

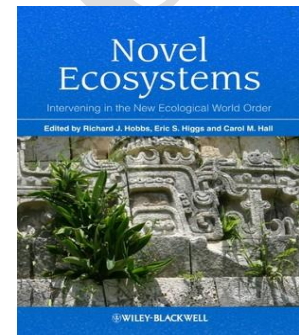
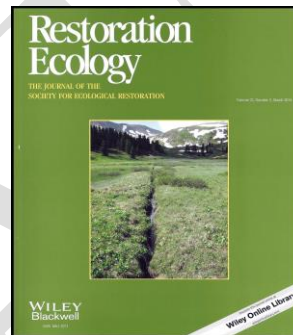


# ERS 211 Environmental Analysis and Solutions IV: *Restoration Ecology*

## 2016 Syllabus



The professor for the course is [Stephen D. Murphy](#)



Steve has a B.Sc. (Hons.), Ph.D. in Biology & is a Professor & the Department Chair.  
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Steve is also Editor-in-Chief of *Restoration Ecology*, Chair of the Centre for Applied Sciences in Ontario Protected Areas, Director of the University of Waterloo Centre for Ecosystem Resilience & Adaptation, Chair of the Western Ontario Stream Monitoring & Research Team. He is also short, voluble, has a family, and, apparently, does not sleep.

ERS 211 has only one required text (@ UW Bookstore or other sellers; used copies are OK). This is a field guide used in 4 other ERS/ENV courses and by professionals - Newcomb L; Morrison. G. 1977/1989. *Newcomb's wildflower guide*. Little Brown and Company.

All other readings will use sources available on-line at LEARN; no extra cost. You're welcome.

## This is the class, field skills, & assignment schedule

DATE/TOPIC – TUES & THURS 1430-1600 (PAS 2083 OR OUTSIDE - YAY!)	CLASS OR FIELD ACTIVITIES & ASSIGNMENTS	LEARNING OUTCOMES
Se 8: Foundations & Applications of Ecological Restoration  <i>SER Primer</i>	We will discuss the changing nature of what restoration ecology is	Understand the scope & practicalities of restoration ecology
Se 13/15 + Se 20/Se 22: Field skills in Applied Ecological Restoration I Group A: Sept 13 + Se 20 Group B: Sept 15 + Se 22	This is a field activity. <i>You only attend one of the two classes each week.</i> We do Site Assessments & Implement Ecological Restoration	For most, this is advancing your ability to use proper field methods & analyses to interpret field data; some may have more experience
Se 27: Measuring Biodiversity in Restoration Ecology  <i>Booth et al 2010</i>	We discuss why biodiversity is considered important in restoration ecology & how we measure it	Critically assess whether biodiversity is as important as claimed & if we measure it right
<i>Se 29 - No formal class today; you can use this time to finish polishing your assignment; TAs can be contacted for help beforehand</i>	<b>On or before 2359 h on <u>Se 30</u>, you submit a draft introduction contextualizing an assigned applied ecological restoration study; worth 5% of final grade</b>	<i>The assignment is designed to get you skilled up on how to write a professional style consulting report or academic paper</i>
Oc 4: Data analysis for professional practice in restoration ecology I	We discuss how to do parametric & non parametric analyses of data in restoration ecology projects	Regardless of your prior knowledge, everyone will have a better idea of applied statistics after this class
Oc 6: Data analysis for professional practice in restoration ecology II	We use an Excel file analyzing biodiversity & restoration outcomes; we use that to help learn data analysis	I show you how to do analyses; very important for your Assignment
Oc 13: Data analysis for professional practice in Restoration Ecology III <i>(NB: Oct 11 had no class)</i>	We use an Excel file analyzing biodiversity & restoration outcomes; we use that to help learn data analysis	I show you how to do analyses; very important for your Assignment
Oc 18: Ecological indicators in restoration ecology  <i>D'Amico et al 2004</i>	Explores the use and misuse of ecological indicators in restoration	Understand how indicators are chosen & how to use them in measuring effective restoration

