Winter 2011

Moving "Eco" Back Into Socio-Ecological Models: A Proposal to Reorient Ecological Literacy Into Human Developmental Models and School Systems

Nicholas Stanger
Western Washington University, nick.stanger@wwu.edu

Moving "eco" back into socio-ecological models: A proposal to reorient ecological literacy into human developmental models and school systems

Nicholas R.G. Stanger[1]

Department of Curriculum and Instruction
University of Victoria, British Columbia, Canada

Abstract

Socio-ecological models contribute to the understanding of how context influences human development and construction of worldviews. However, the claim that socio-ecological models represent the "true" influencers of an individual might be a misrepresentation of the complexity of whole ecological systems. This paper explores the possibility of adapting the use of the "socio-ecological model" to better represent the ecological influencers, rather than the primary focus of human and social factors. With reference to the new trends in environmental education, this paper explores the definitions of ecologically-based language, outlines the current domain of socio-ecological models, and proposes a re-orientation of socio-ecological models to "eco-sociological models." The conclusion provides five ways to incorporate a more ecologically-based approach to understanding contextual influencers and a rework of Bronfenbrenner's socio-ecological model as an eco-sociological model.

Keywords: *socio-ecological model; environmental education; greenwashing, ecosystem domain, reform*

Introduction

When Urie Bronfenbrenner (1975; 1979; 1986) first proposed a radical new way to see the world (and research it) through the *Ecology of Human Development*, he was met with few objections. The application of the concepts of ecology (including microsystems, mesosystems, exosystems, macrosystems and chronosystems) has been valuable for early childhood educators (Swick & Williams, 2006), environmental educators (Kyburzgraber, Hofer, & Wolfensberger, 2006), philosophers (Swartz, 2010), primatologists (Kappeler, 1999), and even ant biologists (Robson & Kohout, 2007). However, the claim that socio-ecological models represent all influences, may be a misrepresentation of the complexity of ecological systems. Does the term "socio-ecological model" fully represent its ecological etymology or has it become a moral-political term with metaphorical value?

As a biologist, my intuition and training tells me there is something missing in the "ecological" analogy within socio-ecological models and the adoption of ecological terms within public human spaces. I am not suggesting that humans exist outside of these models or that biological nomenclature is the gatekeeper, but that the socio-ecological models are not entirely representative of the complexity of the overall system in which humans are a part.

I want to reflect on the use of these terms for a moment. The co-adoption of ecological language or "eco" is pervasive in marketing. For instance, the word ecosystem is bandied about to describe everything from Apple Computer's products (Copeland, 2009; Siegler, 2011) to political economic recovery discourses (Blackwell, 2011). I understand that such a label suggests that these "systems" are complex and interrelated, however, technology products and economic-political discourses do not meet the fundamental nature of ecosystem complexities as described by ecologists. If we are to use ecosystem-based language, it needs to describe the complex interrelationships that support the long-term integrity of living systems rather than the short-term singularity of human-designed marketing. Otherwise, the word itself loses integrity, which might contribute to apathy in the environmental sector (Strife, 2010).

Some have coined the use of "eco" and the environmental marketing trend as "greenwashing" and suggest that it is a rampant profit-grab and pseudo-moral paradigm shift (Bekessy, Samson, & Clarkson, 2007; Strife, 2010; TEM, 2007). Unfortunately, socio-ecological models, which were so innovative in their early use, are now mired by greenwashing and misrepresentation of ecological language. Yet, we can strive to be more accurate in the use of this term, and in doing so, perhaps be closer to creating a sustainable society. Given this challenge of shaping modern environmental discourse and with better knowledge of ecological systems than the 1970's (Potter, 2009), I suggest that there is a way to re-center the socio-ecological model to an "eco-sociological model" and provide a more sustainable approach to contextualizing human-life and educational systems. Below, I explore the definitions of ecosystems, outline the current domain of

socio-ecological models, and propose a reorientation of socio-ecological models to "eco-sociological models" as a framework for educational reform.

