

**University of Toronto, School of the Environment**  
**ENV 1001: Environmental Decision-Making: Interdisciplinary Perspectives**  
Winter 2022 – Prof Steve Easterbrook,  
Wednesday 12-3pm (Eastern time zone), online

**Contact information:**

**Instructor:** Professor Steve Easterbrook, <sme@cs.toronto.edu>

**Steve's Office hours:** online Mondays 3-4pm Eastern or by appointment.

**TA:** Ellyse Winter <ellyse.winter@mail.utoronto.ca>

**Course location – online:** The course will make use of a series of online tools. Our core course site will be the online learning platform *Quercus*; we may also make use of Blackboard Collaborate, Zoom, MS Teams, Sharepoint documents, Slack, and other tools as needed. Zoom links and Readings will be available online through Quercus.

**Course overview**

***Description:*** ENV1001 is the core course for the graduate Collaborative Specialization in Environmental Studies at the School of the Environment. This course is on “environmental decision-making,” which we understand broadly as the challenging process of how humans engage with the natural world, and the many iterative (and sometimes invisible) decisions we make about how to organize human societies and activities. While decision-making is itself a field of study, this course takes a more flexible interpretation of the term, involving choices about, and affecting, the environment.

Drawing on insights from across a range of disciplines—throughout the humanities, social sciences, and natural and applied sciences—and with attention to fields beyond academia, we consider multiple perspectives on the environment. Through bi-weekly guest lectures, student presentations, group projects, and individual written assignments, we explore worldviews and values (what assumptions we make about the world that shape the kinds of decisions we can make), conflicting interests and information (at multiple scales), and decision-making models and tools (a survey of the range of tools that are available), along with questions of uncertainty, adaptation, and iterative decision-making processes.

In a time of online learning provoked by the global pandemic, we will also turn analytic attention to the benefits and challenges associated with virtual technologies for interdisciplinary collaboration, research, and decision-making. As travel becomes constrained not only by the pandemic, but also as a response to climate change and environmental degradation, we anticipate the need for these tools will increase in the future. In the class, we will consider how online platforms may be useful in enabling ongoing research efforts at a distance, and how different strategies and tools may be designed for better communication and action.

Students should emerge from the course with a broader perspective on environmental and social challenges, enhanced communication skills across disciplines, and additional experience working in diverse teams. In addition, students should also leave the course more confident about the options for inter-disciplinary collaboration online. Our central goal in the course and the Collaborative Specialization program is to enable conversations to take place within and beyond the classroom about the challenges of human-environment relationships, with new ideas on creative and just approaches to social and political decisions.

**Structure:** Weekly 3-hour online classes. The course is aligned with the School of the Environment's Environment Seminar Series, so six of the twelve weeks of class will have an invited guest lecturer. These seminars will be open to the public. Any changes to the schedule will be announced in our synchronous online class sessions and posted on Quercus (UofT's online course platform). Please note that this is a seminar course, rather than a lecture course; active engagement in online sessions is expected (and crucial to the value of the course!) Please also note that there is quite a bit of reading and other work outside our two-hour weekly classes—full engagement and preparation will make our class sessions better.

**Assignments (details available on Quercus)**

- Weekly participation: 20% (continuous)
  - attendance, active listening & engagement each week
  - weekly participation in online discussion board chats & activities
- One-time guest seminar speaker facilitation: 20% (varying deadlines)
  - Pre-seminar posting of reflection paper and discussion questions
  - In class mid-seminar coordination of break-out room discussions
  - In class, post-seminar facilitation of small group discussion
- Individual “3-minute thesis” presentation: 15% (due week 5)
  - to be recorded and posted online
- Individual written assignment: 20% (due week 7)
- Group-based project: 25% (due week 12)

In case of unexpected challenges (guest speaker cancellations, student illness, other emergencies, etc.), grading policies may be changed as follows:

- Deadlines may be moved (as a class or individually; extensions are possible)
- Guest speaker facilitation may be altered to involve shorter/longer student-facilitated discussions, including without a seminar speaker (with discussions to be based on assigned readings and possible supplementary video material)
- Individual students facing challenges may be exempted from group projects, with alternate assignment options and/or grades redistributed to other assignments.