<p><i>Oc 20 – No formal class today; you can use this time to finish polishing your assignment; TAs can be contacted for help beforehand</i></p>	<p><b>On or before 2359 h Oc 21, you submit Assignment 2 demonstrating how you use Excel to analyze biodiversity &amp; restoration outcomes; this is what we did in earlier classes. Worth 5% of final grade.</b></p>	<p><i>The assignment using Excel is intended to get those who are phobic or self-doubting to see that it's not hard to do analyses once you practice more; for the pros, this will be a really easy exercise</i></p>
<p>Oc 25: Measuring outcomes of ecological restoration</p> <p><i>Allison 2002 Anand &amp; Desrochers 2004</i></p>	<p>We would like to know when restoration succeeds or fails</p>	<p>Synthesize previous weeks' lessons and experiences in terms of fundamental outcome measures</p>
<p>Oc 27: Professional practice, planning &amp; project management in restoration ecology I</p> <p><i>Quon et al. 2001 Pellant et al 2004 Murphy 2011</i></p>	<p>How Planning &amp; Environment + Resource Studies are interlinked via professions like restoration ecology</p>	<p>Understand the challenges and opportunities presented by cross-disciplinary linkages between professions like planning &amp; ecological restoration</p>
<p>No 1: Professional practice, planning &amp; project management in restoration ecology II</p>	<p>While we discussed project management earlier, we now move to focus on implementation</p>	<p>Building on previous weeks' lessons, understand the practicalities of actually getting restoration to work</p>
<p>No 3: A second look at diversity (biodiversity, spatial diversity, heterogeneity, food webs)</p>	<p>Now that we've had some more experience, let's look at how we apply diversity in restoration</p>	<p>Learn how to apply diversity of biota (food webs) and space (topography) in restoration</p>
<p>No 8: Restoration ecology at population scales</p> <p><i>Larkin et al 2004</i></p>	<p>Provides examples of how population scale restoration works</p>	<p>Use population theories in problem solving for restoration ecology</p>
<p>Nov 10: Restoration ecology at community scales</p>	<p>Provides examples of how community scale restoration works</p>	<p>Use community theories in problem solving for restoration ecology</p>
<p>Nov 15: Restoration ecology at landscape scales</p> <p><i>Jacquemyn et al. 2003</i></p>	<p>Explores spatial processes in restoration</p>	<p>Use landscape ecology theories &amp; apply to restoration ecology</p>

<p>Nov 17: Assembly theory in restoration ecology</p> <p><i>Cramer et al 2008</i></p>	<p>Explores the complex and advanced concept of how assembly theory can help use advance successful restoration</p>	<p>Assembly theory is just on the cutting edge of new approaches to restoration ecology; best we keep current and looking ahead</p>
<p>No 22: Alternative stable states in restoration ecology</p> <p><i>Holmgren and Scheffer 2001</i> <i>Suding et al 2004</i></p>	<p>Building on assembly theory, how should we examine restoration ecology</p>	<p>Understand how alternative stable states changes our understanding of restoration ecology</p>
<p>No 24: No formal class today since Assignment 3 is due; Steve and TAs available in classroom for last minute help</p>	<p><b>On or before 2359 h No 25, submit consultant style report on analysis of an ecological restoration project; worth 30% of final grade</b></p>	<p>This is where you can build a great portfolio to show to employers - now or in the future</p>
<p>No 29: Novel Ecosystems as a controversial interface of natural sciences &amp; policy</p> <p><i>Hobbs et al 2014a; 2014b</i> <i>Murcia et al 2014</i> <i>Murphy 2013c</i></p>	<p>We'll discuss how controversies erupt, especially when long held ideas are challenged; this builds on assembly and alternative stable state theories</p>	<p>Novel ecosystems are ones not likely to be restored to a 'historical' condition; we seek to answer if this is defeatist or simply practical</p>
<p>Dec 1: The big picture of restoration &amp; conservation ecology - environment, sustainability &amp; resources</p> <p><i>Lindenmeyer et al 2009</i> <i>Ben Dor et al 2015</i> <i>Epstein et al 2015</i></p>	<p>We will also be doing an exam review; might be a good idea to come to class, eh?</p>	<p>We started with changes to the profession or restoration ecology &amp; end with where all that fits with the wider scope of environmental issues</p>

### **Experiential Learning: We Have Two Weeks of Field Skills Practicum: Se 13 + 15 and Se 20 + 22**

During these 2 weeks, you attend one of two outdoor classes. ½ the students will be outside with Steve and the TAs and ½ the students will get time to start working on the first assignment.

The assignments assume you will take advantage of the block of the 3 hours of time not spent in class lessons. Yes, I am that naïve. But if you don't do that, you will have to write them in some bar instead of having fun at night. Unless you're not of legal age. Then you have to write them in some bar instead of having fun at night. How much fun you have at night is up to you. No, don't go there. No one needs that image in their brains.

During the exercises, I go outside with you and we do some data collection on the type of plants found at areas undergoing ecological restoration and we do some actual seeding for the purpose of ecological restoration. This ensures you do some experiential learning during the late summer and early fall. I will be sectioning people off into two Groups - mostly splitting you alphabetically by surname - and sending this information out once the final class rosters for ERS 211 stabilize in 1<sup>st</sup> week.

We will all convene as a single group for all other course days.