Meaning, model and metaphor of *ecosystem*

Contextualizing the word ecosystem, where *ecology* can be considered the study of these systems, provides a linguistic setting for my argument. Within the technical definition, the term *ecosystem* is composed of the scientific observation of interactions, organisms, and environments. *Ecosystem* can be broadly defined as: "The whole system...including not only the organism-complex, but also the whole complex of physical factors forming what we call the environment" (Tansley, 1935, p. 299). They can be further defined as the interrelationships of the complexes of biotic and abiotic components. Ecosystems are scale-dependent, being any size as long as they have organisms, physical environment, interactions, and a specified extent as a way to bound and define them (Pickett & Cadenasso, 2002). For instance, Earth's biosphere can be considered an ecosystem as well as a branch of a tree with all the fungi, lichens, mosses, and micro-organisms that grow on it.

To actualize the concept of ecosystems further, practitioners have employed ecosystem models. Indeed, this is where socio-ecological modeling exists within ecosystem interpretation. Tantamount to the breadth of its definition, these models also range widely:

> *Ecology arose at the intersection of organismic biology and various physical sciences (Hagen 1992; Golley 1993); it ranges from population genetics, evolution, and physiological ecology at one extreme, through landscape ecology and biogeochemistry at the other (Likens 1992). In addition, ecologists are increasingly exploring their links with the human sciences (Golley 1993; Cronon 2000), a relationship that has deep roots (Park 1936; Odum 1971; Odum 1977). It is a testament to its rigor that the concept of the ecosystem is relevant throughout this amazingly broad spectrum. (Pickett & Cadenasso, 2002, p. 3)*

That ecosystem definitions are also approaching human sciences indicates the relevancy of ecological-based models within human systems research. Moreover, the diversity of models allows for a cornucopia of interpretations, including that of socio-ecological models. Ecosystem models provide a testable structure that is delimited by the biological and physical constraints as well as the researcher's own imposed constraints which are called the domain. A domain of a model is established through the following five elements:

(A) Identify the components of the model;
(B) State the spatial and temporal scale addressed by the model;
(C) Delimit the physical boundaries of the system;
(D) Articulate the connections among the components; and
(E) Identify the constraints on system behaviour
(adapted from Odum, 1993; Pickett, Kolasa, & Jones, 1994)

Notice that despite these limitations, these elements are holistic, without judgment or prejudice. The challenge of modeling such as this, is that public-social discourse is ripe with metaphor that can both elaborate and misconstrue the concepts within the model. Take letters B and C (geo-spatial, time, and physical boundaries) of the above list within a political context and you might see a politician lobbying for a short-term solution that does not include the most needy recipients and further dichotomize humans from other organisms and nature.

As stated above, the word *ecosystem* seems to be increasingly used as a metaphor in public discourses including those of education, media, policy-making, and management. Despite the value of these metaphors providing richness to language, they can also be somewhat problematic. For instance, in the case of socio-ecological models that attempt to represent the interrelationships between humans, families, cultural context, and (to a limited degree) their environment, metaphorical concepts such as equilibrium, resilience, and diversity, all of which are continued to be studied and debated in scholarly circles, can create contradictory understandings: "The metaphorical dimension allows science to be injected into the public discourse, but it also introduces the problem of "unpacking" the baggage of often contradictory assumptions and values that are a necessary part of social and political discourse" (Pickett & Cadenasso, 2002, p. 8).

Metaphors, like the ones used within socio-ecological models, are the weakest link within ecological analogies to human-systems and contribute to the anthro-dominant focus of the model (see Figure 1). Further to this point, building limitations within a domain is not without challenges when considering the interpretation of those limitations through the assumptions of public discourse. There is value in metaphoral language, but it requires stringent and transparent use of language so that misinterpretation is reduced. Despite this weakness of metaphors, there is high potential in using the domain approach to rebuild socio-ecological models as eco-sociological models. This will re-orient the user of eco-sociological models by increasing their ecological literacy, such that environmental factors are considered in the development of humans.

