



UNIVERSITY OF WATERLOO

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Leveraging systems  
approaches to improve  
human & planetary health

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APR 25-26, 2018  
FUNDED BY WICI



We acknowledge that we live and work on the traditional territory of the Attawandaron (Neutral), Anishinaabeg, and Haudenosaunee peoples.

The University of Waterloo is situated on the Haldimand Track, land promised to the Six Nations.



On 25 October 1784, Sir Frederick Haldimand, the governor of Québec, signed a decree that granted a tract of land to the Haudenosaunee (Iroquois), also known as the Six Nations, for their alliance with British forces during the American Revolution (1775-83). The Haldimand Tract extends 10 kilometers on both sides of the Grand River, from its source in Dundalk Township to its mouth at Lake Erie. Originally, 950,000 acres was designated for the Haldimand Tract; today approximately 48,000 acres remain.

Read more about the history and ongoing negotiations: [Six Nations Lands and Resources](#).



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Program designed by Kirsten Lee



**Welcome from Waterloo Institute for Complexity and Innovation (WICI) Director Madhur Anand**

WICI is exceptionally pleased to support this workshop, Leveraging systems approaches to improve human and planetary health, which contributes to WICI's goal of gathering expertise from across campus to build capacity to find solutions to our biggest challenges. The invited speakers and planned hands-on activities will provide an unparalleled opportunity for faculty and graduate students to engage in interdisciplinary discussions around this topic at Waterloo, and to utilize the methodologies and frameworks Complex Systems Theory offers.

**Welcome from co-organizer Sharon Kirkpatrick, School of Public Health and Health Systems**

On behalf of the Planning Committee, I am delighted to welcome you to two exciting days of compelling and informative keynotes, case studies, oral and poster presentations, hands-on training, and opportunities for dialogue. Anticipated outcomes include supporting capacity among faculty and trainees in the application of systems thinking and methods, and fostering university-wide (and beyond) networks of researchers. Additionally, we hope to spark coordination among efforts to promote health while also reducing our environmental footprint right here on campus. We are very pleased to host several oral and poster presentations led by trainees and invite you to check out the posters during the lunch break and the wine and cheese reception following the panel.

Wishing you a productive and inspiring workshop!

**Welcome from co-organizer Amanda Raffoul, School of Public Health and Health Systems**

Transdisciplinary work is a key component of our efforts to address the complexity that drives, and connects, the health of humans and the planet. By bringing together researchers and trainees with varying levels of expertise from multiple disciplines, we can begin to tackle the complex structures that underlie health. With the support of WICI, we hope this workshop will provide a unique opportunity for trainees in particular to explore the potential for transdisciplinary collaboration and to connect with researchers from across faculties, as well as to receive hands-on training in systems methods that will assist them in addressing complex questions.

We look forward to engaging with you over the course of this workshop and beyond!



## ACKNOWLEDGEMENTS

We are very grateful to WICI for sponsoring this event, and to the members of our planning committee—Scott Janzwood, Kirsten Lee, Vanessa Schweizer, and Katharine Zywert—for their assistance in creating what we hope will be an engaging and informative program. We are deeply appreciative of all of our presenters, discussants, oral and poster presentation judges, and workshop facilitators for their contributions.

We are grateful to Kirsten Lee of the School of Public Health and Health Systems (SPHHS) for sharing her talents to help organize this workshop and for designing this program, to Andy Xu in SPHHS and Eden Mekonen, Bernice Ma, and Leanne Wright in Applied Health Sciences for their assistance with planning, Donna Schell for answering our frequent queries about campus resources for events, and to Noelle Hakim of WICI for helping us to disseminate information about this workshop.

All foods and beverages served at this event are vegetarian. Lunch will be catered by Seven Shores, which is a local community café that describes itself as a simple, ethical and relational business at the heart of the local food scene in Uptown Waterloo. Seven Shores continually strives to source as much local food as possible, have a living wage policy for all employees, and support the local community by offering space, events, and services.

## ABOUT OUR FUNDERS AND SPONSORS

### Waterloo Institute for Complexity and Innovation

The Waterloo Institute for Complexity & Innovation (WICI) is a research hub that promotes the rigorous transdisciplinary study of innovation within—and the resilient and beneficial transformation of—the complex adaptive systems essential to human well-being. Within the University of Waterloo, WICI acts as a “centre of centres” for research on complex systems. Within southern Ontario, WICI activities bring together scholars, practitioners, and policy makers working on both theoretical and applied complex systems problems. Beyond the immediate geographic scope of southern Ontario, WICI uses online and interactive technologies to disseminate its findings and to engage vigorously with complexity researchers around the world.



### School of Public Health and Health Systems

The School of Public Health and Health Systems advances learning, knowledge, practice, and capacity in the fields of public health and health systems through strategic partnerships and excellence in teaching, research, and service with a focus on transdisciplinary practice. This transdisciplinary approach fosters transformative ideas and leaders with the knowledge, experience, competencies, confidence, and connections to solve significant health problems.



**UNIVERSITY OF WATERLOO**  
FACULTY OF APPLIED HEALTH SCIENCES  
School of Public Health and Health Systems





## OVERVIEW

Human and planetary health are inextricably linked. For example, relationships between dietary patterns and environmental sustainability, undernutrition and soil degradation, and sanitation and extreme weather conditions are increasingly recognized. As a result, although public health has traditionally focused on the health and wellness of human populations, it is evolving to advocate for the protection of planetary health. For example, in 2015, the Canadian Public Health Association identified nine categories of recommended actions for public health researchers and stakeholders to promote ecological health ([https://www.cpha.ca/sites/default/files/assets/policy/edh-discussion\\_e.pdf](https://www.cpha.ca/sites/default/files/assets/policy/edh-discussion_e.pdf)). Simultaneously, those working on issues such as climate from an environmental perspective are integrating considerations related to human health.

To better understand and address complex challenges related to health and the environment, systems science represents a promising avenue. Systems thinking and methods allow researchers and policymakers to simultaneously consider multiple drivers that interact in complex ways to influence multi-scale global problems, such as climate change, and to predict the outcomes of interventions to begin to resolve such problems and improve the health of humans and ecosystems. Further, systems approaches can facilitate transdisciplinary teams, which are essential to addressing these complex challenges. However, methods for implementing systems approaches can be daunting and remain underutilized. Fostering linkages and collaborations across campus can help to enhance understanding and appropriate application of these approaches to advance the identification of solutions to complex health and environmental challenges. This workshop is meant to facilitate and leverage such linkages and collaborations.



Lyle Hallman Institute (LHI) South 1621

9:00 Registration and light breakfast

9:30 The challenge: How do we leverage systems thinking and methods to bring together researchers working on human health and planetary health?