**Class topics and readings: order of classes may change; advance notice will be given**

**Week 1:** Jan 12: Introduction

**Week 2:** Jan 19: *Guest: Dr Jennifer Wemigwans, professor of Indigenous Knowledge Education.*

**Week 3:** Jan 26: Environmental decision-making in times of crisis

**Week 4:** Feb 2: *Guest: Dr Eduardo Souza-Rodrigues, professor of environmental economics*

**Week 5:** Feb 9: Systems thinking

**Week 6:** Feb 16: *Guest: Dr Susan Jay Hassol, Climate Communicator*

**Winter Term Reading week:** Feb 23 - No class;

**Week 7:** Mar 2: Decision-making tools,

**Week 8:** Mar 9: *Guest: Patrick Moldowan: Ecologist and Conservationist*

**Week 9:** Mar 16: Environmental Values

**Week 10:** Mar 23: *Guest: Dr Jessica Hernandez, professor of Indigenous Science*

**Week 11:** Mar 30: Uncertainty and Adaptation

**Week 12:** April 6: *Guest: Dr Soren Brothers, Climate Change Curator at the ROM*

## **Policies and Expectations**

***In general:*** In this course, you can expect that I will strive to be fair, respectful, prepared, responsive, and enthusiastic. In return, I anticipate you will be respectful of your classmates and of me, be prepared, and be flexible. We are all learning new skills, practices, and norms with online learning arrangements, and doing so amidst a series of personal, community, and global challenges. I hope that together we can foster a safe and engaging online space, and I will rely on all of you to help create that environment.

***Online course site:*** We will have a course website (Quercus) for readings, course announcements, course materials, and discussions. We will also use tools including Blackboard Collaborate, Zoom, Slack, MS Teams, and more. Please check in frequently with the Quercus site. Please also be patient with this site, and all our online tools, as we will encounter glitches and challenges. If/when communication on the site goes awry, please feel free to use email for assignments, questions, etc.

***Deadlines and late penalties:*** I anticipate all assignments will be submitted on time. However, some of you may find yourselves with valid conflicts and challenges, especially in light of your diverse programs and courses of study, and the exceptional challenges of this particular time (illness, caregiving duties, housing and financial insecurity, technological connectivity challenges, etc.). Please contact me as early as possible if you anticipate being unable to meet deadlines. Please also contact your group members if you run into challenges during the group project. As this is a seminar class, attendance is the bedrock of the course, enabling us to build a strong community and develop enriching conversations across weeks—still, we'll need to be flexible and understanding when conflicts and problems arise. If you know in advance you need to miss class, it helps me tremendously to be aware of these absences.

***Backups and rough drafts:*** You are strongly advised to keep rough drafts and backup copies of all assignments and essays you submit. Please take a minute at the start of the term to set yourself a backup strategy. Whether it's a backup external hard drive, a web-based cloud service like Dropbox or Google Drive, or some other option, it's important you have multiple copies of your work in the case of a hard drive failure or computer problem (this is important not only for this course, but also (especially!) for your research and thesis/dissertation projects). In a time where, working from home, you may not have access to a printer or multiple computer stations (as at the UofT library), this may be even more important.

***Names:*** If your name on the official course registration list does not, for any reason, match the name by which you would like to be addressed (and under which you would like to submit assignments and sign emails and be addressed in class) please let me know. I am not able to change official course lists, but I can certainly call you by your preferred name. Also, please let me know the pronouns you use (mine are he/him). I encourage you always to begin your interactions in academic settings with more senior scholars using formal forms of address—especially “Dr.” or “Professor” titles for profs/instructors. That said, as graduate student colleagues, I am happy to have formal or informal exchanges with you: you are welcome to call me Dr./Prof. Easterbrook, Prof. Steve, or Steve, whichever makes you most comfortable. (If you use a title for me, though, please choose “Dr.” or “Prof.”, not “Mr.”)

**Exceptions and Assistance:** The University has many resources to help students who need assistance for any number of reasons, both in and outside of the classroom, including library, academic, and health and counseling resources. That said, I know these may be difficult to access from a distance and may be overburdened during this unusual year. Let's aim to work together as a class to help each other find academic support in the midst of challenges. The University remains committed to providing allowances for religious observances, as do I. A few helpful resources:

- <https://www.sgs.utoronto.ca/gradlife/Pages/Grad-Wellness.aspx>
- <https://www.sgs.utoronto.ca/currentstudents/Pages/Writing-Centre.aspx>
- <http://uoft.me/religiousaccommodation>
- <http://familycare.utoronto.ca/resources/>

If you are struggling or you encounter unanticipated challenges or crises during the term (whether for academic and/or personal reasons), please seek the support you need as early as possible, as best you can. Some students find themselves facing challenges unexpectedly. If you find yourself in a difficult situation, even if you have not yet gone through all the official channels, it is best to let me know right away that you are seeking university assistance and may need accommodations (you do not need to disclose the details of your situation to me). If you will need accommodation from me for any reason, in the classroom or on coursework and assignments, please let me know as soon as you can.