Historical domain of socio-ecology

Bronfenbrenner (1976) suggested that the socio-ecological approach contributes to a holistic research methodology of human development and education. That is, an ecological approach helps us to understand the context outside of a laboratory. However, Bronfenbrenner's model is *ecological* only through "interrelationships" and immediate built and natural environments; This is a weak metaphor of ecosystems. For instance, he describes how people learn through their educational settings as a function of two systems:

> (A) The first comprises the relations between the characteristics of learners and the surroundings in which they live out their lives (e.g., home, school, peer group, work place, neighborhood, community).
> (B) The second encompasses the relations and interconnections that exist between these environments. (Bronfenbrenner, 1976, p. 5)

At this point it is necessary to point out that Bronfenbrenner's idea of *environments* focuses almost entirely on that of human, cultural, and social environments and "encompasses both immediate and larger social contexts" (Bronfenbrenner, 1976, p. 6) rather than that of the entire ecosystem. Perhaps the easiest way to understand his models is by referring to diagrams that illustrate his ideas of the ecology of human development (Figure 1).

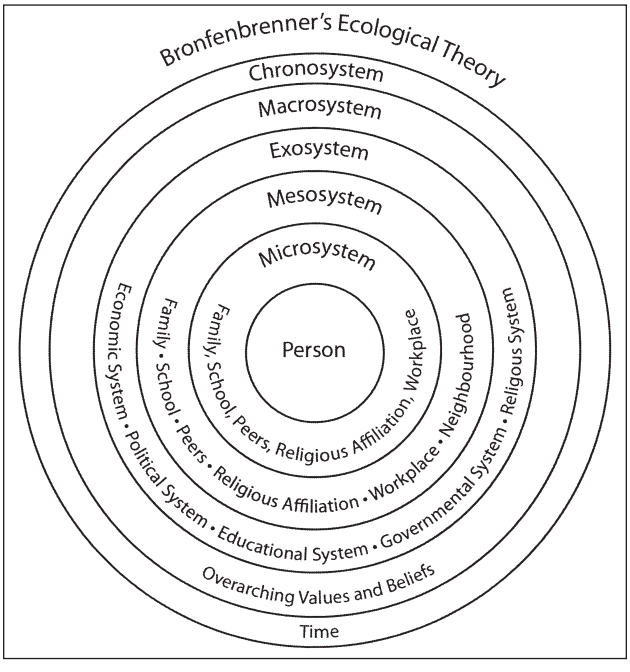

Figure 1. An adapted illustrated model of a Bronfenbrenner's Ecological Theory (Adapted from Berger, 2007).

Notice in the multiple scales of systems in this model, the human is represented in the centre. These systems range from microsystem (family, school, peers and so on), mesosystem (the inter-relationships of these factors), exosystem (the governmental, cultural structures), macrosystem (overarching beliefs and values, to chronosystem [factors over time]). Bronfenbrenner's ecological structure of the educational environment is rooted in the metaphorical interpretation of ecosystems. Its foundation is that human relationships resemble ecological relationships. However, emotional, social, cognitive, and spiritual development in humans does not occur in an ecological vacuum. In fact, many researchers suggest that environmental and ecological influences directly contribute to psychological development (Ewert & Galloway, 2009; Gotschi, Vogel, Lindenthal, & Larcher, 2010; Maller, 2009; Mueller Worster, 2006; Nicolaou, Korfiatis, Evagorou, & Constantinou, 2009; Schusler & Krasny, 2010). The true ecology that sustains and affects us, including but not limited to, food systems, energy systems, biological systems, nutrient systems, water systems, and atmospheric systems (notably local and global climate change), seem to be underrepresented in Bronfenbrenner's views of human development (especially cultural development).

I do not deny that socio-ecological models have been useful in describing social systems. These models are likely the closest concept we currently have to describing learning and education in human systems. However, I wonder if the limitations of socio-ecological models, by their very nature, provide an exaggerated human-based approach to understanding how the world affects us and how we influence the world.

