Chapter 52

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- Population Ecology — Study of populations in relation to environment, including environmental influences on density and distribution, age structure, and population size
- A population is a group of individuals of a single species living in the same general area
  1. Rely on the same resources
  2. Interact
  3. Interbreed
- Population Density — How many organisms are present in an area
  1. Mark and recapture method to determine density
- What causes population size change?
  1. Adding or Removing individuals (birth, death, immigration, emigration)
- Spacing patterns within a population provide insight into the environmental associations & social interactions of individuals in a population
  1. Clumped — Most common. Animals live in groups or packs that make it easier to survive and protect territory. Common in animals such as wolves.
  2. Uniform — Roughly the same distance between each organism. Common in animals such as penguins.
  3. Random — No pattern for population density. Common in plants.
- Life tables represent trends in survivorship rate of a population.
- Types of survivorship curves:
  1. Type I (e.g. Humans) — Flat at start. Low death rates in middle and early life, but death rates rise as it gets farther right $\left(\text{looks like } \frac{1}{x} \text{ in the third quadrant}\right)$

2. Type II (e.g. squirrels) — Straight line. Constant death rate.
3. Type III (e.g. frogs) — High death rate for the young, but flattens out farther to the right $\left(\text{looks like } \frac{1}{x} \text{ in the first quadrant}\right)$

- Exponential Growth

  1. Exponential growth is population increase under idealized conditions
  2. Under these conditions, the rate of reproduction is at its maximum, called the rate of intrinsic increase

- Population Growth (exponential model)

  1. Change in population = births - deaths
  2. Exponential Model: $\frac{dN}{dt} = r_{max}N$, where N is the number of individuals, r is the rate of growth, and t is time
  3. Characteristic of populations without limiting factors (like animals in a new environment or one rebounding from a catastrophe)

- Carrying Capacity (K) — The maximum population size that an environment can support. This is not fixed.

- Population Growth (logistic model)

  1. Curve looks like an S
  2. Graph can "overshoot" the carrying capacity by small amounts
  3. Logistic Model: $\frac{dN}{dt} = r_{max}N\frac{(K-N)}{K}$, where r is the growth rate $\left(\frac{\text{Births}-\text{Deaths}}{N}\right)$

- Populations may either be K-selection or r-selection based.

  1. Like the Type I graph, K-selection is density dependent. Reproduction is iteroparous (repeated small litters).
  2. Like the Type III graph, r-selection is done to maximize reproductive success. Reproduction is semelparous (one massive birth).

- Trade-Offs

  1. Number and size of offspring vs. Survival of offspring or parent

- What causes populations to stop growing?

  1. Limiting Factors
     (a) Density independent (environmental disturbances)
     (b) Density dependent (food supply, competition, predators)
  2. Population Cycles (fluctuations in the population, e.g. Dungeness crab)

   (a) Some are unpredictable (like the moose)
   (b) Boom-bust cycles

3. Population Dynamics (complex interaction of biotic & abiotic influences that cause variation in population size.

- Age Structure shows relative number of individuals of each age