

## **ERS 382 ENVIRONMENTAL MONITORING**

Spring 2015

Wednesday August 19 - Friday August 28, 2015

### **Course Outline**



#### **Instructors**

Brian Craig, Adjunct Professor, Environment and Resource Studies, [becraig@uwaterloo.ca](mailto:becraig@uwaterloo.ca)

Lisa Grbinicek, Senior Strategic Advisor, Niagara Escarpment Commission

Anne Marie Laurence, Ecological Monitoring Specialist, Niagara Escarpment Commission

**Prereq:** ENVS 200 or BIOL 250 or consent of instructor

#### **Course Location**

Skidders Bluff Management Area, near Warton, Ontario

**Course Maximum** – 13 students

## **Course Description**

This course is a collaborative effort between the University of Waterloo's ERS Department and the Niagara Escarpment Commission (NEC), the regulatory agency that administers scenic and natural lands along the Niagara Escarpment geological formation stretching from Niagara Falls in the south to Tobermory in the north. Because its jurisdictional lands (i.e. the Niagara Escarpment Plan Area) are recognized as a UNESCO World Biosphere Reserve, the NEC is required to monitor the health of its lands to ensure that they are maintained in good health. A substantial part of this monitoring is accomplished through the work of the students in this course. Thus ERS 382 is a field course designed to provide students with the theoretical and practical knowledge of environmental monitoring in the context of the Niagara Escarpment Biosphere Reserve.

The course consists of three primary components:

1. An overview of the Niagara Escarpment Commission, its mandate, activities, and lands; the international Man and the Biosphere Program and its forest biodiversity monitoring project (tree, shrub/sapling, ground cover and tree health monitoring); biosphere reserves and land use planning and management; and an overview of ecosystem monitoring frameworks, indicators, methods, and community based monitoring. You will be made familiar with recent advances in ecosystem planning, the Ontario's Niagara Escarpment (ONE) Monitoring Program, the ONE Monitoring Framework, and information management and analysis techniques.
2. Hands-on field experience in a complete, comprehensive vegetation monitoring exercise in a permanent one-hectare (100x100 m) plot of native forest as well as an introduction to some other monitoring procedures.
3. Data input using computer software, as well as verification of monitoring information. In addition, there will be opportunities to learn about the ecology and natural history of the Niagara Escarpment and the activities of individuals, organizations, and agencies that contribute to the ecological health of the area via a Bruce Peninsula Field Trip.

## **Course Objectives**

1. To provide students with familiarity or understanding of recent advances in ecosystem planning, biosphere reserves, the ONE Monitoring Program, information management and analysis techniques, and communication of monitoring information.
2. Provide an introduction to other monitoring programs and techniques operating along the Niagara Escarpment.
3. To give students an opportunity to learn about the conduct of systematic fieldwork through hands-on monitoring experience at the "plot" scale, using protocols developed for monitoring forest biodiversity, as well as other monitoring techniques (e.g. tree health monitoring).
4. To complete the fourth 5-year monitoring review, data collection, data input and mapping, and quality checks for the Hope Bay Forest Nature Reserve monitoring site.
5. To provide students with the chance to meet professionals engaged in various ways in protecting the natural environment (e.g., ecological and environmental management and

administration, policy setting and implementation, scientific research) and learn about how they practice their professions.

6. To provide students with the opportunity to participate in focused lectures and group discussion on environmental monitoring, to evaluate the monitoring activities, generate ideas for further research, and provide an evaluation of the course.
7. To establish a “learning community” that nurtures both individual creativity and mutual assistance, and operates successfully at both the pedagogical and social levels.
8. Completion of an individual report based on course lectures, monitoring literature and issues, and a case study.
9. To provide you with opportunities to experience nature, to sense it in all possible ways, learn to wonder about it, appreciate its beauty, and reflect on our place in the natural world.
10. Have fun working and learning together with colleagues and instructors.

