SOCIAL-ECOLOGICAL INVENTORIES

BUILDING RESILIENCE TO ENVIRONMENTAL CHANGE WITHIN BIOSPHERE RESERVES

A Climate Change Adaptation Workshop held
at Brock University on 7-8 March, 2011.

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Preface

This report was prepared under contract for the Adaptation and Impacts Research Section of Environment Canada (AIRS) by lead author Dr. Richard C. Mitchell (Service Contract KM 170-10-1416). Based upon Environment Canada's national program focus on community climate change adaptation in different areas of Canada, one of the main goals of AIRS is to ensure Canadians are informed of impacts and are prepared to adapt to their effects – a simultaneous process occurring throughout many regions of the world. As part of this process, a five-year Memorandum of Understanding (2010-2014) has been formalized with Environment Canada, Mistra Swecia/Stockholm Environmental Institute, and the Brock Environmental Sustainability Research Unit (BESRU) to facilitate collaborative research in these areas. Under this agreement, in January 2011 AIRS proposed holding an experts' workshop with Swedish and Canadian colleagues familiar with conducting a "social-ecological inventory" (SEI). The SEI was first developed in a 2007 case study in Sweden's Kristianstads Vattenrike Biosphere Reserve (Schultz, Folke and Olsson, 2007) with the main goals of strengthening capacity for local actors involved in ecosystem services and improving human well-being. The workshop provided the opportunity to review projects from both countries with the aim of cross-scale adaptation (Schultz, Folke and Olsson, 2007; Gafarova, May, and Plummer, 2010; Armitage and Plummer, 2010; Velaniškis, 2010).

The author wishes to thank workshop participants from Sweden and Canada, as well as Ms. Kerrie Pickering whose important preparations and research contributions formed the basis of this report. Lisen Schultz of the Stockholm Resilience Centre, Åsa Swartling of the Stockholm Resilience Centre and Stockholm Environment Institute, Bradley May of Environment Canada and Brock University, and Ryan Plummer of Brock University and the Stockholm Resilience Centre are also gratefully acknowledged here. Ms. Crystal Vella also provided invaluable editorial assistance during the final review of the report. Responsibility for errors or omissions rests solely with the lead author, and while the report provides research, analysis and expert opinions of workshop participants, it does not necessarily represent the views of Environment Canada or any individual workshop participant. Please see Appendix One for a complete list of contributors.

Table of Contents

Introduction

This report is a synopsis derived from a two-day experts' workshop with Swedish and Canadian collaborators that included an overview and analyses of findings from socio-ecological inventories (SEIs) undertaken in two biosphere reserves - Sweden's Kristianstads Vattenrike Biosphere Reserve and the Niagara Escarpment Biosphere Reserve (Schultz, Folke, and Olsson, 2007; Armitage and Plummer, 2010; Gafarova, May and Plummer, 2010; Velaniškis, 2010). Entitled "Social-ecological inventories: Building Resilience to Environmental Change within Biosphere Reserves", the event was hosted by core faculty from the Brock University Environmental Sustainability Research Unit (BESRU) in Ontario, Canada (see **http://brocku.ca/brock-environmental-sustainability-research-unit**). The workshop engaged scientists, academic researchers, practitioners and students familiar with SEIs, those in governmental and non-governmental leadership roles, those familiar with research within United Nations Educational, Scientific and Cultural Organization (UNESCO) Biosphere Reserves, and those familiar with similar participatory methodologies and processes outside and beyond the boundaries of biosphere reserves. The event was organized utilizing principles from relevant international frameworks including those underlying the UN Decade of Education for Sustainable Development (see also Lundholm and Plummer, 2010; Krasney, Lundholm and Plummer, 2010; Plummer, 2010; Schultz and Lundholm, 2010) with the following aims:

- To advance lessons and commonalities from the application of SEIs in Sweden and Canada with those engaged in similar processes
- To develop a document outlining some common methodological and conceptual grounds

Based upon their case study in Sweden and the mission, functions and criteria of UNESCO's Man and the Biosphere Program (MAB), Schultz, Duit and Folke (2010) have proposed that biosphere reserves "constitute potential sites for testing the effectiveness of participation in general and adaptive co-management in particular" (p. 663). Nestled in the Niagara Escarpment Biosphere Reserve (designated in 1990), Brock University is one of a small but growing cadre of Canadian academic institutions located within such reserves. As such, conservation, sustainable socio-economic development, and education are suggested as the basis for improvements in relationships between humans and their ecosystems.

In the journal *Environments*, however, Jamieson (2004) notes that Canadian biosphere reserves have tended not to function very well in achieving UNESCO's goals (see also Francis and Whitelaw, 2004) since "the average Canadian knows nothing about biosphere reserves ….Current public ignorance about biosphere reserves in Canada is partly the result of our unique situation relative to Europe - Canada has extensive

areas of relatively undisturbed wilderness" (pp. 103-104). Responding to this gap in domestic knowledge, the Brock Environmental Sustainability Unit has begun to interrogate the scientific, pedagogical and cultural intersections of our geographical location more precisely as a proposed site of excellence.

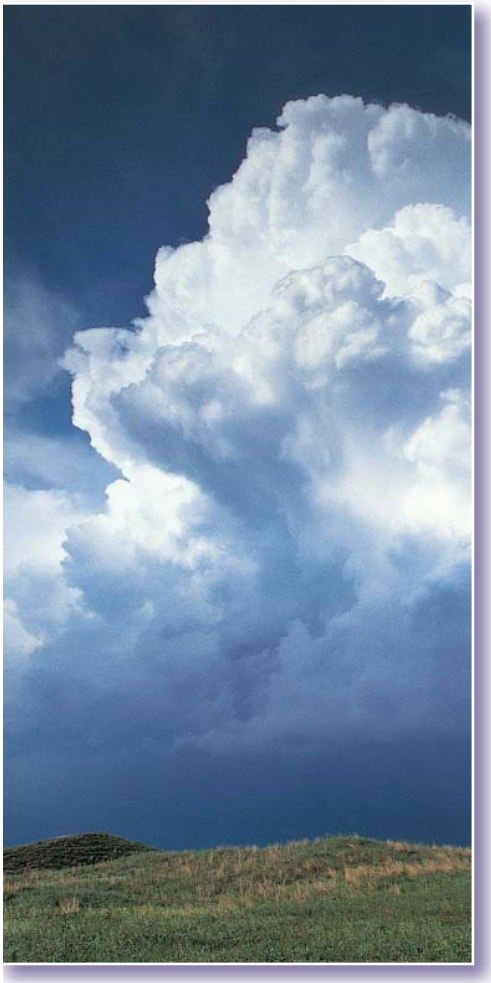
While SEIs have been framed using much of the language of conservation biologists, they involve participatory mapping of existing stewardship and monitoring of landscape management processes that facilitate baseline achievement of UNESCO MAB goals. It is also the case that many regions of the world lie beyond the boundaries of biosphere reserves but would nonetheless benefit from adopting the SEI within their own national parks, protected areas and ecosystems under pressure from human activities. During the workshop common frameworks for interpreting and understanding SEIs emerged that could facilitate their cross-scale adaptation, and the following points reflect these participatory values:

