

# **Climate Change, Sustainable Living, and an Ecosystem Approach to Management: Some Thoughts**

Paul A. Gray

Ministry of Natural Resources, 300 Water Street  
Peterborough, Ontario, K9J 8M5, Canada  
paul.gray@mnr.gov.on.ca

## **Abstract**

*Current trends and modelled predictions indicate that the impacts of global warming during the next century will be significant and widespread. Most, if not all, ecosystems and their constituent organisms, including people, will be affected. While it is logical to assume that the best solutions for a sustained future will result from combinations of cultural-social-economic-ecological decisions, determining optimal mixes of decisions in a rapidly changing world (the ecosphere) will be difficult. In large part, effective management of climate change impacts will depend on how well societies embrace sustainable living objectives and implement an ecosystem approach. This paper examines tools and techniques that could be used in support of a commitment to sustainable living in a changing climate.*

*Keywords: climate change, sustainable living, ecosystem approach, adaptive management, tools and techniques*

## **Introduction**

Greenhouse gases are critical to life on Earth. For example, water vapour (the most abundant greenhouse gas) and carbon dioxide help regulate climate by trapping the Sun's energy that has been re-radiated from Earth's surface in the form of heat. This natural greenhouse effect, where the gases function as an insular blanket to maintain the Earth's surface temperature 33°C warmer than it would be if the blanket did not exist, provides enough heat for life on Earth as we know it.

People have added carbon dioxide, nitrous oxide, methane, and other greenhouse gases to the atmosphere by extracting and burning fossil fuels such as coal, oil, and natural gas. The drainage of wetlands and the conversion of forests and grasslands to other uses have also contributed to the release of greenhouse gases to the atmosphere. In fact, atmospheric carbon dioxide has increased 30% since pre-industrial times, and these additional greenhouse gas molecules have trapped new heat and accelerated the rate of global warming.

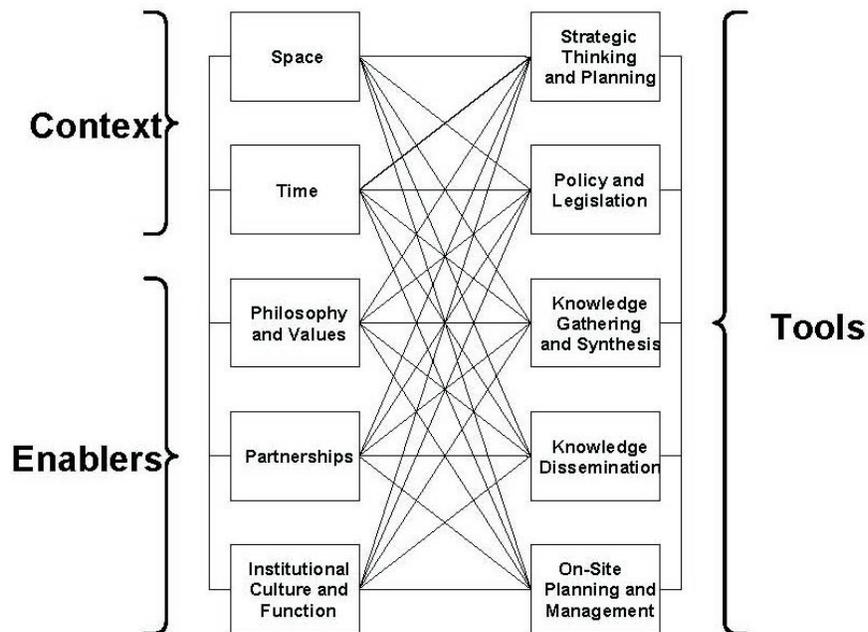
In Ontario, mean annual temperatures have increased by 0.5°C in the last hundred years and could increase another 2 to 5°C in the next century. Although temperature increases likely will be greater in winter than in summer, and in the north than in the south, there will be significant changes to all seasons in every ecosystem throughout the province. The additional heat energy will increase variability in temperature, precipitation (rain, snow, and ice), and wind patterns. For example, as more heat energy is trapped in the lower atmosphere by greenhouse gases, it is likely that the frequency and size of extreme events such as ice storms, heavy rains, droughts, and windstorms will increase.

Given that just about every ecosystem on Earth is or will be affected, managing for climate change must occur within the context of a commitment to sustainable living. While admittedly anthropocentric, the ideas and values associated with the concept of ‘sustained life’ signify balance—balance between the people who draw from and use Earth’s processes and resources to survive and the ecosystems of which they are a part. Sustainable living, therefore, is envisioned as an ecosphere filled with healthy ecosystems and healthy people—a condition or state of ecospheric-human balance that a sustainable society would predict can be attained and maintained (Gray and Davidson, 2000).

An ecosystem approach to management is often cited as one method through which sustainable living might be achieved. During the last 30 years, thousands of journal papers, technical reports, books, and online documents have been prepared about the subject. These products describe ecosystem composition, structure, and function, outline principles, provide tools and techniques, and cite examples of ecologically oriented programs. And yet, after decades of work, a clear and concise description continues to elude us. As one approach, I suggest that program designers spend time identifying the appropriate questions that help us decide how we want and need to conduct our lives in ways that allow us to aspire to a goal of sustainable living.

### An Ecosystem Approach to Management

An ecosystem approach to management is based on the idea that appropriate values combined with the required knowledge and tools can protect and maintain ecosystems and provide a range of benefits to society now and in the future. Asking the right questions helps organizations design the most suitable approach—questions about the spatial and temporal context in which to make decisions and questions that enable organizations to apply a suite of tools and techniques to keep the landscapes, the waterscapes, and the aircscapes working (Figure 1). Even though all ecosystems are different, questions can be organized according to these three interrelated themes:



**Figure 1:** An ecosystem approach to management framework. The modules are linked and often employed simultaneously or in unison to develop and deliver ecologically-based programs (adapted from Gray *et al.*, 1995).