### **The Forest Biodiversity Monitoring Protocol**

We will be using a biodiversity monitoring procedure or “protocol” prepared by the Smithsonian Institution in Washington developed for the International Man and the Biosphere Program (now called the Monitoring and Assessment of Biodiversity Program) sponsored by the United Nations (hence the term SI/MAB protocol). This protocol is designed for establishing permanent one-hectare plots for long-term monitoring of forest biodiversity. The Ecological Monitoring and Assessment Network (EMAN) of Environment Canada endorsed this protocol as the “national standard” for monitoring forest biodiversity in Canada’s temperate forests. Ecological knowledge reveals the importance of biodiversity in maintaining the integrity of natural systems. Thus, it is important to have baseline information on the composition, structure, and function of ecosystems so that the natural state of health of a system is known and thus the effects of perturbations caused by stressors can be understood and appropriate policies implemented for preservation or remediation.

These SI/MAB plots are already showing their usefulness. About 15 years ago a severe ice storm paralyzed eastern Ontario and neighbouring Quebec. The effect on trees and forests was devastating. Fortunately, a SI/MAB plot had been established in the area affected and thus there was a good picture in hand of the characteristics of the pristine mature native forest. Most of the large trees in the experimental plot were brought to the ground by the ice storm and there was little growth intact above a few meters. However, the monitoring in this plot now assumed a unique importance: because of the wealth of data describing the original forest, subsequent monitoring will show how such a forest recovers over time and whether the eventual mature forest at the site will resemble the original forest or evolve into something different. A SI/MAB plot in the Long Point Biosphere Reserve in southern Ontario quantitatively tracked the decline of the Eastern Flowering Dogwood and the information was used in the 2007 COSEWIC assessment and status report:

[http://publications.gc.ca/collections/collection\\_2007/ec/CW69-14-533-2007E.pdf](http://publications.gc.ca/collections/collection_2007/ec/CW69-14-533-2007E.pdf)

A common tree species in the five Escarpment plots monitored by this class is white ash. A few years ago a shipment of goods from China was delivered to Detroit. The goods were packed in wooden crates infested with the larvae of the emerald ash borer beetle. This beetle feeds voraciously on living ash trees and kills the tree within 2 to 4 years. Attempts to contain the

infestation to Detroit were unsuccessful and the ash borer is now decimating ash trees in the Great Lakes Forest Region including southern Ontario. It has spread north to Sault Ste. Marie and east to Montreal. <http://cfs.nrcan.gc.ca/pages/318>

It will be interesting to document the effects of the invasion of the ash borer in the five plots. How will it affect species composition and the overall productivity of the forest?

The plot near Milton is near an infestation of dog-strangling vine, an exotic and highly invasive species. There is much concern about this plant in Ontario. During our initial visit to the plot in the Halton Agreement Forest, a small infestation was observed in a pine plantation approximately 300m away from our plot. This species has now invaded the interior forest at the site (the first few individuals reached the plot in 2006) and Halton Region staff are now working to control this species.

Air pollution, climate change and recreational use (several of our plots are on or near the Bruce Trail) may also have effects. All of the Escarpment plots are recovering from varying degrees of past human disturbance, which is apparent when examining species composition and distribution. However, the majority of the forests contained by the plots are also showing signs of approaching an older growth state, (e.g. based on the presence of shade-tolerant canopy species, trees with relatively large diameters, relatively large stand basal area). To date, the results of data analysis suggest that the Escarpment plots consist of healthy, sugar-maple dominated forests that represent stable cores of the greater forested landscape, with little change in biodiversity between monitoring intervals. With continued protection from human disturbance through the implementation of the policies of the Niagara Escarpment Plan (which includes the requirement to develop park management plans that align with NEP policies and objectives), the sites may eventually provide mature forest conditions not commonly found in southern Ontario.

