School of Science

BIOL 220
Ecology

Fall 2023

3 Credits

Course Outline

INSTRUCTOR: Scott Gilbert, BSc., Ph.D.

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OFFICE HOURS: Tues / Thurs 9:20-10:20 or by email appointment

LECTURE: Tues / Thurs 10:30-noon **Room**: A2714 **Dates:** Sept. 5 – Nov. 30
LAB: Friday **Room:** A2605 **Dates:** Sept. 8 – Dec. 1

COURSE DESCRIPTION

Biology 220 introduces the science of ecology by focusing on the interrelations between individual organisms, their populations and communities. The course begins by reviewing the factors that limit distributions and then considers population demography, life tables, regulation of natural populations and managing harvested populations. We briefly review some of the mathematical models to explain interspecific competition and predation. The course continues with an overview of community ecology and considers selected topics: succession, species diversity gradients, energy flow, biogeochemistry, and the role of predation, competition and disturbance in structuring communities. Finally, we conclude by considering the prospects for global change and the ecological processes that may shape these changes.

COURSE REQUIREMENTS

Prerequisite(s): BIOL 101 and 102 or equivalent; COMM 193 or COMM 204 recommended.
Lectures and lab activities during Fall 2022 are planned as face-to-face classes.

EQUIVALENCY OR TRANSFERABILITY

UBC	BIOL 230 (3)	TRU	BIOL 2170 (3)
UBCO	BIOL 201 (3)	UVIC	BIOL 215 (1.5)
SFU	BISC 204 (3)		

See https://bctransferguide.ca/ for an up-to-date list of transfers within BC. Further information and assistance with transfers may be available from the School of Science.

LEARNING OUTCOMES

On successful completion of this course students will be able to:

- describe the ecological factors that affect the distribution and abundance of organisms;
- understand the interplay between evolution and ecology;
- construct simple life tables and interpret simple models of population growth, interspecific competition and predator-prey interactions;

- propose testable hypotheses along with experimental tests to resolve ecological questions.

COURSE FORMAT

Lectures: Three hours per week (2 classes of 1.5 hours, face-to-face). This is a fast-paced course and students are strongly encouraged to attend lectures so they can ask questions and participate in class discussions. If technically possible, a video recording of the classroom lectures will be made available online after class but students should participate in each class rather than relying on a possible video archive.

Labs: Three hours per week, face to face, with physical distancing as required. The 11 activities will include 4 tutorials focused on numerical problem sets, 2 field data collection exercises with formal lab reports and 5 seminars that will focus on critiquing papers or ideas in ecology.

ASSESSMENTS:

Attendance & Participation

Students are expected to attend both lectures and the scheduled activities (including field activities). Several of the lab exercises involve collecting data or making observations and this would make it difficult or impossible for students who miss the lab to complete the lab assignment. There is a strong correlation between regular attendance and academic performance.

Assignments

There will be weekly short take-home reading assignments and there will be a written assignment with each week's lab activity. Students must pass the field/lab portion of the course to receive a passing grade for the overall course.

Tests

Rather than a single mid-term examination we will have two shorter quizzes. The final 3-hour exam is scheduled for Dec. 12 at 9:00 AM. It will be comprehensive and cover all topics taken up during the term.

EVALUATION:

Short in-class quizzes	5%
Take home readings & questions	10%
Field / lab exercises	30%
Midterm exams (2 @15% each)	30%
Final Exam	25%
Total	100%

COURSE WITHDRAWAL INFORMATION

The Last date to withdraw without academic penalty is Nov. 2nd, 2023. Refer to the YukonU website for other important dates https://www.yukonu.ca/admissions/important-dates

TEXTBOOKS & LEARNING MATERIALS

Manuel C. Molles, Andrew Laursen. 2020. *Ecology: Concepts and Applications* 5th Canadian ed.

ACADEMIC INTEGRITY

Students are expected to contribute toward a positive and supportive environment and are required to conduct themselves in a responsible manner. Academic misconduct includes all forms of academic dishonesty such as cheating, plagiarism, fabrication, fraud, deceit, using the work of others without their permission, aiding other students in committing academic offences, misrepresenting academic assignments prepared by others as one's own, or any other forms of academic dishonesty including falsification of any information on any Yukon University document. Please refer to Academic Regulations & Procedures for further details about academic standing and student rights and responsibilities. https://www.yukonu.ca/policies/academic-regulations

ACADEMIC ACCOMMODATION

Reasonable accommodations are available for students requiring an academic accommodation to fully participate in this class. These accommodations are available for students with a documented disability, chronic condition or any other grounds specified in section 8.0 of the Yukon University Academic Regulations (available on the Yukon University website). It is the student's responsibility to seek these accommodations by contacting the Learning Assistance Centre (LAC): LearningAssistanceCentre@yukonu.ca.

