MSc and PhD Programs in Environmental & Life Sciences

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The Environmental & Life Sciences Graduate Program is an interdisciplinary program leading to either a MSc or a PhD degree in the natural sciences. Students conduct research in applied and basic science and many students develop their research projects in partnership with governmental agencies, industry, organizations, and other universities. The centrepiece of student training is the thesis – an original investigation in the natural sciences – augmented by seminars, a mandatory core course (for MSc students), elective courses, and the candidacy examination (for PhD students).

The Program is served by faculty principally from the departments of Biology, Chemistry, Forensic Science, and School of the Environment, as well as adjunct faculty from provincial and federal government agencies, non-governmental organizations and industry. The program serves as a broad umbrella for these disciplines to interconnect. Four Canada Research Chairs and one NSERC Senior Industrial Research Chair are appointed to the program.

The program offers instruction in six areas of emphasis:

- Cell Biology and Genetics
- Stress Physiology
- Physical Geography
- Trace Contaminant Toxicology and Chemistry
- Ecosystem Biogeochemistry
- Ecology and Conservation Biology

The aim of the program is to provide students with a background in the theory and practice of environmental and biological science that will enable them to function and thrive in a variety of work environments.

GRADUATE PROGRAM DIRECTOR

M. Dorken, BSc (Guelph), MSc (Queen's), PhD (Toronto), *plant evolution and ecology*

FACULTY AND RESEARCH AREAS

Anthropology

J. Conolly, BA (Toronto), MA, PhD (London), *spatial ecology & conservation biology, palaecoecology*

W. Fox, BA, MA (Toronto), *First Nation trade networks In the Great Lakes region with particular emphasis on the Middle Woodland and Historic (17th Century) periods, lithic sourcing in Ontario, symbolic artifact evidence for native religious belief systems in the Great Lakes region, the identification of ethnicity in the archaeological record*

E. Morin, BSc, MSc (Montréal), PhD (Michigan), *archaeology, paleolithic of Europe, methods and theory in faunal analysis, human behavioural change during the late Pleistocene, prehistory of Northeastern North America*.

P. Szpak, BA (McMaster), PhD (Western), *stable isotopes, palaeoecology, historical ecology, archaeological science, environmental archaeology, bone chemistry, palaeodiet, domestication and animal husbandry; North American Arctic, Peru and Chile, British Columbia, California*

Biology

D. V. Beresford, BEd (Queen's), BSc, PhD (Trent), *role of dispersal In Insect and mite populations, stable flies as pests, Insects that colonize corpses*

C. Brunetti, BSc, PhD (McMaster), *molecular biology of human poxviruses*

G. Burness, BSc (Memorial), MSc (Brock), PhD (British Columbia), *animal energetics, avian physiological ecology*

M. Dorken, BSc (Guelph), MSc (Queen's), PhD (Toronto), *plant evolution and reproductive strategies*

N. Emery, BSc (Queen's), PhD (Calgary), *physiological ecology of plants*

M. Fox, *Emeritus*, BA (Pennsylvania), MEDes (Calgary), PhD (Queen's), *fish ecology, pond culture*

J. R. Freeland, BSc (Saskatchewan), MSc, PhD (Queen's), *molecular ecology, population and conservation genetics*

P. Frost, BSc (Rochester), MSc (Ohio State), PhD (Arizona State), *biological stoichiometry in aquatic ecosystems (David Schindler Professor in Aquatic Science)*

A. Greer, BSc (Mount Allison), MSc (Trent), PhD (Arizona State)

T. Hossie, BSc, MSc (Trent), PhD (Carleton), *predator-prey interactions and seek to understand ecological and evolutionary mechanisms which operate at the interface of behavioural ecology and population biology. Primarily amphibian and insect systems*

R. Huber, BSc, PhD (Toronto), *social amoeba Dictyostelium discoideum as a model system for studying the functions of proteins linked to human disease and the structure and function of the extracellular matrix (ECM)*

C. Kapron, BSc (Waterloo), MSc, PhD (McGill), *cellular and molecular mechanisms of embryonic toxicity and teratogenicity*

L. Kerr, BSc, MSc (Carleton), PhD (British Columbia), *behavioural neuroscience, cellular mechanisms, cancer growth and chemotherapeutic efficiency*