Eco-sociology as a way to reform education

Re-orienting the education system through an ecological perspective is not a new concept. There are many communities and scholars looking for the reform of educational systems so that they integrate environmental systems (Craig, 2010; Meadows, 2002; Orr, 1992; Perrault, 2010; Potter, 2009; Sobel, 1999; Sriskandarajah, Bawden, Blackmore, Tidball, & Wals, 2010). I propose that an eco-sociological recentering should be the catalyst for this educational reform, at least in the influential role of educational research. As for educational research as it is conducted now, and despite my concerns expressed above Bronfenbrenner's model is perhaps the best we have for understanding the ways in which humans develop within social environments. However, we must do better in this time of severe ecological crises so that our research, on which policies, curriculum, and school structures are based, is more representative of the complexity of ecological systems. Helping our human systems resemble natur-

al systems would be a good start. Using ecosystem domain identification, as described by Odum (1993), the following five elements outline how to re-center sociological development research within an ecosystem-based approach:

(A) Identify the components of the model. For instance, a child's eco-sociological model would consider the components of green-space, food quality and source, outdoor play, exposure to toxins, and ecological connection in addition to the familial relations, societal norms, and other social influencers;

(B) State the spatial and temporal scale addressed by the model. In this instance, consider the complexities of space and time as they relate to environmental influencers. How do humans play a role in affecting the environment over the space and time of their lives and vice-versa? Does a young child growing up in an urban centre develop differently from a young child in a rural area? What are their effects on the environment around them?;

(C) Delimit the physical boundaries of the system. Physical boundaries might be identified within human-built structures, however, understanding that these boundaries are suffused within other systems is tantamount to this re-centering. That young people are affected by systems at various scales such as a) international food systems, b) migratory patterns of birds and wildlife, and c) atmospheric and ecological effects from climate change;

(D) Articulate the connections among the components. This is perhaps the weakest part of a socio-ecological model as it consistently ignores the significance of connections among local and global environmental components and human development. By articulating the connection of humans to the local and global environments that sustain them, an eco-sociological model would provide insights into the less visible connections to human development. Perhaps infamously over cited, *chaos theory* does help provide insight into this domain feature. One simple adaptation of one component in the environment can have drastic effects on the remainder of that ecosystem.

(E) Identify the constraints on system behaviour. Within socio-ecological models, constraints often are represented through anthro-centred assumptions. By identifying the roles of environment on behaviour and vice-versa, a more holistic approach to modeling will occur. For instance, incorporating the interactions between young people and their access to nature will provide insights into wellbeing and potentially reasons for learning disabilities (Louv, 2005).

With this domain approach in mind, the socio-ecological model can be redesigned to incorporate the complexity of ecological systems. The descriptions above can only paint a limited picture of what this looks like. So perhaps by adapting Bronfenbrenner's model, we can find further insights into suffusion of ecological principles into the socio-ecological model.

Of course there are limitations when attempting to represent complexity through two-dimensional models in that they can lead to over-simplification. The nested circles of Bronfenbrenner's model seem only valuable as an introductory speaking position but not useful when discussing the details of an individual's life experiences. Still, initial conversations from a redesign of this model might allow for further development of this eco-centering concept. Below, I have redesigned the model using the domain constrains above as my guide (Figure 2).

The model is relatively unchanged from representations of Bronfenbrenner's model, in that an individual still exists in the centre of the model. However, this should represent human and other-than-human individuals considering that primatologists and ant ecologists already use this research method (Kappeler, 1999; Robson & Kohout, 2007). Other adaptations include nomenclature and suffusion of ecological language and concepts throughout the levels. This figure also adds one more level not included in the original model, the nano ecosystem level. The nomenclature is changed so that each level is named *prefix ecosystem*, rather than just *pre-*

