

# ENVIRONMENTAL STUDIES 240

## Ecological Processes

**Instructor:** Dr. John Volpe

**Lecture Location:** DTB A110

**Lecture:** Mon & Thurs 8:30-9:50am    **Tutorial:** No Tutorials / Labs

**Office Hours:** [jpv@uvic.ca](mailto:jpv@uvic.ca) by appointment - UH4

**Teaching Assistants:** Sandra Frey    [safrey@uvic.ca](mailto:safrey@uvic.ca)  
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### **Teaching Objectives**

Students are introduced to

- i) fundamental concepts of ecology and “sustainability”
- ii) ecological processes with emphasis on conservation contexts
- iii) introduction to analysis approaches and techniques

Students successfully completing this course will gain understanding of

- the nature of scientific evidence
- experimental design and statistical power
- basic techniques of data collection and critical analysis
- basic working knowledge of summary statistics
- critical functions of (and human impacts on) basic ecological processes
- intro to interactions among social, political and ecological systems
- factors limiting species abundance and distribution
- factors regulating population growth
- linkages among individual, population, community and ecosystem dynamics
- appreciation of the role of energy as the currency of all life

### **Course Structure**

This course is a lecture format (no tutorial) with bi-weekly quizzes making up the majority of the course grade.

You will be responsible for reading / viewing the assigned background materials PRIOR to each class and tutorial session.

### **Course Materials**

No textbook is required for this class. All class material (readings, lecture slides etc.) will be made available through the course web page at [coursespaces.uvic.ca/](http://coursespaces.uvic.ca/)

To access this page you will require

- i) UVic Netlink ID (your UVic email “name” eg. [name@uvic.ca](mailto:name@uvic.ca))
- ii) your Netlink ID password

### **Office Hours**

Any time by appointment [jpv@uvic.ca](mailto:jpv@uvic.ca) at University House 4 unless otherwise specified. If you have not been to UH4 previously, bring a map ;) Come in the main door, go up the stairs, JPV’s office is at the top of the stairs.

## **Evaluation**

Lecture Quizzes	50%
Midterm Exam (In Class)	20%
Final Exam (Take Home)	<u>30%</u>
	100%

Writing quizzes is mandatory. There are no make-ups or deferments. If you do not write a quiz and present **substantive medical documentation WITHIN THREE DAYS of the close of the quiz to your TA**, the quiz value will be amortized across the remaining quizzes. Travel, sports (save UVic varsity) and other scheduling conflicts will not be considered for amortization.

## **Academic Integrity**

Academic integrity is intellectual honesty and responsibility for academic work that you submit individual or group work. It involves commitment to the values of honesty, trust, and responsibility. It is expected that students will respect these ethical values in all activities related to learning, teaching, research, and service. Therefore, plagiarism and other acts against academic integrity are serious academic offences. UVic's policy on Academic Integrity is available here:

<http://web.uvic.ca/calendar2012/FACS/UnIn/UARe/PoAcI.html> Depending on the severity of the case, penalties include a warning, a failing grade, a record on the student's transcript, or a suspension.

The responsibility of the institution: Instructors and academic units have the responsibility to ensure that standards of academic honesty are met. By doing so, the institution recognizes students for their hard work and assures them that other students do not have an unfair advantage through cheating on essays, exams, and projects.

The responsibility of the student: Plagiarism sometimes occurs due to a misunderstanding regarding the rules of academic integrity, but it is the responsibility of the student to know them. If you are unsure about the standards for citations or for referencing your sources, talk to your instructor or take advantage of the following resources: <http://ltc.uvic.ca/initiatives/integrity/student.php> or <http://www.uvic.ca/library/research/citation/plagiarism/index.php> .

## **UVic Grading Scale (New - Please Read)**

An **A+ (90-100)**, **A (85-89)**, or **A- (80-84)** is earned by work which is technically superior, shows mastery of the subject matter, and in the case of an A+ offers original insight and/or goes beyond course expectations. Normally achieved by a minority of students.