**Academic integrity:** The seriousness of academic integrity really cannot be stressed enough, and is perhaps even more important in these virtual times and spaces. Academic integrity remains **essential** to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very seriously, seeing these as serious academic offenses. As graduate students, your academic integrity will be the foundation of your scholarly and practitioner careers.

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters, through the School of Graduate Studies. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, you are expected to seek out additional information from your instructor or other institutional resources. As some norms differ across disciplines and universities, please take a moment to familiarize yourself with UofT policies.

- <https://www.sgs.utoronto.ca/facultyandstaff/Pages/Academic-Integrity.aspx>
- <http://www.governingcouncil.utoronto.ca/policies/behaveac.htm>
- [www.artsci.utoronto.ca/osai/students](http://www.artsci.utoronto.ca/osai/students)

Potential offences include, but are not limited to:

- Using someone else's ideas or words without appropriate acknowledgement
- Using someone else's words without using quotation marks
- Submitting your own work in more than one course without instructor permission
- Making up sources or facts
- Obtaining or providing unauthorized assistance on any assignment.
- Looking at someone else's answers during an exam or test
- Falsifying institutional documents or grades
- Falsifying or altering any documentaMartion required by the University

**Course details by week, in brief:****Week 1: Jan 12: introduction**

In this first week of class, held on Zoom, we will introduce the goals for this course on environmental decision-making and set out our expectations and practices for the online semester. We find out a bit about each other and the perspectives from which we are each coming to the course, as well as various motivations for enrolling in the collaborative program in environmental studies.

Substantively, we discuss environmental studies, decision-making, and how a range of perspectives might inform different ways of approaching challenging environmental issues. Our readings discuss the broad topic of environmental decision-making (raising questions of scientific uncertainty and measurement, time horizons and contingencies, and values and equity), and different approaches to understanding the environment and land.

**Readings: environmental decision-making and approaches**

- Lein, James. 1997. "The nature of environmental decision making," pp. 11-39 in *Environmental Decision Making: An Information Technology Approach*. Malden, Mass.: Blackwell Science.
- Simpson, Leanne Betasamosake. 2014. Land as pedagogy: Nishnaabeg intelligence and rebellious transformation. *Decolonization: Indigeneity, Education & Society*, 3(3): 1-25.
- Cunsolo, Ashlee, Harper, Sherilee L., Minor, Kelton, Hayes, Katie, Williams, Kimberly G., and Howard, Courtney. 2020. Ecological grief and anxiety: the start of a healthy response to climate change? *The Lancet*, 4: e261-e263.

**Week 2: Jan 19: Guest Speaker**

**Dr Jennifer Wemigwans, professor of Indigenous Knowledge Education, OISE, U of T.**

In guest speaker weeks, we'll convene on Zoom for a public seminar. These sessions will involve a lecture, a ten-minute audience break-out room discussion session (in which student seminar facilitators will help to moderate short discussions), and an instructor-moderated question-and-answer session. Following the public seminar, we'll have a short break, and then our ENV1001 class will reconvene. This post-talk class will involve student-facilitated small-group discussions.

**Indigenous Knowledge and the Mainstream Environmental Movement**

Historically Indigenous Knowledge was not recognized or acknowledged by colonial settlers who were intent on maintaining their racial and epistemological superiority for the purposes of occupying and taking Indigenous land. Now consultation with Indigenous communities is considered the salve to every existing Canadian institution post TRC. This talk centers Indigenous Knowledge and practices in the Environmental Movement and questions the practice of consultation as a way of re-inscribing settler colonial epistemologies.

**Jennifer Wemigwans**, PhD is from Wiikwemkoong Unceded Territory on Manitoulin Island, Canada. She is a new media producer, writer and scholar specializing in the convergence between education, Indigenous knowledge and new media technologies. Her book *A Digital*

Bundle: Protecting and Promoting Indigenous Knowledge Online (2018) explores the prospects of education and digital projects in a networked world. Dr. Wemigwans takes pride in working to invert the conventional use of media by revealing the potential for Indigenous cultural expression and Indigenous knowledge through new technologies, education and the arts.