*Dr. Madhur Anand, WICI Director; Professor and University Research Chair in Sustainability, School of Environmental Sciences, University of Guelph*

9:45 The potential of systems methods to advance our capacity to identify solutions to human health and environmental challenges

*Dr. Bruce Y. Lee, Global Obesity Prevention Center, Johns Hopkins*

10:45 A complex-systems approach to managing the dynamics of shallow lakes: A case study with Lake Erie

*Dr. Brad Bass, Environment and Climate Change Canada*

The Canada-Ontario Action Lake Erie Action Plan outlines the federal–provincial approach to meeting Canada’s commitments to reduce phosphorus loads to Lake Erie in order to reduce the frequency and severity of Harmful Algal Blooms (HABs) and eutrophication. Eutrophication is in fact a well-documented attractor of shallow lakes, but the frequency and severity of HABs in Lake Erie has made this the dominant attractor in parts the lake. This presentation will explore the roots of our understanding of shallow lakes as complex systems and how that understanding can inform the analysis and policy process, as well as the role for new best management practices and the adoption of new innovations. The presentation will draw on the work and thinking of Stafford Beer, Marten Scheffer, James Kay and John Holland. Stafford Beer developed the first approach to adaptive management based on real-time data collection. Marten Scheffer outlined the two attractors of shallow lakes, the dynamic process that produces these attractors, and the drivers for these attractors. James Kay united the work of these and other thinkers into a process for the development of policy. Dr. Bass’ own work draws on genetic algorithms, first developed by John Holland, to explore incorporating resilience into the design of new management practices for reducing phosphorus loads. Thus, the use of complex systems thinking covers multiple scales from green infrastructure in a field to the whole lake.

11:15 Networking break

11:30 A seamless partnership in ways of knowing: systems thinking as a transcendent ordering paradigm for meeting “the other”

*Dr. William Sutherland, Institute of Complexity Medicine*

How does a health clinician utilize complexity concepts in pragmatic and manifest ways, thereby becoming a more effective change agent within the greater Living system? This case study looks at a collaboration between a Western trained medical doctor and a traditionally mentored Mi'kmaq elder in the treatment (healing) of a Mi'kmaq youth struggling with concurrent mental health and drug addiction challenges. This case provides a lens into how we can leverage systems thinking as vehicle towards a richer and more nuanced medical practice that utilizes the potential of dormant relationships present within the system as a whole. In this case study, we will examine the relevance of vicious and virtuous circles (and the notion of the double-bind), the process of circular causality (including feedback, and bottom-up/top-down causality), the necessity for perceiving abstraction and systems hierarchies in health, and strategies of utilization to promote relational connectivity and diversity within a system.



- 12:00      Discussant: Integrating human and planetary health using systems thinking and methods  
*Katharine Zywert, Social and Ecological Sustainability, University of Waterloo*
- 12:15      Lunch (*provided*) and networking
- 1:00      Oral presentations (*see abstracts on page 8*)  
*Moderator: Kirsten Lee, School of Public Health and Health Systems*
- The complex nature of cultural systems in the context of the climate crisis - Sophia Sanniti & Katie Kish, School of Environment, Resources and Sustainability**
- Safeguarding health and wellbeing in small island states in the Caribbean: Exploring pathways of climate change impacts on non-communicable diseases in Barbados - Roxanne. A. Springer, Department of Geography and Environmental Management**
- Trends in nutrition and climate change impacts of Ontarians' dietary choices - Basak Topcu, School of Environment, Enterprise & Development**
- A social-ecological systems approach to govern coastal ecosystems under conditions of rapid change - Ana Carolina Esteves Dias, School of Environment, Resources and Sustainability (also visit Ana's poster during the poster session)**
- System level enablers and barriers to a basic income guarantee: Lessons from Speenhamland - Brian Hyndman, Sessional Instructor, School of Public Health and Health Systems**
- Relational hierarchies in global sustainability and resilience - Perin Ruttonsha, School of Environment, Resources and Sustainability**
- Systems thinking as a tool to promote human health and sustainable behaviour change - Katharine Zywert, School of Environment, Resources and Sustainability**
- 2:30      Discussants: *Threads connecting projects across campus*  
*Dr. Steffanie Scott, Department of Geography and Environmental Management, University of Waterloo*
- Jodi Koberinski, School of Environment, Resources and Sustainability, University of Waterloo*
- 2:45      Building intersectoral teams (*facilitated group discussion*)  
*Dr. Warren Dodd, Dalla Lana School of Public Health, University of Toronto; School of Public Health and Health Systems, University of Waterloo*
- 3:15      How researchers from across disciplines can effectively work together to address complex challenges using systems thinking and methods  
*Dr. Vanessa Schweizer, Department of Knowledge Integration, Faculty of Environment, University of Waterloo*

4:00

**Opportunities for moving forward: Panel**

*Moderator: Dr. Sharon Kirkpatrick, School of Public Health and Health Systems*

**Panelists:**

*Dr. Bruce Y. Lee, Global Obesity Prevention Center, Johns Hopkins*

*Amanda Raffoul, School of Public Health and Health Systems, University of Waterloo*

*Dr. Vanessa Schweizer, Department of Knowledge Integration, Faculty of Environment, University of Waterloo*

*Mat Thijssen, Office of Sustainability, University of Waterloo*

4:20

**Posters and reception (see abstracts on page 12)**

Presentation of trainee oral and poster presentation awards

**Understanding the association between dietary quality and health care utilization among Canadian adults** - *Stephanie Aboueid, School of Public Health and Health Systems*

**Examining the impact of food insecurity on disordered eating behaviours and attitudes in urban dwelling adolescent and young adult Canadians** - *Lesley Andrade, School of Public Health and Health Systems, University of Waterloo*

**Integrating nutritional and environmental security metrics for healthy people and planet** - *Goretty Dias, School of Environment, Enterprise & Development*

**A complex systems approach for understanding the transformative potential of connectedness with nature** - *Norman M. Kearney, School of Environment, Resources, and Sustainability*

**A scoping review of food-related interventions on post-secondary campuses** - *Kirsten M. Lee, School of Public Health and Health Systems*

**From simple to complex solutions to undernutrition: Assessing the impact of agricultural biodiversity on child nutrition in Guatemala** - *Diana V. Luna-Gonzalez, School of Environment, Resources and Sustainability*

**Human biomonitoring to complement risk assessments of environmental contaminants in traditional food systems** - *Sara R. Packull-McCormick, School of Public Health and Health Systems*

**Exploring potential consequences of obesity prevention on psychological health** - *Amanda Raffoul, School of Public Health and Health Systems*

**Reforming healthcare systems using a cognitive systems framework** - *Braden K. Tompke, School of Public Health and Health Systems*

**Water Balance: A sculpture** - *Adrienne Mason, School of Environment, Resources and Sustainability*

## ABSTRACTS

### Oral abstracts

#### **A social-ecological systems approach to govern coastal ecosystems under conditions of rapid change**

Ana Carolina Esteves Dias, School of Environment, Resources and Sustainability, University of Waterloo

Marine protected areas (MPAs): are they fulfilling their role of preserving nature and culture? MPAs are “any area of intertidal or sub-tidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment” (Kelleher 1999). This definition is twofold, it accounts for both nature conservation and the preservation of cultural and historical legacies, varying in a range of no-take to sustainable use zones. Notwithstanding, many MPAs have been established in ways that ignore or discount the pre-existence of human communities that depend upon marine resources located inside the boundaries of these MPAs, leading to numerous conflicts. Furthermore, incipient evidence exists to support the idea that current participatory governance approaches can result in ecological improvements in MPAs, including lack of assessment of the conservation strategies implemented. Under a system thinking perspective, this research aims to critically analyze how communities and decision-makers can adjust to uncertainty and rapid change in coastal and marine systems towards a more effective MPA governance under the lenses of ecosystem services and social wellbeing. I will draw on a case study design concerning the governance system of a MPA at the Coast of São Paulo State, Southeast Brazil. Through a multi-level perspective, focusing on community, management council, and provincial levels, this research is divided into three steps as follows: (i) identification of ecosystem services and social wellbeing bundles through Photovoice method; (ii) collective discussion through participatory workshops on how to incorporate findings from step 1 into the design of conserve strategies; and (iii) evaluation of MPA effectiveness and support strategies through document analysis and interviews. This research will be conducted through collaboration with local partners, aiming to foster social support for conservation and effective conservation efforts. The ultimate goal of this research is to provide theoretical and empirical contributions to MPA governance through an adaptive approach, favoring the incorporation of new knowledge and adequate strategies to deal with up to date challenges.