A **B+ (77-79)**, **B (73-76)**, or **B- (70-72)** is earned by work that indicates a good comprehension of the course material, a good command of the skills needed to work with the course material, and the student's full engagement with the course requirements and activities. A **B+** represents a more complex understanding and/or application of the course material. Normally achieved by the largest number of students.

A **C+ (65-69)** or **C (60-64)** is earned by work that indicates an adequate comprehension of the course material and the skills needed to work with the course material and that indicates the student has met the basic requirements for completing assigned work and/or participating in class activities.

A **D (50-59)** is earned by work that indicates minimal command of the course materials and/or

minimal participation in class activities that is worthy of course credit toward the degree.

**F (0-49)** is earned by work, which after the completion of course requirements, is inadequate and unworthy of course credit towards the degree. (UVic Calendar)

### **Course Evaluations**

I value your feedback on this course. Towards the end of term, as in all other courses at UVic, you will have the opportunity to complete an anonymous survey regarding your learning experience (CES). The survey provides vital feedback to me regarding the course and my teaching, as well as helping the School improve the overall program for students in the future. When it is time for you to complete the survey you will receive an email inviting you to do so. Please ensure that your current email address is listed in MyPage (<http://uvic.ca/mypage>) . If you do not receive an email invitation, you can go directly to <http://ces.uvic.ca>. You will need to use your UVic netlink ID to access the survey, which can be done on your laptop, tablet, or mobile device. I will remind you and provide you with more detailed information nearer the time but please keep your ideas for constructive feedback in mind throughout the course.

### **Accessibility Statement**

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or the Resource Centre for Students with a Disability (RCSD) as soon as possible. The RCSD staff are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations <http://rcsd.uvic.ca/>. The sooner you let us know your needs the quicker we can assist you in achieving your learning goals in this course.

**NOTE:** *The University of Victoria is committed to promoting, providing and protecting a positive and safe learning and working environment for all its members. Student evaluation forms now include questions on the respect shown by the instructor for students, particularly those of diverse origins, orientation and physical abilities.*

## **Lecture Schedule ES240 Spring 2016 (*Subject to change*)**

All lecture slides and readings on CourseSpace page in pdf format

Topics and order of presentation are tentative and may (likely...?) change. *Check CourseSpace regularly for readings, self study questions, tutorial information and other support materials.*

### **1 Class Introduction**

- introductions of ES240 team
- learning objectives
- expectations
- marking scheme and exam dates
- CourseSpace
- Readings, Self Study Qs, Quizzes
- office hours, locations etc.

### **2 The science of ecology / What is ecology?**

- ecological hierarchy from DNA to biome
- trophic functional groups, auto/heterotrophs,
- nature of evidence
- natural history vs. ecology
- scientific method
- sampling, repetition
- paradigm shifts - Lewontin
- punctuated equilibrium - Kuhn, Gould
- case study - sea lice & salmon

### **3 Ecosystem metabolism I – Primary Production**

- photosynthesis
- inorganic vs. organic energy
- carbon, nitrogen-phosphorus, water cycles
- gross and net 1<sup>o</sup> productivity
- productivity differences by habitat
- eutrophication
- case study - Ancient Rome (urban footprint / human appropriation of 1<sup>o</sup> production)

### **4 Ecosystem metabolism II – Secondary Production**

- trophic web
- metabolism (body mass ~ metabolism)
- Lindeman efficiency
- Eltonian pyramids
- bottom up vs. top down control
- case study - emergent properties of additive effects

### **5 & 6 Predation**

- producers vs. consumers
- functional classes of consumers (herbivore, frugivore, carnivore etc)
- evolution of adaptations
- Red Queen Hypothesis
- cooperative vs. solitary hunters
- optimal foraging theory
  - time and energy optimizers
  - diet and patch models
- case study - human directed evolution (commercial fisheries / silversides)

