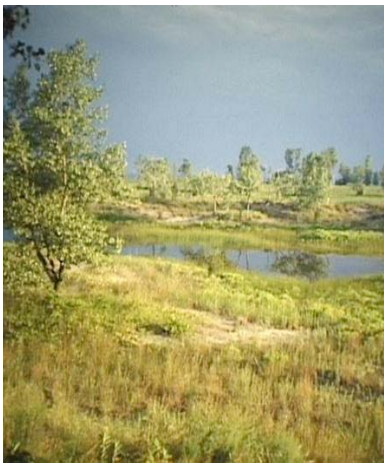
Examining Southern Ontario Biosphere Reserve Initiatives and their Contribution to Sustainability



Long Point Biosphere Reserve

Niagara Escarpment Biosphere Reserve

Georgian Bay Biosphere Reserve

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Executive Summary

Biosphere Reserves are pilot sites for applied sustainability. Created by UNESCO, biosphere reserves began as conservation efforts but developed into a more complex model of land management with a mandate that considers the interrelated functions of conservation, development and logistic support to be the biosphere reserve (UNESCO 2008). This paper will provide detail on biosphere reserves, their history, organization and practice as well as navigate through the literature behind complex systems and sustainability and how they relate to biosphere reserves. It will then look at initiatives in three Southern Ontario biosphere reserves that created positive feedback between two or more of these functions, analyze their strengths and shortcomings and assess them in terms of how well they exemplify the UNESCO biosphere reserve mandate and promote sustainability. This paper hypothesizes that the cases examined here will support the conclusions made in complex systems and sustainability theory and that the advantages of fulfilling the biosphere reserve mandate outweigh the difficulties in doing so.

The concept of biosphere reserves has been informed by complex systems theory as well as sustainability and the current theory behind the biosphere reserve is that strategies (for conservation, sustaining livelihoods and research) developed with regard to the needs of specific regions need to be implemented to promote world wide sustainability. Examining these strategies will provide insight to real biosphere reserve experiences and their role in sustainability. These strategies or initiatives can include things like activities, policies or programs that are developed by biosphere reserves and follow their mandate. The initiatives looked at in depth by this paper are education in Georgian Bay, the ALUS project in Long Point and the Bruce Trail in the Niagara Escarpment.

The literature already published on topics important to this research helps define what is important and relevant for both information collection and analysis. Background on complex systems and sustainability provides a context for the analysis of biosphere reserve initiatives, as does a fuller description of the framework behind biosphere reserves. The key considerations here are the integrated approach to complex systems, the eight sustainability requirements and the Seville Strategy criteria. The information gathered on the three biosphere initiatives pertains to their age, region, purpose, method of achieving their goal, where the integration is, what the reinforcing benefits are, the outcome or progress, difficulties in implementation, general opinions about them from key informants, and what the lessons to be learned are.

The analysis indicates that biosphere reserves are able to implement projects that address the specific needs of an area and are based on the framework of sustainability and complex systems. The cases examined here support the conclusions made in complex systems and sustainability theory and the advantages of fulfilling the biosphere reserve mandate seem to outweigh the difficulties in doing so. More time is needed to reveal the outcomes of the Education Network and ALUS program but the preliminary examination indicates that they are promising initiatives.

1.0 Introduction

As the demands on the environment increase due to factors such as population growth, consumption of resources and urban sprawl, it is becoming increasingly obvious that strong initiatives are needed to protect ecological processes and conserve resources. Achieving and maintaining an economically, socially and environmentally healthy future means addressing connected factors from all these areas (Gibson 2005, 12). Because humans have created systems which are inextricably linked to the environment and because of the complexity within and between those systems and the environment, human and ecological goals cannot be achieved on a large scale if their interconnections are ignored. Unless the practical initiatives address both social and economic needs of communities in and around the focus environment, they will not be successful in creating a sustainable future.

One way of working towards better integration is through the designation of biosphere reserves. Created by UNESCO, biosphere reserves began as conservation efforts but developed into a more complex model of land management through the acknowledgement that all things are related, and that to achieve a sustainable, healthy ecosystem every process and action which influences it or is altered by it, must be considered (UNESCO 2008). UNESCO considers the interrelated functions of conservation, development and logistic support to be the biosphere reserve mandate (UNESCO 2008). This paper examines how the interrelated functions of conservation, sustainable development and research and education work to reinforce each other. There is a large amount of theory behind complex systems and sustainability, to be discussed further on, which supports the claim that ecological goals can only be achieved by integrating these different functions (Rozzi 2006, 44). This leads to the conclusion that a program or solution which benefits more than one function will have high quality and realistic results because the progress made in one area will come back and help the other area(s), and a cycle of reinforcing benefits develops. The significance of this approach should not be underestimated and may be determined by analyzing the theory behind it and the practical initiatives that stem from it. The practicality of implementing this approach is important because, if with the translation from theory to reality it is inefficient and the advantages are lost, it becomes useless.