#### **System level enablers and barriers to a basic income guarantee: lessons from Speenhamland**

Brian Hyndman, School of Public Health and Health Systems, University of Waterloo

Basic income guarantee (BIG), also known as a guaranteed annual income, is a cash transfer from government to citizens that is not contingent upon labour market participation. At present, pilot tests of BIG policies are at various stages of implementation in a number of jurisdictions, including Finland, Italy, Scotland, the Netherlands and Ontario, Canada. BIG policies are informed by a number of historical antecedents. One of the earliest BIG prototypes was introduced in Speenhamland, a district of Berkshire, England, in 1795. Alarmed by public unrest in the wake of rising grain prices, local authorities created a subsistence-level BIG for the working poor. The amounts paid were tied to the price of bread. Each member of a family qualified for payment, so that larger families received higher supplements. The

Speenhamland policy differed significantly from the Elizabethan poor laws in that it did not stipulate work as a condition of eligibility: the level of relief was the same whether or not family members were working, and due to concerns that people should not be discouraged from working, payments were not decreased as household income rose. While there is some evidence that the Speenhamland policy was successful in reducing poverty and malnutrition, a number of system-level barriers contributed to its demise in 1834 when the Poor Law Amendment Act prohibited supplements to the wages of full-time workers. The proposed presentation provides a comparative case analysis of the income support systems in late 18th century England (at the time of Speenhamland) and present day Ontario. Using a series of systems maps and diagrams, the presentation notes how the convergence of interests among multiple stakeholders enabled support for the exploration of BIG options in both jurisdictions. It also describes shared systems-level barriers that led to the dissolution of the BIG policy in Speenhamland and may pose threats to the sustainability of a BIG in Ontario and elsewhere. The presentation illustrates how the application of historical research methods can serve as a valuable tool for guiding effective systems-level responses to current global health challenges (i.e., ensuring an adequate income as a prerequisite for optimal health).

### **Relational hierarchies in global sustainability and resilience**

Perin Ruttonsha, School of Environment, Resources and Sustainability (SERS), University of Waterloo

The three pillar (ecology, economy, society) approach has been one of the most prevalent and popular attempts to arrive at a holistic, systemic, cross disciplinary interpretation of sustainability. As a framework, it is simple to apply, though also limited for this reason. In recognition of these limitations, some scholars now use a reconfigured heuristic, which resembles a nested holarchy, showing how society is embedded within ecology, and economy within society. The holarchy concept was first introduced by Arthur Koestler to convey how systems organize in interdependent hierarchical levels. The related concept of panarchy, as developed within resilience scholarship, illuminates the interactions that can cascade between higher and lower levels. Extending from this, synchronous failure, as has been discussed by Dr. Thomas Homer Dixon, reveals interlinked vulnerabilities between global ecological, economic, political and social phenomena. Each of these dynamics have implications for systems change and transition management, necessitating multilevel approaches to analyses and governance. They may also ultimately provoke a shift away from issues oriented sustainability: "Almost all existing approaches to the challenge of global sustainability focus on relatively specific issues, such as the environmental consequences of future energy sources, the economic consequences of climate change, and the social impact of future energy and environmental choices...They focus primarily on the trees and risk missing the forest" (West, 2017, p. 412). Establishing specific targets for change can offer a clear scope of action around which different stakeholders can organize, however, sometimes at the expense of identifying dependencies between complex systems phenomena. In this paper, I work with three themes (population health, natural resource management, and economic development) that are comprehensively inclusive of the three pillars of sustainability, and apply qualitative complexity methods, along with systems mapping, to identify possible levers for transition that exist at their intersections. The overall goal of this research is to identify opportunities to enhance quality of life, while also forging deeper connections between human populations and the ecosystems they inhabit.



### **The complex nature of cultural systems in the context of the climate crisis**

Sophia Sanniti and Katie Kish, School of Environment, Resources and Sustainability, University of Waterloo

New technology and green business models, better governance and a rationalist approach to changing environmental behaviour have proved insufficient for the unprecedented challenges of today. The ecological crisis that has emerged in the wake of the globalizing consumer society requires not only alternative (post-capitalist) models of political economy, but also radically differing ontologies. Such meaning systems are necessary to precipitate rapid, cross-scale political and cultural transformation, and moreover to provide the moral-psychological architecture of a more embedded form of political economy. Using critical systems thinking as a jumping off point, we draw upon cultural anthropology, social psychology, and psychoanalysis to explore the role of human culture in both compounding and ameliorating the present environmental crisis through sophisticated systems of meaning that play unconscious, non-rational, but extremely pervasive roles in human beliefs, values and behaviour. For many social commentators there is a clear link between existential anxieties on the one hand, and socio-spatial mobility, individualization, the erosion of small scale, lack of citizen-owned production of goods and the loss of familial communities on the other. Modernization seems to involve an unavoidable Faustian trade-off between material progress and a hemorrhaging of meaning. Reflecting on the impact of modernity on society, Max Weber famously construed this in terms of the imbalance between 'formal' and 'substantive' rationality. In this context of late modernity, consumerism has largely been internalized as a function of re-establishing that meaning which has led not only to unprecedented levels of environmental degradation but is also socially and psychologically corrosive. These claims are supported by empirical research gathered over nearly three decades by Terror Management Theory, which demonstrates that consumerism is contemporary culture's primary ideology for mitigating and managing existential anxiety. In the wake of the climate crisis, new cultural meaning systems must be built and established that can reap mutually enhancing human-earth relationship. Our research illustrates the opportunities provided by community, reciprocity, trust, and care to re-embed livelihood in economic participation. Through a complex systems approach, this work demonstrates the critical role of cultural meaning systems in providing ontological security and psycho-social resilience for human communities across the globe.

### **Safeguarding health and wellbeing in small island states in the Caribbean: Exploring pathways of climate change impacts on non-communicable diseases in Barbados**

Roxanne. A. Springer and Susan. J. Elliott, Department of Geography and Environmental Management, University of Waterloo

The increasing prevalence of non-communicable diseases (NCDs) is a major concern for small island developing states in the Caribbean. Health in the Americas (2012) reported that seven of the ten leading causes of mortality in the region were NCD related (strokes, heart disease, hypertensive diseases, diabetes and respiratory diseases), accounting for more than 35% of deaths reported (PAHO, 2012). Alongside the growing burden of NCDs in the region is the added threat that climate change presents to human health and wellbeing. Climate change drivers (i.e., temperature increases, decreases in rainfall, air pollution, extreme weather events (EWE)), will have an exacerbating effect on cardiovascular diseases, certain cancers, respiratory illnesses, mental health, malnutrition and injuries. The multiplier effect of climate change on NCDs will likely increase existing health inequalities within and between countries, adversely affect individual and national wellbeing and hinder development agendas across the region. Urgent efforts supported by theoretically-grounded research are needed to address these health and wellbeing threats, in order to limit the impacts on current and future climate-sensitive health outcomes. Yet, this is an area of research which has received little to no attention in the region. Using Barbados as a case study, this research employs key-informant interviews with public

health professionals to explore the knowledge of the relationship between climate stresses and NCDs within the existing social, cultural, economic and political systems and physical environment. We argue that Barbados is favourably positioned to proactively protect the health and wellbeing of its citizens by identifying and implementing synergistic solutions that address the dual burden of climate change and the increasing prevalence of NCDs. Climate change impacts the prevention, management and treatment of NCDs and thus involves a variety of stakeholders, actors and sub-systems. The application of systems thinking can therefore be beneficial to this research: it will aid in deconstructing the complexities of how climate change can impact NCDs, and further help with identifying leveraging points that can maximise the benefits yielded by the investment of the limited resources available in this small island state.