- Due to the mission and functional criteria of biosphere reserves, accomplishing the aims of the SEI will allow greater fulfillment of their role as sites of excellence comprising the three inter-related dimensions of conservation, human and socio-economic well being, research, evaluation and education.
- Since human well-being is an underlying principle and the motivation behind development of the SEI, common conceptual frameworks defining human health could facilitate identification of 'bridging organizations' for those conducting the SEI within or beyond biosphere reserves.
- Due to the globalized nature of corporate, institutional and individual *power relations*, SEIs were seen as a participatory pathway to allow these actors to be identified locally.

The remaining sections of the report are organized under the following themes that include a definition and overview of SEIs, international frameworks currently being utilized to understand and evaluate resilience within complex adaptive ecosystems, and some additional theoretical resources emerging from those conducting the SEI within biosphere reserves.

What is a Social-Ecological Inventory?

Social-ecological inventories (SEIs) were developed as a community-based approach for assessing resilience in Sweden's Kristianstad Vattenrike Biosphere Reserve by Dr. Lisen Schultz during her doctoral research, and as "a means to identify people with ecosystem knowledge that practice ecosystem management" (Schultz, Folke, and Olsson, 2007, p. 140). The methodology has been further applied in the Niagara Escarpment Biosphere Reserve in Ontario, Canada since 2009. These authors highlight how SEIs are dynamic and propose their application during the preparation phase of conservation and resilience assessment projects. SEIs are a way of approaching the social landscape as carefully as the biophysical landscape with a systematic mapping of actors, their values, motives, activities, experiences over time, and networks. These authors note how the approach "complements stakeholder analyses and biological and ecological inventories, and assesses existing management systems behind the generation of ecosystem services, thus providing a starting point for participation" (Schultz, *et al.*, 2007, p. 141). During the process "bridging organizations" are identified as those "coordinating and connecting many of the local steward groups to organizations and institutions at other levels" (Schultz, *et al.*, 2007, pp. 140-141). The inventory complements stakeholder analyses as well as biological or ecological inventories by assessing existing management systems behind the generation of ecosystem services. As such, groups such as these "represent an undervalued and sometimes unrecognized source of knowledge and experience for ecosystem management" (Schultz, *et al.*, 2007, p. 141).



These same authors further observe how the means to map, analyze and facilitate stakeholder engagement in order to develop participatory conservation projects have been discussed in previous literature. They caution, however, that while 'participation' by a variety of stakeholders may be desirable from a "democratic perspective, it is not in itself a recipe for successful ecosystem management. Participation has to be connected to management practices that generate ecological knowledge, draw on experience, and learn about and respond to ecosystem dynamics". Thus, the SEI allows local actor groups "generally operating at the level below municipalities, who effect management of ecosystems and their services on the ground" to be identified (Schultz, *et al.*, 2007, p. 141). It has also become apparent from application that the SEI prepares the methodological ground for democratic, active and meaningful stakeholder participation. "We do not claim that the SEI is complete" (Schultz, *et al.*, 2007, p.142), and an iterative, ongoing process is envisioned that will be enhanced by those further applying SEIs in cross-scale adaptation.

From an analysis of preliminary phases of the Niagara Region SEI, Velanaškis (2010) maintains "a key factor in understanding social-ecological system interactions is identifying linkages or lack of linkage among the actors who are directly involved in ecosystem and risk management" (p. 14). It was further confirmed during the workshop by those engaged in further application of the Niagara SEI that the preparatory phase of identifying bridging organizations and actors rests upon trust-building and researcher transparency. Participants emphasized the importance of not being overly proscriptive and to communicate expectations from the outset highlighting the collaborative ownership of the process as well as outcomes. Clear expectations and well-defined research protocols are to be communicated since those engaged in conducting the SEI could well be understood as agents of change themselves, and as researchers even becoming a type of 'bridging organization' through the exercise of reflexivity.

UNESCO's Role in Defining and Evaluating Resilience

The year 2011 is marked by important global challenges that have affected humanity as never before. While globalization has had a positive effect on millions of people by helping them rise out of poverty, a global crisis of unusual proportions - economic, financial, social, and environmental - endangers fulfillment of the most important agenda of present-day multilateralism, the **United Nations Millennium Development Goals**.

This workshop report also coincided with UNESCO's Madrid Action Plan for Biosphere Reserves (2008-2013) as well as the 40th anniversary of the Man and the Biosphere Program (MAB). MAB invites stakeholders within the World Network of Biosphere Reserves (WNBR) to engage in fostering more harmonious integration of people and nature for sustainable development through participatory dialogue, knowledge sharing and improvement of human well-being. The Madrid Action Plan notes a "commitment to innovative time-bound socio-ecological and policy actions integrating the three biosphere reserve functions and the willingness to share data, information, experience and knowledge are vital to the role for biosphere reserves to be learning sites during the Education for Sustainable Development (ESD) 2005-2014" (p. 10).

Lundholm and Plummer (2010) emphasize how a growing interest in environmental education has contributed to greater literacy in sustainability "dating from the 1977 UNESCO conference in Tblisi to the current Decade of Education for Sustainable Development" (2005-2014) which reached mid-term in 2009 (p. 475). Pigozzi (2010) further observes that through ESD, UNESCO seeks to integrate principles, values, and practices of sustainable development into all aspects of education and learning to address social, economic, cultural and environmental problems faced by humans in the 21st century. Nevertheless, as Lundholm and Plummer (2010) astutely inquire, in terms of "the political and pedagogical aspect of resilience, is the concept working as a heuristic cognitive tool in guiding us to look critically at ourselves [positively in terms of both human resourcefulness and strengths, and our shortcomings]?" (p. 486). It is clear that UNESCO offers just such conceptual and political tools internationally for mobilizing domestic public opinion, and intellectual and academic communities in pursuit of these values and priorities.