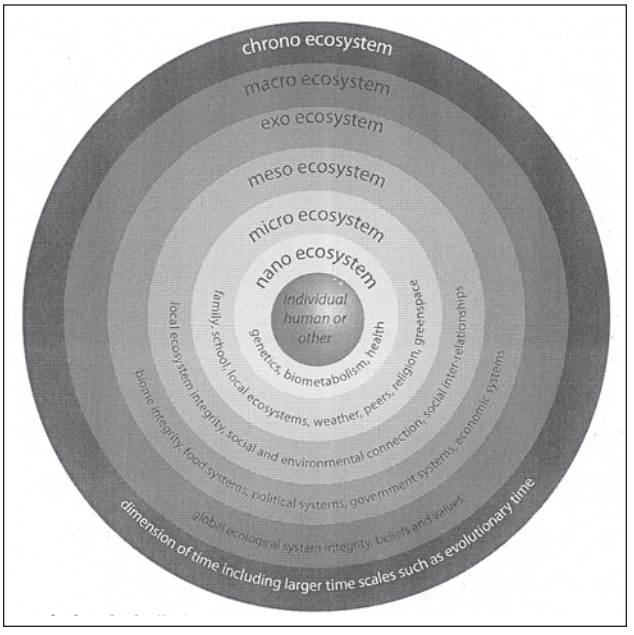

Figure 2. A reworked ecologically-based version of the socio-ecological model (adapted from Bronfenbrenner, 1986).

fixsystem. This reminds the user of the role of ecological elements in each of the levels. Below I explain the rationale and adaptations for each of the levels with the caveat that time affects each of them in different and sometimes unknown ways.

Nano ecosystem

In this level, nano ecosystems refer to the "smaller than visible" systems of species and components that influence health, integrity, metabolism, and other biochemical interactions that are necessary to life. In humans, this could be analyzed through psychiatry, physiology, biochemistry, and genetics. The "nature" of our bodies and their health is that they are influenced by food, stress, and other external factors (Bakker, 2010; Kubik, Lytle, & Fulkerson, 2004). As well, there is a baseline of what our bodies bring to any external factor, such as genetic predispositions, what some have termed a *genomic nanoecosystem* (Lefroy, Hobbs, O'Connor, & Pate, 1999).

Micro ecosystem

Micro ecosystems refer to the immediate natural surroundings, like that of the needs of a tribe. This includes the social networks of family, peers, friends, and enemies as well as the environmental influencers such as weather, immediate greenspace, aesthetics of neighbourhoods, and local food systems. For example, day-to-day weather patterns have significant effects on our psychological, mental, and physical development (Laurence & Robert, 1989; Murray, 2010). Consider for a moment, a young person who grows up north of the Arctic Circle versus one that grows up on an island in The Bahamas. Social network aside, her or his experiences will be very different in relation to seasons, general weather patterns, health, and wellbeing.

Meso ecosystem

In the meso ecosystem level, a researcher must pay attention to the integrity of the local ecosystems as they interrelate to social systems. This might include understanding community level access to green-space, waste-disposal, food production/importing, integrity of water systems, and biodiversity. Functioning community level ecosystems will influence our emotional and physical ways of life. For instance, food production that is grown locally is considered to be healthier for both humans (typically less toxins and preservatives) and the environment (less shipping and mass production) (Torjusen, Lieblein, Wandel, & Francis, 2001). Human health is well known for being made up of both mental and physical health especially when considered in conjunction with environmental health (Bell & Dyment, 2008; Fabian, 2002; Kingsley, Townsend, Phillips, & Aldous, 2009).

Exo ecosystem

The Exo ecosystem consists of the overarching systems that influence us such as governmental and political systems, economic systems, religious systems, and ecological systems. That ecological systems were left out of this level in Bronfenbrenner's interpretation is troubling. Of all the levels, this is where understanding the influence of biomes, oceans, and ecosystem integrity on human wellbeing, health, and survival is most necessary. Humans are tied to our environment through everything we do such as eating, sleeping, loving, and breathing (Macy, 2007).

Macro ecosystem

The macro ecosystem level could easily be renamed "Earth." Currently, this Earth is the only planet available to us and everything we do to it will affect us in all of the other system levels mentioned above. Climate change is an obvious example of the tenuous relationship that humans have with earth. It is a worldwide phenomenon that affects every human, and other-than-human species on this planet in some way (IPCC, 2007). Young people today are growing up in a different ecological world than their parents and therefore are being influenced by both the physical and mental effects of climate change, unsustainable development, habitat loss, and mass extinctions (Sobel, 1999; UNFPA, 2009).

