The application of ecosystem approaches in the Golden Horseshoe Region, Ontario

By Marta Berbés
208 222 606

Submitted to Dr. Martin Bunch
Faculty of Environmental Studies

A Major Paper submitted to the Faculty of Environmental Studies in partial fulfillment of the requirements for the degree of Master in Environmental Studies

York University
Faculty of Environmental Studies
North York, Ontario, Canada

December 10, 2007

Student signature: ____________________
Marta Berbés

Supervisor signature: ____________________
Martin Bunch, PhD

Abstract

Environmental crises have prompted a re-evaluation of traditional approaches to environmental management that has often highlighted their inability to deal with the complexity of social-ecological systems. The ecosystem approach (EA) offers an alternative that combines ideas from systems theory, participatory decision-making and adaptive management. However, EAs are still relatively young both as a discipline and as a practice, and as such, their meaning is continuously being redefined. This paper assesses the current state of development and the direction of EAs in the Golden Horseshoe Region (Ontario) by analyzing quantitative and qualitative data from interviews with EA practitioners. Practitioners were involved in projects that applied EA in a variety of fronts from ecological restoration to eco-health to urban development. The survey used helped to identify the theoretical foundations and core themes of EA; the methods, techniques and tools used; and, the factors and barriers to its implementation and potential application to other contexts. Two findings emerged from this research: first, despite the diversity of practitioners and applications, the theoretical understandings of EA are coalescing into a unified view that emphasizes the principles of integration, connectivity and participation. Second, successful implementation of EAs will require a parallel shift in the current institutional setting towards more adaptive forms of governance. Despite this obstacle EA continues to spread to applications in the fields of eco-health and urban development.

Foreword

This paper is the product of a Plan of Study centred on the application of systems thinking approaches to environmental management. The project has allowed me to combine two areas of research that I am passionate about: systems thinking and implementation. Approaches to environmental management that fall under the rubric of systems thinking - e.g. the ecosystem approach (EA), adaptive environmental management, among others – represent a much needed effort to deal with the uncertainty, complexity and diversity of views surrounding social-ecological systems in a methodical manner.

Along with the theoretical advancement of this field, I am interested in the practical dimension: systems approaches demand adjustments to the current environmental management practices. Through this paper, I was able to explore aspects of a transition in the way that we do management, both in terms of identifying a set of guiding principles for ecosystem approaches and exploring the implementation of a paradigm shift in environmental management.

The paper fits into a larger initiative led by Professor Bunch (and other collaborators) that aimed at evaluating the experience of ecosystem approach practitioners in Ontario with the purpose of identifying strengths of the approach, the barriers to its implementation and critical gaps in knowledge. To this end, in 2001-2002 the team of researchers interviewed a variety of ecosystem approach practitioners involved in projects and programs in Ontario. My contribution to this project is in the form of a synthetic data analysis that provides a snapshot of the theoretical and practical understandings of EA this far.

The findings emerging from the study are relevant to those seeking to further solidify the use of systems approaches in environmental management because they capture what has been done in the past and can guide what actions should be done in the future. This unique comprehensive assessment of EA in Ontario will hopefully add accuracy to the concept of ecosystem approaches, provide an arena for further discussion, and outline practical considerations that lie ahead.

Table of contents

List of tables

List of Figures

Acknowledgements

I would like to thank Dr. Martin Bunch for his advice and supervision in the past two years. Dr. Bunch's work and expertise have provided me with a much-appreciated opportunity to develop my own understanding of systems ideas. Special thanks go to Dr. Bill Found for his mentoring and his optimism about my work, even at times when mine faltered. I thank my family for asking only every now and then when I was going to finish; and for their honest attempt at understanding – and quiet bewilderment of – systems theory. Finally, Matt Feagan has been an unconditional source of emotional and intellectual support. Now, we are even.

1. Introduction

Humans draw from their environment the goods and services required for their subsistence. This relationship constitutes the cornerstone of the field of environmental management. Thus, environmental management can be defined as the set of practices and principles that are used to organize and regulate the interactions of humans with their surroundings. It should be emphasized that environmental management is about managing *people*, rather than the environment itself (Lee, 1999). However, because environmental management focuses on the intersection of human and natural systems, knowledge of both is necessary.

From hunters and gatherers to modern agriculture, environmental management has been practiced in one form or another and by different societies since time immemorial. However, this discipline – or group of disciplines – has come under closer scrutiny in the past few decades accompanied by successive shifts in its dominant paradigm. Some factors that have prompted the questioning and reshaping of environmental management are a higher demand for environmental goods and services worldwide; an increased awareness of the dependency of humans on their natural environment; successive crises ranging from the effects of large scale pollution, to declining stocks of natural resources, to global climate change; and, a realization of the link between environmental quality and political stability (Hessing, Howlett and Summerville, 2005). All too often, examination of past and recent issues highlights the inadequacy of traditional environmental management approaches.

Environmental situations involve managing social-ecological systems (SES), which are both, complex and complicated[1]. Complexity in SES arises as a consequence of irreducible uncertainty, that is, there are aspects of a system that cannot be fully understood in practical terms but still need to be managed. Uncertainty arises partly due to non-linear behaviour where the magnitude of a response does not correspond to the magnitude of the cause; and, in part because a reaction may be separated spatially or temporally from its trigger, making it difficult to establish causality. As a result, surprise is a common element in SES, however, traditional management frameworks rely on predictability and are thus ill-suited to handle surprise.

Aside from the internal workings of the system that make environmental situations complex, there are additional factors that make them complicated. For instance, these situations often involve a variety of stakeholders with diverse, or opposite, points of view. At the same time, stakes are high for environmental decision-makers as the resolutions adopted are likely to affect the livelihood and the values of stakeholders, as well as key functions of the ecosystems on which they depend. Finally, there is a sense of urgency when it comes to environmental problems because the consequences of inaction are likely to be severe.

Although traditional tools have handled complicated situations with various degrees of success, managing complexity requires a new set of tools. As a result of a growing understanding of complexity in social-ecological systems and the factors outlined above, environmental management has moved from a single-variable, narrow approach centred on maximizing resource extraction to multidimensional approaches that emphasize sustainability. One of the approaches that has been hailed as an alternative to traditional

[1] The terms 'complex' and 'complicated' are often mistakenly considered interchangeable in every day discourse. In this paper, they will not considered equivalent. I make the following distinction: 'complex' is a characteristic of a system consisting of different parts that possesses irreducible uncertainty. 'Complicated' is used to refer to something that is intricate, confusing or difficult. A complex situation can be complicated; however, a complicated situation needs not exhibit complexity.

management is the ecosystem approach (EA). A variety of institutions operating at the local, national and international level started to adopt this approach beginning in the 1970s with the International Joint Commission that crafted the Great Lakes Water Quality Agreement (GLWQA). Others have joined more recently such as the Healthy City Project Initiative (1989), the Waterfront Plan for Metropolitan Toronto (1991), or the Convention of Biological Diversity (1992). Ecosystem approaches are conceptually rooted in systems thinking and practically oriented towards adaptive management and participatory research (Waltner-Toews, 2004); and they integrate traditional science into more holistic methods of enquiry that treat situations as systems of interrelated elements and actors (Bunch and Jerrett, 2003).

However, the ecosystem approach is still relatively young both as a discipline and as a practice, and as such, its meaning is continuously being redefined. The range of projects that use an ecosystem approach to management suggests that EA is evolving into a family of approaches where the same core components are present but adaptations are introduced to suit specific applications. Given the increasing diversity, it seems opportune at this time to take stock of the multiple evolving perspectives. In 2002-2003 Bunch, Jerrett *et al.* surveyed practitioners and theorists of the ecosystem approach in the Golden Horseshoe Region (GHR) in Ontario to evaluate their understanding of theoretical foundations of EA and to investigate the tools used in its implementation. Their analysis was based on quantitative data. In this paper I continue their work by integrating the analysis of qualitative data obtained from the same survey.

The survey probes practitioners of the ecosystem approach on five regards: first, their academic and professional background; second, their conceptual understanding of the ecosystem approach in theory; third, the actual direction of the approach in practice; fourth, the factors that have contributed to the success or the failure of ecosystem approaches in Ontario; and fifth, the potential for applying this approach to eco-health situations and urban development issues. These are the five guiding questions around which the paper has been structured.

The analysis of ecosystem approaches in the GHR will demonstrate the following: first, despite the diversity of practitioners and applications, the theoretical understandings of EA are coalescing into a unified view. Particular uses may result in variations on the emphasis given to certain components of EA, but there is a core set of values derived from systems thinking, and influenced by different environmental currents, that stands out in practitioners' understanding. Second, the practical application of ecosystem approaches requires a parallel shift in the current institutional setting towards more adaptive forms of governance. Despite this obstacle EA initiatives continue to spread to applications in the fields of eco-health and urban development.

The paper is organized as follows: it will begin on the second chapter with a literature review that situates the ecosystem approach within the larger theoretical body of systems thinking literature; chapter 3 explains the methodology used to analyse the responses to the survey, content analysis, and the survey itself; the data obtained is shown in chapter 4; in chapter 5 I discuss the results from a theoretical and from a practical perspective; last, chapter 6 contains a summary of the findings and future research directions.

2. Literature Review

The purpose of this chapter is to situate ecosystem approaches within the larger body of literature of systems thinking. I will be focusing on three aspects: first I will examine the epistemological roots of ecosystem approaches starting with the limitations of reductionism and the evolution of several disciplines towards a general theory of systems; next, I will introduce the concept of a system itself defining the characteristics that produce complexity and that are fundamental in environmental management; lastly, I will provide the reader with a definition of ecosystem approaches by presenting their main characteristics defined in key initiatives that have taken place in Ontario.

2.1. System approaches

Ecosystem approaches fall under the rubric of applied systems thinking. Hence, it is appropriate to begin the survey of the literature by examining the origins of systems thinking in different disciplines. This field started to develop in the 20^{th} century in response to the limitations of traditional science when examining behaviour exhibited by natural and social systems.

Science has undoubtedly been one of the most powerful and instrumental forces shaping Western thought. As a method of inquiry science applies rational thinking to empirical observations, normally by means of a controlled experiment whose purpose is to gain insight into the underlying laws that govern the patterns of the universe (Checkland, 1981). To a large extent this rigorous approach has withstood the test of time: proof of it is that much of today's science and engineering are based on Newtonian physics that date back some three hundred years.

The three defining characteristics of Newtonian science are reductionism, linearity and repeatability. Reductionism consists of breaking down a complex problem into simpler parts to analyse them separately (Jackson, 2000). It is implicit in this reasoning that: first, the division will not affect the phenomenon being studied; and second, the individual parts will keep the same qualities whether examined singly or collectively (Checkland, 1981). Linearity is another characteristic of scientific reasoning. The assumption here is that the condition of summativity applies, that is, the whole can be assembled by adding up the equations governing the separate parts (von Bertalanffy, 1968) or, that at least the assembling principles are straightforward (Checkland, 1981). Finally, repeatability distinguishes scientific facts from opinion or preference because a given set of experimental conditions will reproduce the same results independent of the researcher (Checkland, 1981).

It is apparent that the principles of reductionism, linearity and repeatability can be applied in some situations and for some problems but not for others. For instance, while projectile motion can be successfully studied in a laboratory using classical physics, certain biological occurrences such as bird migration, or social phenomena such as predicting the outcome of an election, pose challenges to the application of the scientific approach because of the level of complexity in these systems. In 1956 Boulding suggested a classification for systems based on their complexity as shown in table 2.1. Boulding also pointed out that each level was associated with specific tools for its study and so, the lower three levels (1 to 3) were the subject of physical sciences; the next three levels (4 to 6) were the concern of biologists; and the upper three levels (7 to 9) were the domain of social scientists (Kast and Rosenzweig, 1972). Furthermore, there would be a mismatch if one were to apply the tools of a lower level to a system of a higher level of complexity. This explains in part why voting as a social phenomenon does not lend itself well to scientific analysis.

Table 2. 1

Boulding's hierarchy of complexity

Level 1	Structures and frameworks which exhibit static behaviour, e.g. crystal structures
Level 2	Clockworks which exhibit predetermined motion, e.g. solar system
Level 3	Control mechanisms which exhibit closed-loop control, e.g. thermostat
Level 4	Open systems which exhibit structural self-maintenance, e.g. a cell
Level 5	Lower organisms with functional parts, exhibit blue-printed growth and reproduction, e.g. a plant
Level 6	Animals which have a brain to guide behaviour, capable of learning, e.g. an elephant
Level 7	People who posses self-consciousness, employ symbolic language, e.g. a human
Level 8	Socio-cultural systems typified by the existence of roles, communications and the transmission of values, e.g. a nation
Level 9	Transcendental systems, e.g. the idea of God

Source: Jackson, 2000

Complexity surfaced as a challenge in a variety of disciplines during the first half of the 20th century. Until then, the tendency had been to break up the system of study into its most elemental components for analysis as prescribed by the scientific method with enormous success. However, because of its subject matter, biology was among the first disciplines to face questions about systems whose answers were not found in the study of the individual constituents. Just as hydrogen and oxygen on their own do not possess the qualities of water, biologists found that the building blocks of organisms did not possess the characteristics of the whole. There were opposing theories that offered an explanation for the missing component: vitalist biologists attributed it to a non-physical entity while organismic biologists focused on the organizing relations of the parts relative to each other (Checkland, 1981; Capra, 1996; Jackson, 2001). Eventually vitalism was abandoned, but it is important to emphasize that both schools recognized how the whole was greater than the sum of its parts. This idea would become one of the central tenets of systems thinking.

Another subject that grappled with reductionism at the beginning of the 20th century was the area of psychology concerned with perception. The dominant currents of the time embraced the principles of reductionism, thereby establishing that perceptions of one's surrounding were created by adding the individual entities until a full picture appeared. Max Wertheimer challenged this idea and proposed instead that humans perceived things in the form of integrated patterns, not just as the sum of isolated elements (Capra, 1996). For instance, when looking the picture below the image of a Dalmatian dog sniffing the ground emerges all at once as a whole without previously having identified the parts (ear, collar, sidewalk). Wertheimer's ideas developed into a branch of psychology referred to as Gestalt psychology.

Figure 2. 1 Dalmatian dog.
Source: Ramachandran (2002)

Finally, even within the realm of traditional scientific disciplines such as physics the laws of Newtonian mechanics began to fail at the subatomic level. Conventional physicists assumed that subatomic particles were solid objects albeit of infinitesimal mass; however, in the first half of the twentieth century, it was demonstrated that in fact sub-atomic elements possessed both particle-like and wave-like characteristics. As a result, the field of quantum physics emerged, which concerned itself with defining probabilities of interconnections among the subatomic units (Capra, 1996).

In this context, there were some key thinkers who developed systems thinking into a theory. The first one was Alexander Bogdanov in the early 1900s who developed the theory of "tektology". Bogdanov described tektology as the science of the principles of organization governing living and non-living systems (Capra, 1996; Jackson, 2000). However, Bogdanov's ideas were interpreted as contradictory to the political regime in Russia at the time and failed to gain recognition. Several decades later biologist Ludwig von Bertalanffy postulated what would be the beginning of general system theory (GST) in these words:

> there exist models, principles, and laws that apply to generalized systems or their subclasses, irrespective of their particular kind, the nature of their component elements, and the relations or "forces" between them. It seems legitimate to ask for a theory, not of systems of a more or less special kind, but of universal principles applying to systems in general (von Bertalanffy, 1968, p.32).

Hence, it follows that the purpose of general system theory is to distil those principles that are common to any system, be it physical, biological or social in nature. In drawing out these common principles, systems theory encourages interdisciplinary communication leading ultimately towards the unity of science (von Bertalanffy, 1968).

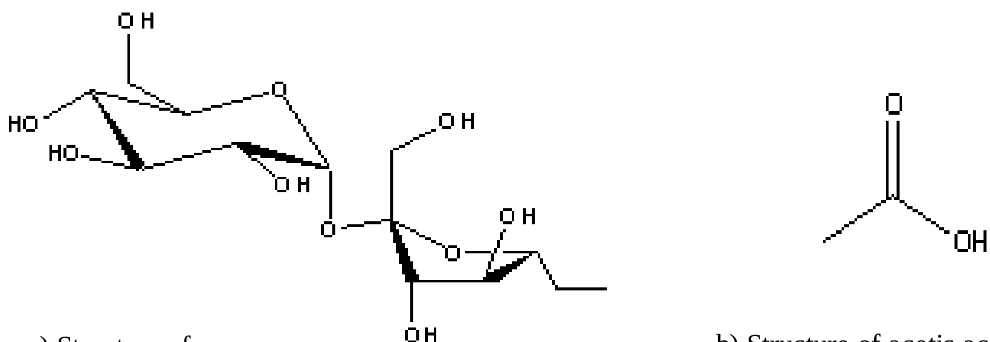
2.2. Social-ecological systems (SES)

2.2.1. Characteristics of systems

The currents of thought described above led to the birth of systems thinking. Before addressing ecosystem approaches, it is useful to define what a system is – in particular social-ecological systems – and their key characteristics. These two goals will occupy the current section.

A system is described as a collection of interrelated parts with emergent properties different from the properties of the individual components (Capra, 1996). Although somewhat intuitive, it is worth explaining further the attributes alluded to in this definition. First, there is the idea of interrelated parts. System thinking switched the focus from the analysis of the parts to the analysis of the whole. That is, the organizational structure of the system became as important as the components themselves, if not more. Also, it is understood that the delineation of a boundary around a system responds more to human convenience than to an actual demarcation. Often, an entity that is considered a system for purposes of study or management is part of a larger network and this network part of another one and so on. For instance, Allen and Hoekstra (1990) pointed out how conventional levels of organization used in ecology such as cells, organisms, populations, communities and ecosystems, form a hierarchy whose boundaries do not coincide with specific temporal or spatial scales; rather, they serve as criteria to separate the object of study from its context. Hence, while at times boundaries may reflect time and space considerations, the definition of the system is more strongly a function of the management intervention that is required (Allen et al., 1993). A corollary of the new focus on relationships and the awareness of a context is that system analysis can result in multiple interpretations of the same whole (Allen et al., 1993; Gallopin et al., 2001). This concept is radically different from the scientific paradigm that emphasizes analysis of the parts instead of their context and where only one interpretation is considered valid.

Another aspect of systems contained in the above definition is the idea of emergent properties. Emergent properties are those characteristic that are displayed by a system acting as a whole but that are not intrinsic to any of its individual components. For instance, cookies do not have the same qualities as the sugar and the other ingredients used to make them; and likewise, the chemical elements carbon, hydrogen or oxygen do not resemble the compound that they form when they combine to make sugar. Furthermore, the type of emergent properties that appear depend on the relationships that develop among the elements, e.g. the same elements appear in the structure of sugars as in the structure of acetic acid (vinegar), as shown in figure 2.2, however the final products have very different properties.



a) Structure of sucrose (table sugar)

b) Structure of acetic acid (its dilute form is vinegar)

Figure 2. 2 The same elements, carbon, hydrogen and oxygen combine in different ratios to form either sucrose (table sugar) or acetic acid (vinegar). Source: Chemfider (2007)

The phenomenon by which elements interact to produce a large-scale coordinated structure and/or behaviour is known as self-organisation (Gallopin et al., 2001). Why does self-organization occur? Kay and Scheneider (1994) proposed an explanation based on energy input. Energy is supplied to a system in incremental steps that cause it to move away from equilibrium. In turn, the system responds with the spontaneous emergence of organized behaviour that uses up energy to maintain its structure. There is an optimal energy input that allows for the system to fulfill its structural requirements while dissipating the energy. If not enough energy is supplied, the system does not develop self-organization. If too much energy is supplied, its capacity to absorb it becomes overwhelmed and the system falls apart. When such disruption occurs, there is an opportunity for true novelty to arise from newly form configurations.

Although the earlier cookie example is trivial, it helps to demonstrate another important characteristic of systems, that is, hierarchy. The emergent properties aforementioned are observed at some levels and not at others. For instance, the qualities of carbon, hydrogen and oxygen are seen at the elemental level, the properties of sugar emerge at the molecular level and so on. Figure 2.3 shows an example of a hierarchy in an ecological system such as a forest. Notice that in the example below hierarchical levels are chosen to coincide with time and space scales at which an ecosystem can be examined.

It is important to realize that there exists couplings between the levels, and hence an intervention at one scale is likely to have ramifications at other scales. This brings attention to yet another characteristic of systems, that is, the magnitude of the effects needs not be proportional to the magnitude of the cause(s) (Gallopin et al., 2001), nor are the effects gradually distributed over time and space (Holling, 1978). In other words systems display non-linear behaviour due to the presence of feedback loops, which often times are poorly understood.

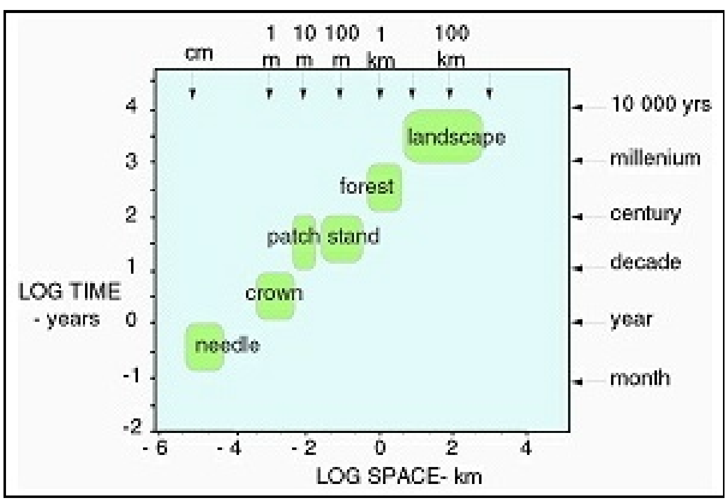


Figure 2. 3 Hierarchy of vegetation and landform for a forest. Source : Holling, 1978

Figure 2.4 shows two stylized graphs of cause and effect in a system. The tendency is to expect a response such as the one depicted on the left, that is, the effects of an intervention are more strongly noticed in its vicinity and the impact decreases with time and distance. This is indeed the case in many phenomena such as point source pollution. More challenging is when the situation depicted on the right arises, that is, the effect of an intervention is felt in places or at a time that are separated from the original point of intervention. Examples of the latter include the acidification of lakes in Eastern Canada, geographically removed from the major sources of sulphur dioxide.

