ERS 335
Restoration Ecology

2021 Syllabus
IN PERSON

The professor for the course is Stephen D. Murphy

Steve has a B.Sc. (Hons.), Ph.D. in Biology.
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Office hours: For this year, I recommend appointments given the legacy of COVID-19 disruptions.

Steve is also Editor-in-Chief of Restoration Ecology, Chair of the Centre for Applied Sciences in Ontario Protected Areas, and Board Member of the Ontario Invasive Species Centre. He is also short, voluble, has a family, and, apparently, does not sleep.

UW kept changing its mind at the last minute about supervised outdoor exercises (and I do mean last minute); as such, the required text is:

Allison SK and Murphy SD Routledge Handbook of Ecological and Environmental Restoration. https://www.routledge.com/Routledge-Handbook-of-Ecological-and-Environmental-Restoration-1st-Edition/Allison-Murphy/p/book/9781138922129. I recommend purchasing or renting an e-version; the 6-month rental is cheapest (~$35.00 CDN). We will use almost every chapters in the 600+ page book.[1]

All other readings will use sources available on-line via LEARN; there is no extra cost.

[1] Yes, the 2nd author is me. No, I will not get rich by having you buy or rent a copy; I get about 50 cents per hardcopy sold and much less for e-rentals; we sold/rented a LOT of copies and, so far, I've made about 80 cents an hour on this. Stu Allison and I edited the book because we wanted a modern book that people could use to teach restoration ecology; we did not do it to make any real income.

ERS 335 Schedule (Sept 8 – Dec 7 Classes; Term Ends Dec 23)

Several Study or Health Breaks (Including UW Fall Study Week) are Scheduled.

LESSON DATE/TOPIC/READINGS (IN PERSON = AL 113)	ACTIVITIES & FOCI	LEARNING OUTCOMES
Se 8 Foundations & Applications of Ecological Restoration I *Murphy and Allison 2017; Choi 2017; Higgs and Jackson 2017; Cabin 2017; Allison 2017*	We will discuss the changing nature of the broad conceptual, theoretical and methodological frameworks of restoration ecology	Understand the scope & practicalities of restoration ecology and its frameworks (and what the heck a framework is…)
Se 10 Foundations & Applications of Ecological Restoration II *Murphy and Allison 2017; Choi 2017; Higgs and Jackson 2017; Cabin 2017; Allison 2017*	We will discuss the changing nature of the broad conceptual, theoretical, and methodological frameworks of restoration ecology	Understand the scope & practicalities of restoration ecology and its frameworks (and what the heck a framework is…)
Se 13 Research communication in restoration ecology	We'll discuss how to communicate ideas effectively	This is meant to show you how professional and job communication can be done well; no, I am not perfect at it, either – let's learn together
Se 15 – outside; free-range	Contemplate opportunities for restoration I	Don't come to class; go outside and observe opportunities for restoration for Assignment 1
Se 17 Data comes from good experimental design in restoration ecology	We discuss controlled and mensurative experimental designs in restoration ecology	Learn to design experiments in restoration ecology
Se 20 – outside; free-range	Contemplate opportunities for restoration II	Don't come to class; go outside and observe opportunities for restoration for Assignment 1
Se 22 Principles of data analysis in restoration ecology *Murphy 2018 (primer on stats)*	We examine parametric, non-parametric, and multivariate analyses in restoration ecology	Learn the principles of analyses in restoration ecology

Se 24 Practicum in data analysis in restoration ecology *See dataset provided in LEARN folder for this class.* *Murphy & Brook (2019)*	We do a class exercise where we use the open-source program r to analyze a real dataset from a restoration ecology project	Learn how to do analyses using software; prepares you for Assignment 2
Se 27 Synthesizing data and measuring outcomes of ecological restoration *Wortley et al 2013*	Provides theoretical foundations of how data supports decisions in restoration ecology	Learn the fundamental options of measuring outcomes in restoration ecology
Se 29 Restoration ecology at population scales *Murphy et al 2017* *McKay et al 2005*	Provides theory behind how population scale restoration works	Use population theories in problem solving for restoration ecology
Oc 1 No Class - Assignment 1 Reflecting on Restoration Opportunities is due at 2000 h		
Oc 4 Restoration ecology at community scales I *Palmer et al 1997*	Provides theory behind how community scale restoration works	Community scales are perhaps the major focus in restoration ecology, so this shows how we use theory to problem solve
Oc 6 Restoration ecology at community scales II *Harris 2009;* *Kardol & Wardle 2010*	Provides theory behind how community scale restoration works	Community scales are perhaps the major focus in restoration ecology, so this shows how we use theory to problem solve
Oc 8 Restoration ecology at landscape scales I *Bell et al 1997*	Explores examples of spatial processes (landscape ecology) in restoration	Use landscape ecology theories & apply to restoration ecology
Oc 11-15 Fall Term Study Week (No Classes)		
Oc 18 Restoration ecology at landscape scales II *Perring 2017*	Explores examples of spatial processes (landscape ecology) in restoration	Use landscape ecology theories & apply to restoration ecology
Oc 20 Governance, law, policy, and restoration ecology *Cliquet 2017; Mansourian 2017*	Natural & physical sciences are important but social science issues may be even more critical to restoration ecology	Examine the legal, governance and government (policy) drivers for and against restoration ecology