### **Trends in nutrition and climate change impacts of Ontarians' dietary choices**

Basak Topcu, School of Environment, Enterprise & Development, University of Waterloo

Within a systems thinking perspective, food systems are comprised of food activities (from production to consumption), and their outcomes (i.e., food and environmental security and social welfare). Moreover, consumers' dietary choices drive agricultural production practices, which in turn are implicated in global environmental change and food security. For example, food production contributes to 24% of global greenhouse gas emissions, and higher temperatures can affect food production. Thus, understanding dietary choices can contribute to how to attain climate targets, among other goals. This study uses Life Cycle Assessment (LCA), a tool that takes a systems approach to quantify environmental impacts in supply chains from production to consumption. LCA can also be used to compare systems and understand trade-offs by calculating how perturbations in one part of the life cycle can shift impacts to other parts of the life cycle, other regions of production, or other resources. For example, if consumers shift from beef to chicken consumption, LCA can show whether impacts are reduced overall and where "hotspots" could occur. In this study, the Canadian Community Health Survey 2004 and 2015 are analyzed to compare changes in types and amounts of food groups from 2004 to 2015, and also to identify dietary patterns of Ontarians (e.g. omnivorous, vegetarian). We also assess the carbon footprint (CF) of each dietary pattern by using LCA. The nutritional value of each dietary pattern is compared and improved based on Canada's Food Guide's recommendations, and the CF is reassessed. This research is still in process, but the expected results are as follows: (1) over the last 10 years, there is an increase in poultry, fish and egg and a decrease in beef and milk consumption; (2) animal-based dietary choices have higher CF than plant-based dietary choices; and (3) overconsumption of protein intake by people that have animal-based dietary choices are linked with higher impacts. The potential outcomes of this research are to provide advice to consumers on how to make their dietary choices more environmentally-friendly and nutritionally-balanced, and to provide guidelines to policy makers for designing policies to incentivize consumers to make these choices.

### **Systems thinking as a tool to promote human health and sustainable behaviour change**

Katharine Zywert, School of Environment, Resources and Sustainability, University of Waterloo

Human health depends on the ability of planetary biophysical processes to operate within relatively narrow parameters. In spite of this, human activities are increasingly exceeding planetary boundaries. Eroding the ecological foundations of human wellbeing will inevitably result in declining health outcomes at a global scale. However, to date, the work of multilateral organizations, NGOs, academic researchers, and environmental activists has had little effect on unsustainable behaviour patterns. Instead, material resource and energy use continue to rise, coupled with an increase in pollution, climate change, and environmental destruction. This paper argues that systems thinking can be a powerful tool for both promoting health and inspiring the adoption of sustainable behaviours and meaning frameworks. In the past, public communication about the devastating effects of climate change has been shown to raise concern about ecological problems, but also to increase the despair people feel

about the likelihood of finding humane solutions. If communicating about climate change makes people fear death, studies in terror management theory suggest that knowledge-sharing can have the opposite of its intended effect, causing people to cling more closely to existing materialistic worldviews. Using systems thinking to emphasize the interconnectedness of human health and social-ecological resilience could gain more traction, raising concern for nature by making it easier for people to perceive the environment as part of the self. Recent high-profile reports including the CPHA's "Global Change and Public Health" and the Lancet's "Safeguarding Human Health in the Anthropocene Epoch" draw strong connections between human health and the integrity of planetary biophysical systems. Informed by complex systems science, these emerging perspectives create new leverage points for sustainable behaviour change by linking environmental issues to health concerns that people generally experience as more immediate and pressing. Highlighting the extent to which human and planetary health are interdependent also creates space for new cultural meaning frameworks that could significantly impact feedback patterns in social-ecological systems by, for instance, reducing our reliance on fossil energy and economic growth or curbing material consumption.

## Poster abstracts

### **Understanding the association between dietary quality and health care utilization among Canadian adults**

Stephanie Aboueid and Sharon I. Kirkpatrick, School of Public Health and Health Systems, University of Waterloo

Among Canadians, quality of dietary intake is low relative to guidance to promote health and reduce disease risk. Recent research estimated the burden (due to disability and premature mortality) of low fruit and vegetable intake alone at \$4.4 billion per year, whereas high sugar-sweetened beverage intake is projected to lead to \$50 billion in health care costs over 25 years. While these studies highlight potential implications of suboptimal intake of particular dietary components, analyses shedding light on the implications of suboptimal dietary quality more holistically are lacking. This is important given increasing recognition that it is eating patterns (the totality of habitually-consumed foods and drinks, which may act in synergistic and cumulative ways) that predict disease risk, with implications for the health care system. To assess healthcare utilization and expenditures in relation to dietary quality, using comprehensive population-level dietary intake data for Ontarian adults. This interdisciplinary study will draw upon data for Ontario adults drawn from the 2004 and 2015 cycles of the Canadian Community Health Survey (CCHS), nationally representative cross-sectional surveys that administered 24-hour dietary recalls. To address diet quality holistically, the US Healthy Eating Index (HEI)-2015, which characterizes the mix of foods and beverages consumed in relation to dietary guidance, will be adapted to the Canadian setting. Unique linkages between CCHS and data on health care encounters (derived from Ontario Health Insurance Plan (OHIP) records) will be leveraged. Methods developed to examine the characteristics of high-cost health care users will be applied to calculate annual per-person health care costs. Regression modeling will then be applied to examine whether diet quality is associated with healthcare spending, with covariates and stratification to assess whether associations differ in relation to age, sex/gender, income and education. Findings from this study, which will draw upon expertise in nutrition, econometric analyses, and the health care system, will provide evidence regarding the relevance of healthy eating patterns to health care costs. This work is a starting point for understanding how eating patterns interact with other behaviours and risk factors, such as socioeconomic status, to drive health care utilization in Canada.

### **Examining the impact of food insecurity on disordered eating behaviours and attitudes in urban dwelling adolescent and young adult Canadians**

Lesley Andrade and Sharon I. Kirkpatrick, School of Public Health and Health Systems, University of Waterloo

Food insecurity, which refers to compromised food access due to insufficient economic resources, has been consistently associated with compromised dietary intake and poor physical and psychological health among both adolescents and adults. Recently, attention has been drawn to potential relationships between food insecurity and indicators of eating disorder pathology. A study of US adults found that higher levels of food insecurity were associated with binge eating, purging, dietary restraint, and internalized weight bias. It is thus possible that the anxiety and deprivation inherent to experiences of food insecurity may contribute to disturbed relationships with food and ultimately, to disordered eating. However, public health strategies tend to focus on one or the other of the two issues in isolation, without considering their potential interactions or shared underlying risk factors. My research will examine the co-occurrence of food insecurity and disordered eating behaviours and attitudes among young Canadians. Data will be drawn from three waves of a Canadian cohort study of youth and young adults, aged 16 to 30 years, recruited from five urban areas. At baseline, I will examine the prevalence of food insecurity and disordered eating, as well as socio-demographic and health-related factors associated with their co-occurrence. Multilevel longitudinal regression analyses models will then be employed to examine whether food insecurity at baseline predicts indicators of disordered eating at year three, accounting for missing data as well as potential confounders such as age, gender, and race/ethnicity. By shedding light on how these two issues interact and factors associated with their co-occurrence, this study will inform policies and programs that can result in meaningful impacts for both outcomes among youth and young adults.