D. Murray, BSc (McGill), MSc (Alberta), PhD (Wisconsin), *mammal and amphibian ecology, population dynamics, behavioural ecology, predation, parasitism (Canada Research Chair in Integrative Wildlife Conservation)*

E. Nol, BSc (Michigan), MSc (Guelph), PhD (Toronto), *conservation ecology of birds*

G. Raby, BSc (Trent), PhD (Carleton), *fish ecology*

J. A. Schaefer, BSc (McGill), MSc (Manitoba), PhD (Saskatchewan), *behaviour and population dynamics of terrestrial mammals*

J. Sutcliffe, Emeritus, BSc (Waterloo), MSc, PhD (Toronto), *infectious disease*

S. Tobin, BSc (Western), MSc, PhD (York), *animal physiology and stem cell research. Beneficial to students interested in conducting research in biomedicine.*

S. West, BPhysEd, MSc, PhD (Toronto), *examining exercise and bone health in children and adults with chronic disease*

P. Wilson, BSc, MSc, PhD (McMaster), *evolutionary genetics, DNA profiling (Canada Research Chair in DNA Profiling, Forensics, and Functional Genomics)*

M. A. Xenopoulos, BSc, MSc (Québec), PhD (Alberta), *global change and its effects on aquatic communities in lakes and rivers*

J. Yee, BSc, MSc, PhD (British Columbia), *molecular & biochemical parasitology*

Chemistry

J. Hendel, BSc (Waterloo), MSc (Guelph), PhD (National Univ. of Ireland), *glycoscience*

H. Hintelmann, BSc, MSc, PhD (Hamburg), *fate of metals in environment, bioavailability/ speciation of metals and organometals, stable isotope methods and hyphenated ICP-MS techniques*

E. Keske, BSc (Western), PhD (Queen's), *organic synthesis, organometallic chemistry, homogeneous catalysis, reaction mechanism elecidation*

S. Narine, BSc, MSc (Trent), PhD (York), *biomaterials precursor synthesis, formulation and materials characterization (NSERC Industrial Chair in Biomaterials)*

M. Parnis, Emeritus, BSc., PhD (Toronto), *estimation and application of partition coefficients in environmental fate modelling*

S. Rafferty, BSc (Waterloo), PhD (British Columbia), *environmental biochemistry*

A. Vreugdenhil, BSc, PhD (McGill), t*race contaminants, transformation of organic & non-organic contaminants*

Forensic Science

C. Kyle, BSc (Bishop's), MSc (Guelph), PhD (Alberta), *conservation and population genetics, molecular ecology*

S. Martic, BSc (Bishop's), MSc (McMaster), PhD (Queen's), *biological biomarker identification, detection and toxicology screening using a variety of bioanalytical and biochemical tools*

A. Moorthy, BEng (McMaster), MSc, PhD (Guelph), *computational approaches for improved data interpretation, particularly as it relates to mass spectral measurements in forensic science*

B. J. Saville, BSc (Guelph), MSc, PhD (Toronto), *fungal genomics*

A. B. A. Shafer, BSc (McMaster), MSc (Acadia), PhD (Alberta), *applying genomic methods to conservation, wildlife management, and legal issues. understanding the drivers of important processes like migration and adaptation in nature*

Kinesiology

D. Forman, BHS (Ontario Institute of Technology), MSc (Memorial), PhD (Ontario Institute of Technology), *biomechanics specializing in injury and ergonomics*

Nursing

School of the Environment

J. Aherne, BA (Trinity College, Dublin), MApplSc, PhD (University College Dublin), *impacts and disturbance on aquatic and terrestrial ecosystems*

K. Borden, BSc (Queen's), MSc, PhD (Toronto), *plant root ecology, nutrient acquisition and cycling in soil, and greenhouse gas emissions in more diversified agroecosystems (e.g., agroforestry, intercropping, and cover cropping).*

M. Buell, BSc (Guelph), MSc, PhD (Trent), *Great Lakes water and sediment quality, toxicology, fish biology, knowledge collaboration, Western science and Indigenous knowledge systems, ecotoxicological risk assessment*