Tree health is also monitored in a sub-sample of the one-hectare plot using an EMAN-endorsed protocol developed by the Canadian Forest Service (CFS). This data has been collected in the Escarpment plots since 1999. The addition of this protocol to the ONE Monitoring Program is useful in order to identify and track possible pest infestations or disease (e.g. butternut canker, beech bark disease) and their impacts on biodiversity. If a notable decline in a particular species is identified, the CFS can be contacted for further investigation.

There is a growing international program, initiated by the United Nations Educational, Scientific, and Cultural Organization, to protect major representative natural areas as World Biosphere Reserves. The Niagara Escarpment was proclaimed a World Biosphere Reserve more than 20 years ago, and this provides the NEC with an additional compelling reason for setting up a chain of stations or plots for monitoring a number of pertinent ecological factors.

The main reason for establishing monitoring plots along the Niagara Escarpment was to answer the question, *“Is the Niagara Escarpment Plan, with its unique set of environmental land use policies, achieving its goals for the preservation of natural areas under its jurisdiction”?* The Plan implements the *NEC Planning and Development Act (1973)*, which was created *“to provide for the maintenance of the Niagara Escarpment and land in its vicinity substantially as a continuous natural environment, and to ensure only such development occurs as is compatible with the natural environment.”* Your work in this course will not only teach you about environmental monitoring, but you will also make an important contribution to the knowledge base about Escarpment natural areas that will be used and reused for planning decisions in the future.

Through the NEC-UW partnership 5 “control” (undisturbed) SI/MAB plots have been established

and are monitored on a 5-year rotational basis at Halton Agreement Forest near Milton (1996, 2001, 2006, 2011), Hockley Valley Provincial Nature Reserve (1997, 2002, 2007, 2012), Cabot Head Provincial Nature Reserve beside the Bruce Peninsula National Park (1998, 2003, 2008, 2013), the Hope Bay Provincial Nature Reserve (1999, 2004, 2009, 2014) and the Skinner's Bluff Management Area near Wiarton (2000, 2005, 2010). All of the plots are located within core protected areas of the Biosphere Reserve. The Ecological Monitoring and Assessment Network, which in the past coordinated such monitoring in Canada, periodically evaluated the accuracy of the work done on our plots. They found the work to be exemplary. The Escarpment plots are part of a network of plots in Biosphere Reserves and other protected areas across Canada and worldwide.

### **Assignments and Evaluation**

1. Participation and learning (30% of mark). You will be assessed on your general experience in our learning community, your cooperative performance in the field, your conscientious participation as a member of the field research team, your contribution to maintaining the camp and necessary activities, and any special creative touches or contributions. To assist us in doing this, we ask you to submit 2 short statements. One, no more than one page long, should list your contributions to the course. The second, up to two pages, should reflect on your learning outcomes. Learning outcomes can be varied, from the methods and techniques you have learned, experiences in the field, working in teams, coming to appreciate nature, learning to observe, etc. Some students in the past have had quite transformative experiences. Due date for these 2 short assignments is prior to 11:59 p.m. on Friday September 12.
2. Quality of fieldwork and data entry (40% of total). On a team/group basis, you will be assessed on the general quality of your fieldwork and data entry. We will expect data to be gathered with reasonable efficiency and team organization; accurate, legible, and neat, according to desired formats, and kept in good order. Conduct on the site is also important (e.g., minimizing disturbance to soil vegetation, keeping equipment in good order). Your progress in data inputting and eventual checking of the quality of field data will also be included in this assessment. We also encourage curiosity and good observations: appreciation will be shown for such additional contributions. Naturally, we will make allowance for your need to learn through experience and there will not be unreasonable expectations. Be conscientious and try your best.

Don't be afraid to ask questions. We encourage them. If unsure or confused – ask! Don't be shy: our paramount rule as instructors is that students must always be treated with respect and every question is welcomed without judgment. If you notice something interesting or curious, think about it and mention it to the instructors or your colleagues. Such observations can prove valuable. If you have an idea for improving fieldwork procedures or operations – propose it. Also, take notes and write comments on the data sheets.