### **Integrating nutritional and environmental security metrics for healthy people and planet**

Goretty Dias, Sadaf Mollaei, Basak Topcu, School of Environment, Enterprise & Development, University of Waterloo

Food systems, from farm-to-fork, are responsible for more than 30% of all global environmental impacts and resource use, mostly from agricultural production. Population growth projections to 2050 suggest the need to double food production, and rising standards of living are creating demand for more resource-intensive diets (e.g. meat). Therefore, dietary shifts are crucial to meet food security and environmental sustainability goals. The global availability of protein, vegetables, and fruits is insufficient for a nutritious and equitable diet. Almost 85% of available protein is animal-based (65% of which is red meat) and 40% of vegetables are carbohydrate-rich. If this trend in meat consumption continues as population rises, there will be substantial irreversible environmental impacts as well as health costs from a range of diet-related non-communicable diseases. Providing nutritional security for a growing population requires an understanding of which foods simultaneously deliver the highest nutritional benefits and the lowest environmental impacts. The farm-to-fork environmental impacts of dietary patterns can be measured using life cycle assessment (LCA), a systems-based tool used in the field of Industrial Ecology. A recent LCA of calorically-equivalent Ontario diets showed that beef consumption contributed to 50-70% of the carbon footprint and that replacing some of the beef with plant-based protein resulted in carbon reductions of 30%. However, calorie-based comparisons are overly-simplistic for understanding trade-offs between environmental impacts and nutritional quality. We propose integrating life cycle approaches with metrics that properly capture the complexity of nutritional quality through “functional units”, an LCA-based concept which allows different systems to be compared on an equivalent basis. This requires defining a single metric that simultaneously assesses nutrients in a food item. The overall objective is to establish an appropriate index that can be used to combine foods to provide both nutritionally-balanced, and lower environmental impact, food baskets. This knowledge can



help identify critical leverage points within public policy, business practices and consumer behavior that lead to more sustainable food production and consumption. Ultimately, healthy and sustainable diets can save money in our health care system, increase food security, protect our resources and natural capital, and mitigate climate change.

## A complex systems approach for understanding the transformative potential of connectedness with nature

Norman M. Kearney, School of Environment, Resources, and Sustainability, University of Waterloo

Although deep system change is widely recognized as necessary for social and ecological sustainability, many sustainability interventions have targeted weak leverage points (Abson et al. 2017). My research explores a potential leverage point of growing interest to academics and practitioners: connectedness with nature (Ives et al. 2017). People who think and feel as though they are connected with the rest of nature, rather than detached from it, are less interested in status, wealth, and power and behave more responsibly towards others and the rest of nature (Crompton & Kasser 2009). My research takes a cross-scale, system-theoretic approach to answering the following questions: In the context of interacting biological, psychological, cultural, social, and environmental factors, and at the global level, what role might connectedness with nature play in (1) helping to promote a sustainability transition and (2) helping to maintain sustainability?

To answer these questions, I will conduct systematic reviews of the literature on factors directly influencing planetary boundaries (Steffen et al. 2015), social boundaries (Raworth 2017), connectedness with nature (Zylstra et al. 2014), and detachment (Berman 1981). Next, I will represent and explore the implications of my findings from these reviews using a novel method for studying complex systems, i.e. cross-impact balance analysis, or CIB (Weimer-Jehle 2006). CIB assembles pairwise judgments about how system elements are interrelated and, using a mathematical algorithm, assesses the self-reinforcement of combinations of those elements. The results of a CIB analysis are: (i) an exhaustive list of element combinations, ranked in terms of their internal consistency and their strength of attraction, and (ii) a stability landscape, which shows how a system moves stepwise from one element combination to another. First, focusing on element combinations with high internal consistency and/or strength of attraction, I will analyze the element combinations that are both sustainable and that include connectedness with nature (Research Objective 2). Second, using an iterative search process, I will explore the stability landscape for pathways from the status quo to element combinations that are both sustainable and that include connectedness with nature (Research Objective 1).

Table 2  
Cross-impact matrix of the "oil price" system

	1. World GDP growth	2. Borrowing industrial countries	3. World tensions	4. Cohesion OPEC	5. Oil price
	< 2 %/yr 2-3 %/yr > 3 %/yr	high medium low	Strong Moderate Weak	Strong Moderate Weak	< 20\$ 20-35\$ 35-50\$ > 50\$
1. World GDP growth					
	< 2 %/yr	1 0 -1	2 0 -2	0 0 0	2 1 -1
	2-3 %/yr	0 0 0	0 0 0	0 0 0	-1 1 1
	> 3 %/yr	-1 0 1	-1 0 1	0 0 0	-2 -1 1
2. Borrowing industrial countries					
	high	1 0 -1	1 0 -1	0 0 0	0 0 0
	medium	0 0 0	0 0 0	0 0 0	0 0 0
	low	-1 0 1	-1 0 1	0 0 0	0 0 0
3. World tensions					
	strong	1 0 -1	1 0 -1	1 0 -1	-3 -2 3
	moderate	0 0 0	0 0 0	0 0 0	0 0 0
	weak	-1 0 1	-1 0 1	-1 0 1	1 2 -1
4. Cohesion OPEC					
	strong	0 0 0	0 0 0	0 0 0	-3 -2 3
	moderate	0 0 0	0 0 0	0 0 0	-1 1 1
	weak	0 0 0	0 0 0	0 0 0	1 1 0
5. Oil price					
	< 20\$	-2 0 2	-1 0 1	0 0 0	-2 0 2
	20-35\$	-1 0 1	0 0 0	0 0 0	2 -1 -1
	35-50\$	0 0 0	0 0 0	0 0 0	0 0 0
	> 50\$	1 0 -1	0 0 0	1 0 -1	-1 0 1
States according to test-scenario:					
Impact balances:					
States according to impact balance:					
Impact score of state "Borrowing: medium"					
Impact balance of descriptor "Cohesion OPEC"					

Gray rows mark an arbitrary scenario example ("test-scenario", cf. text).