Lecture Topic Outline and Schedule – *July 4 version*

Date	Topic	Concepts	Chapter
Sept. 5	Introduction, Hypothesis testing (*Lecture #1)*	def'n ecology, levels of organization, hypothesis testing, theme of temporal and spatial heterogeneity, proximate vs. ultimate explanations	Chapter 1
Sept. 7	Land and Water (*Lecture #2)*	Biomes, water & temperature as master limiting factors, soil horizons, hydrological cycle, flux, turnover time, oceanic zonation (horizontal and vertical), still waters, zonation, lake turnover, isothermal , limits to distributions, abiotic and biotic factors, allelopathy	Chap 2 (skip pp 29-36), Chap 3 (skip 55-64, 68-74)
Sept. 12	Natural selection and evolution (*Lecture #3)*	Evolution, genetic drift, natural selection, adaptation, fitness, , phenotype, genotype, ecotypes, common garden expts., stabilizing selection, disruptive selection, directional selection	Chap 4
Sept. 14	Coevolution and speciation *(Lecture #4)*	Coevolution,, Mullerian and Batesian mimicry, Mayr's biological species concept,2 types of reproductive isolation – pre- and postzygotic isolating mechanisms, 3 types of speciation,	con'd
Sept. 19	Temperature relations *(Lecture #5)*	How do organisms respond to temperature? range of tolerance, heart budgets, ectotherms, endotherms, thermal neutral zone, 8 strategies for extreme conditions	Chap 5
Sept 21	Nutrient & energy relations *(Lecture #6)*	Energy sources, trophic classifications, light (PAR), 3 photosynthesis pathways by name, C:N ratios and challenges to herbivore diets, , principle of allocation	Chap 7 (skip 181-183) (delay 187-191)
Sept 26	Optimal foraging *(Lecture #7)*	Foraging decisions, numerical & functional responses, optimal foraging theory and assumptions, diet width mode & predictions, 3 types of functional responses, Fundamental & realized niche	Chap 7 - read 187-191,

Sept. 28	Behavioural ecology *(Lecture #8)*	Kin selection, inclusive fitness, costs & benefits of group living, trade-offs …	Chapter 8
Oct 3	Life History Patterns *(Lecture #9 * via Zoom)*	Life history classifications, r & K selection, principle of allocation, Grimes approach to plant life histories, disturbance, stress tolerance, Winemiller & Rose – 3 factors to classify life histories, climate change	Chap 9 up to page 246
Oct. 5	Intro to Populations & Estimating density *(Lecture #10 * via Zoom)*	(see Sept 8 notes where we introduced limits to dist'n), what is an individual: unitary, modular organisms, genet, ramet; patterns of dist'n: random, regular clumped, def'n of pop'n, metapopulation, relative and absolute abundance	Chap 10
Oct 10	Population Structure *(Lecture #11)*	Intro to life tables, mortality, static and cohort life tables, n_x, l_x, d_x, q_x, 3 types of survivorship curves, fecundity schedules, net reproductive rate	Chap 11
Oct. 12	Pop'n Structure (continued) *(Lecture #12)*	Generation time, T, actual or realized *r,* dispersal, jump dispersal , sex ratios & frequency dependent selection,	con'd
Oct. 17	Population Growth *(Lecture #13)*	Density dependent and independent birth and death rates , , lambda - geometric rate of increase, exponential growth using dN/dt = *r*N, eq'n for logistic pop'n growth, assumptions of models, realized *r* vs r_{max}	Chapter 12
Oct. 19	Competition – Intraspecific & Interspecific *(Lecture #14)*	Types of spp interactions, exploitation or resource competition, interference competition, impacts of competition on growth, survival and reproduction, Lotka-Volterra model of interspecific comp. and how to interpret LV graphs, comp. coefficients	Chap 9 – p 247-251; Chap 13 (skip 357-358)
Oct. 24	Competition – Interspecific *(Lecture #15)*	…competition continued with more on Lotka-Volterra graphical models	
Oct. 26	Intro to Herbivory & Predation *(Lecture #16)*	Types of predation, impacts of exploitation on individuals and populations, invasive spp and enemy release hypothesis, LV-predation equations, coupled oscillations, neutral stability, Huffaker's case history showing role of prey refuges, other ways to escape predators	Chap 14
Oct. 31	Exploitation, Predation and Harvesting populations *(Lecture #17)*	Recruitment curves, role of intraspecific comp in determining shape of curve, maximum sustainable yield, fixed quotas harvests, managing harvest effort	pp. 325-327
Nov. 2	Mutualism & Parasitism *(Lecture #18)*	Parasites can affect behaviour; winter ticks and moose, flour beetles and competition affected by parasites. Plant-ant protection mutualisms	Chapter 15 – up to page 407
Nov. 7	Community structure and function *(Lecture #19)*	Emergent properties of communities, species abundance, spp diversity, role of disturbance, conclude spp diversity & disturbance	Chapter 16
Nov. 9	Food webs & keystone species *(Lecture #20)*	Review 2nd midterm . Who eats who? Food webs. Why are food chains short (2 hypotheses), Keystone species vs dominant spp, ecosystem engineers	Chapter 17 (skip 17.2)
Nov. 14	Disturbance & Community Equilibrium *(Lecture #21)*	Disturbance & stability , comparison of community properties at equilibrium and non-equilibrium	Chapt 18 (skip p 490-492)
Nov. 16	Community succession *(Lecture #22)*	Primary & secondary succession, climax, patterns in succession, Connell & Slatyer model of succession. Facilitation, inhibition & tolerance, , resilience and resistance – Park Grass expt	Chapter 18
Nov. 21	Community stability & Energy Flow & nutrients *(Lecture #23)*	Primary production, GPP, NPP, limits to NPP in terrestrial and aquatic systems,	Chapter 19