Oc 22 Social capacity and ecological Restoration I *Metcalf et al 2017; Packard 2017; Baker 2017; Heneghan & Heneghan; Edwards et al 2017*	Building social consensus and social capacity was once overlooked in restoration ecology; this addresses that form gap	Allows us to understand how social processes can help or hinder restoration ecology solutions as this is a big part of being a professional
Oc 25 Social capacity and ecological restoration II *Metcalf et al 2017; Packard 2017; Baker 2017; Heneghan and Heneghan; Edwards et al 2017*	Building social consensus and social capacity was once overlooked in restoration ecology; this addresses that form gap	Allows us to understand how social processes can help or hinder restoration ecology solutions as this is a big part of being a professional
Oc 27 Ecological restoration and economics I *Bowers & Norris 2017 Baumber 2017*	The business and broader economics of restoration ecology are a driver to the green economy	Gain a high level but still practical understanding of green economy and restoration ecology
Oc 29 No Class – Rest or Take Time to Push Forward on Assignment 2 (Due No 1)		
No 1 No Class – Assignment 2 Analysis of Ecological Restoration Data is due at 2000 h		
No 3 Ecological restoration and economics II *Blignaut 2017; Williams 2017*	Delving more deeply into the restoration economy's theory and practice	Be able to use case studies for comparative understanding and analysis of restoration economy projects
No 5 Restoration Ecology in Tropical Ecosystems I *Byers 2017; Brown 2017; Segura 2017; Overbeck and Muller 2017; Lamb 2017*	Shows how people approach restoration ecology in different types of tropical ecosystems	We'll understand if there anything unique about restoration in the tropics
No 8 Restoration Ecology in Tropical Ecosystems II *Byers 2017; Brown 2017; Segura 2017; Overbeck and Muller 2017; Lamb 2017*	Shows how people approach restoration ecology in different types of tropical ecosystems	We'll still understand if there anything unique about restoration in the tropics
No 10 Restoration Ecology in Temperate Ecosystems I *Kulluvainen 2017; Stanturf 2017 Prach et al 2017; Hanberry et al 2017*	The temperate zones include much of Canada, so we need to understand how restoration is done here – and in places like Canada	We'll understand if there anything unique about restoration in the temperate zones

No 12 Restoration Ecology in Temperate Ecosystems II *Kulluvainen 2017; Stanturf 2017 Prach et al 2017; Hanberry et al 2017*	The temperate zones include much of Canada, so we need to understand how restoration is done here – and in places like Canada	We'll understand if there anything unique about restoration in the temperate zones – yes, again
No 15 Restoration Ecology in Desert/Dryland Ecosystems I *Abella 2017; Mucina 2017*	Deserts and drylands tend to get neglected in some cases and over-pampered in others; we will explore what happens	We will understand when we should or should not try and restore these ecosystems (and if so, how)
No 17 Restoration Ecology in Desert/Dryland Ecosystems II *Abella 2017; Mucina 2017*	Deserts and drylands tend to get neglected in some cases and over-pampered in others; we will explore what happens	We will understand when we should or should not try and restore these ecosystems (and if so, how)
No 19 – No Class; I want you all to take a health break today		
No 22 Restoration Ecology in Freshwater Ecosystems I *Smith and Chadwick 2017; Jeppesen et al. 2017; Keddy 2017*	Freshwater ecosystems are the 'canary in the coal mine'; we'll explore options for ecological restoration	We will understand how freshwater ecosystems are affected by disturbance and how we can restore them
No 24 Restoration Ecology in Freshwater Ecosystems II *Smith and Chadwick 2017; Jeppesen et al. 2017; Keddy 2017*	Freshwater ecosystems are the 'canary in the coal mine'; we'll explore options for ecological restoration	We will understand how freshwater ecosystems are affected by disturbance and how we can restore them
No 26 Restoration Ecology in Marine Ecosystems *Burdick and Adamowicz 2017; Coen and Humphries 2017; Hancock et al 2017*	Marine ecosystems are perhaps a big mystery to most because they are hard to access; we'll mainly explore inshore and near shore types of ecosystems	Learn how we can restore such iconic ecosystems as coral reefs and estuaries
No 29 The Big Picture of Restoration Ecology *Trevenen et al 2017; Chazdon and Rey Benayas 2017; Murphy 2018*	The regime changes caused by anthropogenic climate change and the tools needed to address these Earth scale issues will be explored	We will learn the scope of the problem in detail and how we can cope with such widespread and rapid degradation – how do we effect restoration in a hostile social/environment?