## **7 Competition**

- exponential growth, Malthus
- Darwin's "struggle for existence"
- niche, fundamental and realized
- Eltonian niche and Hutchinsonian niche
- niche space / niche volume / hyperdimensional niche
- mate competition / secondary sexual characteristics
- exploitative, preemptive and interference competition

## **8 Population Ecology**

- immigration and emigration
- Malthus revisited
- develop the exponential growth equation ( $N$ ,  $dN$ ,  $B$ ,  $D$ ,  $r$ )
- explore  $r$
- predicting future population size  $N_t = N_0 e^{rt}$
- develop the logistic growth equation
- differences between what is going on vs. being able to see it, monitor it, and predict
- $r$  and  $K$  strategists; survivorship curves
- experimental design
- randomization and independence

## **9 Logic, Reason and Central Tendency**

How do you know what you know?

Separating patterns (correlations) from cause and effect

Science as a way of knowing

Sample & populations and variable & parameter

The Golden Rule of sampling

Continuous, Discrete, and Categorical variables

Median, Mean and Mode

$R^2$  and variation

## **10 Variance and Power**

Variation and the power of inference

Range, Variance, Standard deviation, Standard error of the mean, 95% Confidence intervals

Statistical power

Power curve

Sir Ronald Fisher

p-value

Type I and Type II errors

## **11 Power and Confidence**

Experimental examples illustrating the elements of the previous two lectures

## **READING BREAK Feb 12-16**

## **12 Midterm (20%) Monday Feb 19 (in class)**

## **13 Diversity**

- taxonomic / (bio)diversity
- global and continental distribution of biodiversity
- genetic - species - ecosystem levels of diversity
- alpha, beta, gamma diversity

- diversity through (prehistoric) time
- intermediate disturbance hypothesis
- diversity vs. efficiency (why are there so many species?)
- statistical significance

#### **14 Stability**

- stability ~ diversity debate
- MacArthur, May, Yodzis
- food webs / secondary effects and relationships
- network theory / Milgram / Erdos
- small world networks
- strong and weak links, Granovetter
- dominant vs. keystone species

#### **15 Community Development**

- succession - Primary and Secondary
- Clement's superorganism vs. Gleason's individualistic development
- intermediate disturbance hypothesis (yes, again)
- assembly rules
- ecological networks

#### **16 What is a "systems approach" to the study of ecology**

- Newton vs. Hooke
- Descartes, Hobbs
- Laplace
- Darwin and Malthus
- Adam Smith
- Newtonian systems / reductionism
- complexity and non-Newtonian systems
- properties of complex systems
- Lewontin and Kuhn revisited

#### **17 Self Organization**

- entropy
- laws of thermodynamics
- deterministic vs. complex systems
- energy flow in ecological systems
- Schrodinger; Order from Order and Order from Chaos
- principles of most and least action
- self organized complexity / Benard cells
- Odum and the strategy of ecosystem development

#### **18 Metabolic Ecology**

- catalysis, autocatalysis
- knits together production, competition, predation, material cycles in the context of the overarching systemic imperative: maximize entropy. The twist is that life assists by resisting entropy at all costs (the biological imperative).

#### **19 Death and Collapse**

- the limits of growth
- panarchy
- recasting network ideas in the context of finite growth
- ecological restoration

- dual edge nature of efficiency as applied to conservation

**20 Invasion Ecology - Cane Toads**

- the multiple dimensions and sometimes bizarre perspectives of a now classic invasion story

**21 Overview**

- applied lessons from the course

- the role of ecology in public discourse

- conservation biology studies the manifestation of underlying social/economic drivers

- overview of course material

**22 Optional Q&A For Final Exam**

**TAKE HOME FINAL EXAM (30%) Posted Thursday April 5**

Hardcopy Answers due 10am Tuesday April 10

Drop Box Turpin Building B243 (next to ES Main Office)