### A scoping review of food-related interventions on post-secondary campuses

Kirsten M. Lee, Sharon I. Kirkpatrick, School of Public Health and Health Systems, University of Waterloo; Goretty Dias, School of Environment, Enterprise & Development, University of Waterloo; Leia Minaker, School of Planning, University of Waterloo; Tanya Markvart, Community, Health, Environment, Communications (CHEC), University of Waterloo; Steffanie Scott, Department of Geography and Environmental Management, University of Waterloo; Karla Boluk, Recreation and Leisure Studies, University of Waterloo

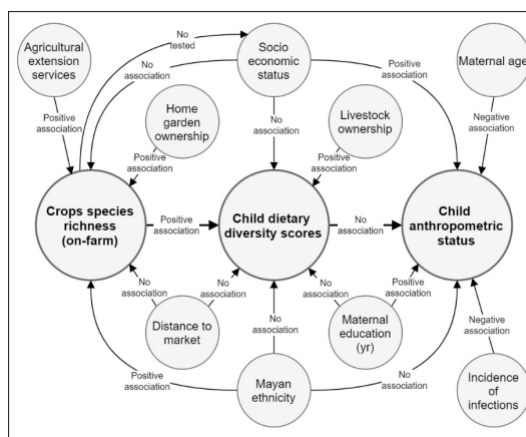
Academic institutions have unique opportunities to engage young adults in critical thinking about food by exposing them to food systems that promote health and environmental sustainability. Such exposure can be complemented by educational initiatives that explore the contemporary food system and its implications for health and the environment. We conducted a scoping review to characterize existing research on interventions to support healthy and environmentally-friendly food-related practices on post-secondary campuses. Keywords related to healthy eating, sustainability, interventions, and post-secondary institutions were used to search four academic databases for peer-reviewed articles published from 2000-2016. After screening, 39 articles were identified and reviewed. Interventions were categorized using the NOURISHING framework and examined for attention to health and the environment. Within the 39 articles reviewed, 35 interventions were identified; these tended to focus on education, the provision of nutrition information (e.g., labels), and point-of-purchase initiatives. One intervention—an on-campus course—addressed both environmental sustainability and health. However, the majority of interventions targeted individual dietary change more specifically without addressing the environmental implications of eating patterns. The remaining four articles identified the need for a framework to support the assessment of campus food systems. Within the peer-reviewed literature, research on food-related interventions on post-secondary campuses appears to be narrowly focused on dietary change at the individual level. Efforts to identify effective strategies to shift campus food systems to better support goals associated with both health and environmental sustainability are needed; such efforts may benefit from comprehensive campus assessments.

### From simple to complex solutions to undernutrition - assessing the impact of agricultural biodiversity on child nutrition in Guatemala

Diana V. Luna-Gonzalez, School of Environment, Resources and Sustainability, University of Waterloo

Undernutrition remains a major development challenge that requires transdisciplinary and systemic approaches to be solved. Often, undernutrition is understood as the result of the linear relationship between nutritional status and insufficient food production and consumption. It is also frequently approached with reductionist interventions aiming to increase production and consumption of single dietary components. However, these interventions have occasionally failed to improve nutrition and have caused adverse effects in human and environmental health, probably because they overlooked the complexity of the food and nutrition security system. Therefore, nutritional interventions should be more holistic to effectively and sustainably combat undernutrition. Agricultural interventions aiming to diversify local system (e.g., home gardening) have been proposed as holistic alternatives to combat undernutrition in rural areas.

Diversified agriculture could improve nutrition through the three following pathways: (a) increasing availability of food and dietary nutrients (b) raising on-farm income that farmers can use to buy



nutritious foods, and (c) boosting resilience via enhanced ecosystem services. These interventions could effectively reduce undernutrition because they can influence the multiple elements interrelated to nutritional status. However, the empirical evidence is neither conclusive nor sufficient about their effectiveness. Aiming to understand and describe the elements and the interrelationships between diversified agriculture and child nutrition, I assessed the correlation among crop and animal species richness, dietary diversity, and child nutrition in Guatemala in 2016. Also, I measured the association of other variables with agricultural decision, diets, and child nutrition; such as child morbidity, maternal education and age, socio-economic status, ethnicity, land ownership, access to agricultural extension services, and distance to market. I found that higher species richness on-farm was associated with higher child dietary diversity scores, but I found no correlation between dietary diversity scores and child nutritional status (Figure 1). Also, I found that low maternal schooling, frequent child infections, and poor housing conditions were correlated with child undernutrition. Therefore, I concluded that investments in women empowerment and improvements in WASH (Water, Sanitation, and Hygiene conditions) can be leveraging points to reduce child undernutrition in rural Guatemala.

### **Water Balance: A sculpture**

Adrienne Mason, School of Environment, Resources and Sustainability, University of Waterloo

Water Balance is a kinetic sculpture to convey a Holling's loop (based on adaptive systems theory) and Bernoulli's law in hydrology. The sculpture is meant to demonstrate that restored watersheds can be visualized as systems in dynamic equilibrium states. The sculptor interfaces with Water Balance by standing on two platforms and moving back and forth over three fulcrums. The balancing act and multitasking required are intentional, meant to convey the proximity of a global system threshold that could push us into another epoch, as well as the inherent complexity involved in interdisciplinary work, such as watershed restoration.



### **Human biomonitoring to complement risk assessments of environmental contaminants in traditional food systems**

Sara R. Packull-McCormick and Brian D. Laird, School of Public Health and Health Systems, University of Waterloo.

Traditional foods such as locally harvested and hunted fish, mammals, birds, and plants have important nutritional, economic, and cultural benefits for First Nations and Inuit communities in Northern Canada. However, elevated levels of environmental contaminants have been measured in some traditional foods. For example, in the Northwest Territories elevated levels of mercury have been measured in certain fish species and elevated levels of cadmium have been measured in moose organs from certain regions. When elevated levels of environmental contaminants are measured through environmental monitoring projects or programs, consumption notices may be released by the provincial/territorial authority (e.g., Chief Public Health Officer). Generally, these consumption notices advise people to limit their consumption of certain foods in areas where elevated contaminant levels

have been measured. Although these consumption notices often highlight the general healthfulness and importance of traditional foods, they can increase concerns about the safety of traditional foods. This can further entrench the ongoing nutrition transition where traditional foods are being replaced in the diet of Indigenous peoples by highly-processed store-bought foods that are high in salt, fat, and sugar. In order to address this, policy-makers in particular northern jurisdictions are encouraging systems approaches that consider human exposure data alongside the results of environmental monitoring research. In Canada, human biomonitoring for environmental contaminants is regularly conducted as part of the Canadian Health Measures Survey (CHMS) for the general Canadian population. However, the CHMS does not include people living in the Northwest Territories, Nunavut, and the Yukon, and also does not include Indigenous peoples living on-reserve. To address this knowledge gap, a number of biomonitoring projects are taking place in Northern First Nations and Inuit communities. The information generated from these human biomonitoring projects is increasingly being used by policy-makers and health professionals to inform how they respond to and discuss environmental data that may affect food consumption patterns in Northern communities. The inclusion of human biomonitoring data facilitates systems approaches that better balance the benefits and risks of food choices in Northern Indigenous communities.

