POPULATION DYNAMICS

Population Ecology

- Exponential growth and doubling time:
- Exponential growth: growth at a constant rate of increase per unit of time. The sequence follows a geometric rate of increase (ex. 2,4,8,16)
- Doubling time: Amount of time necessary for the population to double. 70 / annual % growth (ex. Populations growing at 35% will double every 2 years.)

This results in a J-curve of population growth which is very, very FAST!

Animals that grow in a J-curve often have a R-selection reproductive strategy. They are low on the trophic level, grow quickly and mature early, produce lots of offspring and are dead-beat parents. ex. insects, rodents, marine invertebrates, parasites and annual plants.

- Arithmetic growth: increases at a constant amount per time which is added together. (ex. 1, 2, 3, 4, 5)

The population growth is slow.

- Doubling time: Amount of time it takes for the population to double.
- Rule of 70= 70 / annual % growth (ex. populations growing at 35% will double every 2 years.)

Biotic Potential and Carrying Capacity

- Biotic potential- the maximum growth rate of a population of organisms.
- Carrying capactiy- the maximum number of individuals of a population that can be sustained indefinitely in an ecosystem.

- Population Oscillations:
- Population exceeds carrying capacity or limiting factors come into effect, death rates surpass birth rates = crash or dieback
- Extent to which a population exceeds the carrying capacity = overshoot
- Population explosion followed by a population crash = irruptive/ Malthusian growth
- Sometimes populations go through cycles of exponential growth and catastrophic crashes, usually they are quite regular if they depend on certain factors like seasonal light, temperature. May be irregular if they depend on complex environmental and biotic relationships.

- Catastrophic Population Decline:
- Catastrophic System: when the population jumps from one seemingly steady state to another without any intermediate stages.

Growth to a Stable Population

- Growth rates regulated by internal and external factors limit population growth. This pattern of logistic growth is called a S-curve.

- The factors that reduce population growth rates are called environmental resistance. ex. space, food, water, ability to reproduce.
- Organisms in the K-selection reproductive strategy often exhibit logistic growth. They grow and mature more slowly, have less offspring, and care for their young. There is a high expectation that the young will survive. ex. wolves, elephants, whales and primates.

Factors that Increase/Decrease Populations

- Natality, Fecundity and Fertility:
- Natality: production of new individuals, main source of adding to populations, sensitive to environmental conditions (nutritional levels, climate, soil and water conditions, social interaction between species),
- Fecundity: physical ability to reproduce
- Fertility: measure of the actual number of offspring produced.
- Immigration: Seeds, spores, and small animals may be introduced by wind, water (major source of organisms to islands), carried inside other animals, walking, swimming, flying,
- Mortality and Survivorship:
- Mortality: death rate, death rate is found by dividing the number of organisms that die in a certain time period by the number alive at the beginning of the period.
- Survivorship: the percentage of a certain organism that lives to be a certain age.
- Life Expectancy: probable number of years of survival of an individual of a given age.
- Life Span: longest period of life reached by a given type of organism.

Survivorship Curves gives us the predicted life expectancy at each age interval.

- Type I or a: Mortality mostly occurs in old age. ex. Humans in the first world.
- Type II or b: Mortality is not dependent on age. ex. Hyrdas, squirrels and sea gulls randomly die throughout their lives.
- Type III or d: Species that mostly die when they are young would follow this curve. ex. Most marine organisms have a low survivorship- they are cast out into the waters, but once they survive that trauma they are likly to live out their full age. Other examples are trees and other plants that spread a lot of seeds.
- Type "c": Some surviviorship curves include a fourth opinion in which high mortality occurs in the very young AND old. ex. White tailed deer, moose, song birds.

-Emigration: movement of members out of the population

Factors that Regulate Population Growth

- Density dependent and independent factors and Biotic/Abiotic:
- Mostly these things affect natality and mortality, therefore changing the population.
- Intrinsic: operating within individual organisms or between organisms of the same species.
- Extrinsic: imposed from outside the population
- Biotic: caused by living organisms

- Abiotic: caused by non-living components of the environment
- Density dependent: effects are stronger or a higher percentage of the population is affected as the population density increases (food shortage)
- Density independent: the effect is the same or a constant proportion of the population is affected regardless of the population density (fire, climate conditions, volcano)
- In general, biotic factors are density- dependent while abiotic factors are density-independent