Chrono ecosystem

Human-life forms have been on this 4.5 billion-year-old Earth for approximately 2.5 million years. Therefore, we are newcomers to the system, evolutionarily speaking. Day to day this fact might not enter our spheres of influence, yet it has profound effects on our species as a whole (Bruce, 1980). Almost all of the biota that support humans have been in some form or another on this planet for hundreds of millions if not billions of years. They continue to evolve, establish, and contribute to ecological systems in spite of us! However, humans are the most prolific of the megafauna. We are the fastest niche-grabbers, evolvers, and ecological system adapters currently on Earth. Also, we are on the verge of yet another evolutionary landmark, human technological evolution, which is affecting young people in day to day life. Whether it is screen-time, open access information, or genetic manipulation, young people's development is intrinsically linked to evolutionary time (Young, 2011).

Of course time affects all of the systems above in varying ways. For instance, in the nano ecosystem, microbiological interactions and synapses perform in microseconds. In the macro ecosystem, evolutionary changes can take place over millions of years. Thus, time construes, changes, and adapts all of these levels and their sub-components in ways that are challenging to understand. The interrelation of time

and ecological components are perhaps the most difficult part of two-dimensional representation within this model. We need to find better ways of expressing models such as the eco-sociological perhaps through computer graphics or physical sculptures.

Ecological systems have been relegated to a periphery for far too long. Whether it has been caused by politics, apathy, or simply ignorance, our neglect of incorporating ecological literacy and principles into our research methods and education systems has finally caught up with us. In this age of environmental crises, such as climate change, unsustainable development, air and water pollution, and deforestation (CBD, 1992; Earle, 1991; IPCC, 2007) we must quickly and effectively adapt our practices. If we do not protect the remaining global biodiversity by the year 2030, ecological systems will be in a state of unpredictable change, further threatening life on Earth (CBD, 2010). Society continues to apply conventional, ineffective solutions to these catastrophic problems. It is time to embrace the multiple interpretations of "ecosystems" within the models we use to describe human development rather than letting the human-centric politicians and economics drive our space-ship earth. If we adopt this eco-sociological technique in schools and school-based research, perhaps we will see and think differently. It will make us reject marketing and sponsorship from extractive and deleterious industry, refuse to continue to build schools like prisons, and dismiss curriculum that supports factory-like settings. We will quickly see the need to build more livable schools with more green space, connection with local community, sustainable materials, sustainable pedagogy, local healthy foods for cafeterias, and integrated buildings that support ecological habitat development and student creativity. It is time to re-orient the way we see young people develop through a true ecological lens.

Acknowledgments

This paper was written as a project for a PhD class in *Contemporary issues* in Education. My professor, Dr. Deborah Begoray, helped conceptualize this paper as a critical analysis of socio-ecological models. Editing and flow was supported by my partner, Joy Vance Beauchamp MA.

Endnote

1. nstanger@uvic.ca

References

Bakker, N. (2010). Fresh air and good food: Children and the anti-tuberculosis campaign in the Netherlands c.1900-1940. *History of Education*, 39(3), 343-361.

Bekessy, S. A., Samson, K., & Clarkson, R. E. (2007). The failure of non-binding declarations to achieve university sustainability: A need for accountability. *International Journal of Sustainability in Higher Education*, 8(3), 301-316.

Bell, A. C., & Dyment, J. E. (2008). Grounds for health: The intersection of green school grounds and health-promoting schools. *Environmental Education Research*, 14(1), 77-90.

Berger, K. S. (2007). *The developing person through the life span*. New York: Worth Publishers.