3. Individual Assignment (30% of total). During the course there will be several lectures including: millennium ecosystem assessment; introduction to monitoring; monitoring frameworks; monitoring indicators; monitoring protocols; and community based monitoring. You will be given the opportunity to undertake an interesting assignment to demonstrate knowledge you have gained on the course. The course instructor will review the assignment expectations towards the end of your course. Use your course notes, bibliography, library resources, scientific journals, Web sites, interviews with experts or practitioners, or your own experience. Make sure to acknowledge your sources of information and assistance; usual UW policy applies. The assignment is due prior to 11:59 p.m. on Friday September 26.

## **Important Course Dates**

Reading Assignment distribution – July 13, 2015

Pre Field Trip Meeting – Tuesday, August 4, 2015 at 5:30 pm at foyer outside of Dr. Stephen Murphy's office

Introductory Course Meeting – Wednesday, August 19, 2015 at 9:00 a.m. EV2 2006

Depart from University of Waterloo – Wednesday, August 19, 2015 at 1:00 p.m. for Trillium Woods Campground, Wiarton.

Return to University of Waterloo on Friday, August 28, 2015 at end of day

Assignment 1 and 2 due Friday September 11, 2015 by email before 11:59 p.m.

Assignment 3 due Friday September 25, 2015 by email before 11:59 p.m.

## **Course Fee**

The cost is \$440 to defray camping fees, most of your food costs, transportation, entry fees, and course materials. Cheques payable to the University of Waterloo with your student number on the back and completed course fee form should be given to Patti Bester on August 20 at the introductory course meeting (don't go to the UW cashier).

## **Preparing for the Course**

A group tenting sites has been booked Trillium Woods Campground [www.trilliumwoods.ca](http://www.trilliumwoods.ca) on Spry Lake on the Bruce Peninsula, about 10 kilometers west of Wiarton and 2 km east of the western shore of the Bruce Peninsula.

For camping we use a combination of tents brought by course members and a few that we have in the course supplies. Please let Brian Craig know if you will be able to bring a tent and how many it can accommodate. As you will need space for baggage, a tent listed as "three or four person" will really only sleep two (and your gear) comfortably! Also let Brian Craig know if you plan on sharing a tent with specific course participants.

You will need to bring your own bedding and air mattress and items for your personal needs. Warm clothing, and good boots (waterproof, good ankle support), rainwear (preferably hat, coat, and pants), bug repellent, sunscreen, and a flashlight are very important. Bring a small backpack and water bottle for our field excursions and Tupperware/reusable containers to pack your field lunch. There will be opportunities for swimming, so include swimwear. Usually the weather has been good at this location in August, but it can be unpredictable and you should be prepared for adverse conditions. Please be economical with your baggage because space is limited in the vans. If you have any questions, concerns, or needs, please contact Brian Craig ([briancraig@kwic.com](mailto:briancraig@kwic.com)) or (519) 582-4264.

We will rent vans. The minimum age for drivers is 21. There will be three vans and we will need a roster of three volunteer drivers (Brian Craig will also be a driver). Our daily return travel distance will be about 60 km on quiet roads. The hike into the plot takes about 15 minutes. The

traveling distance from Waterloo to the Summer House Campground is about 180 km. Please let Brian Craig know if you will be available to drive one of the vans.

You are encouraged to bring “extras” to enhance the course: Frisbees and other toys or games, musical instruments and song books, photos or presentations of work or experiences you have had that would interest the other students (e.g., one student had a summer job studying flying squirrels, another had monitored snapping turtles, a third had taken a vacation in Alaska).