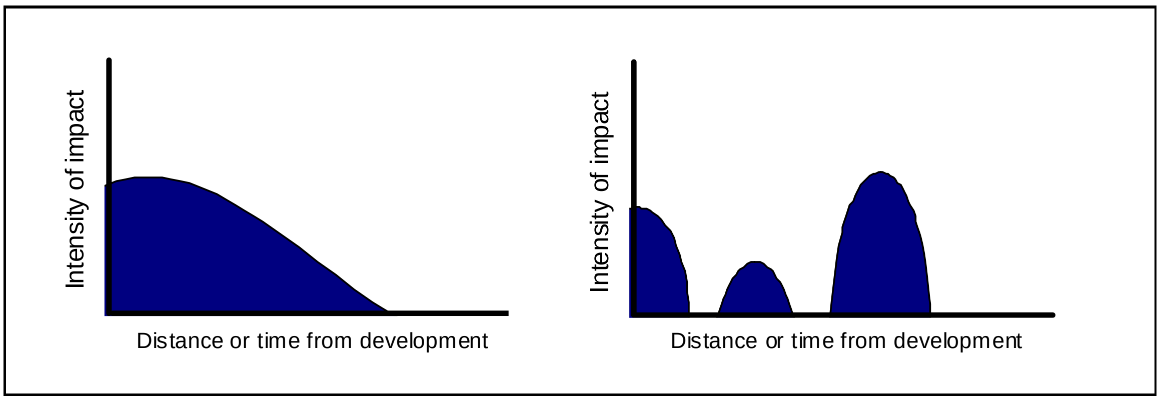


Figure 2. 4 Stylized illustrations of expected cause and effect in systems. Source: Based on Holling (1978)

As a result of the combination of the above properties – interrelated networks, emergence, self-organization, hierarchy, feedbacks and non-linearities – systems are characterized by irreducible uncertainty. Irreducible uncertainty arises when further data and additional research do not suffice to explain or predict the workings of a system. For instance, research can (and has) helped determine the components of sugar, its structure and its behaviour. However, in practical terms, no amount of research will be able to dissect in the same way the behaviour of a riparian ecosystem.

The above comparison serves to illustrate the last point: systems can demonstrate different degrees of complexity. The presence of irreducible uncertainty is a defining characteristic of a complex system. In addition, it is likely that a complex system will also have many of the other characteristics aforementioned. Funtowicz and Ravetz (1994) differentiate between ordinary and emergent complexity in systems. Ordinary complexity involves structure and self-organization but the system exhibits only limited teleology with simple goals such as growth or survival. Elements in an ordinary complex system maintain dynamic stability until a major perturbation overwhelms it.

Emergent complexity is different in at least two ways: first, some elements in a system that shows emergent complexity possess individuality and a higher degree of intentionality, i.e. purpose, consciousness, foresight or morals. Second, continuous novelty is a characteristic of emergent complex systems whereas simple complexity is characterized by recombination and variations but true novelty is indeed rare (Funtowicz and Ravetz, 1994).

Most of the terms defined above apply to complex systems in general. In the next section I describe social-ecological systems (SES), which are the ones that are dealt with more often in environmental management.

2.2.2. Social-ecological systems

A social system is defined as “any group of people who interact long enough to create a shared set of understandings, norms, or routines to integrate action, and established patterns of dominance and resource allocation” (Westley et al., 2002: 107). An ecological system, or an ecosystem, consists of “a community of organisms occupying a given region within a biome. Also the physical and chemical environment of that community and all the interactions among and between organisms and their environment”

(Dearden and Mitchell, 1998: 539). These two systems interact to form social-ecological systems.

Often times, social-ecological systems are considered either ecological systems with humans regarded just as another species; or, conversely, social systems where nature is a human construct that does not exist separate from people (Westley et al., 2002). While systems everywhere share certain characteristics, it is important to recognize that these approximations mask substantial differences. Westley et al. (2002) identified four sources of divergence between social and natural systems: first, human's capacity for abstract thought adds a third dimension to social systems in addition to space and time. Societies effectively create structures of meaning with corresponding structures of power and structures of legitimation (Giddens, 1987). In doing so, humans can dissociate themselves from space and time to some degree. A second distinction is that social systems are reflexive. The prevalent structures of meaning in a society can be created and destroyed at fast rates; hence a social system may change dramatically in short time periods. The teleology that is implied in these changes is absent in natural systems in which the closest equivalent to teleology may be survival instinct. Third, there is a higher degree of foresight in human societies than in ecosystems. The configuration of an ecosystem is determined to a large extent by its past history, e.g. a patch of Boreal forest will continue to be Boreal forest for a long time. People on the other hand are capable of anticipating and preparing for the future, e.g. a treaty can be signed to meet a desired end. Lastly, humans are unique in the use and creation of technology, which magnifies their impact on the surroundings. Given these differences Westley *et al.* (2002) conclude that SES belong to a category of systems that stand alone and that is different from social or ecological systems.

Systems of humans and nature have evolved together for millions of years; human existence depends on a range of benefits derived from ecosystems. Although these benefits vary widely, they can generally be grouped under four categories (see figure 2.5): provision of goods, regulating services, cultural services, and supporting services (Millennium Ecosystem Assessment, 2005).

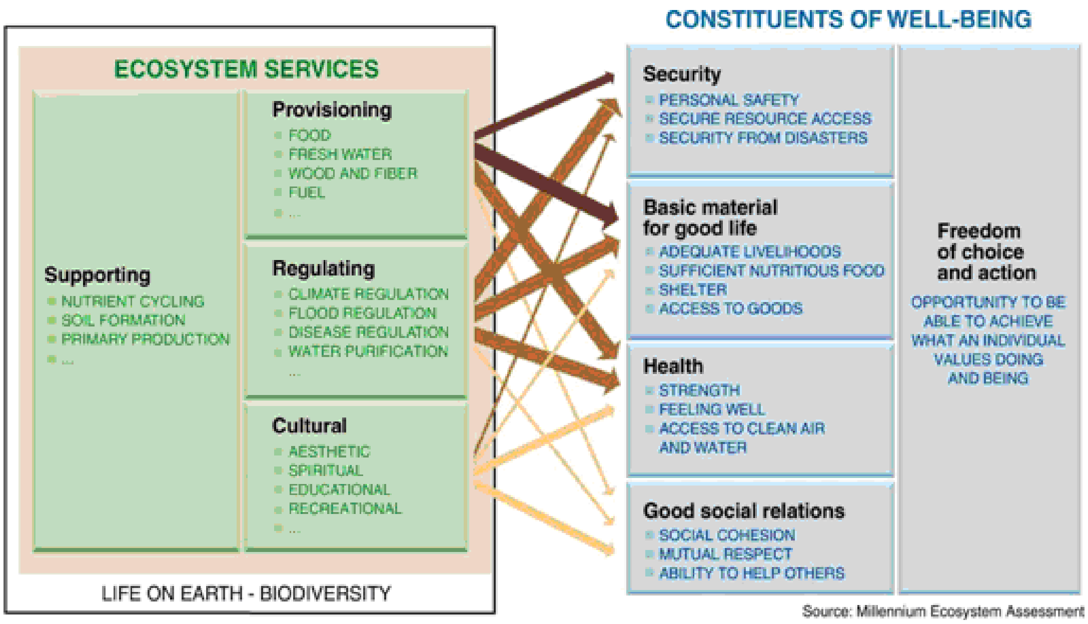


Figure 2. 5 Relations between ecosystem good and services and human well-being. Source: Millennium Ecosystem Assessment (2005)

For the most part, obtaining these benefits involves performing activities that transform the ecosystem in one of these three ways: by removing components, e.g. harvesting a tree species; by adding components, e.g. venting gas by-products to the atmosphere; or, by manipulating keystone ecological processes, e.g. altering river flood plains (Gunderson, 2003). The livelihoods of humans evolve around these processes. Consequently, as humans progressively become more dependent on the ecosystem, the ecosystem become less resilient (Gunderson, 2003).

The concept of resilience is an important one in the literature about ecosystem approaches. Resilience can be understood in one of two ways: the first one, referred to as “engineering resilience”, assumes that a system is at, or near, a steady state equilibrium; hence, resilience is the amount of time that it requires for the system to return to that point following a disturbance (Holling and Meffe, 1996). This is illustrated in figure 2.6 a).

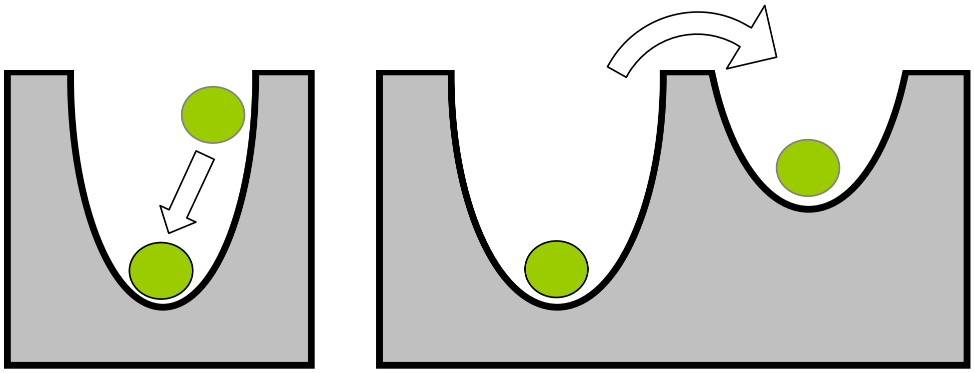


Figure 2. 6 The two types of resilience represented by ball-and-cup diagrams

The second definition (illustrated in figure 2.6. b) assumes that there exist alternative stable states each organized around a stable equilibrium attractor that defines a domain of behaviour for the system. In this case resilience is defined as the magnitude of disturbance that the system can absorb before it changes configurations (Holling and Meffe, 1996). Reconfigurations from one stable equilibrium to another are not gradual, but stepwise, and some changes are wholly unpredictable (Kay et al, 1999). When a reconfiguration occurs the set of processes that regulate the system changes accordingly. The latter definition of resilience is called “ecosystem resilience” and is the one that will be used in the remainder of the paper.

An example that serves to illustrate the concept of ecological resilience and alternative stable states is observed in Northern Florida where the abundance of pine vs. oak trees is regulated by the frequency and intensity of forest fires (based on Peterson, 2002a). A forest stand may be dominated by long-leaf pine, a fire-tolerant species. Frequent fires maintain this first stable state as young pine seedlings are fire-resistant whereas competing oak seedlings are not. In addition, pine trees shed needles that are combustible and serve as fuel. The stand will continue to be dominated by pine until an external trigger is introduced that reduces the occurrence or intensity of fires, e.g. weather becoming more humid, habitat fragmentation that prevents the spread of fire or fire suppression programs.

The disturbance has the potential to cause the ecosystem to switch stable states to an oak dominated stand. With fewer fires oak seedlings will begin to colonize the forest patch. At the same, fire reducing mechanisms will become dominant as oak trees shed leaves that act as fire suppressants. A second trigger, e.g. unusually dry summer, can cause the system to reverse back to pine and so on. It is important to emphasize that both states are equally healthy in an ecological sense; however, human preference may favour one state over the other. In this case, the preference was for the long-leaf pine savannah because it is the habitat of the endangered cockaded woodpecker.

Since human survival has come to depend on nature, indeed on nature in particular states, it is crucial for humans that nature's resilience be maintained. Unfortunately, surprises in ecosystem management are the rule rather than the exception. Sometimes surprises are local, that is, an unanticipated effect is observed locally, the cause of which forms part of a larger scale process (Gunderson, 2003). For instance, before El Niño Southern Oscillation was recognized as a global phenomenon, the change in weather in certain regions was unexplained. Other times, the surprise occurs as a result of an interaction among variables from different scales within a system (Gunderson, 2003). An example is forest fires that are triggered by a spark (fast variable) interacting with forest litter (slower variable). Lastly, sometimes surprises are caused by true novelty, that is, nothing similar has been experienced before in that particular system (Gunderson, 2003), e.g. First Nations exposure to European diseases during colonization. Clearly some of these types of surprises can be avoided by further studying the system, but in many situations this is not practical, or even desirable.

Briefly, this section has discussed the characteristics of complex dynamic systems and has demonstrated how social-ecological systems are a particular type of these. Complex systems pose a challenge for management because they are characterized by irreducible uncertainty. Nevertheless, there is a need to manage ecological systems because they provide the underpinnings for human existence. Hence the question now becomes how do we manage with uncertainty? This is the focus of the next section.

2.3. Ecosystem-based approaches

To recap, the key characteristics of social-ecological systems are: first that SES are complex and hence they are self-organizing and regulated by feedback mechanisms that operate over a range of spatial and temporal scales. Second, SES have hierarchical structures with associated emergent properties. Finally, reconfigurations from one stable equilibrium to another can be sudden and unpredictable. This section will demonstrate how traditional management strategies fall short for addressing the complexity of SES, and it will then introduce one of the alternatives, the ecosystem approach.

2.3.1. Limitations of traditional management

History shows that traditional approaches are ill suited for environmental management. Often, traditional management efforts concentrate on enhancing the stability of the system in order to obtain predictable outcomes. This is done by minimizing natural variation; for instance, farming favours monoculture crops, periodic floodplain inundations are reduced as rivers undergo channelization, and, naturally occurring fires are suppressed (Holling and Meffe, 1996). This logic assumes that the system has a unique stable state equilibrium, as opposed to a series of alternating stable states. When modifications to a SES are first introduced, initially the system behaves as expected which translates into an increased flow of benefits, economic or otherwise. This initial success tends to cement the belief that managers have a good grasp of the functioning of the system and, in the absence of contradictory evidence, work continues towards further optimization along the same principles (Peterson et al., 2003).

What tends to go unnoticed is that changes at one level in a system have repercussions in other parts that operate at larger temporal or spatial scales by virtue of being interconnected through feedback mechanisms (Carpenter & Gunderson, 2001). To illustrate the point using the previous ball-and-cup diagrams management of SES do not only change the position of the ball inside the cup but they may also change the shape of the cup itself making the system less resilient around that attractor as shown in figure 2.7 (Carpenter & Gunderson, 2001).

For instance, a fire suppression program increases the amount of forest floor litter slowly and, in most cases inadvertently. Notice that whereas a decrease on fire occurrences is easily traceable, the changes in forest litter require careful tracking. Managers may not be aware that the very actions that are aimed at avoiding forest fires, are causing a build-up of fire fuel, and that the system is approaching a threshold.

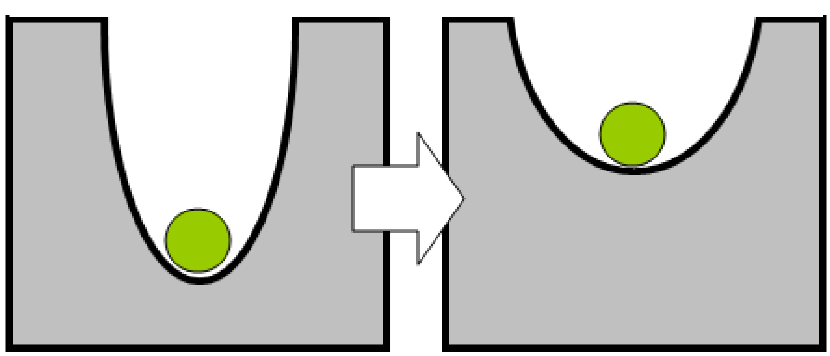
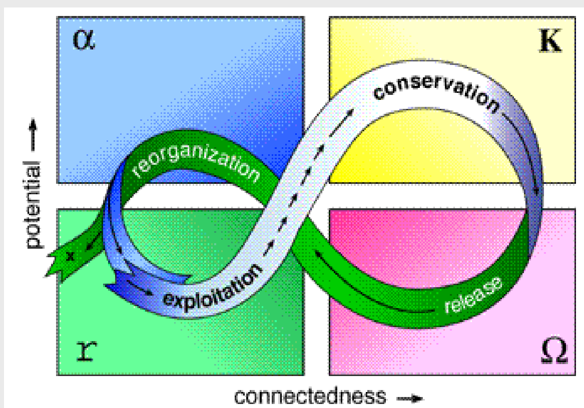


Figure 2. 7 Management actions can result in changes in resilience that are hard to detect.

Past experiences suggest that the system eventually undergoes a catastrophic change. That is, the system goes from being organized around one attractor, to being organized around another one. This transition is sudden. Sometimes there are warning signs that resilience is eroding, e.g. the system starts to behave erratically, or stops responding to treatment. These signs are often mistaken as a signal to intensify management actions. At this point, a vicious cycle ensues, known as the "pathology of command and control" (Holling and Meffe, 1996). In the aftermath, the system switches configurations to an alternative stable state whose characteristics may be less desirable for human purposes. Holling (2001) proposed the metaphor of an adaptive cycle (refer to figure 2.8) to explain the cycles of renewal and destruction.

The adaptive cycle



The adaptive cycle is a stylized representation of the four phases of systems. The arrows represent the speed at which one stage transforms into the next. Short arrows indicate a slowly changing situation while long arrows indicate a quick change. The x-axis represents the degree of connectedness among variables. The y-axis represents the potential that is inherent in the accumulated resources. A system alternates between periods of slow accumulation and transformation of resources (from exploitation to conservati*on, or r to K), with shorter periods that create opportunities for innovation (from release to reorganization, or Ω to α). During the first part* of the cycle, connectedness and stability increase and capital is accumulated. Eventually the system becomes over-connected and increasingly rigid. At this point an external trigger may destabilize the system and cause it to undergo a period of rapid reorganization during which novelty can arise.

From: C.S. Holling (2001)

Figure 2. 8 Holling's adaptive cycle metaphor. Source: Holling, 2001.

Although examples of natural resource collapse are often spectacular and well documented, social systems undergo similar cycles. Funtowicz and Ravetz (1994) refer to this phenomenon as the *ancien régime* syndrome. In such societies a hegemonic state forms, which is characterized by its inability to fulfill key functions, uniformity and a fierce opposition to novelty. As in natural resource systems, when problems arise, they are suppressed instead of being dealt with. Hence, the elite becomes more despotic and out of touch with their constituency. In time, even a relatively minor struggle suffices to topple the ancient regime.

In social-ecological systems, examples of resource mismanagement abound (see Diamond, 2005) the causes of which are varied, including: inability to detect change in resources, rational overexploitation, command and control management, difficulties in managing common resources, and uncertainty (Peterson et al., 2003). Yet, in recent decades there is a growing consensus that the severity of the consequences poses too high a risk to justify not finding an alternative management philosophy that would ensure continuity in the flow of benefits from ecosystems. The task is not easy. New approaches must address situations where decision stakes are high, stakeholders have conflicting interests, uncertainty is high, controllability is low and there is a sense of urgency (Bunch, 2001, Waltner-Toews et al., 2003). Many advocate that systemic approaches to management would solve some of the situations aforementioned. The next section addresses specifically the ecosystem approach.

2.3.2. Characteristics of ecosystem approaches

Environmental management has undergone a transformation in recent decades from a narrow approach emphasizing a single goal, to a more comprehensive approach that strives to maintain sustainability while balancing several interests. However, new and old paradigms coexist along a continuum. The purpose of this section is three-fold: first, I will explain the range of approaches and situate the ecosystem approach within it. Second, I will introduce definitions of the ecosystem approach as used by different initiatives and programs that have adopted it. In particular I will focus on the International Joint Commission (IJC) who oversees ecological restoration activities in the Great Lakes; the Royal Commission on the Future of the Toronto Waterfront whose work is pertinent to urban development; and finally, emerging ecohealth approaches. The reason why these three were chosen is that they capture a good portion of the activity on ecosystem approaches that has taken place in the Golden Horseshoe Region (Ontario). Moreover, many of the practitioners interviewed for this research have been involved directly or indirectly with these initiatives. Third, I will present common themes that emerge from the previous definitions. It is worth emphasizing that despite the attention that the ecosystem approach has gathered recently, a standard definition remains elusive. In this last part I will identify the main components and characteristics of ecosystem approaches.

2.3.2.1. Environmental management paradigms. Yaffee (1996) proposed a typology of new and old environmental management paradigms along a continuum: dominant use, multiple use, environmentally sensitive multiple use, ecosystem approach to resource management and ecoregional management (see table 2.2).

The first three are similar in that they have a distinctively anthropocentric focus and the management boundaries are set following the jurisdictional limits of the managing agency. Dominant use is concerned with the exploitation of a single resource for human use, e.g. softwood. Multiple use shares the tenets of dominant use but there is a combination of resources that are developed simultaneously, e.g. fishing, recreation and softwood extraction. The principle of maximum sustainable yield underlies management decisions in both cases. Some resource protection may be exercised but subject to economic feasibility.

Table 2. 2

The continuum of environmental management paradigms. Source: Yaffee, 1998.

			Ecosystem approaches		
	Dominant use	**Multiple use**	**Environmentally sensitive multiple use**	**Ecosystem approach to resource management**	**Ecoregional management**
Goals	Promote single-purpose human use	Promote multiple human uses	Foster multiple human uses subject to environmental constraints	Promote ecological integrity while allowing human use on a sustainable basis	Manage at the ecoregional level, restoring and maintaining ecosystem function while allowing human use on a sustainable basis
Primary biotic focus	Economically viable species	Economically viable species and sites.	Multiple species; composition and structure	Species and ecosystems; composition, structure, and function	Landscape ecosystems; function (ecological processes)
Spatial focus / boundary	Management unit	Management unit	Management unit plus “problem-shed”	Regional-scale “problem-shed”; consideration of ecologically relevant boundaries	Landscape ecosystem unit
Key principles	Maximum yield; some protection of the means of production subject to economic feasibility	Multi-objective maximum sustained yield; economic feasibility	Sustained yield; minimize environmental and cumulative impacts; protection of biodiversity; consideration of economic costs; public involvement	Ecosystem as a metaphor for holistic thinking; system perspective; ecosystem complexity and dynamism; collaborative decision-making; explicit consideration of uncertainty; interagency cooperation	Ecosystem as an integrated spatial unit, fitting within a nested hierarchy of geographic units; ecosystem complexity and dynamism; collaborative decision making decentralized to the ecoregion level; explicit consideration of uncertainty; reorganization of management along ecoregional lines
Concept of ecosystem	Industrial production platform	Industrial production platform	Constrained production platform; landscape area affected by management actions and that affects management	Construct that matches the problem at hand; focus on sets of interactions dominated by biotic elements	Specific geographic places, defined as bioecosystems or geoecosystems
Ethical precepts	Anthropocentric	Anthropocentric	Anthropocentric	Biocentric	Ecocentric

Environmentally sensitive multiple use remains anthropocentric in focus although it acknowledges the limits of ecological systems. In its notion of ecosystems, it considers some aspects of their complexity; for instance, in addition to the economically valuable species it also pays attention to structural and compositional features of the ecosystem. Other innovative elements in this management paradigm are: first, there is a larger role for public involvement in decision-making; second, the principle of *maximum* sustainable yield is replaced by sustainable yield; and third, negative environmental impacts are actively avoided.

The ecosystem approach to resource management is fundamentally different from the previous approaches: its focus switches from anthropocentric to biocentric. As such, the overarching goal is to promote ecological integrity, while allowing sustainable use of resources to satisfy human needs. Hence, the boundaries are drawn along ecological lines. Also, the conception of ecosystem reflects a deeper understanding of its complexity.