### **The ERS 211 Course Philosophy - Yes, We Have One**

This is a transdisciplinary course that reflects the essence of ecological integrity and restoration ecology – but there still is a clear emphasis on natural/physical sciences, integration with social sciences & engineering, ecosystem function, and quantitative analysis. The philosophy of my idea of restoration ecology is consistent with a version of a quotation attributed to the Taoist philosopher *Zhuangzi*:

"You have this big tree and you are distressed because it is useless? Why don't you plant it in Not-Even-Anything Village, or in the field of Wide and Boundless, then relax and do nothing by its side, or lie down for a free and easy sleep under it? If there is no use for it, how can it come to grief or pain?"



*Before and After Ecological Restoration – Cape Breton NS (15 Years Apart & \$275,000 Investment)*

## Course learning objectives

By the end of this course, you will be able to:

- Acquire and improve field identification skills of organisms for the purposes of ecological monitoring (and assessment) in a restoration ecology context
- Acquire and improve experimental design and advanced data (quantitative/statistical) analysis skills related to measuring outcomes of ecological restoration; you will be at an intermediate level of skill and competence for experimental design and analysis using parametric and non-parametric statistics
- Perform basic implementation of ecological restoration in a long term project (i.e. an ongoing restoration project implemented and monitored by UW students every year)
- Apply explanatory theories to case studies in a range of examples at various spatial and temporal scales
- Critique & evaluate use of explanatory theories in their application in case studies
- Synthesize lessons from case studies in terms of general practice of restoration ecology and assessment of ecological integrity
- Using the comparative method, apply learning outcomes to your assignments, the final exam, and beyond
- Use all of the above skills in a consultant style report (professional communication) and in creative design for ecological restoration

### How TAs and I Grade You as Part of ERS 211

(See the 211 Assignment Folders in the Course LEARN Site for More Details)

- Assignment 1: Each student submits a 750-1000 word synthesis that services as a draft of the introduction (to what will be your final report for Assignment 3). We want to ensure you know how to write well and can find and synthesize comparative literature that allows you to begin with a relevant, broader theoretical framework and move to the narrower objectives of a project. It's worth 5% of the final grade.
- Assignment 2: Each student will simply input data from the excel file posted on LEARN (these will be used to support more formal reporting of results and a discussion in Assignment 3). You will simply be showing the TAs that you can follow instructions, not give into fear of the scary Excel files - I am being facetious - and summarize what the Excel based analysis is telling us about responses to ecological restoration. It's worth 5% of the final grade to incent you to do this without making the work stupidly valueless or over-valued. It is designed to help you build confidence and gain experience at doing analyses. We'll be going over this in class.
- Assignment 3: This is the big one. Each student will write a formal technical report in the format used by consultants. This ensures you have yet another skill set for your life experience and that looks good on a CV/resume. 30% of final grade. Start plotting out this assignment early and start it once Assignment 2 is submitted (you can make any corrections to calculations or formatting per the TA comments as you do a final draft of Assignment 3). Trust me. I've seen too many students in the last 20 years cause themselves grief because of poor time management and a failure to heed this advice. They go down in flames. And I drink their bitter tears. Mmmmm. Bitter tears.

- A final exam is based on our discussions (including all lecture and field days). 60% of final grade. Scheduled in December exam period by Registrar. Do not schedule an early vacation because the Registrar can schedule us for a late exam or there can be a snow day forcing a late reschedule. The exam will focus on point form explanatory style answers to questions largely posed as synthesis or problem solving exercises. Typically, I will have 6-8 questions but there will be some choice in selecting options within the questions given. *If you like to skip the last week on principle - that approach would be a very bad idea.* Despite the scary looking weighting given to the final exam, this is the type of weight and format that professionals have to master when becoming professionally certified. Your grade on the final exam is maximized if you go to class diligently, synthesize your own class notes + my slides each week - keep up with the course, discuss any gaps in your understanding with me + TAs + friends, review practice questions that I send out during term, and step back and give the whole course some deep thought. Basically, if you perform as scholars, you will do well.

