

# BIOL 410

## Ecology of Lakes and Streams

Winter term (2022)

### Calendar description

An in-depth look at the ecology and evolution of freshwater aquatic ecosystems, considering the role of populations, interspecific interactions, and the flow of energy and matter. There will be an emphasis on linking ecological theory with empirical evidence from aquatic systems.

Topics will include dispersal and colonization, ecological genetics, resource competition, predator-prey interaction, evolution of life-history strategies, habitat coupling, and biogeochemical cycling. LEARNING HOURS 120 (24L;12S;84P)

RECOMMENDATION BIOL 335/3.0.

PREREQUISITE (BIOL 300/3.0 or *BIOL 302/3.0* or *BIOL 303/3.0*) and a minimum GPA of 2.0 in the Biological Foundations List.

### Schedule

To be determined

|                        |  |
|------------------------|--|
| Instructor             | Dr. Shelley Arnott   |
| Instructor contact     | <a href="mailto:arnotts@queensu.ca">arnotts@queensu.ca</a> , phone: 613-533-6384 |
| Office hours           | Thursday 10:30-11:30   |
| TA                     | Anna Beckett   |
| TA contact information | <a href="mailto:Anna.beckett@queensu.ca">Anna.beckett@queensu.ca</a>             |

### Learning objectives

#### **By the end of this course, students will:**

- Describe the major anthropogenic impacts on aquatic ecosystems
- Identify the biological linkages such as material and energy flow within aquatic systems as well as linkages between aquatic and terrestrial systems.
- Describe the major forms of adaptation in aquatic systems including phenotypic plasticity and evolution.
- Critically evaluate and synthesize the scientific literature about the ecology of lakes to reveal strengths and weakness of published studies.
- Communicate the results of the literature synthesis in written and oral format

## **Learning Hours**

| Teaching method |                        | Average hours per week | Number of weeks | Total hours |
|-----------------|------------------------|------------------------|-----------------|-------------|
| In-class hours  | Lecture                | 2                      | 12              | 24          |
|                 | Seminar                | 1                      | 11              | 11          |
|                 | Laboratory             |                        |                 |             |
|                 | Tutorial               |                        |                 |             |
|                 | Practicum              |                        |                 |             |
|                 | Group learning         |                        |                 |             |
|                 | Individual instruction |                        |                 |             |
| Other           | On-line                |                        |                 |             |
|                 | Off-campus             |                        |                 |             |
|                 | Private study          | 7                      | 12              | 84          |
| Total hours     |                        |                        |                 | 119         |

## **Course Outline**

In this course, we will take an indepth look at the ecology and evolution of freshwater aquatic ecosystems, considering the role of populations, interspecific interactions, and the flow of energy and matter. There will be an emphasis on linking ecological theory with empirical evidence from aquatic systems. Topics will include dispersal and colonization, ecological genetics, resource competition, predator-prey interaction, evolution of life-history strategies, habitat coupling, and, biogeochemical cycling. Most of the examples in class will be based on studies conducted on lakes.

The class will consist of two lectures each week, followed by a discussion session on a related paper from the recent scientific literature. Lecture material will be based on information from the primary literature. Support material will be posted each week. Students are expected to attend lectures and read associated papers each week.

## **Course schedule**

1. Overview of course and aquatic ecosystems
2. Environmental issues: climate change, changes in nutrients and ions
3. Environmental issues: synthetic chemicals, invasive species, multiple stressors
4. Local within lake processes – physiological tolerances
5. Local within lake processes – species interactions
6. Plasticity and evolution
7. Eco-evolutionary dynamics
8. Benthic-pelagic coupling
9. Aquatic-terrestrial linkages

10. Nutrients and carbon
11. Metacommunities and spatial insurance hypothesis
12. Landscapes
13. Cross-scale interactions

**Textbooks/readings**

Readings from the primary scientific literature will be assigned each week. Students may want to supplement their knowledge with readings from limnology textbooks:

Kalff, J. 2002. Limnology – *although this is at an introductory level, it has good overview material. Lots of Canadian examples, as well as good representation of European limnology. Good place to start.*

Wetzel, R.G. 2001. Limnology: Lake and river ecosystems – *this is more like a reference book – has LOTS of detailed information.*

Dodson, S. 2005. Introduction to limnology – *this is very introductory, but good overview. Heavier emphasis on American examples.*