Readings: Indigenous Knowledge Education

- Tuhiwai Smith, Linda, 2021. Decolonizing Methodologies, Chapter 1. Zed Books.
- Wemigwans, Jennifer, 2018. A Digital Bundle: Protecting and Promoting Indigenous Knowledge Online. Chapter 1. University of Regina Press.
- Browse some of the teachings on <http://www.fourdirectionsteachings.com>

**Week 3: Jan 26: Environmental decision-making in times of crisis**

This week, we tackle the big questions of environmental change, and consider how contemporary events and crises (pandemics, climate change, racism, and other social and environmental challenges) influence decision-making processes. In our discussions, we will explicitly consider the ways in which constraints on movement shape environmental research and collaboration, especially in interdisciplinary endeavours.

Readings: Environmental crises and interdisciplinary research

- Deranger, E. 2019, The Green New Deal in Canada: Challenges for Indigenous Participation. Yellowhead Institute Policy Brief, July 15, 2019.
- IPBES 2020, Workshop Report on Biodiversity and Pandemics of the Intergovernmental Platform on Biodiversity and Ecosystem Services, 27-32 July 2020.
- Record, S., P.F.B. Ferguson, E. Benveniste, R.A. Graves, V.W. Pfeiffer, M. Romolini, C.E. Yorke, and B. Beardmore. 2016. Graduate students navigating social-ecological research: insights from the Long-Term Ecological Research Network. *Ecology and Society* 21(1):7. <http://dx.doi.org/10.5751/ES-08111-210107>

**Week 4: Feb 2: Guest Speaker**

**Dr Eduardo Souza-Rodrigues, Professor of Economics, University of Toronto**

**Optimal Environmental Targeting in the Amazon Rainforest**

This talk sets out a data-driven approach for targeting environmental policies optimally in order to combat deforestation. We focus on the Amazon, the world's most extensive rainforest, where Brazil's federal government issued a 'Priority List' of municipalities in 2008—a blacklist to be targeted with more intense environmental monitoring and enforcement. First, we estimate the causal impact of the Priority List on deforestation (along with other relevant treatment effects) using 'changes-in-changes' (Athey and Imbens, 2006), finding that it reduced deforestation by 43 percent and cut emissions by 49 million tons of carbon. Second, we develop a novel framework for computing targeted optimal blacklists that draws on our treatment effect estimates, assigning municipalities to a counterfactual list that minimizes total deforestation subject to realistic resource constraints. We show that the ex-post optimal list would result in carbon emissions over 10 percent lower than the actual list, amounting to savings of more than \$1.29 billion (36% of the total value of the Priority List), with emissions over 23 percent lower on average than a randomly selected list. The approach we propose is relevant both for assessing

targeted counterfactual policies to reduce deforestation and for quantifying the impacts of policy targeting more generally.

**Eduardo Souza-Rodrigues** is an associate professor of Economics at the University of Toronto. He obtained his PhD degree in Economics at Yale University in 2012. After that, he became a post-doc fellow at Harvard University for one year. Eduardo Souza-Rodrigues' research agenda lies at the intersection of Environmental Economics and Industrial Organization, with an emphasis on Structural Dynamic Models (i.e., on models in which economic agents are forward looking). His research focuses on problems related to tropical deforestation, especially on the Amazon rainforest, and on the performance of existing and yet-to-be-implemented conservation policies. Evaluating yet-to-be-implemented policies involves counterfactual analysis based on economic behavioral models. Eduardo's second research area is dedicated to the questions of when, and under what conditions, counterfactual predictions are identified in structural dynamic models (which have been extensively used in applied work).

#### Readings: Environmental Economics

- Eduardo Souza-Rodrigues, (2019) Deforestation in the Amazon: A Unified Framework for Estimation and Policy Analysis, *Review of Economic Studies* 86 (6) (2019), 2713–2744.
- Marshall Burke et al (2016) Opportunities for Advances in Climate Change Economics. *Science*, 352 (6283), 292-293.

#### **Week 5: Feb 9: Systems Thinking**

This week, we turn to questions of the interconnectedness of many of our decisions, and how to address decision-making at multiple levels. We use ideas of systems thinking to help place our decisions into a broader context, considering how multiple worldviews might help us see environmental challenges in new ways.