UNESCO embraces 193 Member States and six Associate Members, and its mandate is highly relevant in the 21st century where building knowledge-based societies is an imperative, where culture is crucial to any meaningful debate on sustainable development, and where science and innovation mark a new research era in fields such as climate change and water. As learning sites of excellence the 564 ecosystems comprising the current WNBR constellation offer one of the premier planetary frameworks for the development and building of international capacity to manage complex socio-ecological systems. This is achieved through greater dialogue at the science-policy interface, through environmental education and through multi-media outreach to wider communities interested in more sustainable development (adapted from UNESCO's 2008-2013 Madrid Action Plan for Biosphere Reserves). In Canada, researchers, practitioners, professionals, local, governmental and non-governmental stakeholders have begun to engage in this dialogue within the fifteen sites below.

Schultz, Duit and Folke (2010, p. 663) recount how biosphere reserves were designated by UNESCO with the mission of maintaining and developing ecological and cultural diversity and securing ecosystem services for human wellbeing (see also UNESCO, 2008, p. 8) in collaboration with a suitable range of actors, often including local communities and

scientists. Since 1995, biosphere reserves have been expected to fulfill the three functions stated in the Statutory Framework and the Seville Strategy (UNESCO, 1996): (1) conserving biological and cultural diversity, (2) fostering sustainable social and economic development, and (3) supporting research, monitoring, and education. These three functions and several of the criteria of biosphere reserves also correspond to features of adaptive co-management since they focus on monitoring, and an integrated approach to conservation and development along with recommendations of adaptive management and participation of a suitable range of actors.

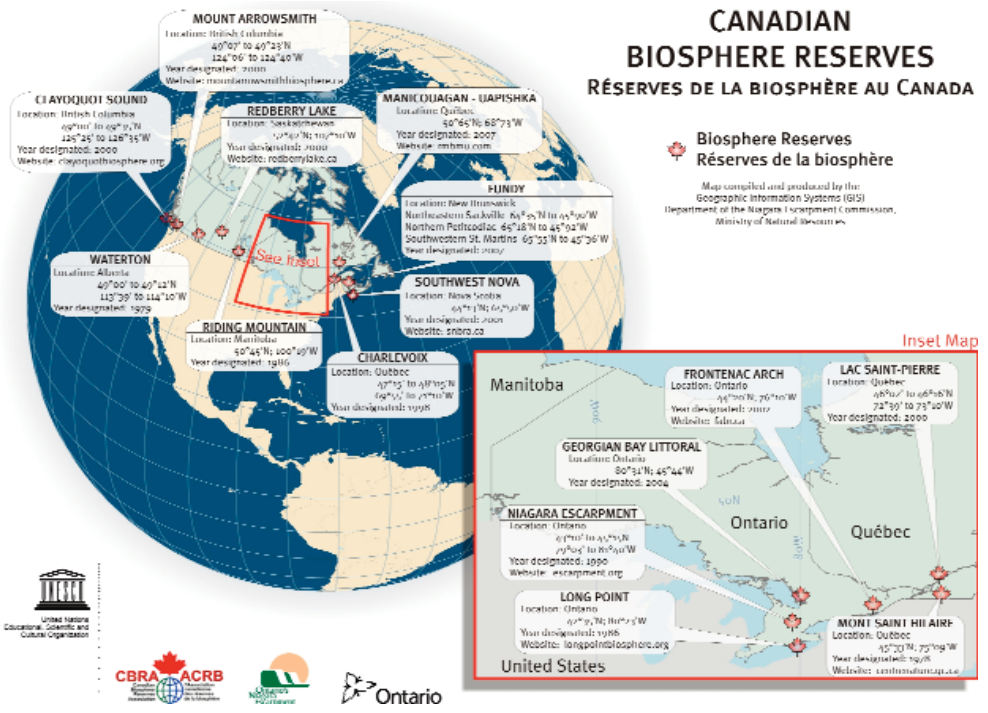


Figure 1.1 – Map of 2011 Canadian Biosphere Reserves under UNESCO's MAB Program
(reprinted with permission from Niagara Escarpment Commission, Ontario Ministry of Natural Resources)

In a discussion of the MAB program, UNESCO's current Director-General Ms. Irina Bokova recently observed that "[s]ustainable development starts with education, but it must reach outside the classroom. The private sector, non-governmental organisations along with wider civil society are all vital for raising awareness ….To build economies and societies that are more resilient in the face of change, we have to make the most of all actors in society and draw on all sources of knowledge …. UNESCO's 564 biosphere reserves, spread across 109 countries, are real-world schools for learning to manage biological diversity in harmony with local communities" (Oman Daily Press, 2011).

Speaking from his experience in Canada's Southwest Nova Biosphere Reserve, Philip Taylor (2004), biology professor at Nova Scotia's Acadia University and Executive Director of the Resilience Alliance, posited one of the

first conceptual frameworks for understanding resilience within biosphere reserves that he presented for cross-scale case study and analysis. While observing a wide variety of approaches to the implementation and management of biosphere reserves, he argued it would be worth exploring how current conceptual frameworks "might be enhanced by more directly considering some of the advancements in theory" made over the past two decades (p. 80).

The following graphic that shows the three interdependent dimensions as units of analysis for research, development and monitoring that UNESCO invites key governmental, non-governmental and academic actors to undertake, the same dimensions from which Taylor posited his approach to conceptualizing and evaluating resilience measures.