This paper will provide detail on biosphere reserves, their history, organization and practice as well as navigate through the literature behind complex systems and sustainability and how they relate to biosphere reserves. It will then look at initiatives in three Southern Ontario biosphere reserves that created positive feedback between two or more of these functions, analyze their strengths and shortcomings and assess them in terms of how well they exemplify the UNESCO biosphere reserve mandate and promote sustainability. The three initiatives are environmental education in Georgian Bay, the Bruce Trail in the Niagara Escarpment, and the ALUS program in Long Point, and they are all in Ontario, Canada. This paper hypothesizes that the cases examined here will support the conclusions made in complex systems and sustainability theory and that the advantages of fulfilling the biosphere reserve mandate outweighs the difficulties in doing so.

1.1 Rationale

The purpose of this paper is to provide a collection of integrated initiatives within the biosphere reserve framework and a critical analysis of those initiatives. The result should be a useful resource for those who are interested in examples of functioning interrelationships between research and education, conservation, and sustainable livelihoods. It links the outcomes of the initiatives as related occurrences rather than ignoring the connections and treating them as

simple, individual results. The paper ascertains lessons from different types of initiatives found in Southern Ontario biosphere reserves which should be helpful when planning new ones. This is an important area of research because the use of examples to assess the practical implications of the theory behind biosphere reserves has not been given adequate attention in the past (Rozzi et al. 2006). By providing ideas for future management and examining the interrelated functions, the paper contributes to the literature on the use of biosphere reserves as a tool for sustainability.

1.2 Methodology

This paper is based on peer reviewed articles and UNESCO and other biosphere reserve documents for its background and theory. Communication by email and telephone with knowledgeable sources, as well as biosphere reserve documents and academic work such as dissertations were used to gather generally qualitative information about integrated initiatives (see Appendix A for questions discussed with sources). The three case studies for this research were chosen with certain criteria in mind. The amount of available information, their age (older models will have time to generate more information and reactions), their location for logistical reasons were used to narrow down possible candidates which had to demonstrate a visible attempt to link two or more functions of biosphere reserves.

This research is limited by the fact that as the number of initiatives reviewed goes up, making the paper more comprehensive, the detail of each initiative will go down, and visa-versa. Also, qualitative information is harder to test and will be based on only a few perspectives due to time constraints. The scope of this paper does not consider a number of other influences (like the influence of the organization and funding of each biosphere reserve).

1.3 Outline

The paper begins by describing UNESCO's biosphere reserves and how and why they began, as well as their structure. It describes the conceptual framework behind using the literature review to provide the basis for analysis. The literature review consists of complex systems theory, sustainability thinking, and UNESCO's Seville strategy and the integrated framework section explains the three main key considerations for analysis derived from the literature review. The literature review also includes a section on The Rhön, a German biosphere reserve acknowledged for its integration and outstanding results in conservation and sustainable livelihoods, which exemplifies the biosphere reserve mandate. Then the Georgian Bay, Niagara Escarpment and Long Point Biosphere Reserves are described, and the three initiatives focused on by this paper are examined in terms of the project's objectives, methods of achieving those goals, outcomes, and the strengths and weaknesses of the integration. The analysis of the initiatives and general conclusions from this study follow.

2.0 Biosphere Reserves

UNESCO is a specialized division of the UN which promotes education, science and culture. Its purpose is to share ideas, foster innovation and research for the wellbeing of people and nations (UNESCO 2008). In 1971, UNESCO developed the Man and the Biosphere programme (MAB), and sought to create an international scientific "network of representative areas where innovative, sensitive forms of nature utilisation were to be developed by research and practice: biosphere reserves" (Heinze 2005, 14). Biosphere reserves also follow the sustainability approach, which UNESCO describes as "bringing together economic performance,

social responsibility and environmental protection to facilitate fair development opportunities for all countries and to preserve the natural foundations of life for future generations" (Heinze 2005, 16). Biosphere reserves do this through their structure, a protected inner zone surrounded by a buffer zone which is surrounded by a transition area, which allows certain areas to be well conserved and others to participate in sustainable development (Heinze 2005, 20). They also recognize that there are links between conservation and socio-economic development, seen in their mandate (UNESCO 2008).

Biosphere reserves have three inter-connected functions:

- *Conservation: landscapes, ecosystems, species and genetic variation*
- *Development: economic and human and culturally adapted*
- *Logistic support: research, monitoring, environmental education and training*

In addition to the mandate, UNESCO has put together a framework, known as the Seville Strategy, to guide the successful development of and effective operation of biosphere reserves (UNESCO 1996, 6). Through biosphere reserves and with this purpose in mind, UNESCO has incorporated the theories of complex systems and interdisciplinary work into a practical program for sustainability. It is through policies and initiatives of individual biosphere reserves that actual progress can be seen. Although there are hundreds of biosphere reserves found all over the world, the focus of this paper is on Long Point, Niagara Escarpment and Georgian Bay Littoral, see Appendix B for map, which are three of the four biosphere reserves found in Southern Ontario, the fourth being Frontenac Arch (UNESCO 2008).