#### Readings: systems thinking

- Meadows, Donella H. (2008). "Chapter 1: The basics," pp. 11-34 in *Thinking in Systems: A Primer*. White River Junction, VT: Chelsea Green Publishing.
- Tufekci, Z. (2021). *5 Pandemic Mistakes We Keep Repeating: We can learn from our failures*. The Atlantic, Feb 26, 2021
- Kimmerer, Robin Wall (2018). Corn tastes better on the honor system. *Emergence Magazine*, 3: <https://emergencemagazine.org/story/corn-tastes-better/>

#### **Week 6: Feb 16: Guest speaker**

**Dr Susan Jay Hassol, Director of the non-profit Climate Communication (3MT due)**

#### **Communicating Climate Change**

Climate change is the greatest challenge facing humanity. The failure to effectively communicate about it is part of what is holding us back from tackling it successfully. This seminar will address what works and what doesn't in communicating about climate change with various audiences. We'll discuss issues of language, framing, and storytelling, and the influence of ideology, values, and disinformation on the social discourse. Participants will gain a better understanding of what

needs to change and what they can do to help solve the massive threats posed by climate chaos while capturing tremendous opportunities at the same time.

**Susan Joy Hassol** is the Director of the non-profit Climate Communication. She is an award-winning climate change communicator and author known for her ability to translate science into English. For three decades she has helped scientists communicate more effectively and provided clear information to policymakers, journalists, and the public. Susan has written and edited numerous high-level reports including the first three U.S. National Climate Assessments. She has testified to the U.S. Senate, written an HBO documentary, and writes popular articles including in *The New York Times*, *The Boston Globe*, *The LA Times*, and *Scientific American* in recent months. Susan is the recipient of the 2021 Ambassador Award from the American Geophysical Union and is an elected a Fellow of the American Association for the Advancement of Science for her exceptional contributions to the communication of climate change science to policymakers and the public. She tweets @ClimateComms.

Readings: Communicating Climate Change

- Richard C. J. Somerville and Susan Jay Hassol. (2011) Communicating the Science of Climate Change. *Physics Today*, 64 (10). October 2011.
- Susan Jay Hassol, et al (2016). (Un)Natural Disasters: Communicating Linkages Between Extreme Events and Climate Change. *WMO bulletin*, 65(2).
- Michael E. Mann, Susan Joy Hassol and Tom Toles (2017) Doomsday scenarios are as harmful as climate change denial. *The Washington Post*, July 12, 2017.

***Winter Reading Week: Feb 23 – no class***

**Week 7: Mar 2: Environmental decision-making tools (*Individual writing assignment due*)**

This week we will consider various tools that can be used to structure environmental decision-making processes, from modelling to environmental impact assessments to community consultations. In this overview of tools, we return to questions about the goals of decision-making, as well as the more technical processes of evaluating alternative courses of action. We also consider science-policy translation processes as part of the suite of environmental decision-making tools.

Readings: decision-making tools

- English, M. R., Dale, V. H., Riper-geibig, C. V. A. N., & Ramsey, W. H. (1999). Chapter 1: Overview. In V. H. Dale & M. R. English (Eds.), *Tools to Aid Environmental Decision Making*. New York, NY: Springer New York.
- Soden, R., & Kauffman, N. (2019). Infrastructuring the Imaginary. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (pp. 1–11). New York, NY, USA: ACM.
- IPCC. (2018). *Global Warming of 1.5°C, Summary for Policymakers*. Geneva.

**Week 8: Mar 9: Guest Speaker****Patrick Moldowan, PhD candidate, Ecology and Evolutionary Biology, University of Toronto****Salamander tales (tails?)—From conservation science to carnivorous plants.**

Amphibians perform numerous ecological roles—as predators and prey, as connectors of energy flow between aquatic and terrestrial landscapes, and as sizable contributors to vertebrate biomass—in wetland and forest ecosystems. Amphibians are also modern “canaries in the coal mine”, serving as a barometer for assessing environmental health. Their persistence is uncertain in the face a host of threats, with climate change being one of the most complex and poorly understood. In general, amphibians—especially high latitude, mid latitude, and northern range edge populations—are expected to respond strongly to climate change due to their specific reproductive requirements, complex life histories, and often short breeding period. Addressing knowledge gaps about species biology and threats at a time of rapid environmental change requires long-term datasets. Global salamander diversity peaks in eastern North America. The Spotted Salamander (*Ambystoma maculatum*) is a widespread species in this region and has been the subject of thorough ecological, life history, and population study in southerly areas of its range. Spotted Salamander life history and reproductive and population biology has been studied since 2008 near their northern climatic range edge in Algonquin Provincial Park, Ontario. The long-term aims of this project are to monitor population vital rates and assess the effects of climate (change) on the health of salamander populations in an otherwise pristine environment. This presentation is a synthesis of the long-term study to date with specific focus on how the environment influences and is influenced by salamanders. We'll dabble in the fascinating natural history of these unassuming amphibians and unexpected aspects of their ecology. Come for the carnivorous plants and stay for the salamanders!