Many of the same principles of the ecosystem approach to resource management are found on ecoregional management. However, they differ on the notion of 'ecosystem'. According to Yaffee (1996) the former uses the term ecosystem as a metaphor to imply holism and systems thinking. In the latter, ecosystem is an actual living geographic space. Management is done at the ecoregional level, where landscape processes are important. Again, the primary goal is to restore and maintain ecosystem function while permitting human use in a sustainable basis.

Yaffee's classification is a useful way to map environmental approaches with respect to their notion of ecosystem, orientation, boundaries, and overarching goals. The ecosystem approach examined in this paper may be considered a hybrid of the last three approaches described by Yaffee (1996), displaying principles from each of them. With this in mind, the next section outlines what these elements are in more detail.

2.3.2.2. Definitions of the ecosystem approach in the Golden Horseshoe Region. In this section I will describe in some depth the approach used by three initiatives that took place in the Ontario's Golden Horseshoe Region (GHR). These are: the International Joint Commission (IJC) in the Great Lakes, the Royal Commission on the Future of the Toronto Waterfront, and emerging ecohealth approaches. These initiatives are pertinent because they operationalize slightly different principles all under the heading of ecosystem approaches and they represent a good cross-section of the transformation of environmental management in Ontario.

The Great Lakes

The Great Lakes constitute the world's largest freshwater ecosystem. In 1909 Canada and the United States signed the Boundary Waters Treaty which created the International Joint Commission (IJC) to deal with water issues in the basin. Due to an evident decline in water quality, the first Great Lakes Water Quality Agreement (GLWQA) was signed in 1972 to combat point source pollution, and later revised in 1978 and 1987.

In the 1978 revision, the Great Lakes Science Advisory Board (SAB) – working under the IJC – was pioneer in advocating the use of an ecosystem approach to environmental management. In part, the recommendation stemmed from a concern that the emphasis of the previous agreement on improving water quality by reducing the concentration of pollutants was unduly narrow and, in many respects, ineffective.

Whereas the previous agreement had focused on point sources and eliminating harmful substances from the lakes, the 1978 revision emphasized the need to consider the entire ecosystem, defined in geographical terms as a "unit of nature in which living organisms and nonliving substances interact with an exchange of materials between the living and nonliving parts" (SAB, 1980, p.23).

The key principles of the ecosystem approach proposed in 1978 are summarized as follows: first, humans were considered part of nature. The "man-in-a-system" concept was radically different from the “system-external-to-man” notion in which the previous agreement was based. Second, interactions with neighbouring areas were recognized as significant for management because the basin is an open system exchanging material and energy with its surroundings. This was especially important when the effects of transboundary pollution started to get observed. Third, the SAB highlighted the need to understand the ecosystem not as a static system, but a highly dynamic one with feedbacks and non-linear effects at work. For instance, the original Surveillance Program from the 1972 agreement monitored concentrations of pollutants; however, there was little done in the way of interpreting the results in terms of interactions of dynamic qualities such as fluxes and rates. Another unexplained omission was the lack of monitoring of biological parameters, e.g. concentrations of pollutants in fish were measured, but fish reproductory success or fish population were not. Last, the ecosystem approach recognized limits to the biophysical capacity of the basin.

The revision of the Great Lakes agreement marks a switch in environmental management from a human-centred and reductionist view to an ecosystem-centred and holistic approach that emphasizes interrelations between the biotic and abiotic parts of the system. Such a change, the Board recognized, would demand the re-education of citizens from primary schools to high level executives in business, industry and government.

The Royal Commission on the Future of the Toronto Waterfront

The Royal Commission was created in 1988 to make recommendations to the federal government, and later to the provincial government as well, regarding the future development of the Toronto Waterfront. The Commission advised on a variety of issues including the fate of the Toronto Island Airport, the restoration of the natural environment, the use of federal lands within the area, strategies for a regional transportation system, or housing and community development.

From the offset the Royal Commission adopted an ecosystem approach. According to the Commission, an ecosystem approach:

> includes the whole system, not just parts of it; focuses on the interrelationships among the elements; understands that humans are part of nature, not separate from it; recognizes the dynamic nature of the ecosystem, presenting a moving picture rather than a still photograph; incorporates the concepts of carrying capacity, resilience, and sustainability – suggesting that there are limits to human activity; uses a broad definition of environments – natural, physical, economic, social and cultural; encompasses both urban and rural activities; is based on natural geographic units such as watersheds, rather than on political boundaries; embraces all levels of activity – local, regional, national, and international; emphasizes the importance of species other than humans and of generations other than the present; and, is based on an ethic in which progress is measured by the quality, well-being, integrity, and dignity it accords natural, social, and economic systems (Royal Commission, 1992, xxi).

Ecohealth approaches

Although many practitioners and theorists of ecohealth approaches are based in Ontario, their work has more often been applied overseas, usually in developing nations. Lebel (2003) identified the three methodological pillars of ecohealth approaches as transdisciplinarity, participation and equity.

Transdisciplinarity is the integration of various kinds of knowledge from stakeholders, different from interdisciplinary and multidisciplinary approaches. According to Lebel (2003), interdisciplinarity implies the study of phenomena occurring at the intersection of two disciplines, as in biochemistry; whereas multidisciplinarity involves experts from several disciplines working together but not necessarily combining their knowledge into integrated actions. Transdisciplinarity ensures that experts from different disciplines and key actors develop a common vision. How this is achieved brings us to the second pillar of ecohealth approaches: participation.

Evidence demonstrates that there cannot be development without community involvement. Ecohealth projects benefit from having representatives from at least three groups work together: experts, community members and decision-makers. The latter term is left ambiguous to highlight that decisions are influenced by those belonging to both, formal and informal, governance structures. Traditionally, local participants have had limited involvement, mostly as sources of information. Ecohealth approaches aim to involve participants at all stages of the process. There exists a variety of participatory methodologies that serve to increase community participation. Soft systems methodology (SSM) and adaptive environmental management (AEM) are among the more commonly used (Waltner-Toews, 2004). In these, stakeholders hold a series of workshops where they develop a conceptual model of the situation (anything from a computer simulation model to a rich picture), and this serves as the basis to define problem areas, identify alternatives and choose solutions that will be later implemented and monitored.

Third, ecohealth approaches are concerned with equity. Health problems cannot be studied from a strictly biomedical or environmental perspective because health is a product of socio-economic and cultural factors as much as it is a product of science and the environment. Ecohealth approaches pay close attention to gender since in most societies gender roles and status determine to a large extent the functions of a person and consequently the likelihood of being exposed to situations or activities that compromise their health. Likewise, the link between the position of women and the health of offspring is well established in development literature.

2.3.2.3. Common themes. Although the above initiatives are by no means the only ones, they are nevertheless a good cross-section of the work done by practitioners in Ontario's Golden Horseshoe Region and the principles expressed suffice to flesh out the main themes of the ecosystem approach philosophy and practice. These are:

1. Ecosystem approaches are holistic, they recognize that the whole is larger than the sum of its parts. The Great Lakes Science Advisory Board (1980) captured this idea when it argued that looking exclusively at water quality to ameliorate the integrity

of the entire Great Lakes basin was equivalent to using blood tests only to improve a patient's overall health.

2. Ecosystem approaches reflect a systems approach to management. A holistic perspective is part of it, as well as an emphasis on interactions among different parts of the system. Ecosystems are seen as highly dynamic, open systems governed by feedbacks and non-linear effects. Also, all three initiatives allude to the complexity of managing social-ecological systems.

3. The management unit is defined geographically considering the landscape features of the ecosystem, e.g. a watershed. Political boundaries are secondary and hence, it often necessitates of the cooperation of different jurisdictional levels. For instance, the Great Lakes basin extends over two countries, one province, eight states, and 54 municipalities.

4. Humans are part of nature, not separate from it. It follows that the actions impinged on the environment have consequences for all parts of the ecosystem – including humans. Westley *et al.* (2002) argued that given the capacity of human beings for abstract thought, reflexivity, foresight and the use of technology; it is more accurate to refer to social-ecological systems, instead of just social or natural systems. While this may seem conflicting, it is a difference of degree rather than kind that she is pointing out.

5. Ecosystem approaches are participatory. The importance, and the benefits, of including all stakeholders in the process can hardly be overstated. In addition, involvement should be as thorough as possible, without limiting the role of

stakeholder to simply being sources of information. Instead, they need to be engaged in all stages from problem identification to program implementation and monitoring.

6. Ecosystem approaches combine different types of knowledge with particular attention paid to the input of individuals traditionally excluded from decision-making and from disadvantaged groups. Conventional ‘experts’ also participate forming interdisciplinary teams. Despite Lebel’s (2003) distinction between interdisciplinarity and transdisciplinarity, the majority of the literature consulted uses the former term to refer to teams of experts working in an integrative fashion to combine knowledge and tools from their respective disciplines and so will we for the remainder of this paper.

7. The role of science continues to be central in decision-making, however instead of prediction its main goal is to serve adaptation. Post-normal science is the term that has been introduced to refer to science that includes a larger holistic perspective (Funtowicz and Ravetz, 1994). Within this paradigm scientists assist decision-making by presenting future possibilities of the system, often in the form of narratives or scenarios which combine qualitative and quantitative data (Kay and Regier, 2000). The underlying goal is to identify the processes that are necessary to maintain the character of the system.

8. Ecosystem approaches recognize that there are biophysical limits to the capacity of social-ecological systems. This is more evident in the introduction of terms such as “carrying capacity” in the Great Lakes agreement. In applications that are more socially oriented “resilience” and “sustainability” indicate the need to find a balance

to human activity. Progress is measured by the “quality, well-being, integrity, and dignity it accords natural, social, and economic systems” (Royal Commission on the Future of the Toronto Waterfront, 1992, p. xxi)

9. Ecosystem approaches recognize the complexity and uncertainty of social-ecological systems and advocate for the use of adaptive management. In this context, managing adaptively means that management objectives are re-evaluated as new information becomes available. It can be done through the implementation of adaptive environmental management (AEM) as originally conceived by Holling[2], but it needs not be limited to this methodology. For instance, some forms of adaptive management may not require the construction of a simulation model – an essential part of Holling’s method – but may use scenario planning or rich pictures which help participants decide on future actions and reassess periodically.

10. Equity is only directly addressed in some of the literature on ecohealth approaches. However, two of the practices advocated by all three approaches – the integration of different types of knowledge and increased participation – could not be achieved unless equity considerations are taken into account.

2.4. Summary

Briefly, systems thinking evolved in response to the challenge that complexity presented for traditional scientific disciplines. Systems thinking switched the attention

[2] Clarification on terminology: In this paper, the terms “adaptive environmental management (AEM)” and “adaptive environmental assessment and management (AEAM)” refer to Holling’s methodology as detailed in his 1978 book *Adaptive environmental assessment and management*. The term “adaptive management” includes AEM, AEAM *and* other forms of management that use workshops with key stakeholders who construct a model (e.g. a rich picture) and decide on future actions and agree to monitor and re-evaluate as needed, e.g. soft systems methodology.

from the study of the parts to the study of the whole. It is therefore a holistic approach that recognizes that the whole is larger than the sum of its parts. It also emphasizes the presence of hierarchies within a system and the mechanisms of communication and feedback among these levels.

Traditional management of social-ecological systems, has been based on linear, reductionist logic where the system is assumed to have a stable state equilibrium. This paradigm often falls short in protecting the resource for prolonged periods of time. As a result the system changes configurations which causes it to reduce, or stop altogether, its capacity to provide good and services for humans.

Ecosystem approaches fall under the rubric of systems thinking and are thought to be a viable alternative for environmental management. Since these methods are relatively young, a precise definition remains elusive. However, common elements found in most definitions include a holistic view of environmental situations as complex, dynamic social-ecological systems; the definition of the problem-shed in geographical terms; inter-agency cooperation; participation by diverse stakeholders; combination of different types of knowledge; an emphasis on equity; and, adaptive management.

3. Methodology

This research uses qualitative and quantitative data analysis to examine the perceptions of ecosystem approach practitioners with regards to their approach and understanding of ecosystem approaches in projects undertaken in the Golden Horseshoe Region (Ontario).

The purpose of this chapter is to explain the method that was used for collecting the data and its subsequent analysis. There are three parts to the chapter: the first one is dedicated to explaining the sampling methodology and the survey that was administered to practitioners; the second part explains the choice of the method used to analyse the data, that is, content analysis; and, the last part contains the list of research questions that were used to guide the analysis.

3.1. Data collection

3.1.1. Sampling

This research is based on the responses of 55 telephone interviews performed by Bunch et al. in 2001 – 2002. The survey targeted practitioners of the ecosystem approach in the Golden Horseshoe Region. An "ecosystem approach practitioner" was defined as someone who has been involved in the design, implementation, monitoring or evaluation of programs or projects that have explicitly used an ecosystem approach.

To find ecosystem approach practitioners to respond to the survey, snowball sampling was used. That is, respondents were asked to identify other potential survey respondents. While this constitutes an efficient way of obtaining information, the data from snowball sampling is necessarily biased and generalization may be difficult. Likewise, results from snowball samples may overemphasize cohesiveness because the reference and the referee belong to the same network, and hence tend to exclude outliers in their field (Atkinson and Flint, 2001). However, this type of sampling is appropriate to gain access to subjects who are few in number or where some degree of trust is required to initiate contact (Atkinson and Flint, 2001). In this case, choosing snowball sampling was justified because the target group, practitioners of ecosystem approaches, represents only a fraction of all of the environmental managers, hence a wider sampling technique would have included individuals that did not have the required experience in the field with EA. Once contacted, respondents were required to characterize themselves as EA practitioners in order to participate in the survey.

3.1.2. Survey

Participants were contacted twice: the first time, a short call was used to assess eligibility and willingness to participate on the survey as well as to schedule time aside for the longer interview (refer to appendix A for sample questionnaire); the second time was used for the actual interview (refer to appendix B for sample questionnaire). The survey consisted of 62 to 85 questions – depending on how participants responded. The goals were: first, to determine the participant's profile; second, to assess his/her conceptual understanding and perceptions of the ecosystem approach; third, to assess his/her degree of involvement with ecosystem approaches; fourth, to evaluate the successes, failures and barriers to the EA; and finally, to discuss the potential for generalizing the approach to urban and health contexts. The survey consisted of a mix of structured and open-ended questions[3]. A more detail breakdown of the questionnaire is offered in table 3.1.

[3] Structured questions refers to questions that required the participant to choose between two statements, choose from a list of options, or identify their position on a Leichhardt scale.

Table 3. 1 Survey concept map..

	Questions*
Personal profile	II.1-5, III. 1a-b, III.2
Practitioners' conceptual understanding of the ecosystem approach	
General conception/definition of the approach	III.3
Influential theories, methods, techniques	III.12, III.13, III.14, III.15
Adaptive vs. mechanistic/programmed orientation	III.6, III.9, III.10
Participation	III.8, III.11
Physical vs. human-physical orientation	III.4, III.5, III.7
The experience of the ecosystem approach as applied in the Golden Horseshoe region	
Program names and implementing agencies	IV.1a-b
Goals and objectives of ecosystem approaches	IV.1e
Adaptive vs. mechanistic/programmed orientation	V.2a-g
Participation	IV.2a, IV.2bi-ix, IV.3
Physical vs. human-physical orientation (incl. gender)	IV.4, IV.5, V.1
Successes and Failures, Bridges and Barriers	
Critical issues in success or failure of the approach	VI.1, VI.2, VI.3
Specific problems and their solutions	VI.3, VI.4, VI.5
Appropriate applications and settings for the approach	VI.6, VI.7
Generalization of the ecosystem approach	
To human health issues	VII.1, VII.2a-b, VII.3-6
In an urban context	VII.8, VII.9a-b, VII.10a
Communication and Dissemination of survey results	VIII.1 thru VIII.6

* Roman character indicates survey section; Arabic numeral indicates the question number within each section.

Source: Bunch and Jerrett, 2003

Responses from the participants were recorded manually on a survey response form and then transcribed to a Microsoft Access database where they were checked for consistency, omissions and other errors by Bunch and his assistants. In preparation for carrying out computer-aided content analysis with QSR NVivo software, the open-ended questions were copied separately into Word documents. The same treatment was given to the set of answers from structured questions, except that Excel spreadsheets were used for their analysis.

3.2. Content analysis: brief introduction

Prior to this work, Bunch and Jerrett (2003) performed quantitative analysis on the data obtained from structured questions. This paper continues the work by adding qualitative analysis of the open-ended questions. Open-ended questions were studied using content analysis.

Content analysis has been used extensively to draw meaning from symbolic, verbal, and written communications. Although applications range, the key to content analysis is that communication data serves as the basis for inference. Content analysis is primarily a technique, that is, the procedures for scanning the text and drawing inferences are explicitly formulated to avoid subjective judgements by researchers (Holsti, 1969; Krippendorf, 2004). Being considered a technique also implies that its rules are applied systematically throughout the data, which ensures reproducibility and impartiality (Krippendorf, 2004).

There is a quantitative element to content analysis, usually related to the frequency at which a theme or a symbol appears in the text (Holsti, 1969). However, content analysis accepts variations on this point, e.g. for certain applications it may be more useful to simply determine if an element is present at all in a communication; or, at times the proximity between two themes may be more relevant than the actual count. Only manifest elements should be counted, that is, the theme must appear written in the text, not deduced from the context (Holsti, 1969). The idea that only manifest elements should be considered is a point of contention, furthermore, in the literature it is understood that at later stages, the researcher may chose to "read between the lines" and draw further inferences from implicit themes. Hence, "content analysis is a research technique for making replicable and valid inferences from texts [...] to the contexts of their use" (Krippendorff, 2004: 18).

There are several reasons why content analysis is appropriate for this research: First, content analysis can manage relatively unstructured data such as the responses obtained from open-ended questions. Second, because the output of content analysis is quantitative, it permits the researcher to merge the results from both, the short-answers and the structured questions, to establish trends in the data. Third, content analysis recognizes that data is contextual (Krippendorf, 2004). Part of the goal of this research is to identify if clusters of ecosystem approach practitioners are forming and hence it will be important to known if differences in opinion are related to their background and experience, or some other characteristic In some instances, content analysis is considered an unobtrusive, non-reactive technique (Krippendorff, 2004). However, this condition does not apply for this research since the data came from telephone interviews where there was interaction – albeit minimal – between the researcher and the participants.

The procedure for analysing responses to the open-ended questions was to read the answers several times to extract a preliminary list of themes that appeared with more frequency or that corresponded with issues discussed in the wider literature. Next, the ideas were organized under different themes and then coding was done for specific words and phrases. Sometimes the coding was done by means of queries using QSR NVivo (version 7); sometimes – when queries for specific words would not suffice – the search for themes was done manually.

QSR NVivo (v.7) is software designed to organize and analyze qualitative, textual data. In this research QSR NVivo was used to classify and store the qualitative answers from interviews so that they could be accessed by question and by practitioner. Although the software contains many more functionalities, this research made use of mostly two: query searches that allow scanning for specific words through text documents; as well as functions that permit to do cross-tabulations.

Here is an example of how a query search was made: on reading the answers to the question “based on your experience with such projects, how would you define the ecosystem approach?” (question 3, part III) I noticed that participants made references to “human interactions with the environment”, “interconnections between them”, “interactions between the organisms and the physical environment”, “connected factors”, “relationships between the ecosystem and other systems”. Hence, I suspected that participants saw the ecosystem approach as one that took into account the interconnections between different parts of the system. I then made a query where the QSR NVivo searched all of the answers to the above question for the terms “connect* OR interconnect* OR interact* OR relation* OR link OR interdependen*”. I repeated this procedure looking for other themes, such as “complexity”, “participation” and so on (see figure 3.1).

Both manual and automatic queries show next to the theme two important pieces of information. The first column, sources, indicates how many of the interviewees referred to the particular theme. The second column, references, indicates how many mentions regarding a theme were found. Both help to determine the frequency of a given theme.

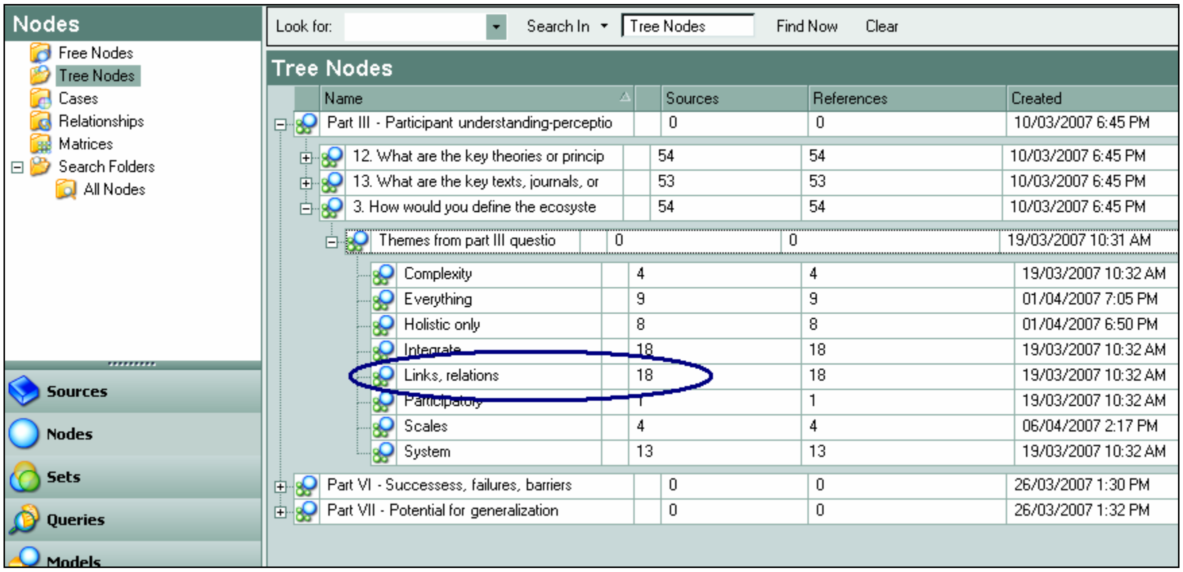


Figure 3. 1 QSR NVivo screen capture showing themes for the analysis of question 3, part III

Chi square (X^2) tests were performed on selected questions to test possible correspondences between specific answers and the characteristics of the respondents, e.g. did practitioners with a scientific background tend to think that the ecosystem approach was not rigorous? Unless reported otherwise, the level of confidence of the chi-square test was 95%. It should be noted that the chi statistic indicates the presence, or absence, of correlation between two variables. It does not show how those variables are related.