### **Context:**

1. *Space* – Have we mapped and described large and small ecosystems, and do we use these descriptions in a framework to plan and manage human activities? Now that human actions have created or contributed to significant change of continental and global proportions (e.g., climate change), an ecological context is increasingly required to identify and understand the issues, establish partnerships, and design appropriate management programs. The ecosystem provides an integrating spatial framework within which natural asset managers can work to address the spectrum of cultural, social, economic, and ecological factors and forces that shape modern life. Many ecosystem classification systems have been developed in countries around the world, such as the Ecological Land Classification system used in Ontario (Crins, 2000).

2. *Time* – Have we made the short- and long-term commitment needed to care for ecosystems in the context of climate change and other impacts? Ecosystem processes operate on a spectrum of time regimes ranging from less than a second to more than a thousand years. And our decisions about the allocation and use of ecosystem services and products must reflect the short- and long-term characteristics of ecosystem composition, structure, and function.

### **Enablers:**

1. *Philosophy and Values* – Do our organizational philosophies allow us to care for ecosystem values? Ecosystems provide many values, including critical life support services such as breathable air and potable water, and social, cultural, and economic products associated with food, clothing, recreation, and other kinds of wealth. Our success will depend on how we use these values to guide our behaviour and pursue sustainable living goals.

2. *Partnership* – Are we involved with all the necessary partners, and do we have the tools to keep partnerships engaged and progressive? No one agency or organization retains the scientific expertise, the legal authority, or the financial resources to care for all ecosystems. Partnership is an important tool in the protection and sustainable use of ecosystems, including education, research, policy formulation and implementation, technology development, and information management.

3. *Corporate Structure and Function* – Do our organizational (corporate) structures and their functions provide a progressive and positive culture to implement an ecosystem approach? An ecosystem approach requires that participating agencies, organizations, companies, and institutions ensure that corporate structure and function supports intellectual development, participatory decision-making, and the creation of appropriate services, products, and experiences—a place where people can organize into productive groups to work in support of an ecosystem approach.

### **Tools and Techniques:**

1. *Knowledge Gathering and Synthesis (Data and Information Management)* – Do we support and/or have access to traditional and community knowledge and to data and information collected and prepared by scientists and resource managers to allow proactive decision-making? Successful development and implementation of an ecosystem approach to management depends on how well we discover, retain, use, and share knowledge and information about the composition, structure, and function of ecosystems and the impacts of people who live and work in them. People must have the best information available to mitigate the impacts of climate change.

2. *Knowledge Dissemination (Education)* – Are we disseminating essential knowledge among staff, partners, clients, and the public in support of decision-making and life-long learning opportunities? Every person must be provided an opportunity to understand climate change and its impact on ecosystem function. Knowledge dissemination through accessible and current life-long learning opportunities (i.e., education, extension, and training programs) is a prerequisite to effective participation in decision-making, particularly in view of the fact that climate change is a complex and encompassing issue.

3. *Strategic Approach (Plan)* – Do we have a vision and/or mission statement that describes the condition or state (of the ecosystem) to which we aspire? In other words, have we described the path we want to take? We use strategic planning to determine the direction we will take and the techniques we will use to care for ecosystems. Effective strategic plans are constantly re-evaluated and modified to meet evolving needs and challenges.

4. *Policy* – Do we make a commitment to care for ecosystems with policies and plans that account for climate change? Given the complex, dynamic, risky world in which we live, policy formulation and implementation must be progressive and flexible. Policy and plans must allow managers to respond effectively to unexpected and unconventional issues and problems—it must be learning oriented, science based, and adaptive.

5. *On-site Actions* – Are we protecting, restoring, and/or using ecosystems in ways that keep the landscapes, waterscapes, and airscares working? Effective protection and sustainable use of ecological assets depends on how well organizations allocate assets, mitigate impacts, and resolve on-site land-use, air-use, and water-use conflicts.

## Concluding Remarks

The importance of a commitment to sustainable living cannot be overstated—it is critical if people expect to prepare for and adapt to a rapidly changing ecosphere (Earth’s largest ecosystem) in the twenty-first century. And identifying the appropriate suite of questions is an important initial milestone. An ecosystem approach to management can be used as a framework with which to ask the questions, define the issues, and address the risks that need to be managed in a new world climate.

## References

- Crins, W. 2000. *The Ecozones, Ecoregions, and Ecodistricts of Ontario*. Peterborough: Ministry of Natural Resources. Map.
- Gray, P.A., L. Demal, D. Hogg, D. Greer, D. Euler, and D. DeYoe. 1995. *An Ecosystem Approach to Living Sustainably: A Discussion Paper*. Peterborough: Ontario Ministry of Natural Resources. 77 pp.
- Gray, P.A. and R.J. Davidson. 2000. An Ecosystem Approach to Management: A Context for Wilderness Protection. pp 59–64. In: S.F. McCool, D.N. Cole, W.T. Borrie, and J. O’Loughlin (eds.). *Wilderness Science in a Time of Change Conference—Volume 2: Wilderness within the Context of Larger Systems, May 23–27, 1999, Missoula, Montana*. Proceedings RMRS-P-15-VOL-2, Rocky Mountain Research Station, Forest Service, U.S. Department of Agriculture, Ogden, Utah.