Nov. 23	Trophic cascades *(Lecture #24)*	Top down & bottom up control, trophic cascades, direct and indirect effects; carbon storage as a result of trophic cascades	Pp 447-456
Nov 28	Energy flow	Biogeochemistry, compartments, flux, pool or reservoir, residence time, phosphorus cycle, nitrogen cycle, carbon cycle	Chapter 20 461-465; 468-470
Nov. 30	Ecology & Global Change *(Lecture #26)*	Course review & highlights – themes and integration.	pp 574-581

Biology 220 Laboratory Schedule - ***July 4 Version***

Sept. 8	#1 Lab Exercise: Decomposition and Forest Soil CO_2 Emissions	Stage 2 – Sept 22
Sept. 15	#2 Tutorial: Hypothesis Testing in Ecology	Sept 22
Sept. 22	#3 Seminar: Natural Selection question	Due before lab
Sept. 29	#4 Seminar: Human Impacts on Ecosystems1 *	Due before lab
Oct. 6	#5 Seminar: Critique of a scientific paper (snakes, loons or turtles)2*	Due before lab
Oct. 13	**Quiz #1**	
Oct. 20	#6 Lab Exercise: Population estimate using mark recapture	TBD… in Nov
Oct. 27	#7 Tutorial: Life Table Analysis	Nov. 3
Nov. 3	#8 Seminar: Critique of paper salmon nutrients3, snail paper4 or Eider ducks 5	Due before lab
Nov. 10	**Quiz #2** date to be confirmed	
Nov. 17	#9 Tutorial: Harvesting Populations6	Due Nov 24
Nov. 24	#10 Seminar: Critique of paper	Due Nov 24
Dec. 1	#11 Seminar: Keystone Species	Due before lab

*Seminar meeting over Zoom on Sept 29 + Oct 6

1 Read 3 papers: Stokstad, E. 2014. The empty forest. (Vanishing Fauna/ Special Section). Science (345) 6195: 396-400;
Redford, K.H. 1992. The empty forest. BioScience (42) 6: 412- 422; and Dirzo, R., H.S.Young, M. Galetti, G.Ceballos, N.J.B. Isaac, B. Collen. 2014. Defaunation in the Anthropocene. Science (345) 6195: 401-406.

2 Choice of 3 papers: Diaz, Franciso R. and Blouin-Demers, Gabriel 2017. Northern snakes appear much more abundant in old fields than in forests. Canadian-Field Naturalist 131: 228-234 plus supplement; Marcogliese , Lucian A., Casselman, John M. and Hodson , Peter V. 1997. Dramatic declines in recruitment of American Eel (Anguilla rostrata) entering Lake Ontario -- Long-term trends, causes and effects. Plenary presentation at the 3rd National EMAN Meeting, Saskatoon, Saskatchewan, 22 January 1997; and Seburn, D.C., and H. McCurdy-Adams. 2019. Do turtle warning signs reduce roadkill? Canadian Field-Naturalist 133(3): 216–220.

3 Reimchen, Thomas E. 2017. Diverse Ecological Pathways of Salmon Nutrients Through an Intact Marine-terrestrial Interface. Canadian Field-Naturalist 131: 350-368.

4 Hershey, Anne 1990. Snail populations in Arctic lakes: Competition mediated by predation? Oecologia 82: 26-32.

5 Reed, J.A., D.L. Lacroix and P.L. Flint 2007. Depradation of Common Eider, *Somateria* mollissima, Nests on a Central Beaufort Sea Barrier Island: A Case Where No One Wins. *Can. Field-Nat. 121*: 308-312.

6 Readings from Pauly, D. V. Christensen, S. Guénette T.J. Pitcher, U.R. Sumaila, C.J. Walters, R. Watson and D. Zeller. 2002. Toward sustainability in world fisheries. Nature 418: 689-695