### **Exploring potential consequences of obesity prevention on psychological health**

Amanda Raffoul and Sharon I. Kirkpatrick, School of Public Health and Health Systems, University of Waterloo

Rates of overweight and obesity among Canadian adults have nearly doubled since 1981. More recently, scientists have turned to complex systems thinking and methods to investigate the intricate system of drivers underlying body weight. However, despite this growing recognition that obesity is impacted by dozens of drivers at multiple levels, a dominant 'weight-centric' framework persists in Canada, paying little attention to the psychosocial implications of obesity. Research suggests that individuals who live in larger bodies experience greater body dissatisfaction, increased psychological stress and anxiety, poorer quality of relationships, and increased risk of engaging in health-compromising behaviours. Nevertheless, obesity prevention initiatives primarily focus on outcomes related to physical consequences associated with weight; these interventions may have the potential to elicit policy resistance, whereby their focus on weight may elicit stronger societal weight bias, through increased blame on individuals affected by overweight and obesity. We aim to investigate experiences of weight bias and stigma and psychological health and well-being among young Canadian adults in relation to population-level obesity prevention strategies. Using longitudinal data from a cohort study, we will investigate the prevalence of internalized weight bias and experienced weight stigma and associations with mental health; changes over a three-year period in experiences of weight bias and stigma in relation to weight-related policies; and changes over time in weight-related perceptions and attitudes. This research will be conducted using data from an ongoing cohort study of young adults aged 16 to 30 years residing in five Canadian cities. Participant data, collected online, are contextualized by on-going scans of weight-related municipal-, provincial- and federal-level policies. We will employ analyses to assess changes over time in experiences of weight bias/stigma and related behaviours among subgroups characterized by gender and race/ethnicity in relation to policies. No known study has investigated the potential impact of weight-related policies on overall psychological health, experienced weight stigma, and weight-related behaviours among young adults, both overweight/obese and 'normal' weight. Through the use of a systems lens to investigate potential consequences of a weight-centred landscape on these constructs, this study will inform future health and weight-related policy.



### **Reforming healthcare systems using a cognitive systems framework**

Braden K. Tompke, School of Public Health and Health Systems, University of Waterloo

A cognitive system is a system that learns by the use of thought or computation. A cognitive systems framework is defined as an integration of theories on cognitive systems to create new concepts that improve understanding of complex systems. The following is an introduction to how a cognitive systems framework can be used to assess the need for a new measure of illness severity in children and its implications within a complex healthcare system. Chronic physical illnesses such as asthma, diabetes, or epilepsy affect 20% of children in Canada. This places a considerable burden on the healthcare system, families and children themselves. These burdens are reduced when the severity and progression of illnesses are monitored and assessed for appropriate management. We developed the Global Assessment of Severity of Illness Scale (GASI)—a one-item scale that can be used to measure severity of multiple illnesses in children. The current research investigates validity of the GASI by assessing four constituents: 1) Construct validity: At least moderate correlation [ $r \geq 0.3$ ] with scores on other clinical measures of illness severity; 2) Reliability: Adequate test-retest reliability [ $ICC \geq 0.7$ ]; 3) Responsiveness: Moderate to large magnitude of responsiveness [ $d \geq 0.5$ ] and detects clinically important changes [half a standard deviation in the GASI]; and 4) Discriminant validity: Children with multimorbidity will return higher scores versus children without multimorbidity. Data come from a study where clinicians assessed 56 children using the GASI and the Duke University Severity of Illness Scale (DUSOI). Construct validity of the GASI will be determined by measuring the strength of association with the DUSOI using the Spearman rank correlation coefficient. Test-retest reliability will be analyzed by paired t-test and intraclass correlation coefficient. Responsiveness of the GASI will be examined by using both GASI scores and DUSOI scores to calculate Guyatt's responsiveness statistic. Discriminant validity will be compared between children with and without multimorbidity using the t-test. I employ cognitive systems thinking, drawing on concepts from artificial intelligence (e.g. frame-systems) to guide questions around implementation of the GASI in research and clinical practice and how the GASI can impact human and planetary health.

## APRIL 26 HANDS-ON WORKSHOPS

### Concurrent morning workshop #1: An Introduction to Mathematical Modelling

9:30-11:30 a.m.

Lyle Hallman Institute (LHI) North 2703

#### Facilitators:

Thomas Bury and Brendon Phillips, Department of Applied Mathematics, University of Waterloo

#### Workshop description:

Mathematical modelling is becoming increasingly important to the analysis of complex adaptive systems, with applications in ecology, sustainability management, economics, and physics. Both macroscopic and microscopic approaches can be used, depending on the structure and scale of the system being modelled. This workshop will encourage the use of mathematical modelling in environmental and health studies, and promote new ideas and perspectives that can be incorporated into current research in complex adaptive systems.

The first half of this workshop will be concerned with dynamical systems - a popular framework used to capture interactions between variables on a global scale. We will introduce the concept of a dynamical system, with simple examples for illustration. We will also go through the construction of a model, such as variable selection, interaction types and time scales. This will allow us to brainstorm, and construct a model for an environmental system. Finally, we will discuss parameter fitting and limitations of dynamical systems. In the second half, we will discuss the use of agent-based models (ABMs), which include spatial structure and stochasticity, unlike dynamical systems modelling. This allows us to explore the complex self-organisation and critical phenomena that can arise from simple rules of local interaction of discrete entities (such as molecules or people). Together, we'll look at examples of ABMs, as well as model construction, parametrisation, and validation.

#### Learning objectives:

1. Understand the principles of setting up and parametrising a dynamical system
2. Construct a simple ABM, choose parameters and rules of interaction of agents
3. Understand the relative merits of each approach, and when each is appropriate

### Concurrent morning workshop #2: Qualitative Methods as Tools in Enacting a Systems Approach

9:30-11:30 a.m.

Burt Matthews Hall (BMH) 1016

#### Facilitators:

Kirsten Lee, School of Public Health and Health Systems, University of Waterloo

Dr. Steven J. Mock, Balsillie School of International Affairs

Amanda Raffoul, School of Public Health and Health Systems, University of Waterloo

Dr. Vanessa Schweizer, Department of Knowledge Integration, University of Waterloo

### Workshop description:

In this workshop, which is ideal for beginners and those with intermediate knowledge and experience with complex systems or qualitative approaches, we will provide an overview of various qualitative methods that can be used in research exploring human and planetary health. We will begin with an overview of how these methods have been useful in our own research and how qualitative systems approaches may complement other, more well-known methods of analyses (i.e., mathematical models, traditional statistical analyses). Following this, we will highlight specific qualitative approaches to tackling systems issues, including:

- *concept mapping*, and the development and analysis of these visual diagrams and figures that represent complex relationships between multiple factors;
- *cognitive-affective maps (CAMs)*, highlighting conceptual and emotional structures that drive human thinking and decision-making; and
- *cross-impact balance analysis*, which can formalize concept maps into basic versions of system models.

### Learning objectives:

1. Understand the role of qualitative methods in systems approaches and apply this knowledge to several brief examples, including those generated by workshop participants
2. Describe and compare varying qualitative methods, including concept-mapping, cognitive-affective maps, and cross-impact balances and their uses in research exploring human and planetary health

### Lunch (*provided*) and networking

11:30-12 p.m.

Burt Matthews Hall (BMH) 1005

### Afternoon workshop: Transdisciplinary teams – The science of team science

12-2 p.m.

Burt Matthews Hall (BMH) 1016

### Facilitators:

Dr. Kathryn Plaisance, Department of Knowledge Integration, University of Waterloo

### Workshop description:

Collaborative and transdisciplinary research is increasingly required to solve complex, real-world problems. However, working in a transdisciplinary team is not without its challenges. One of the biggest barriers to effective transdisciplinary work comes from differing—and often conflicting—disciplinary methods and assumptions. In this workshop, we'll draw on a well-tested method, the [Toolbox Dialogue Initiative](#) (TDI), for addressing these barriers.