J. M. Buttle, Emeritus, BA (Toronto), PhD (Southampton), *hydrology, fluvial geomorphology*

D. H. Dang, BSc, MSc, PhD (Toulon), *environmental geochemistry, trace metals, stable and non-conventional isotopes, aquatic contaminants, mass spectrometry*

C. Eimers, BSc (Toronto), MSc (Trent), PhD (Waterloo), *soil processes, water quality, hydrology and climate change*

R. D. Evans, *Emeritus,* BSc (Toronto), PhD (McGill), *geochemical control of trace metal and radionuclide distribution in the environment, particularly as it relates to the uptake of these substances by aquatic organisms*

C. Furgal, BSc (Western), MSc, PhD (Waterloo), *environmental health, planning and resource development, risk management and communication, and Arctic Indigenous issues*

B. E. Hickie, BSc (Guelph), MSc (Waterloo), PhD (Waterloo), *environmental toxicology, pharmacokinetic modelling*

J. F. Koprivnjak, BSc, MSc (McGill), PhD (Atlanta, Georgia), *spatial and temporal characterization of dissolved organic matter in natural waters*

P. M. Lafleur, *Emeritus,* BSc (Brandon), MSc (Trent), PhD (McMaster), *forest-atmosphere energy interactions, impacts of climatic change*

C. L. McKenna Neuman, BSc (Queen's), MSc (Guelph), PhD (Queen's), *process geomorphology, mechanics of sediment transport, periglacial/coastal aeolian geomorphology*

C. D. Metcalfe, *Emeritus,* BSc (Manitoba), MSc (New Brunswick), PhD (McMaster), *aquatic organic contaminants*

M. Nehemy, BSc (Sao Paulo, Brazil), MES, PhD (Saskatchewan)

R. Ponce-Hernandez, BEng (Universidad, Chapingo), MSc (Colegio de Postgraduados), DPhil (Oxford), *geographical information systems applied to suitability and impact assessments in agricultural and forest ecosystems*

I. Power, BSc, PhD (Western), *carbon sequestration and tailings management, natural analogues for carbon mineralization, and geobiological approaches to carbon management*

A. Tanentzap, BSc, MSc (York), PhD (Cambridge), *ecology and evolution with a focus on solutions to protect biodiversity, drinking water, and carbon sequestration under environmental change*

K. Thompson, BSc (Western), PhD (Guelph), *microbial communities in ecosystem functioning, including SOM stability and GHG fluxes, microbial measures as biological Indicators of soil health, agricultural management, industrial disturbance, climate change and land use change*

A. Watkinson, BSc (Ottawa), MSc (Laurentian), PhD (Alberta), *restoration ecology; land reclamation; plant and soil recovery post-disturbance; novel approaches to facilitate revegetation; development of Anthroposols; habitat restoration for species at risk; prairie ecosystems; boreal ecosystems*

S. Watmough, BSc (Liverpool Polytechnic), PhD (Liverpool John Moores), *impacts of acid rain, climate change, nutrient depletion, forestry and metals on forest and lake ecosystems*

T. H. Whillans, *Emeritus*, BA (Guelph), MSc, PhD (Toronto), *fisheries, wetland ecology, renewable resource management*

OTHER FACULTY

J. Bowman, BSc (Queen's), MSc (Laurentian), PhD (New Brunswick), *spatial population ecology, landscape ecology, ecology of mammal and bird populations (Ontario Ministry of Natural Resources)*

G. S. Brown, BSc (Dalhousie), MSc (Laurentian), PhD (Guelph) *population ecology of large mammals (Ontario Ministry of Natural Resources)*

W. Burr, BSc, PhD (Queen's), *applied statistics: time series, spectrum estimation, and statistical modelling*

N. Jones, BSc (Guelph), PhD (Alberta), *fish habitat and the productive capacity of aquatic ecosystems (Ontario Ministry of Natural Resources)*

R. Metcalfe, BA, MA (Wilfrid Laurier), PhD (Queen's), *basin-scale runoff processes in cold regions, GIS and remote sensing applications in hydrology (Ontario Ministry of Natural Resources)*

J. Northrup, BS (Bates College), MSc (Alberta), PhD (Colorado State), *quantitative ecology, with a focus on large mammals and movement behaviour.*

