stability
  - Moral Issues

INTERSPECIFIC INTERACTIONS

	Species A	Species B
Mutualism	+	+
Predation/Parasitism/Herbivory	+	-
	-	+
Competition (symmetric)	-	-
Competition (asymmetric)	0	-
Competition (asymmetric)	-	0
Commensalism	0	0
	0	+
	+	0

COMPETITION - DEFINITION OF TERMS

Intraspecific -- Within species. --
Interspecific - Between species.

Exploitation Competition (AKA, Resource Competition or Scramble competition). --

Interference Competition (AKA, contest competition)

Pre-emptive Competition

Three Possible Outcomes of Competition Between Two Populations

- 1. Local extinction of one population
- 2. Stable equilibrium
  - The two species coexist, with each population staying close to a certain equilibrium value
  - If a disturbance changes the population size both drift back to the equilibrium values
- 3. Unstable equilibrium
  - A theoretical equilibrium population sizes exist but any departure from the equilibrium results in the extinction of one population

Competition Models

- Lotka-Volterra
- Assume that resource availability are limiting the sizes of both populations
- Assumes that a competition coefficient can quantify the relative amount of resources needed to support each species.
  - If species A consumes twice as much resources per organism than Species B competition coefficient would be 1 for species A and ½ for species B
- Assumes that resource availability does not avry and that population will grow logistically in the absence of competition

COMPETITIVE EXCLUSION PRINCIPLE

“Complete competitors can not coexist”

Selection favors minimizing competition.

Two coexisting species can not occupy the same niche indefinitely.

Niche Theory

OLD, VAUGE DEFINITION

A niche is the ecological role of the organism in the environment

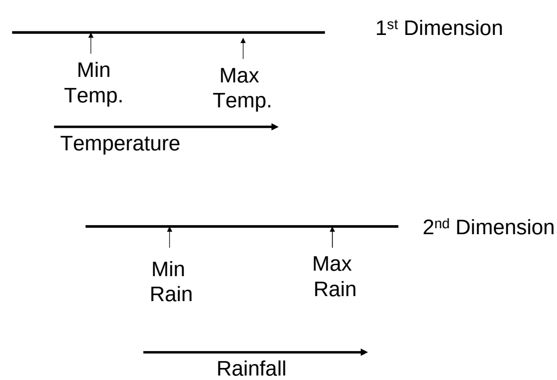
HUTCHINSON'S DEFINITION Of A NICHE

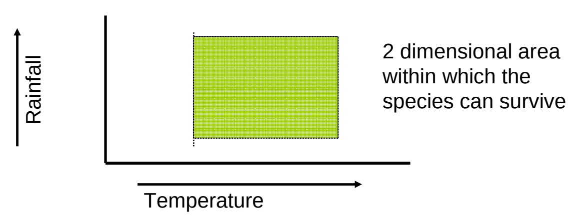
An Nth dimensional hypervolume with which a species can reproduce indefinitely.

1 dimension defines a scalar
2 dimensions defines an area
3 dimensions defines a volume
4+ dimensions defines a hypervolume.

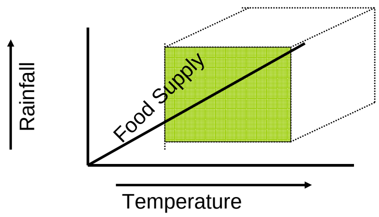
For any species there is a long list of conditions and requirements that must be met if the species is to survive. For example there is a range of temperature in which a species can survive, a range of humidity, a range of available nutrient density, a range predator density etc.

Each of these represents a dimension that can be combined to define a hypervolume.





3 dimensional Volume within which a species can survive

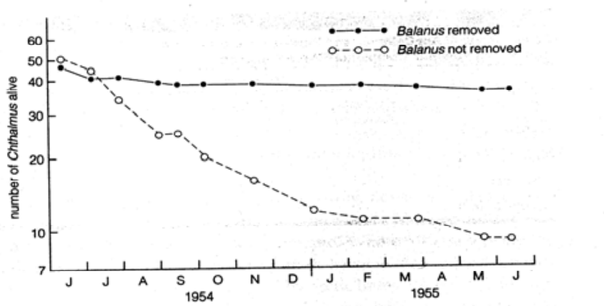


Mathematically it is easy to create 4,5,6, ..N dimensional hypervolumes and compare them

	TREATMENT			
Taxon	**Rodents Removed**	**Ants Removed**	**Control**	**Increase Relative to control (%)**
Ant Colonies	543	--	318	70.8
Rodent Numbers	---	144	122	18
Rodent Biomass	---	5.12	4.13	24

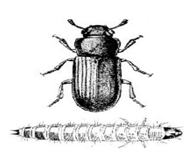
From: Brown and Davidson 1977

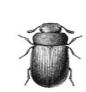
Competing Barnacles?