De 1 The Future of Restoration Ecology I – Novel Ecosystems on a Changing Planet *Hobbs et al 2009; 2014a; 2014b; Murcia et al 2014; Murphy 2013b; 2013c*	We'll discuss how controversies erupt, especially when long held ideas are challenged	Novel ecosystems are ones not likely to be restored to a 'historical' condition; we seek to answer if this is defeatist or simply practical
De 3 The Future of Restoration Ecology II – The UN Decade on Ecosystem Restoration *McDonald et al 2016; Higgs et al 2018a,b; Gann et al 2018; Gann et al. 2019* https://www.decadeonrestoration.org/	What standards and practices are relevant for ecosystem restoration in a changing climate and a toxic political environment?	How can we make the UN Decade on Ecosystem Restoration effective?
Dec 6 – No class (Take this day/time to rest or work on other courses)		
Ecological Restoration Case due December 20 at 2000 h **This ensures you can synthesize course materials in a real-world project**		

How I Grade You in ERS 335

1. **Reflect on opportunities for ecological restoration.** During your solo travels outside on Sept 15 and 20 (no formal classes those days), I want you to think about – and I suggest record or write down – what you consider to be some local opportunities for ecological restoration – a piece of land, an idea, a concept, a skill – anything that interests you. You can then produce any form of reflection – a written assignment, clever prose, a set of memes, a video, art; it can be anything helps you communicate – with a serious intent – what it takes to be a restoration ecologist. I'd say you should not spend more than a half-day total on this. For example, a 1-minute well-done video would be good, or a 500-word written piece is good. Create something that follows the idea of 'economy in storytelling' – keep it pithy, interesting, and informative. Weight is 25% of final grade. **Due Date is October 1 at 2000 h[2] via LEARN.**

2. **Analysis of Ecological Restoration Data.** Analyze data on an ecological restoration study using open-source software and submit the Results in a coherent format (I provide the templates for you; there is no word limit because that is not really relevant when the assignment is all calculations and presentations of the outcomes in tables). Details are in a folder on LEARN. Weight is 30% of final grade. **Due Date is November 1 at 2000 h. via LEARN.**

3. **Ecological Restoration Case Analysis.** This is a final exercise **completed during the exam period**. It draws mainly on what I emphasized in the class lessons – this is why going to class is useful. It is specifically geared to mimic the type of professional certification steps that you would take to become a qualified restoration ecologist. It will have specific descriptions and expectations. There will not be any quantitative data analysis – that should not be done under pressure, and you already did that in Assignment 2 (above). It will ask you to consider a real-world opportunity for ecological restoration and then outline a specific set of items that you must consider and write up to design an ecological restoration project using the principles and processes we covered in the entire course. It will not ask you to cover every last item in the course; that would be unfair. It will be of reasonable length (less than 5000 words) befitting the time allocated relative to other December commitments you may have and germane to the **allocated weight of 45% of the final grade**. **It is due December 20 at 2000 h via LEARN.**

Your assignments will be submitted online via LEARN. They are due on the date and time indicated in this syllabus. They are due on the date and time indicated in this syllabus. Call them surname_firstname_335A1 (or A2 or A3). Don't take this too literally; swap in your own name please.

There are no penalties for submitting after the due date; there is a bonus for submitting by the due date. You get an extra 5% if you submit before or on the due date.

[2] To reinforce the obvious: 2000 h means 800 PM. At night.

Resources for You – University Policies, Your Rights, Mental Health Help, AccessAbility

Each course must refer you to this webpage with many resources (policies, mental health help and so forth): https://uwaterloo.ca/environment/undergraduate-teaching-resources. Beyond that, make all efforts to communicate with me if there are acute or chronic struggles that affect your class attendance or course performance – I know it is tough to admit you need help or to trust anyone. The earlier we address issues and find a success path, the better; I am willing to assist and alter the standard path.

For those who have read this far: Who is this "Stephen D. 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 SERS since 1996, focusing on management, conservation, restoration and mitigation of invasive species in ecosystems.

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 1st 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 and the local UW Chapter of SER recruits students for networking and educational purposes at a nicely reduced membership fee rate). I am the editor-in-chief of Restoration Ecology, and was co-chair of the 2013 25th Anniversary Conference of SER International at Madison WI. 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 3rd or perhaps 4th "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 for more on the history of Restoration Ecology.