B. Patterson, BSc (New Brunswick), MSc (Acadia), PhD (Saskatchewan), *dynamics of vertebrate predator-prey systems (Ontario Ministry of Natural Resources)*

E. Sager, BSc, PhD (Trent), *climate change, pollution, forest and lake ecosystems*

C. Wilson, BSc (Queen's), MSc (Windsor), PhD (Guelph), *evolutionary ecology and biogeography of freshwater organisms, (Ontario Ministry of Natural Resources)*

ADJUNCT PROFESSORS

H. Bates, BSc (Ottawa), PhD (Toronto), *the processes that regulate the production of heat from brown adipose tissue and how these can be harnessed for the generation of anti-obesity therapeutics*

J. Benson, BSc (Humboldt), MSc (Louisiana), PhD (Trent), *population viability model for Algonquin wolves*

L. Braga, BSc, MSc, PhD (Sao Paulo), *environmental microbiology*

J. Brownscombe, BSc, MSc (Trent), PhD (Carleton), *science and management of fish habitat, including studies of fish behavior, physiology, and space use in the Great Lakes*

A. Campomizzi, BSc (Dayton, Ohio), MSc, PhD (Texas A & M), *ecological research to advance the conservation of songbirds in Ontario*

J. Canario, MSc, PhD (Lisbon), *analytical chemistry, environmental chemistry, mercury, sulphur and selenium biogeochemistry in the environment, permafrost chemistry, polar sciences*

L. Cartwright, BSc (Brock), MSc (Trent), PhD (McMaster) *restoration ecology*

D. Catlin, BA (Hamilton), MSc (Oregon State), PhD (Virginia), *coastal conservation, advanced mark recapture techniques, population dynamics, dispersal, conservation biology, model selection and inference, shorebird biology*

S. Côté, BSc (Laval), PhD (Sherbooke) *population ecology, conservation biology and behavioural ecology, conservation and wildlife management of vertebrates*

S. Cooke, BES, MSc (Waterloo), PhD (Illinois) *aquatic conservation and management*

C. Cullingham, BSc (Guelph), PhD (Trent), *the genomics of plants, pathogens, and pests*

C. Davy, BSc (Guelph), MSc (Western), PhD (Toronto), *genetic and behavioural responses of small and declining wildlife populations to environmental changes. (Ontario Ministry of Natural Resources*

M. DiLeo, BSc, MSc (Queens), PhD (Toronto), *Wildlife Species at Risk Research Scientist with Ontario Ministry of Northern Development, Mines, Natural Resources and*

Forestry (NDMNRF), integration of ecology and genomics to study species-at-risk responses to landscape fragmentation and climate change

M. Donaldson, BSc (Waterloo), MBioTech (Toronto), PhD (Trent), *molecular biology, genomics, genetics, evolutionary and population ecology and biological conservation*

M. Drever, BSc (Toronto), MSc (Simon Fraser), PhD (Guelph), *Related to modelling habitat and populations of shore-birds, seabirds, and waterbirds*

E. S. Dunlop, BSc (Guelph), PhD (Toronto), *Aquatic ecosystems of the Great Lakes, evolutionary ecology, fisheries science*

E. Emilson, BSc (Guelph), MSc, PhD (Sudbury), Research Scientist Forest Aquatic Ecology Natural Resources Canada. *A multidisciplinary approach to address how anthropogenic impacts such as forestry and mining interact with climate change, pollution, and other stressors to affect water quality and aquatic ecosystem functions.*

S. Farrow, BSc, MSc (Trent), PhD (Calgary), *advanced molecular biology techniques (gene silencing, cloning), synthetic biology applications (biosynthetic pathway reconstitution in hosts), bioinformatics (transcriptome assembly and gene discovery), analytical chemistry (mass spectrometry, HPLC, NMR) and biochemistry (heterologous expression, purification, crystallography, kinetics)*

R. Feldman, BScH (Kingston), MSc (Vancouver), PhD (Montreal), *Research Scientist with the Ontario Ministry of Northern Development, Mines, Natural Resources, and Forestry. Opportunities to conduct research that links directly to environmental policy*

A. Fisk, BSc, MSc (Windsor), PhD (Manitoba), *Great Lakes aquatic ecology including food webs, fish movement and ecotoxicology*