### Course Process & Other Key Information

- You are expected to review assigned readings before and after each class. I selected peer-reviewed readings (see LEARN Lessons Folder & Class Schedule) for your use as background on the topics we will discuss in class and as sources for your assignments. You can also use these to help you find other relevant references. I follow the readings in class and base my lessons on them; whatever we emphasize in class will be emphasized on the final exam. I do not play Trivial Pursuit on exams.
- **Your assignments will be submitted on line via LEARN to reduce use of paper.** They are due @ 2359 h on the date indicated in the syllabus. They will be graded and commented on using the track changes feature of MS Word. 10 MB limit on file size. Call them surname\_firstname\_211AX where X = 1,2, or 3. Don't take this too literally; swap in your own name please.
- **Read, explore databases, & start work on assignments during the first week of classes – you can do a lot of the work on reports early; if you don't, you will be cursed (and will curse).** Late assignment penalties apply as follows and to all cases except for those few extensions granted for medical reasons or for professional counseling for serious personal problems – extensions can be granted with proper documentation or discussion well in advance. For those actually in their 2A term, take note: This can be a very challenging term. Often, you go through personal changes. I am sympathetic to turmoil but we need to communicate; if you identify a problem of any type, come and see me ASAP. All discussions confidential, we can usually work out a better path, and I have cookies. Yes, cookies. No, there's nothing like THAT in them. I know ERS has a reputation for being home to more potheads per capita than is usual, but I have to maintain some standards. That stuff always just gave me a headache - it made me cranky instead of blissful, dude.
  - Assignments 1 and 2 are either handed in on time or you get a grade of 0. They are short ones.
  - For assignment 3, if the assignment is up to 72 hours late, a flat 10% is deducted. No exceptions barring the reasons above. This is a relatively small penalty and it means that if you are 6 hours late you might as well take another few days anyway. If the assignment is >72 and < 144 hours late, a flat 20% is deducted. Assignments later than 144 hours past deadline receive a grade of 0.

The University of Waterloo has a series of specific *academic policies, procedures and guidelines* that students must be aware of and follow; all course syllabi in the Faculty of Environment are required to include the following information:

- **Students with Disabilities:** Help is available via the [Office for Persons with Disabilities](#)
- **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](#).
- **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 Undergraduate Associate Dean. When misconduct has been found to have occurred, disciplinary penalties will be imposed under [Policy 71 – Student Discipline](#) (this also has information on categories of offenses and types of penalties).
- **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](#).



### For those who have read this far: Who is this “Stephen David Murphy” anyway?

Diverting from music (I was once in love with my guitar; it didn't last due to religious differences), I earned a B.Sc. (Hons.) and a Ph.D. from Queen's University in Biology, specializing in plant ecology.

I completed a post-doctoral fellowship at the University of Guelph in agriculture. I've been at UW in Environment and Resource Studies since 1996, focusing on management, conservation, restoration and mitigation of invasive species in ecosystems. I am helping write 2 textbooks on restoration ecology. One of our best restoration ecologists, Richard Hobbs, has bestowed on me flattery - and I quote – when he said “You are a seriously deranged individual.”<sup>1</sup>



In terms of restoration ecology, I have been both practitioner (consulting) and an academic. Since I first volunteered as a 14 year old with one of the 1<sup>st</sup> formal landscape-scale ecological restoration projects in 1979 (yes, 1979; *STFU*), I helped or led on over a thousand ecological restoration projects world-wide. This means a lot of field work and a lot of teamwork because I sure as hell didn't do a thousand plus projects all by my little 5'6" self.

I am a past-chair of the Board of the [Ontario Chapter](#) of the governing academic and practitioner organization, the [Society for Ecological Restoration International](#) (if you want opportunities beyond this course, SER Ontario recruits students for networking and educational purposes at a nicely reduced membership fee rate). I am the editor-in-chief of [Restoration Ecology](#), on the Board of the [Restoration Institute](#), and was co-chair the [2013 25th Anniversary Conference of SER International at Madison WI](#). I am part of the [Centre for Ecosystem Resilience and Adaptation](#) (as Director) and the [Summit Centre for the Environment @ Huntsville Ontario](#) (a founder) where ecological restoration is be front and centre though by no means the only domain studied. I am also Chair of the [Centre for Applied Sciences in Ontario Protected Areas](#). Don't read this line because it is cursed by a one-eyed wizard named 'Poindexter'. *Just checking to see if you were reading this or not.* I was part of the advisory council to Parks Canada that revised the strategic planning and standard for ecological restoration. I also am on some teams at “[rare](#)” in Cambridge ON, a Reserve that represents one of the largest contiguous ecological restoration and conservation projects in an urban area. I sit on the Boards or advise another two dozen or so organizations that are involved in restoration from municipal to international scales. Essentially, I began to practice “restoration ecology” before it was really codified but I am only part of the 3<sup>rd</sup> or perhaps 4<sup>th</sup> “generation” of restoration ecologists who followed people like Aldo Leopold, Theodore (Ted) Sperry, John Curtis, Tony Bradshaw, Bill Jordan III, George Gann, Keith Winterhalder, John Reiger, Jack Ewel, Keith Bowers, Richard Hobbs, Eric Higgs, and Bob Dorney, among many others. I won't burden you with too many details on the history in the syllabus or in lessons; see [www.ser.org](http://www.ser.org) for more on the history of Restoration Ecology if you want some ideas of where this field originated.

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<sup>1</sup> Yes he meant this in jest but you will find out why he said this soon enough – Bwa ha ha ha ha!! He also called me evil when we were in New Orleans at a conference in 2014. And he turned me into a newt! I got better...