(From: Connel 1961)

Temp °C	Rel. Hum %	Single Species #	*T. confusum*	*T. castaneum*
34	70	conf=const	0	100
34	30	conf>cast	90	10
29	70	conf<cast	14	86
29	30	conf>cast	87	13
24	70	conf<cast	71	29
24	30	conf>cast	100	0





From Park 1964

INTRASPECIFIC COMPETIION
AGE-SPECIFIC NICHE SHIFTS
Komodo Dragons
Homotabalous insect

Predator / Prey Interactions

What is a predator? What is a prey?

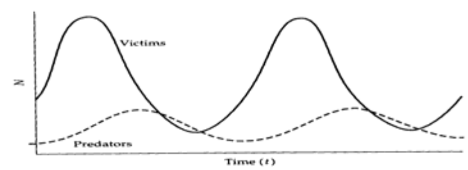
How do predator/prey interactions differ from competitive interactions?

Types of +/- interactions
Predators -- Prey
Parasite -- Host
Parasitoid -- Host

Plant systems
Grazers -- Grasses
Frugivores -- Fruit
Granivores -- Seeds
Parasitiods -- Seeds

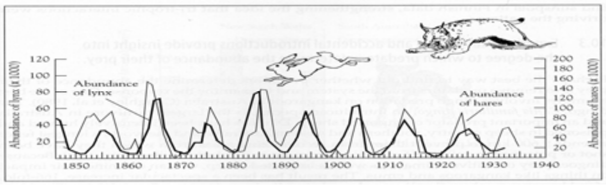
Predation Models

- Lotka-Volterra
- Assume that prey population is limited by abundance of predators
- Assumes that predator population is limited by availability of prey.
- Assumes predators and prey can grow exponentially in the absence of the other population.
- Assumes that predators and prey encounter each other randomly. And there fore the higher the density the more likely an encounter.
- Assumes that there are constants conversion efficiencies, Capture efficiencies.

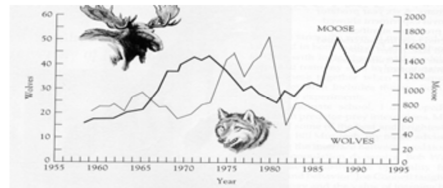


Nifty result -- simplest models about what determines the abundance of predators and prey results in complex oscillations.

Time lags



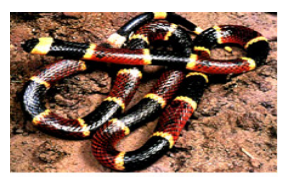
Hares and Lynx in Canada



Isle Royal Michigan Moose and Wolf Populations

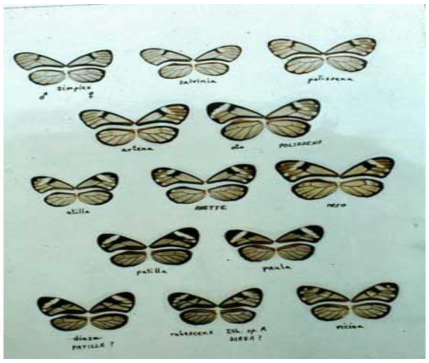
STRATEGIES FOR AVOIDING PREDATION

1. Cryptic coloration
2. Aposematic displays
3. Mimicry
   - Mullerian
   - Batesian
4. Intimidation displays
5. Aggression
6. Chemical Defenses
7. Predator satiation
8. Escape
9. Stolting?



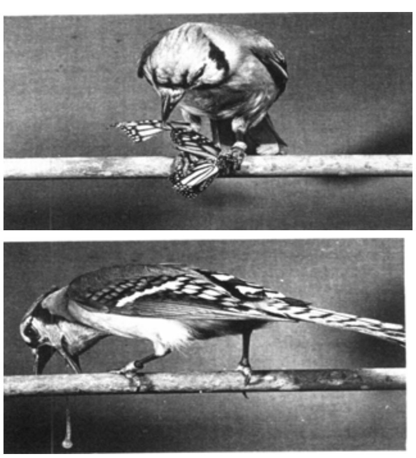
Coral snake
(Micrusus fulvius)

King Snake



Ecological/Evolutionary Strategies to Avoid Predation (How to avoiding being lunch)

Aposematic coloration -- Bright warning coloration in combination with the storage of repellent, distasteful and/or toxic compounds in the tissue of the prey.



MONARCH

VICEROY

From Borror & White A Field Guide to Insects