J. Fitzsimmons, BSc (Queen's), MSc (Memorial), PhD (Ottawa), *terrestrial ecosystems*

K. Fleming, BSc (Trent), MSc (Toronto), PhD (Trent) *connections between anthropogenic disturbances, land-use practices, and their effect on terrestrial and aquatic invertebrate communities*

S. Flemming, BSc (Alberta), MSc (Otago, NZ), PhD (Trent), *shorebird and waterbird monitoring programs; analyze long-term regional population trends*

S. Forbes, BSc, PhD (Univ of Technology, Sydney), *forensic taphonomy and chemistry. Focused on understanding post-mortem (epigenomic) change*

C. Fortin BSc (Montreal), MSc, PhD (Quebec), *interactions of metals with aquatic biota, focusing on the roles of metal speciation (including natural organic matter) and cellular nutritional status*

C. Gibson, BSc (Dalhousie), MEng, PhD (McMaster), *field of geomatics*

M. Gordon, BASc (Waterloo), MEng (Monash), PhD (York), *atmospheric science, air quality and aerosol dynamics*

L. Gutowsky, BSc, MSc (Trent), PhD (Carleton), *fish ecology*

T. J. Haxton, BSc (Guelph), MSc (Trent), PhD (Ottawa), *large-bodied fish, population dynamics, response to anthropogenic stressors, riverine systems, flowing water assessment techniques*

K. Hillsley BSc, PhD (Sheffield, UK) *cellular and molecular biology*

B. Hu, BElectrEng, MElectrEng (Tianjin), PhD (Boston), *remote sensing and its application to a wide range of environmental monitoring applications*

S. Jamieson, BSc (Memorial), MSc (New Brunswick), PhD (Simon Fraser)

T. Johnson, BSc (Guelph), MSc (York), PhD (Wisconsin), *Great Lakes aquatic ecology including food webs, ecophysiology, and stressors (with a focus on aquatic invasive species)*

D. Kaplan, BA (Clark), PhD (Harvard), (Sick Kids Hospital), *neurosciences and mental health*

K. C. R. Kerr, BSc, PhD (Guelph), *applying DNA barcoding and other molecular tools to delimit species, resolve phylogenetic relationships or resolve ecological questions. Exploring the role of modern zoos in conservation strategies*

A. Kisiala, MSc, PhD (Technology & Life Sciences, Poland), *plant physiology and agriculture*

E. Koen, BSc (Western), MSc (Ottawa), PhD (Trent), *wildlife landscape ecology*

W. H. Korver, BSc (Guelph), DVM (Ontario Veterinary College), *biology of stress in captive animals, comparative anatomy and physiology, herpes virus in elephants, musth in elephants*

J. Leach, BSc (Guelph), MSc, PhD (British Columbia), *forest hydrology and water quality*

D. Lesbarrères, BSc (Bordeaux), MSc (Rennes), PhD (Angers), e*cology and evolutionary biology*

J. Liu, BMed (Shandong School of Medicine), MSc (Trent), PhD (Toronto), *endothelial cell gene regulation; vascular pharmacology and toxicology; drug development from herbal medicine*

V. Mangal, BSc, PhD (Trent), *biogeochemistry of organic matter and contaminant cycling, especially with contaminant uptake in algae*

M. Manseau, BSc (Québec and British Columbia), MSc (Laval), PhD, (Swedish University of Agricultural Sciences), PhD (Laval), *conservation biology, animal and landscape ecology, population and landscape genetics, indigenous-led conservation*

G. Mastromonaco, BSc, MSc, PhD (Guelph), *reproductive biotechnologies, stress hormone analysis*

S. Mayor, *Research Scientist at the Ontario Ministry of Natural Resources and Forestry. Research in disturbance ecology, landscape ecology, biodiversity conservation, and climate change impacts*

L. McKinnon, BSc (Toronto), MSc (Michigan), PhD (Rimouski), *alternative prey on nest predation risk or arctic-nesting shorebirds and collaborative networks studying trophic interactions in the Arctic.*

E. Morrison, BSc, PhD (Trent), *molecular biology, metabolomics, biochemistry and plant and fungus physiology*

A. Namayandeh, BSc (Windsor), MSc (York), PhD (Trent), *far north biodiversity project, taxonomy and biogeography of non-biting midges or chironomidae*