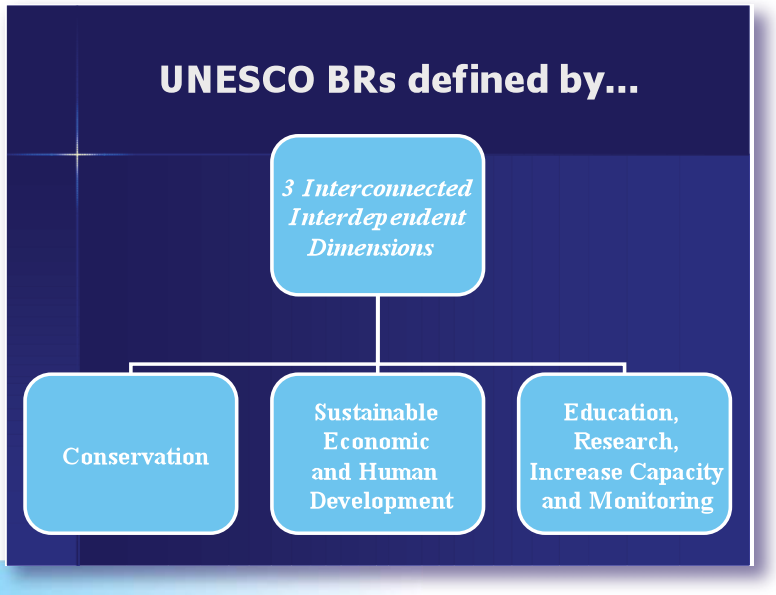


Figure 1.2 – Dimensions of Biosphere Reserves

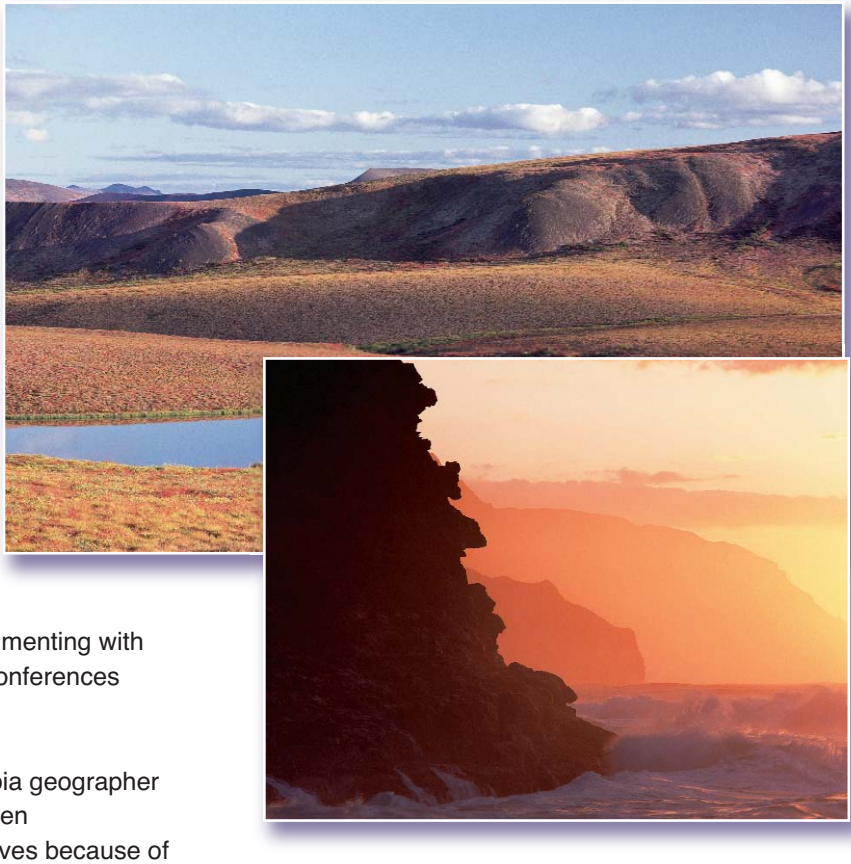
The challenge for those conducting research and evaluation within biosphere reserves, and elsewhere, is to develop and articulate as broad a base of common measures for cross-scale application as possible. In order to target ecological, social and economic dimensions of biodiversity loss and attempt to reduce this loss, new knowledge from applying SEIs and theorizing its assumptions are presented here. Workshop contributors repeatedly acknowledged this search for common language to describe problems associated with climate change is taking place throughout the world.

Some Common Intellectual Ground

Building on Taylor's (2004) arguments for theorizing resilience and building capacity through biosphere reserve research, two common frameworks are presented in this section with a view towards cross-scale adaptation of SEIs - two conceptual approaches that offer a broad understanding of UNESCO's dimension of sustainable human and socio-economic development. Theorizing the "logistics function" from four Canadian biosphere reserves was the focus of Whitelaw, Craig, Jamieson and Hamel (2004, p. 65) through a " 'place based' framework" for ongoing research and periodic evaluations (see also Pollock's [2004] similarly conceived framework in the same volume).

While sustainable development is not solely a contemporary concern, research agendas in the new century have taken an innovative turn with conceptual and methodological approaches mirrored in the literature of scientific journals as well as within social science, humanities and healthcare as "transdisciplinary" (Mitchell, 2011; see also Austin, Park, and Goble, 2008; Holmes and Gastaldo, 2004; Koizumi, 2001; Nicolescu, 2002; Robinson, 2008). Visser (1999) and Nicolescu (2002) consider the contours of transdisciplinary education in the early twenty-first century:

- Learning is an underdeveloped concept, but is necessary for all humans to be able to adapt to continuous and ever-faster change in an increasingly complex world. Fundamental changes are urgently required in the way school systems throughout the world are organized that must include more holistic concept¬ualizations of schools themselves as only one part of a comprehensive learning environment.
- Learning has to do with the capacity to interact creatively and constructively with problems. In most current pedagogical practices such problems are often concealed or ignored altogether. In a manner similar to Brazilian educator Freire (1970, 1999), learning therefore needs to be re-focused on problems, including their historical and epistemological contexts.
- Learning is a transdisciplinary concept related to overarching concerns such as change and growth; community-based processes and development; complex, diverse, and emerging adaptive expressions; new designs for systems of knowledge construction interacting with, and building upon, existing knowledge bases; lifelong learning at different levels of organizational complexity; neuroscience and lifespan cognitive development; the interconnections and distinctions between and among data, information, knowledge and wisdom; and new technologies for learning, languages, cognition, and meta-cognition.



Coincidentally, the institutionalization of transdisciplinarity within universities has UNESCO antecedents beginning in 1987 through the creation of the International Centre of Transdisciplinary Research and Studies (Centre International de Recherches et Études Transdisciplinaires, or CIRET). In 1995, Rumanian physicist Basarab Nicolescu co-founded the Reflection Group on Transdisciplinarity with UNESCO - a project initially involving 16 scientific and cultural personalities in the implementation of transdisciplinary methodologies in various fields of international research. One of its main aims is the implementation of these principles in education, and slowly but decisively, transdisciplinarity has gained an international impact especially in superior educational settings as universities from all over the world have opened themselves to experimenting with transdisciplinary curricula, research activities, and conferences (Dincă, 2011).

In line with this thinking, University of British Columbia geographer John Robinson (2008) emphasizes how "[i]ssue-driven interdisciplinarity" is required for sustainability initiatives because of their "inherently complex, multi-faceted and problem-based focus", and further, that sustainability represents the "paradigm case" for understanding this new concept. Robinson suggests such "transdisciplinarity" has less to do with new theoretical frameworks or the unity of knowledge "than with the emergence of problem- and solution-oriented research incorporating participatory approaches to address societal problems". The intellectual project of forging new sustainability coalitions (such as those that emerge during the process of an SEI) is one of being "undisciplined", he argues, in the sense that "practitioners of this style of interdisciplinarity do not find themselves at the margins between disciplines, but in the sometimes uncomfortable borderlands between the academy and the larger world" (2008, pp. 71-73; see Nicolescu, 2002 for similar analyses).

