





La Monte Cole's definition (1957)

"A biological unit at the level of ecological integration where it is meaningful to speak of birth rate, death rate, sex ratios, and age structures in describing properties or parameters of the unit."

Deme

- "A group of individuals where breeding is random" (Emlen 1984:202)
- "A panmictic population" (Ehrlich and Holm 1963)
- This smallest grouping of individuals should emphasize genetic objective of random breeding within the group.
- In reality random breeding is constrained by the social system of the organism.

Level of aggregation

- biome
- Iandscape
- ecosystem
- community
- population
- individual
- organ
- cell



Hierarchical Aggregations

- Groupings of individuals driven by demography, geography, movements and genetics:
- Species
- Subspecies
- Metapopulation
- Population
- Deme

Deme

- Demography: Smallest grouping where its reasonable to estimate birth, death, immigration and emigration rates.
- Movement: Restricted to home ranges during key seasons.
- Genetics: Random breeding within constraints of social system.
- Geography: Continuous distribution of individuals in one patch of habitat.

Red-winged Blackbird Deme

- Male territories average 0.05 ha with each male defending a harem averaging
- 3.3 females
- Males disperse

average of 1.4 km

Red-winged Blackbird Deme

- Spatially a patch of marsh habitat
- Movement of birds restricted to home ranges during breeding season (male territories)
- Random breeding within polygynous breeding system
- Reproductive rates measured by nesting-fledging success & renesting rates

Rocky Mountain Elk (Cervus elahpus

Movemen Genetics bands Geography habitat?

Red-winged Blackbird Population - Habitat



Red-winged Blackbird Deme - Patch of Habitat (Orians Study Area) A patch of emergent veg.

adjacent to



Red-winged Blackbird Deme

beserved to move farther than 7 km and females rarely observed further than 2.8 km to new breeding area from natal nest [Note: long-distance dispersal important for metapopulations of blackbirds.]

Population

A collection of demes with strong connections (genetically and demographically) between adjacent demes

- Geographically a collection of patches without great expanses of non-habitat intervening
- Genetically closely related
- High rates of dispersal between demes
- High correlations in demographic rates between adjacent demes within the same population

Metapopulation

- A collection of populations sufficiently close together that dispersing individuals from source populations readily colonize empty habitat resulting from local
- population extinctions.
- Possible low correlations in demographic rates
- Producing high levels of independence
- Possible low rates of dispersal Producing genetic differentiation
- Possible sources for recolonization

Metapopulation





Species - Entire Range



Characteristics, Processes, Environment

Population Processes
Birth
Death
Immigration (Ingress)
Emigration (Egress)

Subspecies

- A collection of metapopulations in a region
- Very rare dispersals maintain genetic similarity
- Demographic independence may be nearly complete
- Occupied habitat patches may be separated by enormous areas of non-habitat

Species

- The collection of subspecies encompassing the entire distribution of the species
- Defines the entire geographic range of the species
- May encompass substantial differences in phenotypes (habitat, physiology, behavior) and genotypes

Hierarchy of Methods

- Species Presence-absence
- Subspecies Relative abundance
- Metapopulation Density
- Population Survival, fecundity
- Deme -Immigration/emigration





- Food
- Cover
- Water conditions
- Nest sites
- Disease/Parasites
- Predators
- Competitors
- Weather



D. Limits of a population

 First step in making statements, predictions about a population is to delimit it.



D. Limits of a population

- Metapopulation = a population of several subpopulations in scattered habitat patches separated from each other by non-habitat (Levins 1970)
- Or a group of demes?





C. Uses of population dynamics

- Endangered or rare species
- Harvested species
- Controlling harmful species
- Predicting changes in non-harvested populations

D. Limits of a population

- Our goal is to delimit a population unit which is as discrete as possible that still meets our objectives.
- Ideally chances of mating within this unit should be randomly distributed
- Unit stock

Steps to delimit a population

- State objectives clearly.
- 2. Determine distribution.
- 3. Determine patterns of movement and barriers to movement.
- 4. Determine levels of genetic/phenotypic similarity among subunits.
- 5. Identify associations in demographic rates between subunits.
- 6. Integrate all this information to outline the most discrete unit(s) possible which meet(s) objectives.

Unit Stock

- Cushing 1981
 - Many fish do not disperse much
- Approaches
 - Morphometric measurements
 - Tagging experiments
 - Genetic measurements

Stock

A group of fish spawning in a particular lake or stream at a particular season, which to a substantial degree do not interbreed with any other such group.

Vertebrate Population Policy

- This policy contains the criteria that must be met for a portion of a species' population to be
- designated as a Distinct Population Segment DPS must be
- ØsagtesandstigottidadSFWS to use this authority sparingly and only when supported by biological data (Feb. 1996)

ESU Critique

- Pennock and Dimmick (1996. Conservation Biology 11:611-619)
- ESUs used to tailor management practices to unique circumstances; grant varied levels of protection in parts of range; and protect unique evolutionary entities.

Ricker 1972

"During the first 30 years or so of this century it was customary to regard all populations of a fish species as more or less uniform, at least in respect to biologically important particulars. Observed differences between stocks were ascribed to differences in their environment."

DPS

- The Endangered Species Act allows the listing/delisting of <u>Distinct Population Segments</u> of
- vertebrate species A Distinct Population Segment is a portion of a species or subspecies population or range" and "is generally described geographically" - ESA policy published in Federal Register.

DPS = ESU (USFWS & NMFS)

- Endangered Species Act requires protecting a population if it is an <u>evolutionarily significant unit</u> (ESU):
 - 1. It must be reproductively isolated from other conspecific population units, and
 - 2. it must represent an important component in the evolutionary history of a species.

ESU Critique

 "A strict redefinition [of DPSs as ESUs] will compromise management efforts because the role of demographic and and behavioral data will be reduced. Furthermore, strictly cultural, economic, or geographic justifications for listing populations as threatened or endangered will be greatly curtailed." (1996: 611)

Implications of Stock Concept

- I. Provides genetic perspective.
- 2. Two key concepts:
 a. fish are subdivided into local populations,
 b. genetic differences between local populations are adaptive.
 3. Cause: heterogeneity of
- resources
- 4. Selective processes are most effective if populations are subdivided in local populations (Sewall Wright 1929).

Stock Differentiation

- 1. Population parameters
- 2. Marking
- 3. Physiological/behavioral characters 4. Morphometric/meristic
- characters 5. Calcareous structures
- 6. Cytogenic characters
- **7**. Biochemical characters
- 8. Immunogenetics
- 9. DNA

Implications of Stock Concept

- **5**. Dispersal does not equal gene flow necessarily.
- 6. Ricker (1972) concluded that most transplants with salmonids reduced survival to maturity.
- **7**. Maximum production from a complex of stocks with local adaptation of subpopulations.