3.3. Research questions

3.3.1. Who are ecosystem approach practitioners?

Understandings of ecosystem approaches may depend on the vantage point of the respondent. Hence, it is useful to be able to identify at least some of the likely influences on the survey participants such as their level of education, their academic background, their current area of employment and position, and their years of experience using ecosystem approaches. The information was gathered by means of structured questions (refer to part II of the survey). This data was valuable in determining if, and to what extent, these factors accounted for trends observed in the responses.

3.3.2. What are the theoretical understandings of the ecosystem approach by its actual practitioners?

Yaffee (1999) pointed out how the term "ecosystem approach" has found a way into the discourse of groups that traditionally have disagreed in almost everything else. Hence he reasoned that the popularity of the term was due to different groups attributing different meaning to it; meanings, that ultimately served to advance their own agendas. Therefore, the aim of this guiding question is to dispel the ambiguity surrounding ecosystem approaches by spelling out practitioners' conceptual understandings of the approach.

The analysis for this question was based on the data from part III of the survey. Part III combines short-answers and structured questions. The first open-ended question asked the participant to define the ecosystem approach based on their experience (question 3). Another question aimed to establish the key theories that guided the practitioner's application of EA (question 12), and finally, a question was directed to the literature from which the respondent drew information (question 13). The structured questions probed practitioners on particular details regarding these three areas.

3.3.3. What is the orientation of actual applications of the approach?

The theoretical understanding of ecosystem approaches described in the responses to the previous section needs to be compared to the actual practices in EA projects. This was the aim of parts IV and V of the survey. These two sections complement each other: Part V consists of a series of opposing statements about EA practices with which the respondent needs to identify. The statements were aimed at probing particular understandings such as: Is the approach adaptive? Is it participatory? Is it focussed on social, ecological or social-ecological systems? The data from section V is quantitative and was compiled prior to this research by Bunch and Jerrett (2003).

Part IV combines open-ended questions and structured to gain insight about the goals of the projects in which the practitioners had been involved. It also aims to investigate the challenges of carrying out effective stakeholder participation, which is commonly held as an intrinsic part of ecosystem approaches.

3.3.4. What are the successes and failures, bridges and barriers to the application of ecosystem approaches?

The implementation of ecosystem approaches calls for a deep restructuring of traditional environmental management. Not surprisingly, the changes that are required have been met with resistance by current management institutions. If the adoption of ecosystem approaches is to increase, then it is necessary to understand the factors that contributed to the successes and, or failures, in past applications. This is the aim of the questions in part VI from the survey.

Part VI explores possible solutions to problems with the ecosystem approach (identified by the participant from a list); as well as the most appropriate institutional or jurisdictional setting to implement ecosystem approaches (questions 5 and 7 respectively).

3.3.5. What is the potential for generalization of the ecosystem approach?

For the most part, ecosystem approaches have found use in natural resource management applications where the managing revolved around a central ecological feature of an ecosystem such as a watershed. The move towards the application of ecosystem approaches to social-ecological complexes, e.g. development in an urban waterfront, is more recent.

Part VII of the questionnaire explores the potential for broadening the use of ecosystem approaches to other types of social-ecological systems. Two open-ended questions are used to probe practitioners' opinions on the feasibility of using EA to human health issues (refer to question 2) and in urban settings (refer to question 9).

3.4. Summary

To summarize, this research used snowball sampling to identify environmental managers who have experience with ecosystem approaches. The survey administered consisted of a mix of open-ended and structured questions that probed the practitioner's understanding of the ecosystem approach in theoretical and practical terms. The quantitative data has been analyzed by Bunch and Jerrett (2003); this research contributes to the work by adding the analysis of the qualitative data. The analysis of the latter was performed by using computer-aided content analysis. Content analysis is a technique to draw information from textual and communication data by looking at the pattern of themes that emerge.

The research is structured based on five guiding questions: first, what is the background of ecosystem approach practitioners; second, what are the conceptual understandings of the approach according to these practitioners; third, what is the approach's orientation in practice; fourth, what are considered the successes and failures of EA; and lastly, what is the potential for generalizing ecosystem approaches to other settings such as the human health and urban issues. Chapter four presents the results of the analysis.

4. Results

This chapter contains the results obtained from applying content analysis to the qualitative data from the open-ended questions in the survey. For completeness, the quantitative data presented by Bunch and Jerrett (2003) are also included and sourced accordingly.

The organization of the chapter follows the concept map detailed in table 3.1 which addresses the five guiding research questions: Who are ecosystem approach practitioners? What is their theoretical understanding of ecosystem approaches? What is their practical understanding of the approach? What are successes and failures of EA? And, what is the transferability of ecosystem approaches to other contexts?

4.1. Who are the ecosystem approach practitioners?

This part contains information on the background of ecosystem approach practitioners, such as education, age, employment sector and years of experience. The information will be used to establish trends that may relate similarities in later answers with particular characteristics of the respondents.

To take part in the survey respondents had to identify themselves as practitioners of the ecosystem approach. Their roles in EA projects varied: 58% identified themselves as practitioners, 9% considered themselves participants, 2% theorists and the remainder identified with two or more of these categories. On average participants had 12 years of involvement with EA projects or programs.

4.1.1. Educational background

All ecosystem approach practitioners interviewed had attained at least a bachelor's degree, with approximately a third of them holding a Master's degree and another third a doctorate. The academic background of the largest group of practitioners interviewed was scientific (35%), 20% were social scientists, and 15% came from the medical sciences. Those from management, engineering, and arts & humanities, constituted less than 10% of the total each.

Table 4. 1

Highest level of education obtained by participants. Based on 55 answers, survey question II-1.

	Responses	Percentage
Bachelors degree	21	38%
Master	18	33%
Ph D or equivalent	16	29%

Table 4. 2

Academic background of practitioners. Based on 55 answers, survey question II-2.

	Responses	Percentage
Sciences	19	35%
Social Sciences	11	20%
Medical Sciences	8	15%
Other	8	15%
Arts & Humanities	4	7%
Engineering	3	5%
Management Sciences	2	4%

4.1.2. Employment

The federal government employed the largest group of the ecosystem approach practitioners interviewed (24%) followed by its municipal counterpart who employed 16%. The provincial government, the private sector and the not-for-profit sectors each accounted for 11% of employment positions.

Not surprisingly most of the respondents (33%) occupied managerial positions. Planners constituted 18%, scientists 9% and consultants and policy makers 5% each. In this question there was a considerable percentage of participants that chose the "other" category (29%); for the most part, these were people who identified with two or more of the previous classes. The survey respondents were an experienced group with 63% of them claiming to have more than a decade of experience in ecosystem approaches.

Lastly, the average age of participants was 47 years old and the majority of them (70%) were males.

Table 4. 3

Participants sector of employment. Based on 55 answers, survey question II-3.

	Responses	Percentage
Federal government	13	24%
Other	11	20%
Municipal government	9	16%
Provincial government	6	11%
NGO	6	11%
Private	6	11%
Academic	3	5%
Regional government	1	2%

Table 4. 4

Number of years that participants have worked in the sector. Based on 52 answers, survey question II-4.

	Responses	Percentage
Less than 5	8	15%
5 to 10	11	21%
11 to 20	22	42%
21 to 30	9	17%
More than 30	2	4%

Table 4. 5

Current employment position. Based on 55 answers, survey question II-1.

	Responses	Percentage
Manager	18	33%
Other	16	29%
Planner	10	18%
Scientist	5	9%
Policy maker	3	5%
Consultant	3	5%
Technologist	0	0%

4.2. What is the conceptual understanding of the ecosystem approach according to practitioners?

4.2.1. General definition of ecosystem approaches

Practitioners were asked to define the ecosystem approach based on their experience. Typical answers tended to be concise and emphasize one or two aspects about EA, such as "A holistic analysis and application of ecological principles that integrate human health, social, economic well-being with ecological capacity of resource systems". The main themes that emerged from their answers are shown below.

Table 4. 6

Characteristics of ecosystem approaches. The data shown was obtained by performing query searches on specific words related to a theme. Data based on 54 answers, survey question III-3.

	References (out of 54)	Frequency (%)
Integrative Participants found that EA is an integrated approach in two ways: one, it considers economic, social and environmental factors simultaneously; two, it brings in a variety of disciplines that do not normally work together.	18	33
Connections and interactions Participants emphasized connections and interactions between different elements of a system. Often times, the relationship between humans and the ecosystem was singled out as essential to the practice of EA. Other times they stated how "everything is connected to everything else".	18	33
Systems Respondents referred to human societies as "human systems", the biophysical world as "ecosystems" and the management unit as a "system". However, no one defined what was meant by a system, hence it is hard to determine whether the term was used specifically to designate a complex, self-organizing, multi-level entity.	13	24
All-inclusive Practitioners often mentioned the need to widen the list of factors to include aspects of management not usually considered. This is consistent with, and builds on, the idea of an integrated strategy that considers relationships between different components of the system.	9	17
Holistic Although related to the above category, a mention of the need to broaden the list of factors to include many – or all – aspects was not taken as proof that the participant was referring to the synergy between these factors implicit in holistic thinking. Holism is defined as the idea that the whole is larger than the sum of its parts. Only specific references to the term "holistic" were counted in this category.	8	15

4.2.2. Influential theories, methods and techniques

Participants were asked about the theories and principles that guided their application of ecosystem approaches. Practitioners sometimes alluded to aspects of management that, while important, could not be considered a principle, e.g. sufficient funding. To avoid confusion, for the analysis of this question a principle was interpreted as a fundamental idea that guided the actions of practitioners in their application of EA, e.g. stakeholder participation. A theory was understood to be made up of several principles that normally explain a series of observations, e.g. general systems theory.

Again, participant answers tended to be concise and often cited a principle but they did not elaborate on what it meant explicitly, e.g. "Transparency, inclusiveness, two-way communication, information exchange, rigorous science" or "Hierarchy Theory; Principle of [e]mergent Properties; Issues of Scale and Relatedness; Secondary Principle; Surprise/Chaos Theory; Organizing Principles of Structure Composition and Function; […] Holling Figure 8". Table 4. 7

Themes of the key theories and principles that inform the application of ecosystem approaches. The data shown was found by a combination of key word searches by means of queries and manual scans of the text. Data based on 49 answers, survey question III-12.

	References (out of 49)	**Frequency (%)**
Participation Practitioners considered stakeholder participation a key principle in the application of EA. However, there were different views to the degree of participation, ranging from those who thought stakeholders should be "consulted" to those that called for "full participation".	11	22.4
Connectivity Participants mentioned that recognizing the interconnections between parts of the system guided their application of EA. Similar to the section on concepts, many participants referred to "everything [being] connected to everything else".	10	20.4
Science Science was another one of the principles that guided the practice of EA although it was evident that participants did not share a common understanding of the scientific method. Some spoke of "rigorous science", while others mentioned the need to have good field data, a few raised "post-normal science".	9	18.4
General Systems Theory (GST) Participants brought up concepts related to general systems theory such as complexity, emergent properties, hierarchy, and multiple level networks; or, to systems methodologies such as system analysis and soft system methodology.	8	16.3
Adaptive Management Elements from the adaptive management methodology such as "iterative decision making" and scenario planning; and epistemology such as "Holling's figure 8" influenced the application of ecosystem approaches.	6	12.2
Integration A number of practitioners use the "principle of integration" to guide their application of EA. This principle meant widening the scope of factors in decision-making to include environmental, social and economic considerations.	6	12.2

The list of journals, texts and authors used by practitioners of ecosystem approaches was extensive with little nodes in common. Although interviewees cited more than 70 different sources, most were only used by one or two people. The table below shows those sources that served as reference for two or more practitioners.

Table 4. 8

Key texts, journals and authors that inform EA practitioners. The data shown was found by performing manual scans of the responses. Data based on 45 answers, survey question III-13.

	References (out of 45)	**Frequency (%)**
Great Lakes Water Quality Agreement	5	11.1
Waterfront Regeneration documents (Crombie Commission)	5	11.1
Vallentyne, J.	4	8.9
Allen, T.F.H.	3	6.7
Carson, R.	3	6.7
Hancok, T.	3	6.7
Journal of Ecosystem Health Perspectives	3	6.7
Journal of Environmental Health Perspectives	3	6.7
Leopold, A.	3	6.7
Noss, R.	3	6.7
Odum, H.E.	3	6.7
Brundtland Report	2	4.4
Conservation Biology	2	4.4
Holling, C.S.	2	4.4
Hoekstra	2	4.4
Kay, J.J.	2	4.4
Odum, E.P.	2	4.4
Regies, H.	2	4.4
Riley, J.	2	4.4

Practitioners were also asked to identify the techniques that they associated with the EA as well as the information that was usually required in their projects. Their answers are shown below.

Table 4. 9

Techniques, tools and methods associated with the ecosystem approach. Data based on 55 answers, survey question III-14.

	Responses	Percentage
Mobilization of traditional or local knowledge	54	98%
Stakeholder workshops	53	96%
Development of indicators	45	82%
Educational or awareness campaigns	43	78%
Use of multi- or interdisciplinary teams	42	76%
GIS	41	75%
Visioning exercises	39	71%
Simulation modeling	37	67%
Qualitative methods	35	64%
Environmental auditing	30	55%
Risk analysis	29	53%
Participatory action research methods	29	53%
Forecasting	27	49%

Table 4. 10

Kinds of information that is needed to undertake an ecosystem approach. Data based on 53 answers, survey question III-15.

	Responses	Percentage
Surface water quality data	52	95%
Land use	51	93%
Ground water quality data	50	91%
Biodiversity	50	91%
Local knowledge about the situation	49	89%
Soil characteristics	49	89%
Governmental policies and regulations	48	87%
Information about community preferences	46	84%
Hydrology	46	84%
Socio-economic data	44	80%
Demographic data	42	76%
Air quality data	42	76%
Atmospheric or climate data	41	75%
Knowledge about stakeholder power dynamics	40	73%
Human health data	39	71%
Industrial effluents	38	69%

4.2.3. Adaptive vs. mechanistic orientation

Survey respondents were further probed about the orientation of ecosystem approaches using a series of structured questions. These results have already been presented by Bunch and Jerrett (2003) but are included in this paper for completeness. The first set of questions explored whether practitioners felt that the approach was adaptive. The results are shown below.

Table 4. 11

Degree of agreement with the following statement "We will never know all there is to know about any particular ecosystem". Data based on 55 answers, survey question III-6.

	Responses	Percentage
Strongly agree	34	62%
Agree	21	38%
Neither agree nor disagree	0	0%
Disagree	0	0%
Strongly disagree	0	0%

Table 4. 12

Degree of agreement with the following statement "Ecosystem approaches emphasize learning about ecosystems through the experience of managing them". Data based on 54 answers, survey question III-9.

	Responses	Percentage
Strongly agree	11	20%
Agree	24	44%
Neither agree nor disagree	10	19%
Disagree	9	17%
Strongly disagree	0	0%

Table 4. 13

Degree of agreement with the following statement "Ecosystem approaches lack scientific rigor". Data based on 53 answers, survey question III-9.

	Responses	Percentage
Strongly agree	0	0%
Agree	5	9%
Neither agree nor disagree	3	6%
Disagree	30	57%
Strongly disagree	15	28%

4.2.4. Participation

The second set of structured questions explored the extent to which participants felt that ecosystem approaches were participatory. The results are shown in the two tables below.

Table 4. 14

Degree of agreement with the following statement "The complexity of ecosystems and the size of ecosystem management teams demands that only those stakeholders with relevant professional expertise should be involved". Data based on 55 answers, survey question III-8.

	Responses	Percentage
Strongly agree	0	0%
Agree	0	0%
Neither agree nor disagree	0	0%
Disagree	25	45%
Strongly disagree	30	55%

Table 4. 15

Degree of agreement with the following statement "Stakeholders, not just experts, should be involved in all stages of projects employing an ecosystem approach, from problem definition through to monitoring and program evaluation". Data based on 55 answers, survey question III-11.

	Responses	Percentage
Strongly agree	29	53%
Agree	22	40%
Neither agree nor disagree	1	2%
Disagree	3	5%
Strongly disagree	0	0%

4.2.5. Physical vs. human-physical orientation

The third set of structured questions explored the orientation of the approach towards physical systems or human-physical systems.

Table 4. 16

Degree of agreement with the following statement *"The ecosystem approach is an approach designed to manage human activity"* Data based on 55 answers, survey question III-4.

	Responses	Percentage
Strongly agree	11	20%
Agree	27	49%
Neither agree nor disagree	9	16%
Disagree	8	15%
Strongly disagree	0	0%

Table 4. 17

Degree of agreement with the following statement *"Ecosystem approaches always consider issues of environmental equity"*. Data based on 53 answers, survey question III-5.

	Responses	Percentage
Strongly agree	8	15%
Agree	24	45%
Neither agree nor disagree	9	17%
Disagree	12	23%
Strongly disagree	0	0%

Table 4. 18

Degree of agreement with the following statement *"The ecosystem approach deals primary with physical and biological systems such as watersheds and forests"*. Data based on 55 answers, survey question III-7.

	Responses	Percentage
Strongly agree	4	7%
Agree	14	25%
Neither agree nor disagree	8	15%
Disagree	24	44%
Strongly disagree	5	9%

4.3. What is the experience of ecosystem approaches as applied in the Golden Horseshoe Region (GHR)?

While the above section described the theoretical understandings of practitioners of the ecosystem approach, in this section the focus shifts to its actual practice. Practitioners based their answers on their experience with programs and projects in the Golden Horseshoe Region.

4.3.1. Program names, implementing agencies and objectives

Those interviewed for this research were involved in almost one hundred programs that took place in the GHR and generally fell under one of these three broad categories: urban development, eco-health and ecological initiatives, in particular watershed management and ecological restoration. The majority of the programs were implemented during the late 1990s, most often by municipal governments, several ministries at the federal level, not-for-profit organizations, conservation authorities and some universities. A detailed list of the programs, implementing agencies and the objectives follows. The involvement of participants in the programs was high in all three phases, program design (76%), implementation (88%) and evaluation (73%).

Table 4. 19

Program names, implementing agencies and objectives as described by participants. Survey questions IV. 1 a-b, e.

Agency	Program name	Objective(s)
Canadian Policy Research Networks	Towards a New Perspective Health Policy	To provide a framework of new health policy in Canada.
CAPE	Municipal Pesticide Use in Ontario and Canada	To determine potential health impacts from municipal pesticide use particularly in children. To advocate for stronger restrictions on pesticide use in cities and towns.
Carolinean Canada	The Big Picture Project	To develop a region of a restored landscape in Southern Ontario that includes cores and connectivity of natural areas and that will support biodiversity.
City of Buffalo and Fort Erie	Buffalo-Erie International Gateway Strategy	Two communities were looking for a way to collaborate in evaluating economic, social, ecological strategic plans for smart growth.
City of Hamilton	City of Stoney Creek Open Spaces & Natural Environment Study	
City of Hamilton	Greenlands System	To develop a system of interconnected natural areas.
City of Hamilton	Montgomery Creek	To find a storm water management solution that would address erosion that was impacting private property.
City of Hamilton	Red Hill Creek	To gauge consequences of expressway project on the system and identify measures to mitigate consequences and to enhance ecosystem function.
City of Hamilton	Task Force for Sustainable Development	To investigate principles and concepts of sustainable development and incorporate them into all activities of the region to guide the Official Plan. To incorporate environmental, economic, social aspects throughout.
City of Mississauga	Natural Areas Survey	To document natural areas in Mississauga and ensure long-term protection.
City of Toronto	Development of Environmental Plan for the City of Toronto	To determine an environmental strategy for the amalgamated City of Toronto.
City of Toronto	Development of Strategic Plan for City of Toronto	To determine and facilitate development by City Council's vision.
City of Toronto	Healthy City Initiative	To bring local government, community organizations and citizens together to envision a healthy city and to recommend ways to promote equity between environment, social and economic interests.
City of Toronto	The Sustainability Round Table	To advise the City of Toronto on how best it can advance the city's sustainability objectives as outlined in Council Strategic Plan.
City of Toronto	Waterfront Plan for Metropolitan Toronto	To create a waterfront plan that provided strategic direction and guidance for local activities using an ecosystem approach.
City of Toronto - Parks and Recreation	Reforestation of Riverdale Park East	Reforestation and tree planting.