In another effort to re-conceptualize 'sustainability' in ecosystems, Dempster (2000) addresses some of the tensions inherent in defining resilience through complex systems theory since the basis for much of this literature draws on 'autopoietic systems' defined by Chilean biologists Maturana and Varela (1980). Dempster contends that "heuristics based upon the organism metaphor are often inappropriate and misleading for understanding complex systems". Autopoietic systems, she recounts, have self-defined boundaries, are self-produced and self-replicate, and are organizationally closed (see also Niklas Luhmann's [1995, 1997] autopoietic social systems) - none of these dynamics is the case for ecosystems, she argues, due to human activities. In response, Dempster presents a new heuristic to more accurately represent complex ecosystems as "sympoietic" and to reflect open-ended characteristics and boundaries that are collectively produced and organizationally "ajar" rather than autopoietically closed (2000, p. 1). These are very much the characteristics of human organizations.

By looking more closely at notions of human development and well-being - grounds that were well-defined in the Ottawa Charter for Health Promotion (1986) and adopted by the World Health Organization - workshop participants also attempted to define common epistemological grounds for applying SEIs more broadly. The Charter has been promoted as a federal policy framework by Health Canada known as the *social determinants of population health* since that time. Briefly, the World Health Organization definition underpinning this holistic framework has been unchanged since 1948 as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. These social determinants for health and development have been robustly researched throughout many regions of the world (see Hertzman, 1992; Hertzman, Torres, Subida, and Barroetavena, 1995; Kindig and Stoddart, 2003) and are further posited to enable people to increase control over and even improve their own health - including aspects of 'environmental' health.

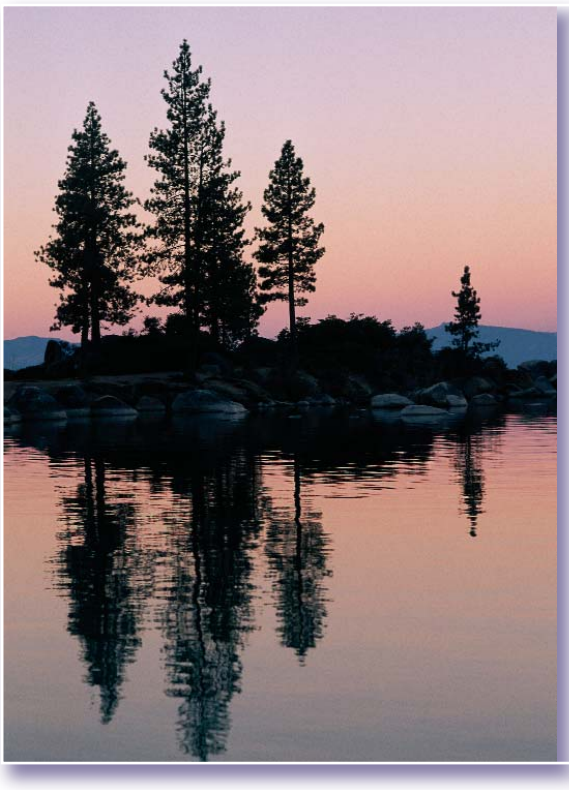
From this perspective of human well-being, the dimension of health in and through the environment is integrally linked, but not solely as the prerogative of those working within the healthcare sector or its various regimes. These *determinants of population health* (Public Health Agency of Canada, 2011; World Health Organization, 2011) include:

- income and social status
- employment
- education
- social environments
- physical environments
- healthy child development
- personal health practices and coping skills
- health services
- social support networks
- biology and genetic endowment
- gender
- culture

These units of measuring human well-being would also allow for SEIs to be explored in new and exciting ways. Adapting a SEI in the context of the ***RA Workbook***, for example, could draw upon these internationally developed resources that are also quite congruent with transdisciplinary approaches and the core concepts from the Decade for Education on Sustainable Development (2005-2014).

Power sharing issues while conducting SEIs

In this context it is useful to note, as Dutch feminist Sevenhuijsen (1999) has argued, that "[p]olicy texts are sites of power…by establishing narrative conventions, authoritative repertoires of interpretation and frameworks of argumentation and communication, they confer power upon preferred modes of speaking and judging, and upon certain ways of expressing moral and political subjectivity" (cited in Moss and Petrie, 2002, p. 81).



This 'meta-issue' was identified repeatedly by workshop contributors as cutting across scales for anyone considering applying the SEI, and for which practitioners and researchers should be cognizant regardless of their institutional affiliations, and global region or jurisdiction. In a paper analyzing power relations from a case study in the Florida Everglades, Dengler (2007) similarly concludes that "collaborative environmental governance within the social setting of an arena" consists of "multiple, complementary spaces that are focused on different types of knowledge" (p. 428). By drawing upon Ostrom's (1990) principle of 'nested enterprises', Dengler identifies the connectivity of multiple layers of governance and the inter-relationships amongst institutions at local, regional and national levels.

In this theorization, each knowledge space within a particular policy or practice arena has a key role focused on different competencies necessary for achieving any agreed upon statutorily-based framework or social policy.

While this concept is useful for understanding linkages across spatial scales, Dengler also identifies the lack of attention in Ostrom's analysis to how power relations impact development of these 'nests', and she has presented the graphic below in order to illuminate some of the contours of these relations. Important decisions about how to adapt any approach for cross-scale application are frequently issues to do with economic, institutional, governmental and/or interpersonal power relations – and necessarily include those to do with applying SEIs.