K. Newman, MChem, PhD (Wales Swansea), *nanoparticle characterisation using single particle ICP-MS, environmental monitoring of radionuclides, mass bias correction for high precision isotope ratio measurements using MC-ICPMS, mass spectrometry design and development*

C. Paulo, Licentiate (Coimbra), MGeoResources (Portugal), PhD (Toronto), *mineralogy and geomaterials that will cover the basis of crystallography*

R. Petri, BSc (Alberta), MSc, PhD (Saskatchewan) *host-microbiome interactions, digestive physiology, microbiology, and bioinformatics*

P. Pillai, BSc, BEd, MSc (Kerala, India) PhD (Trent), *polymeric and organic synthesis, polymer formulations, and biobased/renewable polymers, click chemistry, bio-polymer composites, nanotechnology (nano-metric fiber reinforced composites), electrospinning of polymers and polymers for environmental applications*

J. Popp, BSc, MSc, PhD (Laurentian), Canada Research *Chair in Indigenous Environmental Sciences. Noted expert in research focused abilities In weaving Indigenous Knowledge with western scientific research*

K. Rausis, BSc,MSc (Barcelona Spain), PhD (Catalonia Spain), *geochemistry of mine development, Co2 removal using magnesium ocide and enhanced rock weathering of wollastonite In agricultural soils*

J. C. Ray, BSc, MSc (Stanford), PhD (Florida), *conservation of wildlands and large mammals (Wildlife Conservation Society Canada)*

J. Riley, BSc (Guelph), MSc (Laurentian), PhD (Australia), *ecology and animal behaviour within an evolutionary framework, and its applications to the real-world challenges in the conservation of reptiles and amphibians*

L. Rutledge, BSc, BEd (Western), MSc (Northern British Columbia), PhD (Trent), *hybridization & speciation; ecological shifts in response to environment*

A. Schulte-Hostedde, BSc (Western), MSc (Guelph), PhD (Western), *behavioural and evolutionary ecology (Laurentian University)*

P. Shahpoury, BSc (Azad Univ, Iran), MSc (Putra, Malaysia), PhD (Otago, NZ)

M. Sharifi, BSc, MSc, PhD (Isfahan Univ, Iran), *organic amendment and cover crop management in tree fruits and wine grapes; soil carbon and nitrogen dynamics; Ethnoagronomy (Avalanche lilies and Black Huckleberries)*

S. Shetranjiwalla-Merchant, BSc (Pune, India), MSc, PhD (Trent), *multi-disciplinary research in designing innovative materials and processes from renewable and environmentally sustainable sources*

P. A. Smith, BSc (Trent), MSc (British Columbia), PhD (Carleton), *arctic-breeding shorebirds; effects of environmental change on the demography of arctic birds; assessments of the factors linked to global population declines of shorebirds*

D. Stewart, BSc (Acadia), PhD (Toronto), *molecular evolutionary biology with broad Interests*

N. Stock, BSc, MSc, PhD (Waterloo), *trace contaminants, organic contaminants*

K. Storey, BSc (Calgary), PhD (British Columbia), *potential use of amphibian larvae as bioindicators of wetland heath and water quality*

T. Stotesbury, BSc (Trent), MSc (Auckland, NZ), PhD (Trent), *understanding the (bio)chemical properties of common types of physical evidences and traces deposited at crime scenes and how they persist in the environment*

S. B. Watson, BSc & MSc (McGill), PhD (Calgary), *limnology, cell biology, community ecology and database mining al-low for cell-through-ecosystem analyses*

T. Wheeldon, BSc (Carleton), MSc, PhD (Trent) *conservation and population genetics*

C. Whitfield, BSc, MSc, PhD (Trent), *catchment hydrochemistry, applied biogeochemistry*

S. Wilson, BSc (McMaster), MSc, PhD (UBC), *Canada Research Chair. Focuses on environmental aspects of economic geology and on chemical sedimentology. Mineral behaviour, with a particular emphasis on crystallography and crystal chemistry, to understand and manage environmental change in engineered and natural settings.*