Your course fee will provide for about 80% of your food. We will have breakfast in camp and make our own individual lunches from camp provisions, and prepare 5 or 6 of our evening meals as a group. There will also be ample food for snacking. You are welcome to bring anything special for yourself. The two evening meals eaten out will be at your own expense – we will keep costs reasonable. We will maintain a tasty menu and attempt to keep you happy and well fed. Please let Brian Craig know about any special food preferences (e.g., vegetarian, vegan, Kosher, Halal, diabetic) and food allergies, particularly if they are serious such as peanut allergy. We will try to accommodate you as best as possible. It is best to discuss any special preferences or needs with Brian Craig ahead of time. If your case is really unusual and difficult to accommodate you may be asked to bring special provisions for yourself (for which you will be reimbursed) to complement what you can eat from the group menu.

Please make sure that you have all your needed prescriptions or medical support with you. Brian Craig will carry a basic first aid kit. Please inform Brian Craig of any special health or medical conditions that he should know about as manager of the course (e.g., chronic fatigue, migraines, acute phobias, anaphylactic reactions, dangerous allergies etc). All such information will be kept strictly confidential.

If you haven't camped before or spent much time in the field, and aren't feeling sure of things, don't hesitate to ask Brian Craig or a friend who knows about such things. There is a first time for all of us. It is best to plan well ahead rather than try to second-guess what you will need. Please feel free to contact Brian Craig by phone or email.

### **Last minute problems and emergencies**

Please contact Brian Craig at home (519) 582-4264. Make sure that you fully inform your family or special friends about how to contact you, and that you provide an emergency contact on the field trip form that is in your course package.

### **Agreement on Conduct.**

The Faculty of Environment field trip guidelines apply. You must sign the agreement before departure.

### **Assistance for Students with Disabilities**

If you require special assistance, please ensure that I am aware of your needs through the Office for Persons with Disabilities (<http://www.studentservices.uwaterloo.ca/disabilities>).

### **Plagiarism and Academic Integrity**

You will be held responsible for adhering to UW policy on academic integrity, as outlined in the following guidelines from the office of the Associate Dean of Undergraduate Studies. Plagiarism

and other violations of academic integrity will not be tolerated. If you wish to quote material in your assignments, you must place it in quotation marks (or paraphrase it in your own words); otherwise, this is plagiarism. If you have any questions about what is appropriate, consult Brian Craig.

**Academic Integrity:** To create and promote a culture of academic integrity, the behaviour of all members of the University of Waterloo is based on honesty, trust, fairness, respect and responsibility.

**Grievance:** A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70 - Student Petitions and Grievances, Section 4,

<http://www.adm.uwaterloo.ca/infosec/policies/policy70.html>

**Discipline:** A student is expected to know what constitutes academic integrity, to avoid committing academic offenses, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about “rules” for group work/collaboration should seek guidance from the course professor, academic advisor, or the Associate Dean. When misconduct has been found to have occurred, disciplinary penalties will be imposed under Policy 71 – Student Discipline. For information on categories of offenses and types of penalties, students should refer to Policy 71 - Student Discipline,

<http://www.adm.uwaterloo.ca/infosec/Policies/policy71.html>

**Appeals:** A student may appeal the finding and/or penalty in a decision made under Policy 70 - Student Petitions and Grievances (other than regarding a petition) or Policy 71 - Student Discipline if a ground for an appeal can be established. Read Policy 72 - Student Appeals,

<http://www.adm.uwaterloo.ca/infosec/Policies/policy72.html>

**Turnitin:** Plagiarism detection software (Turnitin) will be used to screen assignments in this course. This is being done to verify that use of all materials and sources in assignments is documented.

### Useful Web Sites

Look these over – and then do some browsing to find other interesting examples of ecological and environmental monitoring, whether government, corporate, scientific, activist, or individual. Environmental monitoring in the broadest sense means monitoring anything to do with the environment, but lately it usually refers to monitoring physical parameters such as pollutants. Monitoring of vegetation, fauna, ecological function, and species richness is now often called ecological monitoring.

#### **Ecological Monitoring and Assessment Network.**

<http://www.ec.gc.ca/faunescience-wildlifescience/default.asp?lang=En&n=B0D89DF1-1>

Until the program was cancelled in 2010 EMAN helped coordinated ecological monitoring in Canada, particularly monitoring that uses SI/MAB plots as our course does. Take a look at the Terrestrial Vegetation Monitoring Protocols. Also take a look at the other kinds of protocols and see how the principles of monitoring are applied in such contexts.