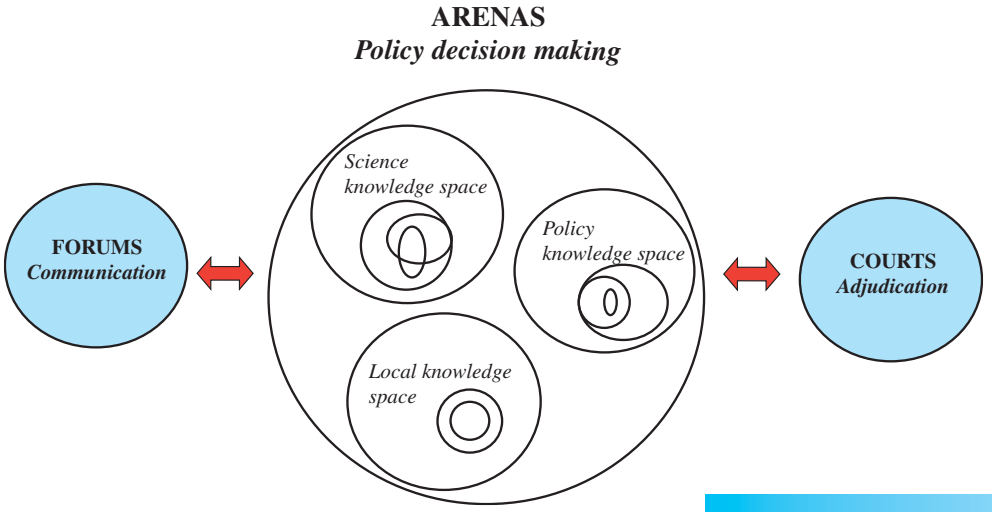


Figure 1.3 – Arenas for decision-making

Dengler's (2007) analysis brings aspects of formal power-sharing during decision-making in complex systems into view, but as was observed by workshop participants, Dengler's model (reprinted with permission) is a way of illuminating important aspects of power-sharing for those conducting the SEI, as well as groups or individuals interested in similar participatory processes.

In a similar commentary on the nature of power relations embedded within biosphere reserve organizations, practitioner Norm Ruttan (2004) notes how most "Canadians assume that you need authority to achieve something" but such power "does not always come from authority" (p. 108). He points out that "**power** in biosphere reserves comes from the lack of any authority of any kind over any local community…Our power comes from the ability to work with a local community to acquire and use knowledge, to facilitate community planning, to coordinate community steering, to encourage collaboration and – in the final analysis – to get things done that those in authority cannot achieve" (ibid., p. 109, emphasis in original). This window into identification of authoritative sources of environmental knowledge – one of the main aims of conducting a SEI – must be opened widely when thinking about sourcing Indigenous knowledge in the context of biosphere reserve metrics. As one of many examples in this national context as well as those within many other international jurisdictions, nested within the complex web of environmental governance relations are local and national Indigenous elders who possess centuries-old oral traditions - an analysis that has received at least one favorable Canadian Supreme Court ruling that not surprisingly began over an environmental ecosystem dispute (Delgamuukw v. British Columbia, [1997] 3 S.C.R. 1010).

Conclusion: From Conceptualizing to Applying the SEI

As previously noted, the SEI has been carried out in two national contexts - each located within a UNESCO Biosphere Reserve - with a main objective to engage participants and stakeholders in a systematic, participatory ecosystem assessment. In addition, those with expertise in participatory research in the field of climate change adaptation beyond biosphere reserve boundaries recognized that applying the SEI offers exciting possibilities for extending the scope of empirical evidence upon which the steps suggested below may be more firmly anchored.

Thus, a main aspect of the workshop was to advance thinking about how to apply SEI procedures as well as how to avoid **potential pitfalls and constraints in conducting the SEI.** A rich dialogue took place about how to start moving from conceptualization to application. Schultz and Plummer presented a summary of these ideas at the *Resilience, Innovation, and Sustainability: Navigating the Complexities of Global Change Conference* in 2011. Subsequently, a workbook was prepared to assist individuals and organizations interested in applying a social-ecological inventory and is entitled:

Shultz, L., Plummer, R. and Purdy, S. 2011. Applying a Social-Ecological Inventory: A workbook for finding the key actors and engaging them. Brock University: St. Catharines. (9 pp.) The workbook is accessible at the ***Resilience Alliance*** website: **http://www.resalliance.org/index.php/resilience_assessment** and is labeled there as the *Social-Ecological Inventory Workbook.*

As per workshop aims, the workbook is a supplementary module contributing to the Resilience Assessment process put forward by the ***Resilience Alliance*** - an international research organization comprised of scientists and practitioners from many disciplines throughout the world who collaborate to explore the dynamics of social-ecological systems. Its shared body of knowledge encompasses key concepts of resilience, adaptability and transformation as the foundation for sustainable development.

References

Armitage, D. and Plummer, R. 2010. *Adaptation, Learning and Transformation in Theory and Practice: A State-of-the-Arts Literature Review and Strategy for Application in the Niagara Region.* Final Report. Prepared for Adaptation and Impacts Research Section - Environment Canada. Toronto, Ontario. (47 pp.)

Austin, W., Park, C. and Goble, E. 2008. From interdisciplinary to transdisciplinary research: a case study. *Qualitative Health Research*, Vol. 18, pp. 557-64.

Bodin, Ö. and Crona, B. 2009. *Social Networks among Stakeholders module for Assessing Resilience in Social-Ecological Systems Workbook for Practitioners*. Available from: **http://www.resalliance.org/index.php/resilience_assessment** and accessed 25 February, 2011.

Dempster, B. 2000. *Sympoietic and Autopoietic Systems: A New Distinction for Self-Organizing Systems.* In Proceedings of the World Congress of the Systems Sciences and ISSS 2000, J.K. Allen and J. Wilby, eds. [Presented at the International Society for Systems Studies Annual Conference, Toronto, Canada, July 2000].

Dengler, M. 2007. Spaces of power for action: Governance of the Everglades Restudy process (1992-2000). *Political Geography* 26: 423-454.

Dincă, I. 2011. *Stages in the Configuration of the Transdisciplinary Project of Basarab Nicolescu.* Available from: **http://basarab.nicolescu.perso.sfr.fr/Basarab/Docs_Notice/Irina_Dinca.pdf** and accessed 29 March, 2011.

Francis, G. and Whitelaw, G. 2004. Biosphere Reserves in Canada: An introduction. **Environments** 32(3): 1-2.

Gafarova, S., May, B. and Plummer, R. 2010. *Adaptive Collaborative Risk Management and Climate Change in the Niagara Region: A Participatory Integrated Assessment Approach for Sustainable Solutions and Transformative Change – General Overview.* Prepared for Adaptation and Impacts Research Section - Environment Canada. Toronto, Ontario. (6 pp.)

Hertzman, C., Torres, E.B., Subida, R.D. and Barroetavena, M.1995. *Environment and Health in the Philippines.* Health Policy Research Unit - Centre for Health Services and Policy Research: Vancouver, Canada.

Hertzman C. 1992. *Environment and Health in the Baltic Countries.* Health Policy Research Unit - Centre for Health Services and Policy Research: Vancouver, Canada.

Holmes, D. and Gastaldo, D. 2004. Rhizomatic thought in nursing: an alternative path for the development of the discipline. *Nursing Philosophy* 5: 258-67.

Jamieson, G. 2004. Commentary. *Environments* 32(3): 103-106.

Kindig, D. and Stoddart, G. 2003. What is Population Health? *American Journal of Public Health* 93(3): 380-383.