City of Toronto - Parks and Recreation	Riverdale Farm Ponds	To create and restore two degraded habitats within the Don River at the Riverdale pond site.
City of Toronto - Toronto 2008 Olympic Bid Committee, IOC	Waterfront Plan for 2008 Olympic Bid	To make the project environmentally progressive, socially responsible and to overcome physical barriers.
City of Toronto - Work and Emergency Services	Chestersprings Marsh	To create a small demonstration habitat in the lower Don River Valley.
City of Toronto - Works & Engineering	City of Toronto Environmental Scan	To assess interactions and complexities of the environment of Toronto's waterfront from a 10,00 ft level to then develop an environmental action plan and sustainable development plan.
Collaborative effort: 50 stakeholders	Remedial Action Plan - Hamilton Harbour	To restore impaired beneficial uses to the local ecosystem (9 identified).
Collaborative effort: 9 sites and their owners.	Fish and Wildlife Restoration for Hamilton Harbour & Cootes	To create a healthy warm water fishery for the fish community. To create healthy habitat conditions for resident and migratory wildlife using biotic integrity as an indicator.
Collaborative Effort: community(s)	Remedial Action Plan - Hamilton Harbour	To clean up the Hamilton Harbour and improve the biological health of the Hamilton Harbour ecosystem.
Conservation Authority	Forest Management	To increase interior forest area in Dundas Valley.
Conservation Authority	Forest Management and Planning	To re-establish vegetation in high priority areas of watershed determined by soils and slopes.
Conservation Authority	Prairie Restoration	To restore existing native prairie and create new prairie sites.
Conservation Authority	Stewardship Outreach Education	Project ties back to the living city concept, encompassing biodiversity, sustainability of education and healthy rivers.
Conservation Authority	Stream Rehabilitation Projects	Demonstrations for private land owners for improving water quality and adjacent habitats through remediation.
Conservation Authority	Watershed Management Planning - Lake Simcoe	To develop a strategy and implementation program for Lake Simcoe watershed based on the ecosystem approach.
Conservation Authority - Credit River and other stakeholders	Credit Watershed Natural Heritage Project	To support long-term health of Credit water ecosystem. To document in a comprehensive database the natural heritage features and functions of Credit River.
Conservation Authority - Credit Valley	Credit River Water Management Strategy	Goals were identified through a stakeholder process. Two phases: first one focused on impacts on hydrologic cycle due to future growth; second one was to develop a practical, comprehensive, environmentally sound management strategy for Credit River Watershed.
Conservation Authority - Credit Valley	Credit River Water Management Strategy - Watershed Plan	To come up with ecosystem approach to manage watershed.
Conservation Authority - Credit Valley	Sub-Watershed Studies	To protect terrestrial and aquatic systems in East Credit Watershed. Specific elements: 1) clean healthy environment; 2) balance areas; 3) area of natural system/process; 4) opportunities for rural/ urban resources group
Conservation Authority - Halton	Watershed Plan for Grindstone Creek	Holistic approach to look at the biophysical character of the watershed and at natural environment items, focused on: flowing water system, ground

		water, environment land units.
Conservation Authority - Halton	Bronte Watershed Study	To develop a plan for watershed for protection and enhancement.
Conservation Authority - Hamilton	Stream Fisheries Management	To increase and improve coldwater fisheries habitat in our watershed.
Conservation Authority - Hamilton Region	Spenser Creek Watershed Study	To identify natural and environmental attributes of the watershed and recommend an appropriate strategy for protection, restoration, and enhancement of these features with consideration of social and economic needs of residents.
Conservation Authority - Hamilton Region	Watershed Strategies	1) To benchmark current conditions in watershed 2) To involve community and stakeholders in planning towards improving and maintaining watershed health.
Conservation Authority - Toronto and Region	Don Watershed Regeneration Strategy	To develop a watershed regeneration strategy that would revitalize the urban watershed.
Conservation Authority - Toronto Region	Second Marsh Project	To monitor and educate.
Conservation Authority and Community Group	Hamilton Harbour Watershed Stewardship Program	To work, encourage and assist landowners in enhancing, rehabilitating, and protecting Hamilton Harbour tied to Hamilton Harbour Remedial Action Plan.
County of Middlesex	Middlesex County Natural Heritage Study	To develop an inventory of the Natural Heritage system of Middlesex County and recommend appropriate planning policies for inclusion in the Master Plan.
Family Doctor - Dr. Nevin,	Health Care	To have patients adopt a sustainable lifestyle (vegetarian diet, avoidance of chemicals, advocate for coal burning reduction), which improves human and ecosystem health.
Friends of Second Marsh	Second Marsh Watershed Stewardship Project	To improve water quality, reduce human impact, improve corridor habitat, increase human awareness of Second Marsh.
Government of Canada	Climate Change and Health	Strategic coordinating office to provide federal leadership for climate change and health based on three pillars: knowledge, policy development and partnerships.
Government of Canada	Community Animation Program	To build understanding and increase community capacity on environmental health issues.
Government of Canada	Remedial Action Plan	To look at whether community health component is relevant to the Remedial Action Plan.
Government of Canada	Great Lakes Water Quality Agreement - Pollution from land use (SWEEP)	To reduce loadings of phosphates and nutrients in Lake Erie. To develop best land practices primarily in agriculture.
Government of Canada - Department of Fisheries and Oceans	Remedial Action Plan - Hamilton Harbour	RAP - Cleaning up and fixing troublesome areas using an ecosystem approach. Balance humans and the natural environment.
Government of Canada:	Remedial Action Plan - Bay of	Remedial Action Plan: cleaning up and fixing troublesome areas, promote

Department of Fisheries and Oceans	Quinte	balance between humans and the natural environment.
Government of Canada: Environment Canada	Lake wide Action Plan	To restore lake wide beneficial uses as defined in the Great Lakes Water Quality Agreement, meeting community water use goals.
Government of Canada: Health Canada	Bioregional Health Effects Office	To use the existing goals and objectives to manage and define the impact to public health of environment factors, based on the ecosystem initiative led by Environment Canada.
Government of Canada: Health Canada	Canadian Handbook on Health Impact Assessment	To give Canadians, organizations and international parties a reference source to conduct Health Impact Assessment on environmental matters.
Government of Canada: Health Canada	Climate Change and Health Office	To build a foundation of knowledge in Canada for the risks of human health on climate change.
Government of Ontario	West Nile Virus	Provincial response to West Nile Virus. To decide what government programs would be appropriate.
International Joint Commission	Ecosystem Work Group and International Joint Commission	Ongoing work group that looks at the parties in United States and Canadian government and explore the potential for the use of the ecosystem approach and health.
McMaster University	Fish and Wildlife Nutrition Program	To identify 1) sport fishing in areas of concern in the Great Lakes basin, 2) identify consumers of Great Lakes fish and any health effects, and 3) understand determinants of sport fish consumption.
Ministry of Municipal Affairs/Housing	Provincial Land Use Planning through Provincial Policy Statements	To influence municipal land use planning to achieve efficient and environmentally acceptable patterns of development
Multi-agency program: all levels of government, private sector, community	Remedial Action Plan - Hamilton Harbour	Improve quality of the aquatic environment and associated environmental components in the Hamilton Harbour watershed to restore beneficial uses that the community desires.
Multi-agency program: City of Vaughan, Conservation Authority Toronto Region and local stakeholders	Basttey Smith Green/ Langstaff Ecopark	Development of habitat regeneration program combined with public access to trail system.
Multi-agency program: Conservation Authority - Hamilton and Halton Region	Hamilton and Halton Watership Stewartship Program	To work, encourage and assist landowners in enhancing, rehabilitating and protecting natural areas, creeks, streams and also groundwater in the watershed of Hamilton and Halton.
Multi-agency program: Environment Canada and Health Canada	Great Lakes Health Effects Program	To clean up Great Lakes watershed and to identify areas of concern and define remediation action plan. Also to monitor pollution in Great Lakes area effects on human health.
Multi-agency program: Environment Canada and Ministry of Environment	Remedial Action Plan - Hamilton Harbour	To restore Hamilton Harbour to meet de-listing criteria.
Multi-agency program: Environment Canada, City of Hamilton	Remedial Action Plan - Hamilton Harbour	To improve water quality and habitat in Hamilton Harbour and Cootes Paradise. To restore healthy aquatic ecosystem. To improve recreation uses while maintaining the harbour's essential economic function.

Multi-agency program: Environment Canada, Ministry of Environment, City of Toronto, Conservation Authorities	Atmospheric Change in Toronto-Niagara Region	To promote information-gathering for decision-makers in the Toronto and Niagara Regions that is meaningful in responding to climate change.
Multi-agency program: Government of Canada and USA Government	Changing Nature of Great Lakes Water Quality Agreement	Looking at the Great Lakes as an ecosystem.
Multi-agency program: Government of Canada and Environment Canada	Great Lakes Sustainability Fund	To develop and implement methods and rehabilitation techniques to restore aquatic environment the environment.
Multi-agency program: Government of Canada, Ontario Government, and IJC	Great Lakes Ecosystem Approach	To manage/reduce risks to human health in the Great Lakes basin based on three pillars: research, policy advice/support and risk communication.
Multi-agency program: Government of Canada, Ontario government, farming industry	Phosphate Reduction in Great Lakes	To reduce excessive plant growth in Great Lakes related directly to the amount of phosphate in water.
Multi-agency program: Government of Canada, Ontario Government, Municipal Government	Remedial Action Plan - Hamilton Harbour	Broad based approach to restore beneficial water and community uses of Hamilton Harbour. Specific targets: restoration of wildlife, improve access, restore land uses and healthy plankton, fish and wildlife.
Multi-agency program: Health Canada, Government of Canada, Ontario Government, and other stakeholders.	Great Lakes Health Effects Program	1) To increase public awareness of links between environment and health. 2) To look at specific adverse health outcomes in the population living in the Great Lakes basin. 3) To provide an information and resource base for the population living in the Great Lakes basin. 4) To investigate specific problems identified in the Great Lakes basin and specifically in the Area of Concerns.
Multi-agency program: Local and Regional Municipalities, Conservation Authorities and Merchants Association	20-Valley/ Jordon Harbour Tourism Strategy	To increase economic benefits from tourism in 20-Valley Jordon harbour area while maintaining and enhancing the environment and heritage resources.
Multi-agency program: McMaster University and Doctors without Borders	Aral Sea and Ferghana Valley Programme	1) To get objective environmental data. 2) To use data to increase scientific advocacy awareness.
Multi-agency program: Ministry of Environment and Environment Canada	Remedial Action Plan - Hamilton Harbour	To clean up of Hamilton Harbour and the restoration of Areas of Concern.
Multi-agency program: Ministry of Municipal Affairs/Housing and Mininstry of Natural Resources	National Heritage System for Oak Ridges Morraine	To identify and protect a natural Heritage System for Oak Ridges Morraine.
Multi-agency program: Ministry of Natural Resources and partners	Settled Landscape Research	To guide, coordinate, and integrate Natural Resources Research in settled areas of the province.

Multi-agency program: Ministry of Natural Resources, Ministry of Environment, Lake Simcoe Conservation Authority, Ministry of Agriculture	Lake Simcoe Environmental Management Strategy	To restore self-sustaining cold water fish population to Lake Simcoe. Specific objectives: to reduce phosphorous loading; to monitor nutrient loading conditions in Lake Simcoe and tributaries; to monitor status of fish populations; and, to develop remediation methods that will be effective at restoring Lake Simcoe's ecosystem.
Multi-agency program: Municipalities, Conservation Authorities around Toronto's Waterfront	Royal Commission - Future of Toronto's Waterfront	Consultations with stakeholders of the waterfront in order to understand issues and chart a course for the future.
Multi-agency program: NAT Christy Foundation, University of Luthbridge and Agriculture Canada - Restoration Section	Climate Change and Agriculture Sustainability in Calgary	To examine the impacts of climate change on Alberta's agriculture and recommend sustainable actions.
Multi-agency program: Toronto Region Conservation Authority and City of Toronto	Don Valley Brickworks	To integrate natural habitat regeneration with the protection of an internationally recognized geological site combined with the celebration of industrial heritage of this site.
NA	Project Paradise	To restore Cootes Paradise and lower Grinestone Creek to make de-listing criteria.
Ontario Government	Walkerton	To deal with gaps in Ontario's regulatory framework for water.
Ontario Healthy Community Coalition	Healthy Communities	To support communities across Ontario at improving social, economic situation in communities and therefore improving their health.
Regional District	Memorandum of Understanding on Habitat Protection- Region District Comox-Strathcona B.C.	To shift habitat protection into more proactive mode. To increase the amount of habitat protection, specifically for salmon.
Royal Botanical Gardens	Project Paradise	To restore the aquatic vegetation and reconstruction of fish community structures in Cootes Paradise and Grinestone Marsh.
Royal Botanical Gardens	Stewardship of Royal Botanical Gardens Natural Lands	To enhance natural bio-diversity of natural lands as much as possible while maintaining the lands for education and recreation.
Royal Commission	Environmental Audit of Portlands in Toronto	To examine the ecological health of the area and to make recommendations for improvement.
Royal Commission	Canadian Medicare	To establish what would a successful reform of Canadian med-care would look like.
Science Advisory Board/ IJC	Dechlorinating Human Society	To get the IJC to reassess chlorine chemistry. Call for taking a new look at harmful chemicals that had an adverse effect in human health and earth worms.
Toronto Public Health Department	Junction Triangle Health Assessment Project	To assess the health impact of urban air quality in a geographically defined population of children.
Toronto Public Health Department	Saint Bruno's School of Health Assessment	To address community concerns about health effects of local environmental contamination of an urban neighbourhood.
Tricouncil : NSERC, SSHRC,	Agro-Ecosystem Health: Analysis	To develop a framework for evaluating and improving the agro-ecosystem on

Medical Research Council	and Assessment	Southern Ontario and the Great Lakes watershed and drainage basin. The project considered social and economic evaluations; environmental evaluations; health perspectives and human well-being.
University of Guelph	Livestock production and stream health in the Great Lakes Basin: an agro-ecosystem health approach	Evaluation of livestock density and health of streams in the Great Lakes Basin. Used classical cross sectional epidemiological design and applied agro ecosystem framework to that problem.
Water Regeneration Trust	Lake Ontario Waterfront Trail	To improve public access to shoreline of Lake Ontario for recreation and appreciation while respecting private property rights and ecosystem restoration.
Waterfront Regeneration Trust and Stakeholders	Lake Ontario Greenway Strategy	To foster a commitment to action to regenerate health and a sustainable waterfront that is clean, green, accessible, connected, open, useable, diverse, affordable, attractive.
Waterfront Regeneration Trust and Stakeholders	Westside Creek Marsh	To resolve issues regarding a quarry license for a wetland in Clarington, looking at the sustainability of the company and impacts on the local residential waterfront community.
Waterfront Revitalization Corporation	Development of Environmental Strategy for Redevelopment of Toronto's Waterfront	To determine how development of the waterfront can proceed to support the City's sustainability goal outlined in the Strategic Plan.
Welsley Centre Health Corporation	Toolbox for Improving Health and City	To define a framework for improving health in south-eastern Toronto.

4.3.2. Adaptive vs. mechanistic orientation

Participants were asked to choose between two statements to determine if the ecosystem approach projects in their experience were more adaptive or more mechanistic. The tables below capture their answers.

Table 4. 20

Degree of agreement with the statements below. Data based on 50 answers, survey question V-2a.

Answers	Percentage	
9	18,0%	Much was known about problem and the environment was certain
41	82,0%	There was much uncertainty about the situation

Table 4. 21

Degree of agreement with the statements below. Data based on 51 answers, survey question V-2b.

Answers	Percentage	
46	90,2%	Tasks involved in carrying out the program were innovative
5	9,8%	Tasks involved in carrying out the program were routine

Table 4. 22

Degree of agreement with the statements below. Data based on 50 answers, survey question V-2c.

Answers	Percentage	
39	76,5%	Planning was incremental
11	21,6%	Planning was comprehensive

Table 4. 23

Degree of agreement with the statements below. Data based on 47 answers, survey question V-2d.

Answers	Percentage	
16	31,4%	Centralized decision making
31	60,8%	Decentralized decision-making

Table 4. 24

Degree of agreement with the statements below. Data based on 55 answers, survey question V-2e.

Answers	Percentage	
5	9,8%	Leadership and coordination could be described as "command-and-control"
50	98,0%	Leadership and coordination could be described as "participation and facilitation"

Table 4. 25

Degree of agreement with the statements below. Data based on 47 answers, survey question V-2f.

Answers	Percentage	
6	11,8%	Monitoring was done in order to adjust the strategy and plan
41	80,4%	Monitoring was done to ensure conformance to the plan

Table 4. 26

Degree of agreement with the statements below. Data based on 48 answers, survey question V-2g.

Answers	Percentage	
38	74,5%	Activities of project staff were guided by project objectives
10	19,6%	Activities of project staff were guided by their allocated functions

4.3.3. Participation

Stakeholders were involved in 93% of the projects making stakeholder engagement a defining characteristic of ecosystem approaches. However, stakeholders had different degrees of involvement in different project activities, as shown in the table below.

Table 4. 27

Degree of stakeholder involvement in different program activities. Data based on 101 answers, survey questions IV-2b i-ix, IV-2b$_2$ i-ix and IV-2b$_3$ i-ix.

	Yes	No	(Not sure)
Problem definition	82%	9%	9%
System identification and conceptualization	74%	10%	16%
Determination of goals and objectives	79%	14%	7%
System modeling	26%	61%	13%
Choice and design of interventions	77%	14%	9%
Implementation of interventions	70%	19%	11%
Monitoring	57%	33%	10%
Evaluation	63%	25%	12%
Others	36%	51%	12%

Participants were asked about the strategies that proved more effective in managing the participation of multiple stakeholders with conflicting positions in processes using an ecosystem approach. Results are displayed in the table below.

Table 4. 28

Strategies that participants identified as effective in dealing with situations with multiple stakeholders. Data based on 55 answers, survey question IV-3.

	References (out of 55)	Frequency (%)
Mediation Appropriate facilitation, mediation and dispute resolution were seen as key. Some practitioners drew special attention to the role of the facilitator that leads the workshop recognizing that the skills of this person are often determining of the success of the process.	14	25%
Factual information Practitioners highlighted the importance of having information that is sound, and unbiased. A few also mentioned the need to base the process on scientific data.	11	20%
Openness Participatory processes rely on gathering a variety of inputs. Practitioners emphasized that stakeholders needed to maintain an open attitude to the ideas of their peers in a way that everyone feels included and dialogue is possible.	10	18%
Dissemination of information Related to the previous, practitioners also pointed out that the information needed to be widely available to all stakeholders. In addition to keeping everyone on the same page, this will serve to reduce conflict, to educate and to make the process more transparent.	9	16%
Consensus A few practitioners emphasized that decision-making should be based on consensus among stakeholders.	7	13%

4.3.4. Physical vs. human-physical orientation

This section explores whether there is a tendency to use ecosystem approaches to deal with physical or with human-physical systems. Survey participants were asked to choose among a series of statements to help identify the nature of their interventions. The results are contained in the table below.

Table 4. 29

Degree of agreement with the statements below. Data based on 52 answers, survey question V-1.

Answers	Percentage	
8	15,4%	Primarily engineering-type interventions intended to modify bio-physical components of the system
28	53,8%	Interventions that target both physical and human elements of the system more or less equally
16	30,8%	Primarily interventions, such as regulation or education, intended to modify human behaviour

Practitioners were also asked whether gender considerations were relevant to ecosystem approaches, and the majority (51%) thought that they were not (independent of the practitioner's own sex).

4.4. What are the successes and failures, bridges and barriers to the application of ecosystem approaches?

4.4.1. Critical issues in the success or failure of the approach

The majority of practitioners (53%) considered that programs and projects that employed an ecosystem approach were successful. A third (35%) thought that these projects were sometimes successful while 5% believed they were not successful. The remaining 7% were unsure. Participants were asked to identify from a list the reasons for success or failure and the results are displayed in the following two tables.

Table 4. 30

Reasons identified as contributing to the success of EA projects (from a list of choices). Data based on 55 answers, survey question VI-2.

	Answers	Percentage
Participation of diverse stakeholders	43	78%
Incorporation of multiple disciplines	43	78%
Clear communication among stakeholders	39	71%
The multi and interdisciplinary nature of the approach	39	71%
Strong leadership	34	62%
Good jurisdictional or institutional relationships	33	60%
Sufficient funding	33	60%
Development of innovative interventions	30	55%
Support for the approach from the research and scientific community	28	51%
Influential champion at higher levels	25	45%
Previous experience with the ecosystem approach	22	40%
Effective monitoring	22	40%

Table 4. 31

Reasons identified as contributing to the failure of EA projects (from multiple choice). Data based on 55 answers, survey question VI-2.

	Answers	Percentage
Time limitations	9	16%
Poor jurisdictional or institutional relationships	8	15%
Difficulty conceptualizing or modelling human dimensions of the situation	7	13%
Lack of support for the approach	7	13%
Jurisdictional situation was too complex	6	11%
Lack of experience with or poor understanding of the ecosystem approach	6	11%
Inadequate funding	6	11%
Lack of communication among stakeholders	4	7%
Project goals were too ambitious	4	7%
Poor leadership	4	7%
Interference from stakeholder groups	3	5%
Too many stakeholders	2	4%

4.4.2. Specific problems and their solutions

Practitioners were then asked to elaborate on how the issues identified might be overcome in future applications. Their answers are shown below.

Table 4. 32

Proposed improvements for the successful application of the ecosystem approach. The data shown was found by performing manual scans of the responses. Data based on 51 answers, survey question VI-5.

	References (out of 51)	Frequency (%)
Bigger context (politics) Ecosystem approaches do not operate in a vacuum, practitioners emphasized the need to improve the alignment between EA and the political agenda. A few practitioners stressed the need to integrate more closely environmental and economic aspects.	14	27.4
Stakeholder management Practitioners often found the stakeholder process trying. They mentioned unresolved issues with respect to the number of stakeholders, the power dynamics of the group, the need for commitment, trust building and managing expectations.	10	19.6
Clarity Respondents pointed out how there is a need to clarify what the ecosystem approach entails as well as the roles of the participants, although they admitted that this would be difficult as the approach is still evolving.	10	19.6
Funding Adequate funding to ensure access to human and capital resources was one of the items that practitioners mentioned was needed to implement ecosystem approaches. Not only the amount of funds received was important, but also the timing.	7	13.7
Leadership Ecosystem approaches integrate groups of people with diverse, if not	6	11.8

opposing, interests. Practitioners felt that having someone with strong leadership and facilitation skills would benefit the application of EA.		
Adaptive Environmental Management (AEM) Participants saw in the AEM methodology a vehicle for carrying out EA in practice. However, some pointed out that AEM is not without implementation challenges and granted that “society is not yet ready for it [AEM]”.	6	11.8
Integration across disciplines Practitioners mentioned the need to form multidisciplinary teams that could integrate scientific knowledge and social considerations. Some emphasized the role of science in informing decisions.	6	11.8

4.4.3. Appropriate applications and settings for the approach

Practitioners were asked to choose from a list the kind of situation or problematic in which the application of ecosystem approaches is more useful. The results are shown in the table below.

Table 4. 33

List of the kinds of problems where the application of ecosystem approaches is more useful. Data based on 55 answers, survey question VI-6.

	Answers	Percentage
Local problems	48	87%
Regional problems	46	84%
Problems that can be managed within a watershed	44	80%
Urban development	44	80%
Human health problems	41	75%
Environmental remediation problems	39	71%
Ill-structured and complicated problems	36	65%
Global problems	34	62%
National problems	33	60%
Agribusiness issues	33	60%
Any problem having to do with the environment	31	56%
Simple, well-defined problems	23	42%

When asked, 85% of survey respondents thought that there were certain institutional settings that could facilitate the application of ecosystem approaches; for the most part these included settings that were defined along “problem-shed” lines – as opposed to purely jurisdictional ones – and where inter-agency co-operation existed. Practitioners’ answers are captured on the table below.

Table 4. 34

Proposed improvements in the institutional setting for the application of ecosystem approaches. The data shown was found by performing manual scans of the responses. Data based on 47 answers, survey question VI-7.

	References (out of 47)	Frequency (%)
Bioregional By far, the preferred institutional setting to carry out an EA was one based on bioregional units, e.g. watersheds, as opposed to units defined by political boundaries. Conservation Authorities were often mentioned by participants.	15	31.9
Local government Next to bioregional units, practitioners felt that local and municipal levels of government were more appropriate for the application of EA.	10	21.3
Intergovernmental collaboration Respondents pointed that forming intergovernmental teams with representatives from the three levels of government could create an adequate institutional setting for EA projects.	6	12.8
Health units Public health departments were seen also as appropriate institutional arrangements for the application of ecosystem approaches because they operate across jurisdictions.	4	8.5

4.5. What is the potential for generalization of the ecosystem approach?

In the last section the survey explored the potential to extend the use of ecosystem approaches to situations related to human health and the urban context.

4.5.1. Ecosystem approaches to human health issues

Although eco-health approaches are relatively new, 69% of the participants interviewed had used ecosystem approaches to address relationships between the environment and human health. Furthermore, 95% of the practitioners thought that there were strong connections between human health and ecosystems; with 76% of practitioners agreeing that ecosystem health indicators could be used to indicate human health, and conversely 78% agreeing that measures of human health can serve as indicators of ecosystem health.

