Chapter #9 – Properties of Populations
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Chapters Covered Thus Far:

Chapter #1 – The Nature of Ecology
Chapter #3 – Climate
Chapter #4 – The Aquatic Environment
Chapter #5 – The Terrestrial Environment
Chapter #8 – Life History Patterns
Chapter #9 – Properties of Populations
Chapters Covered in the Exam:

Chapter #1 – The Nature of Ecology
Chapter #3 – Climate
Chapter #4 – The Aquatic Environment
Chapter #5 – The Terrestrial Environment
Chapter #8 – Life History Patterns
Written Examination Format:

Next Wednesday, you will receive a set of 5 questions, based on the lecture material. You must select three (3) of the five (5) questions and write your response. The response must be formatted to the appropriate journal requirements. You must format a single response for each question.
Written Examination Format:

You have 7 days to write your response to the three questions. You MUST staple the grade sheet to the top of your responses and submit them to me after 7 days.
Oral Examination Format:

I will submit to you a copy of a relevant scientific paper. You must read the paper and respond verbally to a series of questions designed to initiate a scientific discussion on the subject. You will be graded in the same manner (sheet is forthcoming). You must sign up for the time during the examination week (30 minute segments).
### Examination Gradesheet

Student's Name: ________________________  Examination #: 1

Date Received: ________________________  Penalty Points: 0

1. **Style and Format**
   - Followed specified journal format guidelines (5 points) —

2. **Grammar, Spelling, and Punctuation**
   - Grammar (7 points) —
   - Spelling (2 points) —
   - Punctuation (1 point) —

3. **Literature Citations**
   - Used appropriate document background (5 points) —
   - Used appropriate citation format in text (2 points) —
   - Used appropriate citation format at end of text (2 points) —

4. **Tables, Figures and Data**
   - Data presentation (5 points) —

5. **Content and Integrative Thought**
   - Content and Synthesis — covered most points (10 points) —

6. **Did You Staple This Gradesheet to the Paper?** (1 point)

**Total Points (35 points)**

Late Penalty Deduction (1 point/day): 0

**Your Preliminary Score:** __/35__

**Comments:**
After the line, write your response. Indent each new paragraph (≤ 3 sentences). The assignment must be typed and 1,000 words or less; provide me with a word count at the end as shown. Literature citations, tables, and figures do not count in the word limit. Tables and/or figures to illustrate and support the ideas in your paper are strongly encouraged. Standard English grammar, style and format account for 10 points on this assignment.

Your grade for this assignment will also be based on your ability to support your ideas with relevant, appropriate scientific evidence. Please provide me with a literature cited section at the end (it does not count in the word count) (see example below). You can cite sources in the text 2 ways. First, you can cite it at the end of the sentence (Snyder 2008). Or, as Snyder (2008) has shown, you can cite this within the sentence itself. Place a line at the end of the body of the text.

Word Count: 722 words

LITERATURE CITED

PERSPECTIVES

The River Continuum Concept

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From headwaters to mouth, the physical variables within a river system present a continuous gradient of physical conditions. This gradient should result in a series of responses within the constituent populations resulting in a continuum of basic adjustments and consistent patterns of limiting, transport, utilisation, and storage of organic matter along the length of a river. Based on the energy equilibrium theory of floral populationists, we hypothesize that the structural and functional characteristics of stream communities are adapted to conform to the most probable position or mean state of the physical system. We reason that producer and consumer communities characteristic of a given flow reach become established in harmony with the dynamic physical conditions of the channel. In natural stream systems, biological communities can be characterized as forming a temporal continuum of coordinated species replacement. This continuous replacement function is determined by the utilization of energy inputs over time. Thus, the biological system moves towards a balance between a tendency for efficient use of energy inputs through enhanced partitioning (food, substrates, etc.) and an opposing tendency for a uniform rate of energy processing throughout the year. We theorize that biological communities developed in natural streams are processing strategies involving maximum energy loss. Downstream communities are dedicated to capitalize on upstream processing efficiencies. Both the upstream efficiency hypothesis and the downstream adjustment seem predictable. We propose that this River Continuum Concept provides a framework for integrating predictable and observable biological features of both systems. Implications of the concept to the areas of structure, function, and stability of stream ecosystems are discussed.