Koizumi, H. 2001. Trans-disciplinarity. *Neuroendocrinology Letters* 22: 219-21.

Krasney, M.E., Lundholm, C. and Plummer, R. 2010. Environmental education, resilience, and learning: reflection and moving forward. *Environmental Education Research* 16(5-6): 665-672.

Luhmann, N. 1995. *Social Systems.* (J. Bednarz, translator). Stanford, CA: Stanford University Press.

Luhmann, N. 1997. Globalization or world society: how to conceive modern society? *International Review of Sociology* 7(1): 67-79.

References cont...

Lundholm, C. and Plummer, R. 2010. Resilience and learning: a conspectus for environmental education. *Environmental Education Research* 16(5-6): 475-491.

Mendes-Millard, S. and Reed, M. 2007. Understanding Community Capacity Using Adaptive and Reflexive Research Practices: Lessons from Two Canadian Biosphere Reserves. *Society & Natural Resources* 20(6): 543-559.

Mitchell, R. C. 2011. Sustaining Change on a Canadian campus: Preparing Brock University for a sustainability audit. *International Journal of Sustainability in Higher Education* 12(1): 7-21.

Maturana, H. R. and Varela, F. 1980. *Autopoiesis and Cognition: The Realization of the Living*. Dordrecht: Holland: D. Reidel Publishing Company.

Moss, P. and Petrie, P. 2002. *From Children's Services to Children's Spaces – Public Policy, Children and Childhood.* London: Routledge/Falmer.

Nicolescu, B. 2002. *Manifesto of Transdisciplinarity.* State University of New York Press, New York, NY.

Ottawa Charter for Health Promotion First International Conference on Health Promotion. 1986. World Health Organization: Geneva. Available from: **http://www.who.int/hpr/NPH/docs/ottawa_charter_hp.pdf** and accessed 29 March, 2011.

Plummer, R. 2010. Social-ecological resilience and environmental education: synopsis, application, implications. *Environmental Education Research* 16(5-6): 493-509.

Pollock, R. M. 2004. Identifying Principles for Place-Based Governance in Biosphere Reserves. *Environments* 32(3): 27-41.

Public Health Agency of Canada. 2011. *Determinants of Population Health.* Available from: **http://genderandhealth.ca/en/modules/introduction/introduction-genderasadeterminantofhealth-Shayna-02.jsp#HC-1999** and accessed 29 March, 2011.

Resilience Alliance – *A Basis for Sustainability. 2010. Assessing Resilience in Social-Ecological Systems Workbook for Practitioners,* Revised Version 2.0. Available from: **http://www.resalliance.org/index.php/resilience_assessment** and accessed 29 March, 2011.

Robinson, J. 2008. Being undisciplined: transgressions and intersections in academia and beyond. *Futures* 40: 70-86.

Ruttan, N. 2004. Are Biosphere Reserves the missing link in Canada's move towards a more sustainable society? *Environments* 32(3): 107-110.

Supreme Court of Canada. 1997. Delgamuukw v. British Columbia, [1997] 3 S.C.R. 1010. Available from: **http://scc.lexum.org/en/1997/1997scr3-1010/1997scr3-1010.html** and accessed 29 March, 2011.

Schultz, L., Folke, C. and Olsson, P. 2007. Enhancing ecosystem management through social-ecological inventories: lessons from Kristianstads Vattenrike, Sweden. *Environmental Conservation* 34(2): 140-152.

Schultz, L., Duit, A. and Folke, C. 2010. Participation, Adaptive Co-management, and Management Performance in the World Network of Biosphere Reserves. *World Development* 39(4): 662-671.

Schultz, L. and Lundholm, C. 2010. Learning for Resilience? Exploring learning opportunities in biosphere reserves. *Environmental Education Research* 16(5-6): 645-664.

Taylor, P. 2004. Resilience and Biosphere Reserves. *Environments* 32(3): 79-90.

United Nations Educational, Scientific and Cultural Organization. 2010. *Man and the Biosphere Programme*. Available from: **http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/man-and-biosphere-programme/** and accessed 25 March, 2011.

United Nations Educational, Scientific and Cultural Organization. 2008. Madrid Action Plan for Biosphere Reserves (2008-2013). Paris: UNESCO. Available from: **http://unesdoc.unesco.org/images/0016/001633/163301e.pdf** and accessed 28 March, 2011.

United Nations Educational, Scientific and Cultural Organization. 1996. *Biosphere reserves: The Seville strategy & the statutory framework of the World Network*. Paris: UNESCO. Available from: **http://unesdoc.unesco.org/images/0010/001038/103849Eb.pdf** and accessed 28 March, 2011.

Velaniškis, J. 2010. *Report on the Social-Ecological Network Characteristics and Stakeholder Perceptions about Climate Change in the Niagara Region.* Final Report. Prepared for Adaptation and Impacts Research Section - Environment Canada. Toronto, Ontario. (34 pp.)

Whitelaw, G., Craig, B., Jamieson, G. and Hamel, B. 2004. *Research, Monitoring and Education: Exploring the "logistics function" of four Canadian biosphere reserves.* 32(3): 61-78.

Appendix One – Workshop Participant Biographies

Dr. Lisen Schultz

Visiting Scholar, Stockholm Resilience Centre

Lisen is undertaking a post doc at the Stockholm Resilience Centre studying adaptive co-management mainly in biosphere reserves. During her PhD, she and her colleagues developed an approach for identifying key actors (such as local stewards and bridging organizations) in a landscape and engaging them in adaptive co-management known as social-ecological inventories. She is interested in exploring how this method can be refined and used in other cases, and participated in the Millennium Ecosystem Assessment, a UN-programme engaging 1360 experts from 95 countries in analyzing the health of the planet's ecosystems, the consequences for human wellbeing, and possible response options for a sustainable future. She currently works on a quantitative study involving all Man and the Biosphere areas in the world.

Dr. Åsa Swartling

Visiting Scholar, Stockholm Resilience Centre and Stockholm Environment Institute

Åsa is the joint theme leader of Adaptive governance, networks and learning. She specializes in participatory approaches to environmental management and policy. She has been employed at the Stockholm Environment Institute (SEI) since 1994, where she holds a senior research fellow position and a theme leader function of the Transforming Governance for Sustainable Livelihoods research theme. Over the years, Åsa has been involved in numerous research projects dealing with stakeholder engagement, learning, sustainability assessment, project evaluation and policy integration, particularly in the areas of climate change, energy and urban environment. Her research interests and experience include both developing and developed countries. Her current research focuses on the role of social learning in the context of climate adaptation in Sweden (see www.mistra-swecia.se).