The majority (59%) agreed that the application of EA to human health would not be different in neither theory nor practice to its application to other issues. Those who held a different opinion highlighted the points on table 4.34 as sources of divergence. A percentage of practitioners (44%) thought that ecosystem approaches lacked credibility among human health and other professionals.

Table 4. 35

Ways in which the application of ecosystem approaches to human health would be different in theory or method from its application to other issues. The data shown was found by performing manual scans of the responses. Data based on 19 answers, survey question VII-2b.

Applying EA to human health issues	References (out of 19)	Frequency (%)
Level of complexity Most participants made reference to differences in the level of complexity. Interestingly, there was no agreement among practitioners whether the level of complexity in human health issues was more or less complex than in other situations where EA is used.	7	36.8
Differences only at the project level Some practitioners thought that the differences would be noticeable at the application level, e.g. the model used, but not in the theoretical approach.	5	26.3
Emotions Respondents pointed out that dealing with human health issues added an emotional dimension to management.	3	15.8

4.5.2. Ecosystem approaches in an urban context

Most practitioners (85%) were familiar with the application of the ecosystem approach in the urban context. Similar to eco-health, the majority (56%) agreed that there would be no difference in the application of EA to urban settings. Those who disagreed (38%) pointed out the issues on the table below.

Table 4. 36

Ways in which the application of ecosystem approaches in urban settings would be different in theory or method from its application in other environments. The data was found by performing manual scans of the responses. Data based on 21 answers, survey question VII-9b.

Applying EA to urban settings	References (out of 21)	Frequency (%)
Changes of scale Respondents pointed out how there would be differences in scale. For some urban settings meant an intensification of activities due to higher densities, others brought up the need to make connections between the city and the supporting surrounding environments.	5	23.8
Difference only at project level Like before, some participants mentioned that the use of EA in urban settings would not change significantly the methodology, but there would be variations in the specifics of the application.	5	23.8
Factors considered Practitioners agreed that the weight that each of the factor carries into the decision-making process may change in urban settings, e.g. the economic considerations would be greater. Also there would be maybe new factors to consider, e.g. psychological effects.	5	23.8
Level of complexity Participants again made reference to differences in the level of complexity. Although they considered urban settings more complex, they thought that the natural component of them was simpler.	5	23.8
Connection to the environment Some practitioners pointed out that there would be differences between the way that rural vs. urban dwellers relate to the natural environment with the latter being disconnected from it.	4	19.0

4.6. Summary

Briefly, this chapter has presented the answers from the interviews conducted with practitioners of ecosystem approaches with regards to their background; their conceptual understandings of the approach; the approach's orientation in practice; what they have considered reasons for success and failure; and, its potential for generalizing to other settings. In the following chapter, these results are discussed considering first how theoretical constructs of EAs reflect the larger literature; and then moving towards pragmatic considerations in the implementation of EA with emphasis on the role of institutions.

5. Discussion

5.1.Practitioners of ecosystem approaches

It is perhaps tempting, although inaccurate, to conceive of the theoretical tenets of a discipline in absolute and unchanging terms adopted at face value by its practitioners. In reality, approaches are shaped and redefined by those who practice them. This is most true in the case of young disciplines, such as ecosystem approaches; hence it is worth characterizing the background of EA practitioners before defining the conceptual underpinnings of the approach.

From the 55 practitioners interviewed, 40% came from sciences and engineering, followed by social sciences and the humanities (27%), and followed by health (15%). Not only were there more scientists, but these scientists had also been around for longer: the mode of the years of experience of scientists and engineers was 20, compared to 7 for social scientists, and 9 for health specialists.

These numbers may reflect the origins of early work on the theory of systems in the fields of biology and ecology. At the regional level, they are also representative of the history of initiatives that have taken place in the Golden Horseshoe Region. For instance, as mentioned earlier, one of the most influential programs to adopt the ecosystem approach in Ontario was the Great Lakes Water Quality Agreement (GLWQA). Prior to its 1978 revision the GLWQA had defined its objectives in narrow water chemistry terms, which involved mostly scientists. It is expected that those scientists implicated in the program became adopters and practitioners of the ecosystem approach and influenced its subsequent development.

The mode of the years of experience of different disciplinary experts also indicates a broadening of the scope of ecosystem approaches towards an interdisciplinary practice.

During the early days EA practitioners were predominantly trained in the sciences with fewer social scientists. For the most part, social scientists were involved as facilitators during decision-making or used to navigate the political process (Endter-Wada *et al.*, 1998). Nowadays there is a higher integration of disciplines across the board and specialized applications are emerging within ecosystem approaches, e.g. the eco-health approach. Furthermore, non-scientists participants are used not just as facilitators in the process, but social factors are understood to be an essential component in the description of social-ecological systems (Endter-Wada *et al.*, 1998).

The top three employers of the EA practitioners interviewed are the federal government, conservation authorities and municipal governments in that order. Once again, the first seems to be partly a legacy of the history of EA in Ontario, influenced by the Great Lakes Water Quality Agreement and the work of the Royal Commission on Toronto's waterfront. The other two employers, municipal governments and conservation authorities, are consistent with the type of institutions that practitioners agree are best suited for ecosystem approaches, that is, local authorities and agencies whose jurisdiction is defined along ecological lines. The institutional setting is discussed in more depth later on.

While the above trends are significant, it is worth cautioning that snowball sampling was used. Answers obtained from such a sample group may over-emphasize cohesiveness as interviewees referred one another, likely leaving outside those individuals with very contrasting ideas. At the same time, a conscious effort was made to add breadth to the sample, e.g. health and medical practitioners were interviewed in addition to traditional resource managers.

5.2 Conceptual understandings of the ecosystem approach

From the literature review, the themes common to ecosystem approaches in the Golden Horseshoe Region are: 1) ecosystem approaches are holistic, they recognize that the whole is larger than the sum of its parts; 2) they use a systems thinking approach to environmental management; 3) the management unit is geographically defined according to landscape features; 4) humans are part of nature, not separate from it; 5) ecosystem approaches are participatory; 6) EA combine different types of knowledge and are based on interdisciplinary work; 7) decisions are guided by science and post-normal science; 8) there are biophysical limits to the resilience of social-ecological systems; 9) EA use adaptive management to deal with complexity and uncertainty; and 10) equity considerations inform the process.

For the most part, the responses given by practitioners regarding their theoretical understanding of ecosystem approaches coincided with these themes. However, there were different degrees of agreement on the themes. From the answers obtained, connectivity between parts of a system, integration of disciplines and stakeholder participation emerged as core values of EA. Survey respondents placed less emphasis on the use of geographically defined management units, the biophysical limits of social-ecological systems or the need for equity as theoretical principles of EA. This is not to say that practitioners did not recognize the importance of the latter themes when prompted through structured questions. A chi square (X^2) test showed that there was no correlation between the background of practitioners and these answers.

One of the reasons why the principles of connectivity, integration and participation are pointed out by practitioners as central to ecosystem approaches may be that these stand in opposition to traditional management approaches. Connectivity contrasts with the reductionism typical of the scientific method. Integration of knowledge and disciplines differs from the silo mentality prevalent in many management agencies. Stakeholder participation stands against traditional roles of managers and decision-makers as the sole experts. Because the development of systems thinking and its application to environmental management stems from a sense that previous paradigms fell short in addressing the complexity of social-ecological systems, it makes sense then that ecosystem approaches have defined themselves by what they are not, what they stand against and what they can innovate. As a result practitioners hold those tenets that stand diametrically opposite to the old paradigm as core values.

These three principles may also be seen as a common node in the family of ecosystem approaches that has developed since the 1970s and that continues to expand. It is understood that not all the principles of ecosystem approaches will find equal use in particular applications, e.g. the idea of biophysical limits is more closely related to resource management; equity is associated with eco-health approaches (see Lebel, 2003 or Hancock, 1993). However, connectivity, integration and participation can be practiced in a wider variety of settings and may be representative of the intersection of EA values from different applications.

This level of agreement is somewhat remarkable given the variety of projects that practitioners were involved with and the range of literature that influenced their practice. With respect to the literature, there were over 70 sources cited, many of them by one or two participants only. Predictably, the documents that had the highest number of citations were directly related to the GLWQA and the Crombie Commission on the Future of Toronto's Waterfront. It is interesting to notice that some of the most influential references did not come from 'self-declared' systems thinkers. For instance, Rachel Carson and Aldo Leopold were often cited and, while their work reflects an understanding of the complexity of nature, they did not express themselves in terms of ecosystem approaches nor did they intend to define a management system. However, both these authors conveyed the sense that something was amiss in the relationship between humans and nature and more attention needed to be paid to the interrelations, feedbacks and complexity of social-ecological systems (Grumbine, 1998).

5.3.Practical understandings of the ecosystem approach

5.3.1. Adaptive management

This section deals with the perception of ecosystem approaches from a practical standpoint. One of the tensions that the survey aimed to answer was whether the orientation of EAs was mechanistic or adaptive. When practitioners reflected on their experiences, they agreed that the situations they dealt with were uncertain; that the projects tasks were innovative; that planning was incremental; that leadership and coordination could be described as “participation and facilitation”; and, that activities were guided by project objectives rather than assigned tasks (refer to tables 4.20 to 4.26). All of these suggest that the practice of ecosystem approaches is indeed adaptive. Furthermore, agreement on most of these points was very high with typical values of 80% to 90%.

There was one point in which there was less agreement (61%) and that is that decision-making was decentralized. A chi square test on this data revealed a weak correlation (90% confidence level) between participant’s answers and place of employment. Academia and NGOs clearly followed a decentralized model, whereas the responses from the provincial government employees demonstrated a centralized decision-making process. The other categories of employers (federal, municipal and regional governments, and private sector) were more evenly split, although most tended towards a decentralized decision-making model.

While the practitioners identified the approach as adaptive, there was an inconsistency with regards to monitoring: most participants agreed that the goal of monitoring was to ensure conformance to the plan, as opposed to adjusting the strategy. This time the chi square test revealed no correlation between the answers to this question and the place of employment. The emphasis on monitoring and evaluation is one of the distinguishing features of adaptive management. The purpose is to use new knowledge to inform future actions through an iterative process and hence, it is implicit that the project objectives may be adjusted as more information becomes available. Conventional evaluations normally involve an objective assessment of progress versus established goals and this may prove too rigid for a process that is continually evolving. Flexibility, however, can be perceived as poor accountability if the evaluation method emphasizes outcomes rather than process.

Hence, on the one hand practitioners are using adaptive management principles but on the other, the majority are following traditional evaluation methods. It is difficult to implement a new methodology while using old evaluation methods. In fact, the situation described by the practitioners' answers seems to indicate that implementation of adaptive techniques is incomplete and points to an institutional lag where some parts of the methodology are adopted but bottom line aspects, such as evaluation, remain unchanged.

MacKenzie (1997) documented this issue in the Remedial Action Plans under the GLWQA. By the late 1990s, clean up efforts in the Great Lakes Basin had taken care of the low-hanging fruit in terms of pollution. The next steps in the remediation plan required developing new technology, and the results would be slower and less visual, e.g. sediment decontamination. Participants reported that they found themselves hard-pressed to secure funding resources given that they had few results that they could showcase to politicians and the public (MacKenzie, 1997). Waltner-Toews (2001) observed that in the case of communities using an eco-health approach to address tropical diseases a lot of the benefits arose from engaging in the process itself. For instance, having the people come together to identify goals, understand the socioeconomic and ecological constraints and opportunities facing them or negotiating resolutions, were all actions that enhanced the ability of the community to improve their health conditions. However, these benefits were often overlooked because typical program assessments based on the biomedical tradition would emphasize measurable outcomes such as the number of vaccines administered.

Current institutions pose one of the major structural challenges to the implementation of ecosystem approaches. The term institution is defined in its broadest sense to include both formal institutions, such as administrative units, and informal institutions, such as cultural norms. At any given point in history institutions are a reflection of the values of a society. Present-day institutions in Canada are influenced by ideas of human dominance over nature, indeed a dichotomous view of humans and nature, and the prevalence of individual rights over communal interests (Cortner *et al.*, 1998). These values contrast with the theoretical basis of ecosystem approaches. Hence, if an ecosystem approach is to be implemented, a parallel shift in the institutional context towards more adaptive and collaborative forms of governance is necessary. Although still embryonic, the notions of “post-normal governance” (McCarthy, 2003:1) and “adaptive governance” (Folke et al., 2005) have started to emerge as alternatives to the current system in line with a systems approach to management. As we shall see, the institutional mismatch is a running theme throughout the analysis of the implementation of EA.

5.3.2. Stakeholder engagement

Another aspect that was explored in terms of implementation of ecosystem approaches is the role of stakeholder involvement. In some respects this is not exclusive of EA, by and large, nowadays public participation is regarded as an intrinsic component in many environmental decision-making processes, irrespective of whether they fall under the rubric of ecosystem approaches.

As mentioned earlier, participation was one of the principles that emerged as central to ecosystem approaches when practitioners discussed their theoretical understandings. Practitioners used different words to denote the capacity in which stakeholders should be implicated: some considered that stakeholders and interest groups needed to be “consulted”, others thought that stakeholders needed to be “involved”, still others asked for “full participation”. When practitioners were questioned about their actual experiences, stakeholder involvement ranked high throughout all project stages from problem definition to evaluation. There was one exception and that is that stakeholders were mostly excluded from the modelling stage – they participated only 26% of the time – maybe a result of the level of technical expertise required for this activity. Stakeholder participation was also lower in monitoring and evaluation activities, 57% and 63% respectively, which is surprising given that these have been activities where public involvement has been most widely successful (Stringer *et al.*, 2006).

Hence, although the degree of involvement varies, participation is an integral part of ecosystem approaches. There are several reasons why this should be the case: first, participation leads to better outcomes as it solicits ideas from different fields and perspectives whose combination helps create a more complete understanding of the situation; second, participatory approaches are seen as more democratic and enhance the legitimacy of the resolution adopted; third participation can be used to empower traditionally marginalized groups; fourth, participatory adaptive processes can play a role in social learning (Stringer *et al.*, 2006); and fifth, participation serves to promote cohesion among community members (Webler, 2001; Senecah, S.L., 2004). Due to the complexity of environmental issues, the benefits that derive from participatory approaches are not just nice to have, but necessary.

While stakeholder involvement is far from being contested, practitioners recognized that administering such process was challenging. They pointed out that the way forward lies in good mediation, factual information and openness. There is a lot overlap among these three. Mediation is essential given that in these situations the stakes are high, stakeholders often hold polarized positions, and there is a sense of urgency (Bunch, 2001). Openness can help mediate the process. Having an open process requires that participants be made to feel that they are able to exercise some influence over the outcome. Even though the final resolution may differ from a particular person's view, a good decision-making process will ensure that everyone feels that their idea had the potential for impact (Senecah, 2004). Hence it is important that the process of gathering people's opinions be done early enough and with genuine intent to include their views and change the course of the project, if necessary. Furthermore, if this is done conscientiously, it will serve to reduce conflict among stakeholders as they gain an appreciation for alternative points of view (Stringer *et al.*, 2006). Unfortunately, the majority of stakeholder participation in Canada remains plagued with administrative hurdles and seen as largely tokenistic (Boyd, 2003).

Decisions need to be based on unbiased information. But information is not enough to help participants form an opinion. Accessibility, physical or intellectual, can prevent stakeholders from participating. For instance, some of the projects required specific technical knowledge, e.g. Remedial Action Plan for Hamilton Harbour, a participant's familiarity with technical terms, or lack thereof, can be a barrier to effective public engagement (Kinsella, 2004; Diduck and Sinclair, 2002). Although some participants agreed that technical knowledge is key in environmental decision-making, the final decision would be incomplete if it does not give appropriate consideration to the narratives about the issue brought up by less scientifically-inclined stakeholders (Graham, 2004).

Openness, mediation and factual information are but three factors contributing to a good participatory process. Many additional features affecting the process can be project-specific, e.g. the number of people involved, the functions of participants, the power dynamics that evolved among group members. All things considered, while there can be some overarching principles, appropriate stakeholdering seems to be more about flexibility than about following a prescribed set of rules (Stringer *et al.*, 2006).

5.4. Successes and failures, barriers and bridges

5.4.1. Successes

A majority of practitioners considered that the programs that they had been involved with were successful. This assessment was independent from the place of employment. The top five reasons given as contributing to the success of the projects were the participation of diverse stakeholders; the incorporation of multiple disciplines; clear communication among stakeholders; the multi and interdisciplinary nature of the approach and strong leadership, in that order.

Stakeholder participation and the integration of different disciplines have been mentioned before. However, it is somewhat surprising that practitioners highlighted leadership, as often times in approaches that are participatory the role of individual actors is relegated in importance to emphasize instead the overall group performance. In adaptive approaches the literature has paid substantial attention to the influence of strong leadership as a determinant of the success of the process. One of the reasons why leadership is crucial in ecosystem approaches is that their implementation is, or should be, accompanied by a significant institutional restructuring. Danter *et al.* (2000) portrayed the transformation experienced by institutions as a shift from a managerial approach to a leadership approach. The managerial style is consistent with functions of controlling, planning, budgeting, organizing, and staffing; whereas the leadership style is based on creating a vision, aligning people, motivating and inspiring in order to produce change (Kotter, 1995). To go from one form of governance to the other certain individuals capable of catalyzing the transition become key.

The individuals that facilitate the change serve different functions. At times a person may act as an intermediary between different clusters within an organization connecting people and information together. The person can be a mediator that helps to build up trust among actors thereby reducing conflict. Leaders also gather and synthesize knowledge to help generate and communicate a shared vision for the future. Yet at other times, the leader may act as an instigator, mobilizing others to adopt a new resolution and maintaining momentum within the organization (Olsson *et al.*, 2006). The resulting governance has been termed an adhocracy as it is adaptive and dynamic, capable of responding to new needs in a flexible manner. Hence, this type of organization will continue to necessitate leadership to go through subsequent decision-making processes and future rearrangements (Danter *et al.*, 2000).

Another observation is that the reasons that practitioners equated as contributing to the success of EA projects echoed to a large extent the core principles of ecosystems approaches that they had identified earlier, e.g. stakeholder involvement, interdisciplinary approach. This is telling because practitioners are associating success with the foundations of EA, seemingly indicating that ecosystem approaches are successful in and of themselves, when they are implemented. Factors that may be more obvious determinants of the success of any project (not just EA projects) such as funding or previous experience ranked only 7^{th} and 11^{th} out of 12, respectively.

5.4.2. Failures

If success was a reflection of the extent to which ecosystem approaches values are put into practice, the reasons for failure exposed the limitations of current administrations to adopt a systems approach to environmental management. According to practitioners, the following were contributors to the failure of EA projects: time limitations; poor jurisdictional or institutional relationships; difficulty conceptualizing or modelling human dimensions of the situation; lack of support for the approach; and, the jurisdictional situation being too complex (see table 4.31). These concerns are briefly explored in this section.

Time limitations may have been felt as there is a mismatch between the temporal scale of political administrations and the rate at which ecosystem variables evolve. Administrative priorities are set every four years corresponding to electoral cycles. However, variables that control the character of a social-ecological system work in longer time scales and can also experience sudden changes, as depicted in Holling's adaptive cycle metaphor. Because institutions are outcome-oriented, targets would be set to coincide with electoral or funding cycles, and this simply would be too soon for some aspects of SES to bear results.

While the evidence of interrelations and feedbacks in social-ecological systems accumulates, legislation continues to separate and compartmentalize ecosystem services as independent resources, e.g. water, forestry, fisheries (Boyd, 2003). The division runs deep and it is obvious in the structuring of ministries, policies and laws. The kind of interdisciplinary collaboration that EAs demand is at odds with the agencies' mandate and structure (MacKenzie, 1997; Cortner *et al.*, 1998). Hence, trying to arrive at interagency cooperation requires sorting through the complexity of jurisdictional divisions. Adding to the institutional maze EA practitioners need to expect different degrees of cooperation among government agencies. Although it is difficult to generalize, some have pointed out that there is a tendency – a professional culture within resource management agencies – to exercise discreet control over their turf (Cortner *et al.*, 1998; Danter *et al.*, 2000).

One way to increase the support for EA within these administrations is to alter the reward system. Administrations provide a powerful system of incentives and disincentives for those working within it. Traditionally managers have been rewarded for increasing the efficiency and predictability of single-resource extraction (Danter *et al.*, 2000). Adaptive approaches require the opposite; experimentation, risk-taking and iterative decision-making. It is not surprising then that practitioners found lack of support for EA within their institutions. This is not particular to Ontario; managers of the North West Forest Plan (NWFP) in the United States cited that the inordinate amount of red tape that was necessary to obtain an exemption from following standard guidelines was a reason for inaction vis-à-vis the implementation of adaptive management (Gray, 2000).

These shortcomings demonstrate how policy-makers routinely overlook the fundamental administrative re-structuring that is necessary to implement ecosystem approach projects. Part of the reason is that while selective features of ecosystem approaches – e.g. addressing complex situations, combining different types of knowledge, consensus-based decision-making – may be attractive to environmental managers, the implications for institutions are but briefly considered. This speaks once again of the delay between the moment that the early adopters attempt to shift to EA within an organisation and the time that the institutional system catches up. The period in between may very well be one of intense frustration for practitioners because their mandate does not match the resources available.

5.5. Potential for generalization of ecosystem approaches

Ecosystem approaches originated in the fields of ecology and biology and have moved from situations centred on a dominant natural feature (e.g. a watershed management) to multi-dimensional issues that combine and emphasize human-nature relations. Part of the reason for conducting this survey has been to take stock of the collective experiences of ecosystem approaches in Ontario and evaluate the potential to apply them elsewhere, in particular to human health and urban development problems.

From their answers, most practitioners believed that the EA could be successfully applied to ecohealth and urban issues without significant alterations. Indeed the percentages of those already practising eco-health and urban applications of EA were high, 69% and 85% respectively. If there were differences in implementation, these were differences of degree rather than kind. For instance, a few pointed out that the level of complexity would change, however, there was no consensus if it would increase or decrease and in most cases this change would be project-specific.

Aside from methodological considerations, there are other factors that can affect the potential for implementation of the ecosystem approach in other settings. From the previous discussion, administrative obstacles were singled out as the largest impediment to the development of EA in Ontario. Hence, it is worth considering in more detail institutional transitions. Kotter (1995) identified eight typical stages in organizational transformation: 1) establishing a sense of urgency; 2) forming a powerful guiding coalition; 3) creating a vision; 4) communicating the vision; 5) empowering others to act on the vision; 6) planning for and creating short-term wins; 7) consolidating improvements and producing more change; and 8) institutionalizing new approaches.