Bronmark, C. and L.-A. Hansson. 2005. The Biology of Lakes and Ponds – *this is very introductory and focuses on biology, but very well written and good overview.*

Dodds, W.K. 2002. Freshwater ecology: concepts and environmental applications – *this is written more broadly, but has some good content as well*

**Grading Scheme**

- Weekly assignments: 10\*2=20%
- Participation in discussions: 10%
- Term paper: (total 40%)
  - Outline: 5%
  - Paper: 15%
  - Reviews: 5%
  - Revision: 15%
- Presentation: 5%
- Final exam: 25%

**Grading Method**

- In this course, some components will be graded using numerical percentage marks. Other components will receive letter grades, which for purposes of calculating your course average will be translated into numerical equivalents using the Faculty of Arts and Science Letter Grade

| Assignment Mark | Numerical value for calculation of final mark |
|-----------------|---|
| A+              | 93  |
| A               | 87  |

|          |    |
|----------|----|
| A-       | 82 |
| B+       | 78 |
| B        | 75 |
| B-       | 72 |
| C+       | 68 |
| C        | 65 |
| C-       | 62 |
| D+       | 58 |
| D        | 55 |
| D-       | 52 |
| F48 (F+) | 48 |
| F24 (F)  | 24 |
| F0 (0)   | 0  |

#### Queen's Official Grade Conversion Scale

| Grade | Numerical Course Average (Range) |
|-------|----------------------------------|
| A+    | 90-100                           |
| A     | 85-89                            |
| A-    | 80-84                            |
| B+    | 77-79                            |
| B     | 73-76                            |
| B-    | 70-72                            |
| C+    | 67-69                            |
| C     | 63-66                            |
| C-    | 60-62                            |
| D+    | 57-59                            |
| D     | 53-56                            |
| D-    | 50-52                            |
| F     | 49 and below                     |

#### **Academic Integrity and Queen's Code of Conduct**

Students are responsible for familiarizing themselves with the regulations concerning academic integrity and for ensuring that their assignments and conduct conform to the principles of academic integrity. Information is available in the Arts and Science Calendar (see Academic

Regulation 1 - <http://www.queensu.ca/artsci/academic-calendars/regulations/academic-regulations>, on the Arts and Science website (see <http://www.queensu.ca/artsci/academics/undergraduate/academic-integrity>), and at Biology's website (<http://www.queensu.ca/biology/undergrad/integrity.html>) and from the instructor of this course. Departures from academic integrity include plagiarism, use of unauthorized materials, facilitation, forgery and falsification, and are antithetical to the development of an academic community at Queen's. Given the seriousness of these matters, actions which contravene the regulations on academic integrity carry sanctions that can range from a warning or the loss of grades on an assignment to the failure of a course to a requirement to withdraw from the university.

### **Accommodation Policy, Exam Conflicts, and Other Conflicts**

Students who feel they need accommodations for disabilities or extenuating circumstances, or have a conflict between exams or other commitments should consult the Biology Department's website for details about how to proceed (<http://www.queensu.ca/biology/undergrad/integrity.html>). In general, the earlier a course coordinator is apprised of an extenuating circumstance, the more likely an accommodation can be made. Students are encouraged to be proactive in anticipating difficulties, when it is possible to do so.

Students may apply to write a make-up or deferred exam if they have an exam conflict as defined in the Academic Regulations of the Faculty (See Arts and Science Calendar Regulation 8 - <http://www.queensu.ca/artsci/academic-calendars/regulations/academic-regulations>). In this case, the student should report to the Exams Office first to verify that there is a genuine exam conflict. Biology professors will not consider your situation to be a conflict unless it meets the criteria set out by the Faculty of Arts and Sciences.

Students may request a make-up or deferred exam if they have an exam conflict with off-campus travel associated with a field course (e.g BIOL-307/3.0 or 407/3.0) that is held during the fall or winter terms.

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### **Accommodation of Disabilities**

Queen's University is committed to achieving full accessibility for persons with disabilities. Part of this commitment includes arranging academic accommodations for students with disabilities to ensure they have an equitable opportunity to participate in all of their academic activities. If

you are a student with a disability and think you may need accommodations, you are strongly encouraged to contact the Disability Services Office (DSO) and register as early as possible. For more information, including important deadlines, please visit the DSO website at:

<http://www.queensu.ca/hcds/ds/>