Population Dynamics

Reading assignment:
GSF, Chapter 5 (p. 101-109)

What are some applications of population biology?

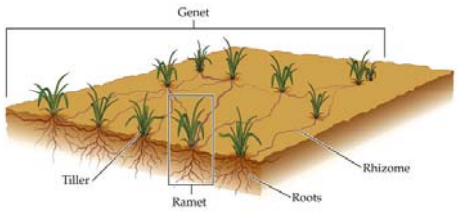
How is the change in population size expressed mathematically?

Per capita rate of increase

- If a hen and a half lays an egg and a half in a day and a half, how many eggs do 3 hens lay in one week?

What are some differences between animal and plant population biology?

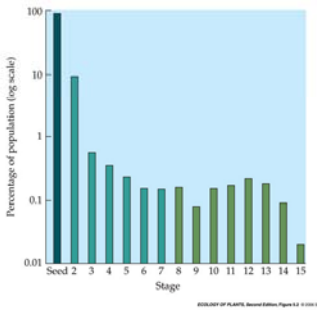
Genets vs. Ramets



Age vs. Stage Classes

- Age classes of animal populations can be used to define changes in vital rates over time
- Age of plant populations can be less important than stage class
- Stage classes can include
  - Size
  - Life history stage
  - Age
- Numbers of individuals in each stage class define plant population structure

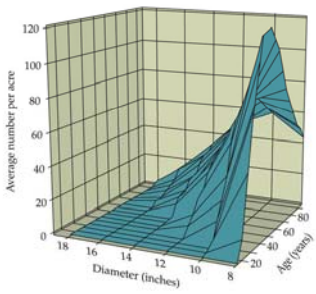
Examples of stages



Age vs. Stage con't

- In animal populations that are age-structured, one needs to know only age based data
- Size is often more important than age in determining vital rates of plants
- Plant growth rates are variable, rarely change linearly with age, so additional information is needed

Age vs. size in longleaf pine



Importance of plant age

- Age distribution (when known) indicates a species' history of survival, reproduction and potential for future growth
- Frequency distributions across age classes can show periods of recruitment and mortality

Importance of plant age

- Age can be important within some stage classes

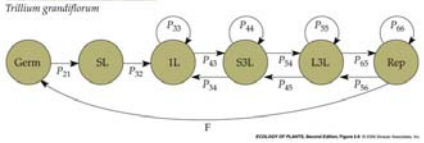
• *Collinsia verna* seeds of different ages have different germination potentials →

← • *Cypripedium acaule* survives as corms underground; survival depends on how many years it has already been dormant

Modular growth of plants

- Stage classes are complicated because plants can move between stages
- Flexible growth patterns allow plant populations to survive changing environment
- Stage classes are useful in population biology only if they have differences in vital rates

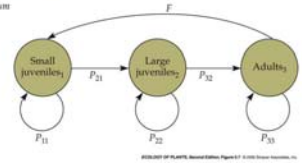
Trillium grandiflorum



Population growth and decline

- Life cycle graphs can be used to construct cohort life tables
- It is difficult to estimate vital rates
  - Cannot locate same individuals
  - Seed germination compromised
  - Mark-recapture approach now applied to plants

Coryphantha robbinsorum



Dispersal

- How are immigration and emigration different in plant and animal populations?

Growth rates of Amazonian trees

Vieira et al., 2005 (PNAS 102:18502-18507)

- Old-growth Amazonian forests cycle 20% of Earth's fresh water and 30% of the C annually
- Deforestation rate in 2002 was nearly 24,000 km^2
- Tropical trees don't have annual rings
- Data on growth rates are needed for understanding forest dynamics and role in C and water cycling

How can ages be estimated?

- Dendrometer bands are main data source
  - Insufficient sampling; few trees, few species
  - Interannual variation in growth rate due to El Nino
- Radiocarbon dating may help
  - Assumptions about ^{14}C production in atmosphere complicate interpretation
  - Adds long-term perspective to short-term dendrometer data

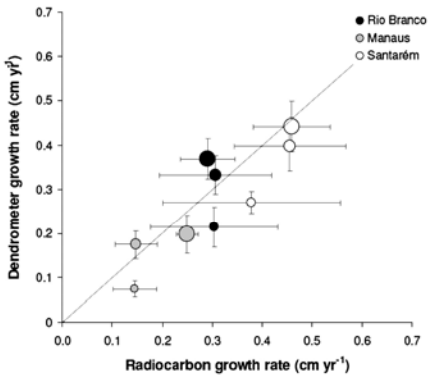
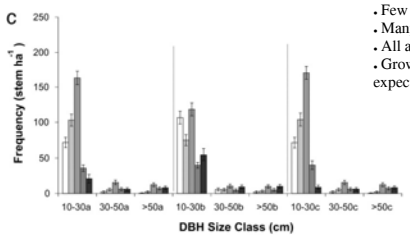


Fig. 2. Mean tree growth rates in three size classes derived from radiocarbon [(diameter divided by radiocarbon-derived age) and annual dendrometer increment (average of 2-3 years of data)]

Tree size distributions in Brazil



- Few large trees
- Many small trees
- All are older than expected
- Growth rates slower than expected

Amazonian trees are old!

- Slowest growth rate in cloudiest region around Manaus
- In Manaus, 50% of all trees were >300 years old; at sites with longer dry seasons 30-40% of trees were >300 yrs old
- These rainforests take up C at slower rates than expected
- Growth rates indicate (minimum) replacement rates of harvested trees