The results of this survey reveal that the institutional transformation necessary to implement ecosystem approaches in Ontario is in the primary stages. The first step, establishing a sense of urgency, requires considering timing. Timing can be understood as seizing the appropriate window of opportunity. It needs to be recognized that there are times when people are receptive to novelty and times when they are not. Nyberg (1999) noted that when adaptive management was introduced to the British Columbia Forest Service, field-level staff had had six years of constantly changing routines and, consequently, they were wary of trying yet another approach. If ecosystem approaches are to be successful, it is important that practitioners evaluate the readiness of those who are going to be involved. Of course, without the benefit of hindsight it is difficult to establish when the timing is right. It could be argued that the mounting evidence indicating a downward trend in most of the world's major ecosystem services (Millennium Ecosystem Assessment, 2005) and current public concerns regarding the environment should be considered propitious timing.

5.6. Summary

To summarize, this section has explored the answers that practitioners gave to the five themes regarding the use of ecosystem approaches in the Golden Horseshoe Region and linked their responses to the larger literature. The findings can be summarized as follows:

1) Practitioners of ecosystem approaches come mostly from the sciences which reflects the origins of systems thinking in this discipline. There is however a tendency towards integration across disciplines in the past two decades, and even some recombination that have resulted in distinct families within EAs, e.g. eco-health.

2) The conceptual understanding of ecosystem approaches by practitioners reflects well the values from the larger literature. Practitioners emphasized connectivity among parts of a system, stakeholder participation and integration. The ecosystem approach as

described by practitioners combines elements of what Yaffee (1996) identified as environmentally sensitive multiple-use, ecosystem approach to resource management and ecoregional management.

3) In practice ecosystem approaches are adaptive and participatory although some challenges remain in the implementation. In particular, participants found that the flexibility that adaptive management requires to modify its goals as new information becomes available is hard to accommodate within the current administration paradigm.

4) Reasons for success in the implementation of the approach mirrored the tenets of EA that practitioners identified earlier. In addition, they emphasize the role of leadership which is necessary to navigate a transition to more adaptive forms of government in accordance to EA principles. Reasons for failure in the ecosystem approach had to do with the rigidity of the institutional setting.

5) EAs have already found use in the domains of eco-health and urban development. The differences between the newer applications of EA and more traditional uses were project-specific.

6. Conclusion

To conclude, EAs emerged as a response to the limitations of traditional environmental management approaches in dealing with the complexity of social-ecological systems. Beginning in the late seventies, several programs in Ontario adopted EAs principles and, since then, EAs have spread and transformed, appealing to specialists across the disciplines from urban planners to medical doctors. Given the interest on, and the fluidity of the approach, it is fitting to perform an assessment that would clarify the theoretical principles and the practical orientation of EA.

To this end, 55 practitioners of the EA in the Golden Horseshoe Region were interviewed. The lines of questioning were aimed at answering the following: who are practitioners of EA; what is their conceptual understanding; what is their practical understanding of EA; what are reasons for success, or failure, in the implementation of EA; and, what is the potential to use EA in health and urban issues.

In their theoretical understanding of EA, practitioners agreed that 1) ecosystem approaches are holistic; 2) they represent a systems approach to management; 3) management units are geographically defined; 4) humans are part of nature; 5) EAs are participatory; 6) they are interdisciplinary; 7) decisions are guided by science and post-normal science; 8) there are limits to the resilience of SES; 9) EAs use adaptive management; and 10) equity considerations inform the process.

Whereas all practitioners did not give equal weight to the aforementioned tenets, there was a remarkable consensus in the overall results both, among practitioners and with the wider literature. Furthermore, the chi-square tests revealed little, or no, meaningful correlation between a person's responses and that individual's background or place of employment. In a way this is a testament to von Bertalanffy's proposition of a general theory of systems where universal concepts traverse disciplinary and professional barriers towards a more integrated approach to managing social-ecological systems. Practitioners agreed that the same broad principles could inform and be used in applications as distinct as the control of lake phosphorus concentrations and the prevention of West Nile virus.

Practical considerations for the implementation of EAs need to address the institutional landscape. Despite the adoption of EAs in a variety of programs, a parallel revamping of the governance structures is pending. Traditional environmental management administrations have focused on increasing the predictability of narrowly defined outcomes, leading to what has been termed the pathology of control-and-command. The calls for broad participation, interdisciplinarity and adaptive management that EAs suggest are at odds with current administrative structures. The limitations imposed by current institutions need to be considered more carefully, otherwise EA implementation will be superficial at best. In view of the need for organizational transformation, the role of timing and leadership is paramount.

It is undisputable that ecosystem approaches have influenced the way that policy-makers, experts and communities think and do environmental management. However, for the methodology to reach its full potential the manner in which implementation occurs needs to be analyzed and some of the obstacles in the process be ironed out. Future research should focus on how to bring about the necessary institutional change.

Bibliography

Allan, C., & Curtis, A. (2005). Nipped in the bud: Why regional scale adaptive management is not blooming. *Environmental Management*, *36* (3), 414 – 425.

Allen, T.F.H. & Hoekstra, T.W. (1990). The confusion between scale-defined levels and conventional levels of organization in ecology. *Journal of Vegetation Science*, *1* (1), 5-12.

Allen, T.F.H., Bandurski, B.L. & King, A. W. (1993). *The ecosystem approach: Theory and ecosystem integrity.* Report to the Great Lakes Science Advisory Board.

Atkinson, R. & Flint, J. (2001). Accessing hidden and hard-to-reach populations: Snowball research strategies. *Social Research Update*, 33. Retrieved March 14, 2007, from http://sru.soc.surrey.ac.uk/SRU33.html

Beishon, R. J., & Peters, G. (1972). *Systems behaviour*. New York: Open University Press.

Berkes, F., Colding, J. & Folke, C. (eds.). (2003). *Navigating social-ecological systems: Building resilience for complexity and change*. New York: Cambridge University Press.

Bunch, M. J. (2001). *An adaptive ecosystem approach to rehabilitation and management of the Cooum river environmental system in Chennai, India*. Waterloo, ON: Deptartment of Geography, University of Waterloo.

Bunch, M.J. and Jerrett, M. (2003, May). *The experience of the ecosystem approach in the Golden Horseshoe Region.* Poster presented at the International Forum on Ecosystem Approaches to Human Health, Montreal, QC.

Boyd, D. R. (2003). *Unnatural law: Rethinking Canadian environmental law and policy*. Toronto: UBC Press.

Capra, F. (1996). *The web of life: A new scientific understanding of living systems*. New York: Anchor Books.

Carpenter, S.R. & Gunderson, L.H. (2001). Coping with collapse: Ecological and social dynamics in ecosystem management. *BioScience*, *51* (6), 451-457.

Checkland, P.B. (1981). *Systems thinking, systems practice.* Toronto: John Wiley & Sons Ltd.

CambridgeSoft Corporation. (2004). *Chemfinder*. Retrieved April, 2007, from http://chemfinder.cambridgesoft.com/

Cortner, H.J., Wallace, M.G., Burke, S. & Moote, M.A. (1998). Institutions matter: The need to address the institutional challenges of ecosystem management. *Landscape and Urban Planning***,** *40,* 159-166.

Danter, K.J., Griest, D.L., Mullins, G.W. & Norland, E. (2000). Organizational change as a component of ecosystem management. *Society & Natural Resources*, *13,* 537-547.

Dearden, P. & Mitchell, B. (1998). *Environmental change and challenge: A Canadian perspective*. Toronto: Oxford University Press.

Diamond, J. (2005). *Collapse: How societies choose to fail or succeed.* New York: Viking.

Diduck, A. & Sinclair, A.J. (2002). Public involvement in environmental assessment: The case of the nonparticipant. *Environmental Management*, *29* (4), 578-588.

Dietz, T., Ostrom, E. & Stern, P.C. (2003). The struggle to govern the commons. *Science*, *302*, 1907-1912.

Edwards, C.J. & Regier, H.A. (Eds.). (1990). *An ecosystem approach to the integrity of the Great Lakes in turbulent times.* Great Lakes Fishery Commission and the Science Advisory Board of the International Joint Commission. 90-4.

Endter-Wada, J., Blahna, D., Krannich, R. & Brunson, M. (1998). A framework for understanding social science contributions to ecosystem management. *Ecological Applications, 8* (3), 891-904.

Forget, G. & Lebel, J. (2001). An ecosystem approach to human health. *International Journal of Occupational and Environmental Health*, *7* (2), 3-38.

Folke, C., Hahn, T., Olsson, P. & Norberg, J. (2005). Adaptive governance of social-ecological systems. *Annual. Review Environmental. Resources, 30,* 441-473.

Funtowicz, S. & Ravetz, J.R. (1993). Science for the post-normal age. *Futures*, *25* (7), 739-755.

Funtowicz, S. & Ravetz, J.R. (1994). Emergent complex systems. *Futures*, *26* (6), 568-582.

Gallopin, G.C., Funtowicz, S., O'Connor, M. & Ravetz, J. (2001). *Science for the twenty-first century: from social contract to the scientific core.* UNESCO.

Giddens, A. (1987). *Social theory and modern sociology.* Cambridge, UK: Polity.

Graham, A.C. (2004). A social communication perspective toward public participation: The case of the Cispus adaptive management area. In Depoe, S.P., Delicath, J.W. & Elsenbeer, M.A. (Eds.), *Communication and public participation in environmental decision making*. (pp. 35-58) New York: State University of New York Press.

Great Lakes Science Advisory Board. (1980). *The ecosystem approach: Scope and implications of an ecosystem approach to transboundary problems in the Great Lakes basin.* 2nd ed. Windsor, ON.

Gumbrine, R.E. (1994). What is ecosystem management? *Conservation Biology*, *8* (1), 27-38.

Gumbrine, R.E. (1998). Seeds of ecosystem management in Leopold's *A Sand Country Almanac. Wildlife Society Bulletin, 26* (4), 757-760.

Gunderson, L.H., Holling, C.S., & Light, S.S. (Eds.) (1995). *Barrier and bridges to the renewal of ecosystems and institutions*. New York: Columbia University Press.

Gunderson, L. (1999). Resilience, flexibility and adaptive management - antidotes for spurious certitude? *Conservation Ecology, 3* (1): 7. Retrieved April 10, 2007, from http://www.consecol.org/vol3/iss1/art7/

Gunderson, L.H. (2003). Adaptive dancing: interactions between social resilience and ecological crisis. *In* Berkes, F., Colding, J. & Folke, C. (eds.). *Navigating social-ecological systems: Building resilience for complexity and change*. New York: Cambridge University Press.

Gunderson, L.H. & Holling, C.S. (2002). *Panarchy: Understanding transformations in human and natural systems*. Washington, DC: Island Press.

Halvorsen, K.E. (2001). Assessing public participation techniques for comfort, convenience, satisfaction and deliberation. *Environmental Management*, *28* (2), 179-186.

Hancock, T. (1993). Health, human development and the community ecosystem: three ecological models. *Health Promotion International, 8* (1), 41-47.

Hessing, M., Howlett, M. & Summerville, T. (2005). *Canadian natural resource and environmental policy (2nd ed.).* Toronto: UBC Press.

Holling, C.S. (1978). *Adaptive environmental assessment and management*. Toronto: International Institute for Applied Systems Analysis.

Holling, C.S. & Meffe, G.K. (1996). Command and control and the pathology of natural resource management. *Conservation Biology*, *10* (2), 328-337.

Holling, C.S. (2001). Understanding the complexity of economic, ecological, and social systems. *Ecosystems, 4,* 390-405.

Holsti, O.R. (1969). *Content analysis for the social sciences and humanities*. Reading, MA: Addison-Wesley.

Imperial, M.T. (1999). Institutional analysis and ecosystem-based management: The institutional analysis and development framework. *Environmental Management, 24* (4), 449-465.

Jackson, M.C. (2000). *Systems approaches to management*. New York: Kluwer Academic.

Juda, L. & Hennessey, T. (2001). Governance profiles and the management of the uses of large marine ecosystems. *Ocean Development & International Law, 32,* 41-69.

Kast, F.E. & Rosenzweig, J.E. (1972). The modern view: A systems approach. *In* Beishon, R. J., & Peters, G., *Systems behaviour*. New York: Open University Press.

Kay, J. J., Regier, H. A., Boyle, M. & Francis, G. (1999). An ecosystem approach for sustainability: addressing the challenge of complexity. *Futures, 31,* 721-742.

Kay, J.J. & Regier, H. (2000). Uncertainty, complexity, and ecological integrity: Insights from an ecosystem approach. *In* Crabbe, P., Holland, L., Ryszkowski, L. & Westra, L. (eds.) *Implementing ecological integrity: Restoring regional and global environmental and human health.* New York: Kluwer.

Kinsella, W.J. (2004). Public expertise: A foundation for citizen participation in energy and environmental decisions. *In* Depoe, S.P., Delicath, J.W. and Elsenbeer, M.A. (Eds.), *Communication and public participation in environmental decision making*, (pp. 83-95). New York: State University of New York Press.

Krippenddorff, K. (2004). *Content analysis: An introduction to its methodology*. (2nd ed.) London: Sage Publications.

Kotter, J.P. (1995). Leading change: Why transformational efforts fail. *Harvard Business Review*. March-April, 59-67.

Lackey, R.T. (1998). Seven pillars of ecosystem management. *Landscape and Urban Planning*, *40* (1-3), 21-30.

Lebel, J. (2003). *Health: An ecosystem approach.* Ottawa: International Development Research Centre.

Lee, K.N. (1999). Appraising adaptive management. *Conservation Ecology, 3* (2): 3. Retrieved April 10, 2007, from http://www.consecol.org/vol3/iss2/art3/

Ludwig, D., Hilborn, R. & Walters, C. (1993). Uncertainty, resource exploitation, and conservation: Lessons from history. *Science*, *260,* 17.

MacKenzie, S.H. (1996). *Integrated resource planning and management; the ecosystem approach in the Great Lakes basin.* Washington, DC: Island Press.

Mackenzie, S.H. (1997). Toward integrated resource management: Lessons about the ecosystem approach from the Laurentian Great Lakes. *Environmental Management, 21* (2), 173-183.

McCarthy, D.D.P. (2003). Post-normal governance: An emerging counter-proposal. *Environments, 31* (1), 71.

Meffe, G.K., Nielsen, L.A., Knight, R.L. & Schenborn, D.A. (2002). *Ecosystem management: Adaptive, community-based conservation*. Washington, DC: Island Press.

Millennium Ecosystem Assessment. (2005). *Ecosystems and human well-being: Synthesis*. Washington, DC: Island Press.

Nyberg, B. (1999). Implementing adaptive management in British Columbia's forests – Where have we gone wrong and right? Proceedings of the 1998 Provincial Science Forum, Ontario.

Olsson, P., Folke, C. & Berkes, F. (2004). Adaptive comanagement for building resilience in social-ecological systems*. Environmental Management*, *34* (1), 75-90.

Olsson, P., Gunderson, L.H., Carpenter, S.R., Ryan, P., Lebel, L., Folke, C. & Holling, C.S. (2006). Shooting the rapids: Navigating transitions to adaptive governance of social-ecological systems. *Ecology and Society*, *11* (1): 18. Retrieved October, 2007 from http://www.ecologyandsociety.org/vol1/iss1/art18

Peterson, G.D. (2000). Political ecology and ecological resilience: An integration of human and ecological dynamics. *Ecological Economics, 35,* 323-336.

Peterson, G.D. (2002a). Resilience and adaptive cycles. *In* Gunderson, L.H. & Holling, C.S., *Panarchy: Understanding transformations in human and natural systems*. Washington, DC: Island Press.

Peterson, G.D. (2002b). Estimating resilience across landscapes. *Conservation Ecology, 6* (1), 17. Retrieved October, 2007 from http://www.consecol.org/vol6/iss1/art17/

Peterson, G.D., Carpenter, S.R. & Brock, W.A. (2003). Uncertainty and the management of multistate ecosystems: An apparently rational route to collapse. *Ecology*, *84* (6), 1403-1411.

Pirot, J.Y., Meynell, P.J., & Elder, D. (eds.). (2000). *Ecosystem management: Lessons from around the world. A guide for development and conservation practitioners.* Cambridge: IUCN.

Ramachandran, V.S.S. (2002). The neurological basis of artistic universals. *Interdisciplines*, *9*, 1. Retrieved November 29, 2007 from http://www.interdisciplines.org/artcog/papers/9

Royal Commission on the Future of the Toronto Waterfront. (1992). *Regeneration: Toronto's waterfront and the sustainable city, Final Report.* Ottawa: Minister of Supply and Services Canada. Toronto: Queens' Printer of Ontario.

Senecah, S.L. (2004). The trinity of voice: The role of practical theory in planning and evaluating the effectiveness of environmental participation processes. *In* Depoe, S.P., Delicath, J.W. and Elsenbeer, M.A. (Eds.), *Communication and public participation in environmental decision making.* (pp. 13-33). New York: State University of New York Press.

Stanford, J.A. & Poole, G.C. (1996). A protocol for ecosystem management. *Ecological Applications, 6* (3), 741-744.

Stanley. T.R. (1995). Ecosystem management and the arrogance of humanism. *Conservation Biology*, *9* (2), 255-262.

Stringer, L.C., Dougill, A.J., Fraser, E., Hubacek, K., Prell, C. & Reed, M.S. (2006). Unpacking "participation" in the adaptive management of social-ecological systems: A critical review. *Ecology and Society, 11* (2), 39. Retrieved November 22, 2007 from http://www.ecologyandsociety.org/vol11/iss2/art39.

Slocombe, D.S. (1993). Implementing ecosystem-based management. *BioScience*, *43* (9), 612-622.

Slocombe, D.S. (1993b). Environmental planning, ecosystem science, and ecosystem approaches for integrating environment and development. *Environmental Management, 17* (3), 289-303.

Slocombe, D.S. (1998). Lessons from experience with ecosystem-based management. *Landscape and Urban Planning, 40,* 31-39.

von Bertalanffy, L. (1968). *General system theory: Foundations, development, applications* (Revised ed.). New York: George Braziller Inc.

Walker, B., S. Carpenter, J. Anderies, N. Abel, G. S. Cumming, M. Janssen, L. *et al.* (2002). Resilience management in social-ecological systems: A working hypothesis for a participatory approach. *Conservation Ecology* 6 (1): 14. Retrieved April, 2007, from http://www.ecologyandsociety.org/vol6/iss1/art14/

Walters, C. (1997). Challenges in adaptive management of riparian and coastal ecosystems. *Conservation Ecology, 1* (2), 1. Retrieved March 31, 2007, from http://www.consecol.org/vol1/iss2/art1/

Waltner-Toews, D. (2001). An ecosystem approach to health and its applications to tropical and emerging diseases. *Caderno Saude Publica, 17* (Suplemento), 7-36.

Waltner-Toews, D., Kay, J.J., Neudoerffer, C., & Gitau, T. (2003). Perspective changes everything: managing ecosystems from the inside out. *Frontiers in Ecology, 1* (1), 23-30.

Waltner-Toews, D. (2004). *Ecosystem sustainability and health: A practical approach.* New York: Cambridge University Press.

Waltner-Toews, D. & Kay, J.J. (2005). The evolution of an ecosystem approach: the diamond schematic and an adaptive methodology for ecosystem sustainability and health. *Ecology & Society, 10* (1), 38.

Webler, T., Tuler, S. & Krueger, R. (2001). What is a good public participation process? Five perspectives from the public. *Environmental Management*, 27 (3), 435-450.

Westley, F., Carpenter, S.R., Brock, W.A., Holling, C.S. & Gunderson, L.H. (2002). Why systems of people and nature are not just social and ecological systems. *In* Gunderson, L.H. & Holling, C.S. *Panarchy: Understanding transformations in human and natural systems*. Washington, DC: Island Press.

Yaffee, S.L. (1994) Ecosystem management in practice: The importance of human institutions. *Ecological Applications*, *6* (3), 724-727.

Yaffee, S.L. (1999). Three faces of ecosystem management. *Conservation Biology, 13* (4), 713-725.

Appendix A

Pre-call survey

PRE-CALL FOR THE SURVEY OF ECOSYSTEM APPROACH PRACTIONERS IN THE GOLDEN HORSESHOE REGION

Project: An Adaptive Ecosystem Approach to Human Health

Grantor: SSHRC (Strategic Grant, Research Development Initiative program)
SSHRC file no. **820-2001-1010**

Principal Investigator:

Martin J. Bunch, PhD
School of Geography and Geology, McMaster University
905.525.9140, ext: 24953
bunchmj@mcmaster.ca

Phone Number Called: ____

Person Called: ____

Name of Interviewer: ____

Date of Interview:____

Interview Index Number:

I. INTRODUCTION TO SURVEY

Hello. My name is Martin Bunch from the School of Geography and Geology at McMaster University. Is this *Name of person phoned.*?

Hi *First Name.* I am Principle Investigator on a research project called "An Adaptive Ecosystem Approach to Managing Urban Environments for Human Health" funded by a grant from the Social Sciences and Humanities Research Council of Canada. Drs. John Eyles and Mike Jerrett also from the School of Geography and Geology, and Dr. Tina Moffatt from the Department of Anthropology are also working on the project as co-investigators.

In part, this research project involves an investigation of the ecosystem approach as it has been applied in the Golden Horseshoe region. To this end we are conducting a survey of ecosystem approach practitioners.

By ecosystem "approach practitioner" I mean someone who has been involved in the design, implementation, monitoring or evaluation of programs or projects that have employed an ecosystem approach. The overall goal of the survey is to develop a better understanding of practitioners' perceptions of what the ecosystem approach is, including successes and barriers to the approach experienced by those in the field. We are also interested in opinions about the potential for applying the approach in the contexts of urban areas, and to the issue of human health.

(go to questions on next page…)

QI.1) Your name has come up as a potential participant in the survey. Would you say that you have used an ecosystem approach or have been involved in projects that have adopted such an approach in the Golden Horseshoe region?

(Pause for response) *YES* *NO*

If asked for clarification on "What is an ecosystem" approach, leave the definition up to the interviewee, saying we would like potential participants to identify themselves in this case, so that we don't bias a person's perception of the approach.

If Yes to QI.1,

QI.2) Would you agree to participate in the survey? I can arrange for someone to call you at a time convenient to you. It should take about 40 minutes.

(Pause for response) *YES* *NO*

If **Yes** to QI.2,

Great. I need to collect some contact information from you and set up a time for an interviewer to call.

(Proceed to Section II)

If **No** to QI.1 or QI.2,

QI.3) Well, thanks anyway. Do you know of anyone who you think would be a good person to include in the survey?

(Pause for response) *YES* *NO*

If **No**,

Thanks again and have a good day. (Get off the phone).

(If **Yes**, proceed to Section III below.)

II. PARTICIPANT CONTACT INFORMATION

First we would like to get some personal information to develop a participant profile. Please feel free to refrain from answering any of the following. Personal information will be kept confidential unless you authorize its release.