**Patrick Moldowan** is a Ph.D. Candidate in the Department of Ecology & Evolutionary Biology and School of the Environment at the University of Toronto. For his dissertation, he is studying the ecology and sensitivity to environmental change of salamanders. Based at the Algonquin Wildlife Research Station in Algonquin Provincial Park, his research leverages long-term amphibian and turtle studies to pursue an array of eclectic research projects at the intersection of natural history, herpetology, conservation science, and evolutionary ecology. Patrick was a recipient of the prestigious New Noah Scholarship from Wildlife Preservation Canada, an award recognizing young leaders in conservation. When not out in the field, Patrick is typically daydreaming about his next field project, canoeing, or dining on fine curries.

Readings: tbc

- Patrick D. Moldowan, Glenn J. Tattersall, and Njal Rollinson (2021). Climate-Associated Decline of Body Condition in a Fossorial Salamander. *Global Change Biology*, Vol 28.
- Moldowan PD, MA Smith, T Baldwin, T. Bartley, N Rollinson, and H Wynen. 2019. Nature's pitfall trap: Salamanders as rich prey for carnivorous plants in a nutrient-poor northern bog ecosystem. *Ecology* 100(10): e02770.

**Week 9: Mar 16: Environmental values**

This week we will return to the recurring theme of environmental values, considering multiple perspectives on the questions associated with value, as well as the persistent question of the misalignment of peoples' actions with their claimed values. We will also consider how our own research groups and labs might incorporate questions of value in our work.

Readings: environmental values and the values-action gap

- Jedediah Purdy (2015) Environmentalism's Racist History. *The New Yorker*, August 13, 2015.
- Steg, L., & de Groot, J. I. M. (2012). Environmental Values. In S. D. Clayton (Ed.), *The Oxford Handbook of Environmental and Conservation Psychology Edited*. Oxford University Press.
- Chan, K. M. A., Balvanera, P., Benessaiah, K., Chapman, M., Díaz, S., Gómez-Baggethun, E., ... Turner, N. (2016). Opinion: Why protect nature? Rethinking values and the environment. *Proceedings of the National Academy of Sciences*, 113(6), 1462–1465.
- The CLEAR Lab book, Civic Laboratory for Environmental Action Research (CLEAR), Memorial University of Newfoundland, Jan 1, 2018. <https://civiclaboratory.nl/clear-lab-book/>

**Week 10: Mar 23: Guest Speaker**

**Dr. Jessica Hernandez, Postdoctoral Fellow, University of Washington Bothell.**

**Indigenous Science & Climate Change.**

Despite the undeniable fact that Indigenous communities are among the most affected by climate devastation, Indigenous science is nowhere to be found in mainstream environmental policy or discourse. And while holistic land, water, and forest management practices born from millennia of Indigenous knowledge systems have much to teach all of us, Indigenous science has long been ignored, otherized, or perceived as “soft”—the product of a systematic, centuries-long campaign of racism, colonialism, extractive capitalism, and delegitimization. This presentation will discuss that.

**Dr. Jessica Hernandez** is a transnational Indigenous scholar, scientist, and community advocate based in the Pacific Northwest. She has an interdisciplinary academic background ranging from marine sciences to forestry. Her work is grounded in her Indigenous cultures and ways of knowing. She advocates for climate, energy, and environmental justice through her scientific and community work and strongly believes that Indigenous sciences can heal our Indigenous lands. Her book, *Fresh Banana Leaves: Healing Indigenous Landscapes through Indigenous Science* was released on January 2022.