Blackwell, R. (2011, Tuesday, March 1). Ontario and Quebec 'more partners than competitors', *The Globe and Mail*. Retrieved from http://www.theglobeandmail.com/report-on-business/economy/ontario-and-quebec-more-partners-than-competitors/article1924191/

Bronfenbrenner, U. (1975). *The ecology of human development in retrospect and prospect*. Paper presented at the Conference on Ecological Factors in Human Development held by the International Society for the Study of Behavioral Development, Guildford, England.

Bronfenbrenner, U. (1976). *The experimental ecology of education*. Paper presented at the American Educational Research Association, San Francisco, CA.

Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Cambridge, MA: Harvard University Press.

Bronfenbrenner, U. (1986). Ecology of the family as a context for human development: Research perspectives. *Developmental Psychology*, 22(6), 723-742.

Bruce, W. (1980). Environmental analysis in human evolution and adaptation research. *Human Ecology*, 8(2), 135-170.

CBD. (1992). *Convention on biological diversity*. Rio de Janeiro: United Nations.

CBD. (2010). *Global biodiversity outlook 3*. Montreal: Secretariat to the Convention of Biological Diversity.

Copeland, M. V. (2009). The apple ecosystem. *Fortune, 160*(10), 102-103.

Craig, C. J. (2010). Research on the boundaries: Narrative inquiry in the midst of organized school reform. *Journal of Educational Research, 103*, 123-136. doi: 10.1080/00220670903323883

Earle, S. E. (1991). Sharks, squids, and horseshoe crabs-the significance of marine biodiversity. *Bioscience, 41*(7), 506-509.

Ewert, A., & Galloway, G. (2009). Socially desirable responding in an environmental context: Development of a domain specific scale. *Environmental Education Research*, 15(1), 55-70.

Fabian, N. (2002). Hope for the future of environmental health. *Journal of Environmental Health*, 64(6), 66.

Gotschi, E., Vogel, S., Lindenthal, T., & Larcher, M. (2010). The role of knowledge, social norms, and attitudes toward organic products and shopping behavior: Survey results from high school students in Vienna. *Journal of Environmental Education, 41*(2), 88-100.

IPCC. (2007). *Climate change 2007: Synthesis report contribution of working groups i, ii and iii to the fourth assessment report of the intergovernmental panel on climate change*. Geneva, Switzerland: IPCC.

Kappeler, P. M. (1999). Primate socioecology: New insights from males. *Naturwissenschaften, 86*(1), 18-29. doi: 10.1007/s001140050563

Kingsley, J., Townsend, M., Phillips, R., & Aldous, D. (2009). "If the land is healthy...It makes the people healthy": The relationship between caring for country and health for the Yorta Yorta nation, Boonwurrung and Bangerang tribes. *Health & Place, 15*(1), 291-299. doi: 10.1016/j.healthplace.2008.05.009

Kubik, M. Y., Lytle, L., & Fulkerson, J. A. (2004). Physical activity, dietary practices, and other health behaviors of at-risk youth attending alternative high schools. *Journal of School Health*, 74(4), 119-124.

Kyburzgraber, R., Hofer, K., & Wolfensberger, B. (2006). Studies on a socio-ecological approach to environmental education: A contribution to a critical position in the education for sustainable development discourse. *Environmental Education Research, 12*(1), 101-114.

Laurence, S. K., & Robert, E. D. (1989). Weather and human mortality: An evaluation of demographic and interregional responses in the United States. *Annals of the Association of American Geographers, 79*(1), 44-64.

Lefroy, E., Hobbs, R., O'Connor, M., & Pate, J. (1999). What can agriculture learn from natural ecosystems? *Agroforestry Systems, 45*(1), 425-438. doi: 10.1023/a:1006293520726

Louv, R. (2005). *Last child in the woods: Saving our children from nature-deficit disorder*. New York, NY: Workman Publishing.

Macy, J. (2007). *World as lover: World as self*. Berkeley, CA: Parallax Press.

Maller, C. J. (2009). Promoting children's mental, emotional and social health through contact with nature: A model. *Health Education, 109*(6), 522-543.