QII.1) Last Name:

QII.2) First Name:

QII.3) Initial:

QII.4a) Telephone: **QII.4b)** Extension:

QII.5) Fax:

QII.6) Email:

QII.7) Age:

QII.8) Sex:

QII.9) What is your professional title?

____

QII.10) What would be a good day to call you for the interview?

11. Date: _________________________ Time: ___________________________

A few hours, or perhaps the day before this time, we will send you a fax of some of the questions on the survey that have lists of items from which to choose. If you have this handy when completing the survey it should make things go faster.

(If no fax number is available, make other arrangements, e.g., by email or regular post). Note alternative below:

____

____

III. OTHER POTENTIAL PARTICIPANTS

QIII.1) Are you aware of anyone else you think should be a part of this survey?

Yes No

If Yes, Please provide name and contact information:

QIII.2

a) Last Name: b) First Name: c) Initial:

d Telephone: e) Extension:

f) Fax:

g) Email:

h) Reason:

____

____

____

QIII.3

a) Last Name: b) First Name: c) Initial:

d Telephone: e) Extension:

f) Fax:

g) Email:

h) Reason:

____

____

QIII.3

a)	Last Name:	b)	First Name:	c)	Initial:
d	Telephone:	e)	Extension:		
f)	Fax:				
g)	Email:				
h)	Reason:				

QIII.4

a)	Last Name:	b)	First Name:	c)	Initial:
d	Telephone:	e)	Extension:		
f)	Fax:				
g)	Email:				
h)	Reason:				

Do you have any questions about the research at this time?

(if Yes, answer the questions or provide contact information)

Thank you very much. I will have an interviewer call you at the time you indicated. In the mean time have a good day.

(Get off the phone)

Provide this information if requested
Contact Information:

Principle Investigator:

Martin J. Bunch, PhD
Assistant Professor
School of Geography and Geology
McMaster University
1280 Main St. West
Hamilton, ON, L8S 4K1
905.525.9140 x:24953
email: bunchmj@mcmaster.ca

McMaster Ethics Review Board:

Dr. Cindy Riach
Chair
McMaster Ethics Review Board
riachc@mcmaster.ca

Appendix B

Survey

SURVEY OF ECOSYSTEM APPROACH PRACTIONERS IN THE GOLDEN HORSESHOE REGION

Project: “An Adaptive Ecosystem Approach to Human Health”

Grantor: SSHRC (Strategic Grant, Research Development Initiative program)
SSHRC file no. **820-2001-1010**

Principal Investigator:
Martin J. Bunch, PhD
School of Geography and Geology, McMaster University
905.525.9140, ext: 24953
bunchmj@mcmaster.ca

Name of Interviewer: ____

Date of Interview:____

Interview Index Number:

I. INTRODUCTION TO SURVEY

Hello. My name is ______*(Interviewer)*_____

Thank you for agreeing to participate in this survey. Before we begin, I want to make sure that you are aware that the survey could take up to 40 minutes to complete, is that alright?

(Pause for response) *YES* *NO*

You can decline to answer any of the following questions. You can also decide to stop participating in the survey at any time.

This survey is intended for practitioners of the ecosystem approach. It is part of a research project called "An Adaptive Ecosystem Approach to Managing Urban Environments for Human Health" funded by a grant from the Social Sciences and Humanities Research Council of Canada. Results of the survey will be made available over the internet.

The principle investigator on the Project is Dr. Martin Bunch from the School of Geology and Geography at McMaster University. If you would like further details on the Project, or would like to contact Dr. Bunch I can provide his contact information. If you have any ethical concerns, I can provide contact information for the McMaster Ethics Review Board which has approved the project.

(Pause for response)

Contact Information:

PI: Martin J. Bunch, PhD
Assistant Professor
School of Geography and Geology
McMaster University
1280 Main St. West
Hamilton, ON, L8S 4K1
905.525.9140 x:24953
email: bunchmj@mcmaster.ca

Ethics: Dr. Cindy Riach, Chair
McMaster Ethics Review Board
riachc@mcmaster.ca

You should have received a fax or email of lists associated with some of the survey questions. If you have them at hand it the survey should go faster.

Would you like to start the survey now? *(Pause for response)* *YES* *NO*

II. PARTICIPANT PROFILE

First we would like to get some personal information to develop a participant profile. Please feel free to refrain from answering any of the following. Personal information will be kept confidential unless you authorize its release.

1) From the following list, what is the highest level of education you have obtained?

☐ PhD or equivalent
☐ Masters Degree
☐ Bachelors Degree
☐ College Diploma
☐ Secondary School Diploma
☐ Other: ____

2) Which of the following subject areas best describes your academic background:

☐ Sciences
☐ Engineering
☐ Medical Sciences
☐ Social Sciences
☐ Arts and Humanities
☐ Management Sciences
☐ Other: ____

3) Which of the following sectors best describes your sector of employment:

☐ Non governmental (NGO)
☐ Private
☐ Federal government
☐ Provincial government
☐ Regional government
☐ Municipal government
☐ Academic
☐ Other: ____

4) Approximately how many years have you worked in this sector? ________ years

5) What profession would best categorize your current employment position?

- ☐ Policy maker
- ☐ Manager
- ☐ Planner
- ☐ Scientist
- ☐ Consultant
- ☐ Technologist
- ☐ Other: ____

III. PARTICIPANT UNDERSTANDING / PERCEPTIONS OF THE ECOSYSTEM APPROACH

That completes the participant profile. The rest of the questionnaire will explore your involvement with and opinions about the ecosystem approach.

1a) Have you been involved in programs or projects which employ an ecosystem approach?

Yes No (Not Sure)

1b) If Yes,

How long have you been involved such with programs or projects?

From ____________ To ___________

2) Which of the following labels best describes your role with regards to ecosystem approaches?

- ☐ Theorist
- ☐ Practitioner
- ☐ Participant
- ☐ Other: ____

3) Based on your experience with such projects, how would you define the ecosystem approach?

____

____

____

____

____

____

I am going to read a series of statements. For each statement, please indicate whether you:

Strongly Agree
Agree
Neither agree nor disagree
Disagree, or
Strongly disagree

4) The ecosystem approach is an approach designed to manage **human activity**.

Do you: SA A N D SD

5) Ecosystem approaches **always** consider issues of **environmental equity**.

Do you: SA A N D SD

6) We will **never know** all there is to know about any particular ecosystem.

Do you: SA A N D SD

7) The ecosystem approach deals primarily with **physical and biological systems** such as watersheds and forests.

Do you: SA A N D SD

8) The complexity of ecosystems and size of ecosystem management teams demands that **only** those stakeholders with **relevant professional expertise** should be involved.

Do you: SA A N D SD

9) Ecosystem approaches **emphasize learning** about ecosystems through the experience of managing them.

Do you: SA A N D SD

10) Ecosystem approaches **lack scientific rigour**.

Do you: SA A N D SD

11) Stakeholders, not just experts, should be involved in all stages **of projects employing an ecosystem approach, from problem definition through to monitoring and program evaluation.**

Do you: SA A N D SD ?

12) For you, what are the key theories or principles that inform your application of the ecosystem approach?

____

____

____

____

____

13) What are the key texts, journals, or authors which you have used to provide information on the ecosystem approach?

____

____

____

____

____

14) In your experience, what techniques, tools and methods are associated with the ecosystem approach? Choose as many as appropriate. This is one of the lists we faxed you. Do you want me to read it to you? You may identify others not on the list.

- ☐ Stakeholder workshops
- ☐ Simulation modelling
- ☐ Forecasting
- ☐ Visioning exercises
- ☐ Development of indicators
- ☐ Geographic Information Systems
- ☐ Risk analysis
- ☐ Educational or awareness campaigns
- ☐ Environmental auditing
- ☐ Qualitative methods (such as key informant interviews and participant observation)
- ☐ Use of multi- or interdisciplinary teams
- ☐ Mobilization of traditional or local knowledge
- ☐ Participatory or action research methods
- ☐ Other (1)________________________
- ☐ Other (2)________________________
- ☐ Other (3)________________________

15) In your experience, what kinds of information are needed to undertake an ecosystem approach? Choose as many as appropriate. This is one of the lists we faxed you. Do you want me to read it to you? You may identify others not on the list.

- ☐ Demographic data
- ☐ socio-economic data
- ☐ Industrial effluents
- ☐ Land use
- ☐ Information about community preferences
- ☐ Local knowledge about the situation
- ☐ Air quality data
- ☐ Atmospheric or climate data
- ☐ Surface water quality data
- ☐ Ground water quality data
- ☐ Hydrology
- ☐ Soil characteristics
- ☐ Biodiversity
- ☐ Knowledge about stakeholder power dynamics
- ☐ Governmental policies and regulations
- ☐ Human health data
- ☐ Other (1)______________________
- ☐ Other (2)______________________
- ☐ Other (3)______________________
- ☐ Other (4)______________________
- ☐ Other (5)______________________

IV. PARTICIPANT INVOLVEMENT WITH THE ECOSYSTEM APPROACH

1) What programs or projects have you been involved with that are associated with the ecosystem approach? (If there is more than one, please select up to three that we can ask you about individually).

(PROGRAM/PROJECT 1)

a) Name of program (or nature of program):

____

b) Implementing agency or organization:

____

c) Time frame of program (Year of inception until year of completion):

____

d) Which of the following components were you involved with:

Design of the program	Yes	No	(Not Sure)
Implementation of the program	Yes	No	(Not Sure)
Evaluation of the program	Yes	No	(Not Sure)

e) Can you give me a brief description of goals and objectives of the project?

____

____

____

____

2a) Did this project involve stakeholders?

Yes No (Not Sure)

2b) If so, which of the following activities were the stakeholders involved in:

(i) Problem definition	Yes	No	(Not Sure)
(ii) System identification and conceptualization	Yes	No	(Not Sure)
(iii) Determination of goals and objectives	Yes	No	(Not Sure)
(iv) System modelling	Yes	No	(Not Sure)
(v) Choice and design of interventions*	Yes	No	(Not Sure)
(vi) Implementationof interventions*	Yes	No	(Not Sure)
(vii) Monitoring	Yes	No	(Not Sure)
(viii) Evaluation	Yes	No	(Not Sure)
(ix) Other activities:______________________	Yes	No	(Not Sure)

*If questioned about what is meant by "interventions", describe that interventions are various activities which are employed in order to achieve the goals and objectives of the particular project/program.

(PROGRAM/PROJECT 2 - - If Applicable)

a_2) Name of program (or nature of program):

____

b_2) Implementing agency or organization:

____

c_2) Time frame of program (Year of inception until year of completion):

____

d_2) Which of the following components were you involved with:

Design of the program	Yes	No	(Not Sure)
Implementation of the program	Yes	No	(Not Sure)
Evaluation of the program	Yes	No	(Not Sure)

e_2)   Can you give me a brief description of goals and objectives of the project?

____

____

____

____

$2a_2$)   Did this project involve stakeholders?

Yes   No   (Not Sure)

$2b_2$)   If so, which of the following activities were the stakeholders involved in:

(i) Problem definition	Yes	No	(Not Sure)
(ii) System identification and conceptualization	Yes	No	(Not Sure)
(iii) Determination of goals and objectives	Yes	No	(Not Sure)
(iv) System modelling	Yes	No	(Not Sure)
(v) Choice and design of interventions	Yes	No	(Not Sure)
(vi) Implementationof interventions	Yes	No	(Not Sure)
(vii) Monitoring	Yes	No	(Not Sure)
(viii) Evaluation	Yes	No	(Not Sure)
(ix) Other activities:____________________________	Yes	No	(Not Sure)

(PROGRAM/PROJECT 3 - - If Applicable)

a_3) Name of program (or nature of program):

____

b_3) Implementing agency or organization:

____

c_3) Time frame of program (Year of inception until year of completion):

____

d_3) Which of the following components were you involved with:

Design of the program	Yes	No	(Not Sure)
Implementation of the program	Yes	No	(Not Sure)
Evaluation of the program	Yes	No	(Not Sure)

e_3) Can you give me a brief description of goals and objectives of the project?

____

____

$2a_3$) Did this project involve stakeholders?

Yes No (Not Sure)

$2b_3$) If so, which of the following activities were the stakeholders involved in:

(i) Problem definition	Yes	No	(Not Sure)
(ii) System identification and conceptualization	Yes	No	(Not Sure)
(iii) Determination of goals and objectives	Yes	No	(Not Sure)
(iv) System modelling	Yes	No	(Not Sure)
(v) Choice and design of interventions	Yes	No	(Not Sure)
(vi) Implementationof interventions	Yes	No	(Not Sure)
(vii) Monitoring	Yes	No	(Not Sure)
(viii) Evaluation	Yes	No	(Not Sure)

(ix) Other activities:________________________ Yes No (Not Sure)

3) In your experience, what strategies are effective in dealing with situations of multiple stakeholders with conflicting positions?

____

____

____

____

4) Is gender a relevant consideration in the ecosystem approach?

Yes No (Not Sure)

5) In your opinion, what does a 'gendered approach' or 'gender-sensitivity' involve?

____

____

____

V. ORIENTATION OF THE ECOSYSTEM APPROACH (ADAPTIVE VS. MECHANISTIC, HUMAN VS. PHYSICAL)

1) Please indicate which of the following 3 statements is most correct:

In programs employing an ecosystem approach, in which you have been involved, interventions in the system have been,

A) Primarily engineering-type interventions intended to modify bio-physical components of the system

B) Primarily interventions, such as regulation or education, intended to modify human behaviour, or

C) Interventions that target both physical and human elements of the system more or less equally.

2) I will read a list of opposing statements. Please indicate which statement in each pair best represents ecosystem approach programs in which you have been involved,

a) Much was known about problem and the environment was certain. *or*
There was much uncertainty about the situation.

First Second

b) Tasks involved in carrying out the program were routine. *or*
Tasks involved in carrying out the program were innovative.

First Second

c) Planning was comprehensive. That is, a blueprint was drawn up, then followed. *or*
Planning was incremental. Later steps were not formalized until earlier activities were complete.

First Second

d) Decision making was centralized. *or*
Decision making was **de**centralized.

First Second

e) Leadership and coordination could be described as "Command and control". *or*
Leadership and coordination could be described as "Participation and facilitation".

First Second

f) Monitoring was done to ensure conformance to the plan. *or*
Monitoring was done in order to adjust the strategy and plan.

First Second

g) Activities of project staff were guided by their allocated functions. *or*
Activities of project staff were guided by project objectives.

First Second

VI. OUTCOMES OF THE ECOSYSTEM APPROACH – *SUCCESSES, FAILURES, BARRIERS*

1) In your experience, have programs or projects that employ an ecosystem approach been successful?

Yes No Sometimes (Not Sure)

2) If Yes, what reasons would you attribute to the success of the ecosystem approach? This is one of the lists we faxed you. Do you want me to read it to you? You may identify others not on the list.

☐ participation of diverse stakeholders
☐ clear communication among stakeholders
☐ strong leadership
☐ good jurisdictional or institutional relationships
☐ previous experience with the ecosystem approach
☐ incorporation of multiple perspectives (scientific, technical, lay)
☐ the multi- and interdisciplinary nature of the approach
☐ development of innovative interventions
☐ effective monitoring

☐ sufficient funding
☐ an influential champion at higher levels
☐ support for the approach from the research and scientific community
☐ Other (1)________________________
☐ Other (2)________________________
☐ Other (3)________________________
☐ Other (4)________________________

3) If No, what reasons would you attribute to the failure of the ecosystem approach? This is one of the lists we faxed you. Do you want me to read it to you? You may identify others not on the list.

- ☐ too many stakeholders
- ☐ lack of communication among stakeholders
- ☐ jurisdictional situation was too complex
- ☐ poor jurisdictional or institutional relationships
- ☐ lack of experience with or poor understanding of the ecosystem approach
- ☐ inadequate funding
- ☐ time limitations
- ☐ interference from stakeholder groups
- ☐ difficulty conceptualizing or modelling human dimensions of the situation
- ☐ project goals were too ambitious
- ☐ poor leadership
- ☐ lack of support for the approach
- ☐ Other (1)________________________
- ☐ Other (2)________________________
- ☐ Other (3)________________________

4) Are there particular problems or concerns you have encountered with the approach that you feel should be stated here?

i) ____

ii) ____

iii) ____

iv) ____

5) How do you feel that these problems or concerns might be overcome in future applications?

____

____

____

____

____

6) To what kinds of problems do you feel this approach is useful or applicable? This is one of the lists we faxed you. Do you want me to read it to you? You may identify others not on the list.

- ☐ local problems
- ☐ regional problems
- ☐ national problems
- ☐ global problems
- ☐ problems that can be managed within a watershed
- ☐ ill-structured and complicated problems
- ☐ simple, well-defined problems
- ☐ environmental remediation and rehabilitation
- ☐ any problem having to do with the environment
- ☐ agribusiness issues
- ☐ urban development
- ☐ human health problems
- ☐ Other (1)____________________________
- ☐ Other (2)____________________________
- ☐ Other (3)____________________________
- ☐ Other (4)____________________________

7) In your experience, are there institutional or jurisdictional settings that can facilitate the application of an ecosystem approach? If so, please expand.

Yes No (Not Sure)

____

____

____

____

VII. POTENTIAL FOR GENERALIZATION OF THE APPROACH TO OTHER CONTEXTS

We are interested in exploring the usefulness of the ecosystem approach in urban areas, and for application to human health issues.

1) Have you used the ecosystem approach to address relationships between the environment and human health?

Yes No (Not Sure)

2a) Do you think the application of the ecosystem approach to human health would be different in theory or method from its application to other issues?

Yes No (Not Sure)

2b) If Yes, how so?

____

____

____

3) Do strong connections exist between human health and ecosystems?

Yes No (Not Sure)

4) Do you think that ecosystem health indicators could be used to indicate human health?

Yes No (Not Sure)

5) Do you think that measures of human health can serve as indicators of ecosystem health?

Yes No (Not Sure)

6) Do you think ecosystem approaches lack credibility among human health and other professionals?

Yes No (Not Sure)

7a) Are you aware of any other projects or practitioners involved with the use of the ecosystem approach applied to environment and health?

Yes No (Not Sure)

7b) If yes, please provide any details you have on the project/practitioner. (If there is more than one, please select up to three that we can ask you about individually):

i) Name: ____

Contact info:____

Other:____

ii) Name: ____

Contact info:____

Other:____

iii) Name: ____

Contact info:____

Other:____

8) Have you used the ecosystem approach in an urban context?

Yes No (Not Sure)

9a) Do you think the use of the ecosystem approach in an urban setting would be different in theory or method from its use in other settings?

Yes No (Not Sure)

9b) If Yes, please expand:

____

____

10a) Are you aware of any other projects or practitioners involved with the use of the ecosystem approach in an urban context?

Yes No (Not Sure)

10b) If yes, please provide any details you have on the project/practitioner:
(If there is more than one, please select up to three that we can ask you about individually)

i) Name: ____

Contact info:____

Other:____

ii) Name: ____

Contact info:____

Other:____

iii) Name: ____

Contact info:____

Other:____

VIII. COMMUNICATION AND DISSEMINATION

We will be developing a web site as part of this project. The purpose of the website is to disseminate information about the experience of the ecosystem approach in the Golden Horseshoe region, and to provide a forum for communication for ecosystem approach theorists and practitioners.

1) Would you object to your name and contact information being listed on this site?

Yes No

2a) May we provide a short description of projects that you have been associated with, and any relevant World Wide Web links?

Description: Yes No

If yes, arrange to get this description. (e.g., via email)

____

____

____

2b) Links: Yes No

http://_____________________________________

http://_____________________________________

http://_____________________________________

3a) Beyond any projects we have already discussed, are there any other ecosystem approach projects within the Golden Horseshoe region that you think we should be aware of?

Yes No

3b) If yes, please provide any details you have on the project:
(If there is more than one, please select up to three that we can ask you about individually)

i) Name of program:____

Implementing agency:____

Contact person:____

ii) Name of program:____

Implementing agency:____

Contact person:____

iii) Name of program:____

Implementing agency:____

Contact person:____

4a) Beyond those already discussed, are you aware of anyone else who you think should be a part of this survey?

Yes No

If Yes, Please provide name and contact information:

4b) Contact info:
i) Last Name:
ii) First Name:
ii) Initial:
iv) Telephone: v) Extension:
vi) Fax:
vii) Email:

viii) Reason:

____

____

____

4c) Contact info:
i) Last Name:
ii) First Name:
iii) Initial:
iv) Telephone: v) Extension:vi) Fax:
vii) Email:

viii) Reason:

____

____

____

5) Finally, if we need to follow up on some of this information, may we call you again?

Yes No

6) That is all the questions we have for you. Do you have any additional comments before we sign off?

____

____

____

Thank you very much for your time and your help with this research. We will let you know when the results of this summary are posted. **Have a good day!**

Appendix C

Chi-square correlation results

Question	Degrees of freedom	P(0,05)	P(0,01)	X2 - Employer	X2 - Background	X2 - Gender	Correlation
III - 4	18	28,869	34,805	na	22,393	na	Absent
III - 5	18	28,869	34,805	na	12,608	na	Absent
III - 6	6	12,592	16,812	na	1,601	na	Absent
III - 7	24	36,415	42,980	na	20,899	na	Absent
III - 8	6	12,592	16,812	na	4,985	na	Absent
III - 9	18	28,869	34,805	na	27,925	na	Absent
III - 10	18	28,869	34,805	na	29,084	na	Present (95 c.l.)
III - 11	18	28,869	34,805	na	7,400	na	Absent
IV - 4	2	5,911	9,210	na	na	0,982	Absent
V - 1	12	21,026	26,217	na	14,453	na	Absent
V - 2a	7	14,067	18,475	4,438	na	na	Absent
V - 2b	7	14,067	18,475	2,395	na	na	Absent
V - 2c	7	14,067	18,475	8,042	na	na	Absent
V - 2d	7	14,067	18,475	14,030	na	na	Absent
V - 2e	7	14,067	18,475	8,306	na	na	Absent
V - 2f	7	14,067	18,475	2,093	na	na	Absent
V - 2g	7	14,067	18,475	5,891	na	na	Absent
VI - 1	21	32,761	38,932	19,430	na	na	Absent
VII - 1	12	21,026	26,217	na	12,396	na	Absent
VII - 2a	12	21,026	26,217	na	22,735	na	Present (95 c.l.)
VII - 4	12	21,026	26,217	na	10,849	na	Absent
VII - 5	12	21,026	26,217	na	4,587	na	Absent
VII - 6	12	21,026	26,217	na	12,984	na	Absent
VII - 7a	12	21,026	26,217	na	19,550	na	Absent
VII - 8	6	12,592	16,812	na	2,720	na	Absent
VII - 9a	12	21,026	26,217	na	23,833	na	Present (95 c.l.)
VII - 10a	12	21,026	26,217	na	22,200	na	Present (95 c.l.)