ANIM3361 ANIMAL POPULATIONS

Week One: Experimental Design & Population Growth

Week Two: Age Specific Survival & Application of Life Tables

Week Three: Life Histories, Population Structure and Growth

Week Four: Sustainable Harvesting & Allee Effects

Week Five: Population Viability Analysis (PVA) & Metapopulations

Week Six: Competition & Predator-Prey Cycles

Week Seven: Predator-Prey Cycles (Functional Response)

Week Eight: What is a Community? & Community Structure

Week Nine: Community Organisation and Processes & Equilibrium Communities

Week Ten: Community Organisation: Special Case of Islands

Week Eleven: Non-Equilibrium Communities & Recruitment Limitation

Week Twelve: Metacommunities & Stability, Alternate States and Ecosystem Function

Week Thirteen: Biodiversity & Ecosystem Functioning

Week One: Experimental Design & Population Growth

Experimental design

- Allows correct interpretation of results of surveys and experiments
- Avoids confounding factors
- Ensures appropriate level of generality (or specificity) is assigned
- Makes stats easier

Why (and when) use statistics?

- Expresses results in terms of probability of occurrence
- Measures difference between groups relative to variation within groups
- T-test: when comparing two groups of results
- One-way/factor ANOVA: comparing more than two groups of results
- Two-way/factor ANOVA: comparing two groups, but with an added factor (comparing sex, but also could be comparing a place of origin)
- Regression: when establishing a relationship between two variables
- Correlation: when two variables are co-relating
- Non-parametric statistics: if the data is not 'normally distributed' data
- One-tailed: when the hypothesis is about one thing being greater than the other
- Two-tailed: when the hypothesis asks which is higher or lower (no preconceived ideas)

Population Growth

- Population: individuals of the same species occupying a defined space at a particular time
    - Problems with this definition: arbitrary, investigator defined, not the same as the definition of a species
- Relationships between N_{T1} (number in the population at time 1) and N_{T2} (number in the population at time 2)
    - $\mathbf{N_{T2} = N_{T1} + (B + I) - (D + E)}$
    - B = birth (the potential to produce offspring)
    - D = death/mortality
    - I = immigration (number moving into the population)
    - E = emigration (number moving out of the population)
- R_0 = net reproductive rate (the number of individuals added per individual per generation)
- ^ (Lambda) = finite rate of increase (number of individuals added per individual per year)
- Instantaneous rate: at a given interval of time an individual has a probability of breeding and a probability of dying, therefore: $r = b - d$

How do we model population growth? – Three Fundamental Concepts:

- Populations tend to grow exponentially

- Populations show self limitation
- Consumer-resource interactions tend to be oscillatory

Populations tend to grow exponentially – either geometric with discrete (non-overlapping) generations or exponential with overlapping generations

- Non-overlapping generations
    - $\mathbf{N_t = R_0^t N_0}$ **or** $\mathbf{l^t N_0}$ (the number after t generations equals the net reproductive rate to the power of t generations x the population size at the beginning **OR** lambda x the population size in the beginning)
    - Assumptions: no immigration or emigration, no interactions with offspring and parents, assumed that R_0 doesn't change
- Overlapping generations
    - $\mathbf{N_T = N_0 \times e^{rt}}$ (the number after t generations equals the number size at the beginning x e to the power of the net reproductive rate x t generations)
    - Rate of increase at time interval is proportional to population size
- For these models to work we need to assume we have unlimited resources and density independence

Populations show self limitation – density dependence

- Populations must have a carrying capacity (K) = number of individuals that can be maintained indefinitely in the population
    - The number of individuals that available resources can sustain
- **Logistic growth =**
    - N cannot exceed K for any significant length of time
    - N will increase initially by exponential growth
    - As the population increases, the rate of increase in N slows
    - At K the rate decreases to zero
- How does competition affect r?
    - Increased competition results in fewer resources
    - Birth and death rate decreases
    - Hence r decreases
- Assumptions =
    - K is constant
    - Age structure does not affect population growth
    - B and D change linearly with N
    - Population is sensitive to K
    - Density affects all individuals equally
    - No environmental stochasticity = no chance effects

Models are deterministic

- = They lead to exact outcomes based on the parameters of the model
- Do natural systems operate deterministically?
    - In reality populations are subject to stochastic (chance) processes that cause population parameters to vary in time and space