**Niagara Escarpment Commission** [www.escarpment.org](http://www.escarpment.org) Familiarize yourself with the mandate (i.e. Niagara Escarpment Planning & Development Act and the Niagara Escarpment



Plan) and activities of the NEC, and especially the section on Monitoring (the ONE monitoring program) found under the “Education” menu at the top of the web page. Our course should be mentioned there. The NEC holds a biennial conference (the Leading Edge) on all the scientific research occurring on the escarpment. You might be interested in browsing the abstracts (summaries) from the papers presented to familiarize yourself with the wealth of activities and the issues and concerns about the escarpment.

**Coalition on the Niagara Escarpment.** [www.niagaraescarpment.org](http://www.niagaraescarpment.org) This is the main citizens group active in protecting the escarpment. Get to know its campaigns and concerns about some of the threats to the escarpment.

### **UNESCO – World Biosphere Reserves.**

[www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves/](http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves/) One of the main activities of UNESCO is promoting and coordinating scientific activities at the world level. For instance, the UN has provided the lead in conducting research on climate warming and issuing the most important reports to guide the formulation of vital cooperative agreements such as the Kyoto Accord on climate change. The World Biosphere Reserve program is also one of its initiatives. The website includes the Biosphere Reserve Directory interactive map that lets you visit all the biosphere reserves in the world. Check out the Ontario reserves as well as the more exotic ones world-wide. Also, check out this document produced by UNESCO which includes the history behind the development of the Smithsonian Institute forest biodiversity monitoring protocol: [www.unesdoc.unesco.org/images/0009/000938/093876eo.pdf](http://www.unesdoc.unesco.org/images/0009/000938/093876eo.pdf)

**Canadian Biosphere Reserves Association.** <http://biospherecanada.ca/> Visit the other superb natural areas in Canada that have been designated as world biosphere reserves.

**Citizens Environment Watch (rebranded to “EcoSpark”).** <http://www.ecospark.ca/> NGOs and activist groups of all description are now using monitoring as a tool in a wide variety of ways. Here’s a good place to see what is happening out there.

**Monitoring the Moraine** [www.monitoringthemoraine.ca](http://www.monitoringthemoraine.ca) This site discusses the monitoring plans now being organized by the very effective citizens group STORM (Save the Oak Ridges Moraine) in collaboration with EcoSpark, as part of its activities to make sure that the recent agreements to protect the moraine are adhered to.

### **Natural Capital**

And finally, a couple good reports on the concept of “natural capital” – all the good things provided by natural areas for the planet as well as human society. Philosophically, we do monitoring to help maintain natural capital, whatever the case. Ducks Unlimited, a long established conservation organization originally financed by very rich US duck and goose hunters has established or rehabilitated many prime wetland areas across North America, has produced a fine document “The Value of Natural Capital in Settled Areas of Canada” which can be found at <http://www.ducks.ca/aboutduc/news/archives/pdf/ncapsum.pdf>

The David Suzuki Foundation also produced an interesting document (2008) entitled, “Ontario’s wealth, Canada’s future – Appreciating the Value of the Greenbelt’s Eco-services”. The value of the Greenbelt’s non-market ecosystems services was estimated to be \$2.6 billion per year (approx. \$3500 per hectare). This is a conservative estimate due to an incomplete understanding of all benefits provided by nature, intrinsic values and the fact that nature itself is irreplaceable. The Greenbelt’s wetlands and forests hold the greatest value, with a combined value

of over \$2.3 billion. Overall, the highest total values of natural capital within the study area were found along the Niagara Escarpment in the Bruce Peninsula.

<http://www.davidsuzuki.org/publications/downloads/2008/DSF-Greenbelt-web.pdf>