Readings:

- Jessica Hernandez (2022) Chapter 1: Indigenous Teaching: Nature Protects You as Long as You Protect Nature. *Fresh Banana Leaves*, Penguin Random House, 2022.
- Jessica Hernandez and Michael S. Spencer (2020) Weaving Indigenous Science into Ecological Sciences: Culturally Grounding Our Indigenous Scholarship (introduction to a special issue), *Human Biology* 92(1), 5-9.

- Jessica Hernandez, Rachel Scherr, and Amy D. Robertson, (2021) Redefining Energy Justice in Physics Classrooms. *Environmental Justice* 0 0:0

### **Week 11: Mar 30: Uncertainty and adaptation**

Recognizing the conditions of uncertainty under which much decision-making takes place, we look this week at decision-making strategies in cases of uncertainty, the need for adaptive approaches, and the challenges of communicating uncertainty to public audiences. We also consider how political changes create uncertainty and opportunities for change.

#### Readings: decision-making under uncertainty

- Polasky, Stephen, Carpenter, Stephen R., Folke, Carl, and Keeler, Bonnie. 2011. Decision-making under great uncertainty: environmental management in an era of global change. *Trends in Ecology and Evolution*, 26(8): 398-404.
- Levin, Kelly, Cashore, Benjamin, Bernstein, Steven, and Auld, Graeme. 2012. Overcoming the tragedy of super wicked problems: Constraining our future selves to ameliorate global climate change. *Policy Sciences*, 45: 123-152.
- Ulibarri, Nicole. 2019. Collaborative governance: a tool to manage scientific, administrative, and strategic uncertainties in environmental management? *Ecology and Society*, 24(2): 15.

### **Week 12: April 6: Guest Speaker**

**Dr Soren Brothers, Curator of Climate Change, Royal Ontario Museum.**

#### **Looking for Climate in Change—Potential Pitfalls in Environmental Research**

Climate change is the defining challenge of our generation, and it can be difficult to conceive of any part of society or nature that will not in some way be affected by it. At the same time, the attribution of environmental change to climate forcing can be challenging, given the multitude faces of climate change, and ways that ecosystems can respond to it. Drawing examples from the field of limnology, I present cases where the attribution of climate change as a driver of significant environmental changes is not necessarily obvious. I also present instances where non-climate drivers have been responsible for environmental changes that could easily be mistaken for the effects of climate change. In the latter case, the misattribution of direct anthropogenic drivers to climate change can result in missed opportunities for both ecosystem managers and even climate mitigation efforts.

**Dr. Soren Brothers** is the Allan and Helaine Shiff Curator of Climate Change at the Royal Ontario Museum (ROM). He is also an Assistant Professor at the Department of Ecology and Evolutionary Biology at the University of Toronto. Soren's research examines the effects of climate change on lakes, and how changes in aquatic systems can influence their greenhouse gas emissions to the atmosphere. More broadly, he is interested in understanding how feedback loops and the transdisciplinary study of lakes can help us better understand and predict global tipping points that may accelerate anthropogenic climate change. Born in Mississauga and raised in Toronto, Soren has worked on lakes in a diverse array of environments around the world, including the Nunavut tundra, Quebec's boreal forests, and the Great Lakes. He is leading a Global Lakes Ecological Observatory Network initiative to improve understanding of the

widespread greenhouse gas impacts of desiccation. He is also passionate about science communication and community outreach. Before beginning at the ROM in 2021 he was an Assistant Professor of Limnology at Utah State University, and a CREATE program manager and postdoctoral fellow at the University of Guelph, focusing on multiple stressors and cumulative effects in the Great Lakes.

Readings: Climate Change and Ecosystems

- Worts, Douglas (2020) How Can Museums Contribute to Solving the Climate Change Crisis? – Reflecting on the Royal Ontario Museum’s Initiative. *Blog post, Coalition of Museums for Climate Justice*, Dec 7, 2020.
- Sabine Hilt, Soren Brothers, Erik Jeppesen, Annelies J. Veraart, Sarian Kosten (2017) Translating Regime Shifts in Shallow Lakes into Changes in Ecosystem Functions and Services *BioScience*, Volume 67, Issue 10, October 2017, Pages 928–936.
- Niall G. Clancy, John P. Draper, J. Marshall Wolf, Umarfarooq A. Abdulwahab, Maya C. Pendleton, Soren Brothers, Janice Brahney, Jennifer Weathered, Edd Hammill & Trisha B. Atwood (2020) Protecting endangered species in the USA requires both public and private land conservation. *Nature Scientific Reports*, volume 10, Article number: 11925.