Dr. Adam Fenech

Climatologist, Associate Director, Adaptation & Impacts Research, Environment Canada, University of Toronto, Scarborough Campus

Adam is the Acting Manager, Adaptation and Impacts Research, Climate Research Branch and a senior climatologist at Environment Canada and has worked on climate change issues for two decades. His current research activities include rapid assessment of climate change impacts, climate extremes at protected areas, and validating community observations of climate with the scientific record. He has worked at the JFK School of Government at Harvard University on global atmospheric issues, teaches annually at the Smithsonian Institution in Washington, D.C. and maintains a climate research lab at the University of Toronto. He is the author of many scientific papers, and editor of 5 major books on climate change

over the past 5 years. Dr. Fenech shared in the 2007 Nobel Peace Prize awarded for his work with the Intergovernmental Panel on Climate Change (IPCC).

Dr. Ryan Plummer

Brock University Professor of Tourism and Environment

Ryan's program of research broadly concerns environmental governance and social-ecological systems. More specifically, it aims to advance knowledge about collaborative and adaptive approaches in addressing environmental challenges and building capacity to pursue sustainable trajectories. Water resources, climate change adaptation, and recreation are the contexts in which his research most frequently occurs. At Brock University he is the Director of the Brock Environmental Sustainability Research Unit (BESRU) and a Professor in the Department of Tourism and Environment. He is also a Senior Research Fellow at the Stockholm Resilience Centre and holds several adjunct faculty appointments to facilitate work with graduate students. His research efforts are primarily supported by a Brock University Chancellor's Chair for Research Excellence, the Canadian Water Network, and the Social Sciences and Humanities Research Council of Canada.

Marc-André Guertin

Chief Executive Officer of the Canadian Biosphere Reserves Association (CBRA)

Marc-Andre has a background in science (agriculture, ecology and environmental science) from UQAM and McGill University. He also holds a Masters in Environmental Sciences at UQAM, in addition to a second round of training in environmental education. He first pursued a career as an activist and manager of community projects in the conservation of biodiversity (1996-2000) before coordinating the conservation of the Mont Saint Hilaire Biosphere Reserve for 9 years. He is currently employed as Executive Director of the Canadian Association of Biosphere Reserves and in this role he collaborates with various federal, provincial and territorial levels of government and various bodies of UNESCO. He has served on boards of directors of environmental groups and has represented environmental organizations in the Montérégie Regional Commission on natural resources and the territory of the Montérégie Est.

Dr. Liette Vasseur

Biology Department Brock University, Canada

Liette is a full professor at Brock University where she previously served as Vice-President, Research. She has occupied other functions such as Associate Vice-President, Research at Laurentian University and the K.C. Irving Research Chair in Sustainable Development at the University

of Moncton. She recently became a Minjian Scholar at the Fujian Agricultural and Forestry University, Fuzhou, Fujian, China. Her research program focuses on climate change, sustainable development, community-based management, conservation, and gender issues in various countries such as Canada, China, and Burkina Faso. Her current projects include a case study on climate change vulnerabilities and adaptation in Sudbury and another one in the Atlantic Canada. She is a member of the Commission for Ecosystem Management of IUCN, and in the past on the Nickel District Conservation Authority, on the Science Advisory Council of Department of Fisheries and Oceans, and on the Joint Public Advisory Committee of the North American Commission for Environmental Cooperation. She is an Associate Editor of "Botany", associate editor-in-chief of the Journal of Biosafety, and on the editorial board of Recherches féministes (2004-2009).

Dr. Maureen Reed

University of Saskatchewan

Maureen is a full professor at the University of Saskatchewan, and is cross appointed to the School of Environment and Sustainability and the Department of Geography and Planning. Her research specializations are environmental governance, conservation practice, rural community sustainability, and feminist analysis. Professor Reed is particularly concerned to explain social dimensions of environmental and land use policies as they affect rural places; hence, her research is focused on how participatory decision-making approaches, working conditions, gender relations, and socio-cultural change affect the capacity of rural communities to work towards sustainability and resilience. She currently works on several research projects involving forestry and agricultural communities, biosphere reserves, model forests, and national parks.

Dr. Rebecca Pollock

B.E.S. (Waterloo), M.Sc.(University College London, U.K.), Ph.D. (Trent-Carleton)

Becky likes to coordinate community projects on sustainability education for social change. She is the Communications Manager for the Georgian Bay Biosphere Reserve, which was designated by UNESCO in 2004. Following her Ph.D. thesis about the role of Biosphere Reserves in governance for sustainability, she took up a Post-Doctoral Fellowship with the Department of Environment and Resource Studies at the University of Waterloo exploring the experiences of Biosphere Reserve areas in Ontario (Long Point, Georgian Bay, Oak Ridges-Greenbelt). She lives in Parry Sound where she can swim, ski and kayak on Georgian Bay (not at the same time) with her husband, Greg Mason, and two boys, Samuel and Baby Benjamin.

Mr. Brad May

Environment Canada, AIRS at Brock University, Adjunct Professor

Brad is both a climate change researcher with Environment Canada, and a lecturer in the Department of Tourism and Environment. His primary research areas are natural hazards, adaptive collaborative risk management and climate change adaptation. Brad is currently working with Ryan Plummer on a participatory adaptation project in the Niagara region. He has a B.A. in Geography from Wilfrid Laurier University and an M.A. from the Institute for Environmental Studies, University of Toronto.

Dr. Richard C. Mitchell

Associate Professor, Brock University Child and Youth Studies

Richard holds a doctorate in Sociology and Social Policy from Scotland's University of Stirling. His research interests include critical pedagogy, human rights, and transdisciplinarity across the physical and social sciences. He is a member of the International Journal of Children's Rights editorial board, has participated during a number of United Nations human rights summits, and has published across a broad range of international social science journals. A 2008 co-edited text with Brock colleague Dr. Shannon Moore entitled Power, Pedagogy and Praxis: Social Justice in the Globalized Classroom is being distributed by Sense Publishers. He has served as academic co-chair of Brock's Sustainability Coordinating Committee and conducted the University's first-ever carbon emissions audit with Toronto-based consultants HRCarbon with preliminary findings published in the International Journal of Sustainability in Higher Education (2011) 12(1):7-21. He is doting father to five-year-old Finn, two-year-old Siobhan, and loving partner to Dr. Shannon Moore.

Ms. Samantha Purdy

Senior Undergraduate Rapporteur

Ms. Joslyn Spurgeon

Senior Undergraduate Rapporteur