Meadows, D. (2002). Dancing with systems. Retrieved from http://www.sustainer.org/pubs/Dancing.html

Mueller Worster, A. (2006). I'm an east coast kid: Surfing the waters of spirituality and place. *Canadian Journal of Environmental Education, 11*(1), 100-111.

Murray, M. T. (2010). Second opinion. Beat the winter blues. *Better Nutrition, 72*(11), 30.

Nicolaou, C. T., Korfiatis, K., Evagorou, M., & Constantinou, C. (2009). Development of decision-making skills and environmental concern through computer-based, scaffolded learning activities. *Environmental Education Research, 15*(1), 39-54.

Odum, E. P. (1993). *Ecology and our endangered life support systems* (2nd ed.). Sunderland, MA: Sinauer Associates.

Orr, D. W. (1992). *Ecological literacy: Education and the transition to a postmodern world*. Albany: State University of New York.

Perrault, H. (2010). Integrated thinking, integrated learning: Changing our ways for changing global realities. *LEARNing Landscapes, 3*(2), 115-120.

Pickett, S. T. A., & Cadenasso, M. L. (2002). The ecosystem as a multidimensional concept: Meaning, model, and metaphor. *Ecosystems, 5*(1), 1-10.

Pickett, S. T. A., Kolasa, J., & Jones, C. (1994). *Ecological understanding: The nature of theory and the theory of nature*. San Diego, CA: Academic Press.

Potter, G. (2009). Environmental education for the 21st century: Where do we go now? *Journal of Environmental Education, 41*(1), 22-33.

Robson, S. K. A., & Kohout, R. J. (2007). A review of the nesting habits and socioecology of the ant genus *Polyrhachis fr. Smith. Asian Myrmecology, 1*, 81-99.

Schusler, T. M., & Krasny, M. E. (2010). Environmental action as context for youth development. *Journal of Environmental Education, 41*(4), 208-223.

Siegler, M. G. (2011). The simple (and perhaps harsh) reality of apple's ecosystem. *Tech*, from http://techcrunch.com/2011/02/15/apple-ecosystem/

Sobel, D. (1999). *Beyond ecophobia: Reclaiming the heart in nature education*. Great Barrington, MA: The Orion Society and The Myrin Institute.

Sriskandarajah, N., Bawden, R., Blackmore, C., Tidball, K. G., & Wals, A. E. J. (2010). Resilience in learning systems: Case studies in university education. *Environmental Education Research, 16*(5-6), 559-573.

Strife, S. (2010). Reflecting on environmental education: Where is our place in the green movement? *Journal of Environmental Education, 41*(3), 179-191.

Sturm, S. (2009). The writing zone according to ecological systems theory. *Te Ipu Pakore: The Broken Vessel.* Retrieved March 24th, 2011, from http://seansturm.wordpress.com/2009/06/21/the-writing-zone-according-to-ecological-systems-theory/

Swartz, S. (2010). "Moral ecology" And "Moral capital": Tools towards a sociology of moral education from a south African ethnography. *Journal of Moral Education, 39*(3), 305-327.

Swick, K. J., & Williams, R. D. (2006). An analysis of Bronfenbrenner's bio-ecological perspective for early childhood educators: Implications for working with families experiencing stress. *Early Childhood Education Journal, 33*(5), 371-378.

Tansley, A. G. (1935). The use and abuse of vegetational terms and concepts. *Ecology, 16*(3), 284-307. doi: 10.2307/1930070

TEM. (2007). The "Six sins of greenwashing": A study of environmental claims in north American consumer markets. *TerraChoice Environmental Marketing Inc.* Retrieved from http://www.terrachoice.com/files/6_sins.pdf

Torjusen, H., Lieblein, G., Wandel, M., & Francis, C. A. (2001). Food system orientation and quality perception among consumers and producers of organic food in Hedmark county, Norway. *Food Quality and Preference, 12*(3), 207-216.

UNFPA. (2009). *At the frontier: Young people and climate change.* New York, NY: United Nations Population Fund.

Young, J. R. (2011). Programmed for love. *Chronicle of Higher Education, 57*(20), B8.