J. Winter, BSc (Liverpool, UK), MSc (Manchester, UK), PhD (Waterloo), *human/aquatic system interactions, nutrient modeling, landscape analysis (Ontario Ministry of Environment)*

K. Woodend, RN, BScN, MSc (Ottawa), PhD (Toronto) aging persons, chronic disease management and self-management, health systems

Q. Xie, BSc (Wuhan, China), MSc (Beijing), PhD (Saskatchewan), *trace elements and isotopes as environmental tracers (Trent Water Quality Centre)*

H. Zhong, BSc (Nanjing, China), PhD (HK University, China), *how biogeochemical factors affect bioavailability and accumulation of metals in food crops; how human beings are exposed to metals in food and medicines*

REGULATIONS

The general regulations and requirements for graduate degrees at Trent University apply to the Environmental & Life Sciences Graduate Program. Application for admission should be received by February 1 for consideration for scholarships, bursaries, and teaching assistantships for Fall admission into the program. A small number of students are admitted in January and May. Applicants should hold an undergraduate Honours degree in Biology, Environmental Chemistry, Environmental Science or Geography. Students must have a supervisor before acceptance in the program. The ENLS course (ENLS 5000H) is compulsory for all first-year MSc students. Students without training in advanced statistics are strongly recommended to take ENLS 5001H too. Students are permitted to take a maximum of one half-credit reading course (ENLS 5090H). In addition to the thesis, candidates for the MSc degree will be required to complete the minimum equivalent of 1.0 course credits. The supervisory committee may specify an additional 0.5 credits, in consideration of the student's academic background and research requirements; any such requirement will be determined by the committee within 8 months of admission.

Prospective PhD students will normally have a thesis-based MSc degree. Candidates for the PhD degree will be required to complete at least 0.5 credits; the supervisory committee may require an additional 0.5 credits, determined within 8 months of admission. Applicants who have achieved excellent standing at the Honours baccalaureate level, and who wish to proceed directly to Doctoral study will enroll initially as a Master's student. If the student achieves a superior academic record and shows particular aptitude for research, the Graduate Studies Committee, on the recommendation of the Environmental & Life Sciences Graduate Program Executive, may authorize conversion to the PhD program without completion of the MSc degree. Direct-entry PhD students (those who have passed the conversion examination) will be required to complete a minimum of 1.0 credit; the supervisory committee may require an additional 0.5 credits, determined within 8 months of the conversion examination. For both degrees, the thesis is expected to include the results of an original investigation. PhD students must enrol in the PhD candidacy examination (ENLS 6100H) at the start of their second year of study; they must undertake the oral candidacy examination within the first 16 months of study. The examination will establish, to the satisfaction of the program, that the student has an effective grasp of her/his research area. Degree candidates (MSc and PhD) have the option of submitting their thesis either in the "traditional" or "manuscript" format. Candidates must pass an oral examination in defence of their thesis research. Students must attain at least a B- (70%) in all course work to remain registered in their program. The expected time for completion is two years for the MSc, four years for the PhD, and five years for those who convert to the PhD program before completion of the MSc. All Environmental & Life Sciences (ENLS) graduate students need to establish a supervisory committee in conjunction with their thesis and research supervisor(s) within the first term. The supervisory committee will consist of three ENLS faculty members. They may be derived from ENLS Trent faculty, ENLS adjunct faculty, or ENLS special graduate faculty; every student supervisory committee must have a minimum of one regular (non-adjunct) Trent faculty member.

FINANCIAL SUPPORT

Full financial support is provided (minimum of six terms or the equivalent of two years of study for full-time eligible MSc students and twelve terms or the equivalent of 4 years of study for full-time eligible PhD students) in the form of teaching assistantships, research assistantships and/or scholarships. Candidates are encouraged to apply for external scholarships on their own behalf. Information on scholarships is available from the School of Graduate Studies.

For further information on financial support for graduate students, please refer to the graduate studies website.

Not all courses will be available every year. Please consult the program office for information on courses that will be offered for the upcoming academic year.

CORE COURSE

» **ENLS 5000H: Research Foundations**
This core course, which serves as the mandatory half credit required by all first year MSc students, will challenge participants to examine their philosophy of science with particular reference to their own research in one of the six ENLS streams. Students also present and defend their research proposals. Excludes ENLS 5100H, ENLS 5200H, ENLS 5300H, ENLS 5400H, ENLS 5500H, ENLS 5600H.