### Learning objectives:

1. Identify your own disciplinary methods and assumptions
2. Understand how methods and assumptions differ across disciplines
3. Practice a dialogue with others to proactively address barriers to successful collaboration

## CONTRIBUTORS

### Madhur Anand



Madhur (WICI director and professor in the School of Environmental Sciences at the University of Guelph) is an ecologist with broad research interests in natural and human-induced changes in terrestrial ecosystems at local and global scales and their implications for sustainability. In addition to having a distinguished interdisciplinary scientific career, with over 100 peer-reviewed scientific papers and one co-authored textbook on Climate Change Biology, she has presented scholarly research in ecopoetics, co-edited a book on ecopoetry, published her own poetry in literary journals, and was elected a member-at-large of the Association for Literature, Environment, and Culture in Canada in 2011.

### Brad Bass



Brad is an educator and researcher in green infrastructure and energy systems planning, with a long history of working in complex systems simulation. Among his accomplishments, he was awarded the Lifetime Achievement Award for Green Roof Research. In 2013, he founded the University Research Experience in Complex Systems to provide secondary school and university students an opportunity to use COBWEB to develop their own simulations and conduct research. Since 2012, Dr. Bass has been working with Environment and Climate Change Canada's Nutrients Team, within the Office of the Regional Director General of Ontario, to develop the multi-agency Canada-Ontario Action Lake Erie Action Plan.

### Thomas Bury



Thomas is a PhD candidate in the Department of Applied Mathematics, under the supervision of Professors Chris Bauch and Madhur Anand. Previously, he completed his Masters and undergraduate studies at the University of Cambridge, where he specialised in mathematical applications to biological and theoretical physics. Thomas' current research concerns the mathematics surrounding regime shifts in complex systems. He is working with epidemiological, ecological, and climate models to better understand how researchers can exploit time-series data to warn of imminent regime shifts.

### Warren Dodd



Warren is a global health researcher who studies the social and ecological determinants of health. His areas of research include labour migration and health, community food security, rural livelihoods, and agricultural development, and climate change and health. He has experience working and conducting research in Central America, Sub-Saharan Africa, India, and Canada. Warren currently holds a CIHR Fellowship in the Dalla Lana School of Public Health at the University of Toronto and is an Adjunct Assistant Professor in the School of Public Health and Health Systems at the University of Waterloo.



**Scott Janzwood**



Scott is a Global Governance PhD candidate at the Balsillie School of International Affairs where his research examines the governance of global catastrophic risks, such as infectious disease outbreaks, runaway climate change, and asteroid impacts. His dissertation research addresses the challenge of prioritizing scientific research tasks that aid decision-making when dealing with time constraints and deep uncertainty.

**Sharon Kirkpatrick**



Sharon's research program in public health nutrition primarily focuses on understanding dietary patterns in populations and influences on these patterns, using a systems thinking lens to consider the array of factors at play. Much of her work is aimed at improving methodologies for measuring diet to foster a more robust evidence base on the influence of diet on health and the impact of interventions on diet. This includes facilitating the development of methods to address the complexity of diet, both in terms of multidimensionality and dynamism.

**Jodi Koberinski**



Jodi is a master's candidate at the University of Waterloo with a focus on investigating sustainability into Canada's pulses sector. She is a co-founder of the Dangerous Ideas Festival in Canada. Other projects include Praxis Project Permaculture-Inspired Art Festival in New Brunswick and the global Seed Freedom Campaign.

**Bruce Y. Lee**



Bruce is an Associate Professor in the Department of International Health at the Johns Hopkins Bloomberg School of Public Health, Executive Director of the Global Obesity Prevention Center (GOPC) at Johns Hopkins, and Director of Operations Research at the International Vaccine Access Center (IVAC) as well as Associate Professor at the Johns Hopkins Carey Business School. Dr. Lee has over 15 years of experience in industry and academia in systems science and developing and implementing mathematical and computational methods, models, and tools to assist decision making in public health and medicine.

**Kirsten Lee**



Kirsten's research aims to understand the influence of food environment interventions on food selection and dietary patterns. In her doctoral studies, she is investigating the influence of interpretive menu labelling formats on food selection and purchasing behaviour among post-secondary students, as well as potential unintended consequences of labelling policies. More broadly, she is interested in investigating the interplay of social and environmental influences on the food system and how they influence our overall health.

**Steven J. Mock**



Steven is Research Director of the Ideological Conflict Project, a research professor at the Balsillie School of International Affairs, and associate member of the Waterloo Institute for Complexity and Innovation. His current research interests focus on modeling the myths, symbols, and rituals associated with the constructs of national and other forms of political-cultural identity, further to understanding the impact of these constructs on conflict and conflict resolution. He is the author of *Symbols of Defeat in the Construction of National Identity* (Cambridge University Press, 2012).

**Brendon Philips**

Brendon Phillips is a PhD student at the University of Waterloo under the supervision of Professor Chris Bauch. His research centres around finding early warning signals of epidemics in large populations.

**Katie Plaisance**



Katie's research interests include philosophy of the behavioural sciences and public understanding of science. She is working on a project called "Making Philosophy of Science More Scientifically and Socially Engaged". She combines her interests in philosophy, biology, and psychology, and has a passion for interdisciplinary education. She received her Masters and PhD in Philosophy, with a minor in Bioethics, from the University of Minnesota in 2006.

**Amanda Raffoul**



Amanda's research interests include psychosocial contributors to weight status, such as dieting, body image, and weight bias, and how they influence our overall health. She has investigated patterns of co-occurrence between dieting and various health-compromising behaviours among adolescent girls in a national school-based study. In her doctoral studies, she will investigate the potential unintended consequences of obesity prevention initiatives on weight-related attitudes and behaviours among Canadian young adults.

**Vanessa Schweizer**



Vanessa's fundamental training was in physics, and she holds minors in mathematics, philosophy, and speech communication. She also holds a Masters in Environmental Studies and a PhD in Engineering and Public Policy. She blends these interdisciplinary interests through her work on scenarios, which are common tools for collective decision-making. Vanessa has ongoing projects around problems in long-term decision-making, such as forecasting and discontinuities. Her recent work has included the influence of occupational, interpersonal, and cultural conflicts on climate change attitudes.

**Steffanie Scott**



Steffanie is the past president of the Canadian Association for Food Studies, and is engaged in research on sustainable food systems in China and Canada. Her work documents the emergence of the ecological agriculture sector and alternative food networks in China. She is also researching the urban food system in Nanjing, China.

**William Sutherland**



William is a general practice physician working in emergency medicine, general practice psychotherapy, and functional medicine. He is the innovator of the complexity medicine paradigm and the author of the upcoming book on the subject, *Grand Rounds: Healing Wisdom for a Complex World*. He is a graduate of the Michael G. DeGroot School of Medicine at McMaster University and completed a residency in rural family medicine. Presently, he is an assistant clinical professor (adjunct) through the Department of Family Medicine at McMaster.

**Mat Thijsen**



Mat coordinates the University of Waterloo's sustainability activities and efforts, in partnership with a broad range of stakeholders on and off campus. He also provides support to the President's Advisory Committee on Environmental Sustainability. Prior to joining the University of Waterloo, Mat worked for three years with Sustainable Waterloo Region, a local environmental non-profit that helps convert organizational interest in sustainability into tangible action.

**Katharine Zywert**



Katharine's research investigates health and care practices that could offer alternative trajectories for health systems coming to terms with the ecological and social dynamics of a novel geological epoch. She is particularly interested in approaches, techniques, and designs that reduce reliance on state and market mechanisms while building community resilience. Her research takes a problem-focused, transdisciplinary approach that brings together knowledge from anthropology, sociology, economics, ecology, social psychology, philosophy, medicine, and complexity science.





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