Key words: river continuum; stream ecosystem; ecosystem structure, function, resource partitioning; ecosystem stability, community succession, river action, stream geomorphology


De la tête des sources à la mer, un réseau fluvial offre un gradient continu de conditions physiques. Ce gradient conduit nécessairement, dans les populations habitant dans le réseau, une séquence de réponses adaptées à ces continus d'ajustements hydrauliques et à des schémas uniformes de charge, transport, utilisation et enrayage de la matière organique sur tout le

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A “Population” defined as:

- A group of organisms of the same species occupying a particular space at a particular time.
  - Should define “space” and “time” in terms that are of ecological relevance to the organism and/or your particular study.
Laysan’s Albatross:
Population at Midway I., breeding season
A Population of Overwintering Monarch Butterflies in Central Mexico
Populations Are Dynamic
- Defining a Mobile Population -

A “Population” as Related to Genes and Evolution

- Populations as Genetic Units
  - Gene pool: Sum of all the genetic material within a population

- Evolution is the change in the gene frequencies of a population over time (>1 generation.)
Characteristics of Populations

- Density is the most basic characteristic of a population (from an ecologist’s perspective)
- Four population parameters change density
  - Natality
  - Mortality
  - Immigration
  - Emigration
- Several important “secondary” characteristics such as age distribution, patterns of distribution, genetic composition, etc…
Quantifying Populations

- Unitary organisms
  - Examples?
- Modular organisms
  - Examples?
9.1 - Modular Organisms: Ramets and genets of Aspen Trees

The collection of 'clones' of identical genetic make-up is called a 'genet'. The apparent 'individuals' of the genet are called 'ramets'.
Modular Organisms: Coral

- What is the “ramet” of a coral?

- Where are the “genet” boundaries?
9.2 – The Distribution of a Population Defines its Spatial Location

A “Meta” Population

- Groups of isolated populations linked together by gene flow
  - What causes these populations to be fragmented rather than continuous?
  - How is “gene flow” accomplished?
  - Real examples…
Queen Conch Metapopulations
9.3 – Density Reflects Both the Populations Abundance and Distribution
9.3 – Density Reflects Both the Populations Abundance and Distribution

Spatial Patterns of Dispersion (not dispersal!)
9.3 – Density Reflects Both the Populations Abundance and Distribution

Uniform Distribution of Golden Eagle (*Aquila chrysaetos*) Territories
Clumped Distribution

*Euphydryas editha* and its host plant, *Plantago*
Populations & metapopulation of *Euphydryas editha*
Temporal patterns of dispersion

- Examples?
- Emigration/immigration (one-way)
- Migration (round trip)
Yearly migrations

• Pacific gray whale migration (blue arrows)
  – Benefits?
  – Costs?
Arctic and Antarctic terns

Arctic tern
Photo by Brian Small

Antarctic tern
Photo by Danny Gallant
Arctic tern migration
Age Structure

• Stable age distribution
  – Continuously breeding populations should tend towards an age distribution where ratio of ages remains constant
Age Structure

• **Stationary age distribution**
  – Deaths balance births; population remains a constant size
  – Stationary populations are also stable.
  – But stable populations aren’t always stationary!

![Diagram of age structure with bars for different age classes and percentages.](image_url)
Age structure and population growth rates

- When might a shrinking population show a high proportion of young?
Effects of missing year class in cactus ground finch

- Notice progression of individual cohorts.
- Why are some cohorts missing?
- Why are some cohorts large?
Effects of missing year class in cactus ground finch
Sex ratios

- **Tends toward 1:1**
- **Often different between conception and birth**
  - 1:1 at conception ➔ slightly favors males at birth ➔ Slightly favors females at sexual maturity
  - Why is male mortality higher than female mortality between birth and maturity. Possible reasons include...
    - Males are hemizygous (why would this matter?)
    - Male behavior may be more stressful (male-male competition during the breeding season)
    - Males of many species more prone to risky behavior
Survivorship curves

- Logarithm of survival vs. Total life span
  - Dependency
  - Reproductive
  - Postreproductive

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Variation in survivorship pattern for the annual garden rocket

- What caused the difference in curves for this species?
Mortality curve compared to survivorship curve
Fecundity curve

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