ELECTIVE COURSES

» **ENLS 5001H: Research design and data analysis**
This course will emphasize advanced statistical techniques for use in field and laboratory studies, including applications of linear and non-linear models, analysis of variance and multivariate statistics. This course is strongly recommended for students who have not taken an advanced statistics course (e.g. analysis of variance, multivariate statistics) as an undergraduate. Prerequisite: an introductory statistics course. Not open to students with credit for BIOL-ERSC 4030H.

» **ENLS 5026H: Wetland restoration and creation**
This is a seminar course that explores the global literature on wetland restoration and creation. The course will compare explicitly the technological and ecological experiences with different wetland types and situations, in order to determine opportunities and limitations. At least one field trip will be required. The course assumes a basic knowledge of wetland ecology and is designed for students who have taken a first course in wetland biology or who have equivalent experience.

» **ENLS 5028H: Communicating science**
Science exists only because scientists are writers and speakers. In this course, students will hone their skills at writing and presenting science with clarity and economy. In class, students will present science, in oral and written form, and evaluate the quality of that communication. We will emphasize that conveying science is storytelling, that modeling good writing can improve one's own writing, and that making science accessible means dispensing with jargon. Enrollment is limited.

» **ENLS 5050H: Directed Research**
This course is available for graduate students who wish to develop their knowledge and skills in a more discipline-specific area by undertaking a small research project or targeted exercises requiring the collection and analysis of original data. The format of the course and associated activities are designed by the student in consultation with the instructor. The research project can entail unpublished data, data from public repositories, a meta-analysis of published data, new data from small lab- or field-based project(s) collected within the timeframe of a half-credit course. Data analyzed from this course cannot be used as part of the student's thesis.

» **ENLS 5088H-ICAN 5001H: Mass spectrometry**
In this course, students will be taught the theory and operating principles of the mass spectrometers used in Trent University's Water Quality Centre, and explore current applications in both organic and inorganic mass spectrometry. Special emphasis will be given to the practical application of mass spectrometry theory to enable students to effectively use the Water Quality Centre mass spectrometers in their graduate research.

» **ENLS 5090H: Reading course**
This course is available for graduate students who wish to receive instruction on a more discipline-specific basis. The format of the course is designed by the student in consultation with the supervisor or supervisory committee. Written justification for the course must be made to the Program Director and must be arranged before registration for the course. Under exceptional circumstances, and subject to program approval, a student may register under the ENLS 5090H to take a course from another academic institution for credit.

» **ENLS 5091H: IIES- International Environmental Science: Topics & Issues**
The International Institute of Environmental Science (IIES) provides a platform for advanced discussion on significant international environmental issues. IIES member institutes will provide online course(s). Interested students will discuss course with their supervisor, develop a syllabus centered around the online component. Additional requirements include: weekly meetings, topic discussion, readings, a final paper and/or presentation.

» **ENLS 5099H: Special topic course**
Courses may be offered in a variety of areas as a way of introducing students to new subject matter, research techniques or methodologies. After one year, these courses will be reviewed for inclusion in the regular program curriculum.

» **ENLS – FRSC 5800H: Bioinformatics**
Bioinformatics – the application of computer programming to the management and analysis of biological information – is necessary for storing, manipulating, and analyzing large datasets. This course will consist of a mix of active lectures (i.e. coding during lecture) and computer-based labs and independent research. Students will work independently, under guidance from the instructor, on a bioinformatics project of their choosing that falls within the concepts covered, and skills developed during lecture and lab. Students will work collectively on writing a primer focused on a topic provided by the instructor.

» **ENLS 6100H: PhD candidacy exam**
Students are required to develop a research proposal for their dissertation in conjunction with their supervisory committee. Once the proposal is approved by the supervisory committee it is submitted to the program office. The proposal must be submitted between 12 and 16 months after enrolment. A candidacy exam is scheduled once it is approved by the examination committee. It is a closed oral examination in front of the examination committee. A grade of pass, fail, or pass with remediation will be given and will be noted on the transcript. Students who fail the exam will be required to leave the program.