2.1 Organization of Biosphere Reserves

The official designation of biosphere reserves and the framework for managing them come from UNESCO. The process of creating a biosphere reserve begins with the community in the area of significance, which must get their proposal nominated at the local level and endorsed by provincial and national governments. The approval depends on stringent criteria set assessed by UNESCO (Heinze 2005, 10). Management of biospheres, is less systematic and differs from country to country and even between specific biosphere reserves. Although individual biosphere committees control day-to-day operations and fundraising, in Canada they usually have to work with government agencies and within government legislation to be part of the decision making process (Reed 2007, 321). Some are protected under national law; some are on privately owned and some are on public land (UNESCO 1996, 4). Also, some Canadian biosphere reserves are partially protected if the core area is part of a national or provincial park (Reed 2007, 321). In general, biosphere reserves have varying organizational and legal structures.

The administrative role in the Long Point Biosphere Reserve is filled by a charitable, non-government organization, the Long Point World Biosphere Reserve Foundation, which elects an executive committee from their members (Buck and Edge 2006, 13). The land is owned by many groups including Canadian Wildlife Services who designated some of the land a National Wildlife Area, the Long Point Company who preserves wildlife and habitats for sustainable hunting and fishing, and two provincial parks (Buck and Edge 2006, 14). Other land owners include the Nature Conservancy of Canada, Ontario Heritage Trust, and Long Point Basin Land Trust (Buck and Edge 2006, 17, 18). The national and provincial governments both have some jurisdiction over Long Point through a few of these organizations. Land management

policies are often enacted by these agencies while local decision making and initiatives are launched by the other groups (Buck and Edge 2006, 59). The Long Point Biosphere Reserve helps to facilitate communication and cooperation between the different stakeholders.

Ontario's Niagara Escarpment Planning and Development Act and the Niagara Escarpment Plan designate the Niagara Escarpment Biosphere Reserve as a protected area (Ontario's Niagara Escarpment, 2008a). These govern land management and conservation decisions in the biosphere reserve. The Niagara Escarpment is managed by a Ministry of Natural Resources regulatory agency, the Niagara Escarpment Commission (Ontario's Niagara Escarpment, 2008b). Along with other provincial and local groups, the Commission works to fulfill the UNESCO biosphere reserve mandate. The Georgian Bay Biosphere Reserve is administered by the NGO, Georgian Bay Biosphere Reserve Inc., working to fulfill the UNESCO biosphere reserve mandate as well (Georgian Bay Biosphere Reserve 2009).

3.0 Conceptual Framework

The concept of biosphere reserves has been informed by complex systems theory as well as sustainability and the current theory behind the biosphere reserve is that strategies (for conservation, sustaining livelihoods and research) developed with regard to the needs of specific regions need to be implemented to promote world wide sustainability. However, as the Man and the Biosphere programme predates sustainability, and the ideas have really evolved together since the 1970s, the principles of complex systems and sustainability reflect those which are implicit in the biosphere reserve mandate (Ishwaran 1992). Real initiatives in biosphere reserves are the embodiment of these principles, which is why they are the focus of this paper. This paper's approach to analyzing these initiatives stems from systems thinking. That requires understanding issues within their context, which is why it is necessary to look at the initiatives in terms of how and why they came about and at their multiple benefits (Gallopin et al. 2001, 6). Examining these strategies provides insight to real biosphere reserve experiences and their role in sustainability. These strategies or initiatives can include things like activities, policies or programs that are developed by biosphere reserves and follow their mandate. The initiatives looked at in depth by this paper are education in Georgian Bay, the ALUS project in Long Point and the Bruce Trail in the Niagara Escarpment.

The literature already published on topics important to this research helps define what is important and relevant for both information collection and analysis. Background on complex systems and sustainability provide a context for the analysis of biosphere reserve initiatives, as does a fuller description of the framework behind biosphere reserves. Specifically, there are certain conditions that should guide initiatives in biosphere reserves which have been set out in the Seville strategy by UNESCO. The strategy will be discussed in more depth further on in the paper, but the main goals which influence the framework are to conserve natural and cultural diversity; to be models of land management and of approaches to sustainable development; to facilitate research, monitoring, education and training; and to implement the biosphere reserve concept (UNESCO 1996, 7-10). The degree to which these goals are realized will be the focus of the analysis for each initiative.

3.1 Complex Systems

The theory of complex systems has developed from the idea that simple systems are not an accurate way to describe natural or human-made processes, which often interact. Complex systems are nonlinear (within component relationships, usually the significance of a cause is not

proportional to the extent of the effect) making them difficult to predict, and emergent (the whole cannot be understood only in terms of its parts) (Berkes 2004, 622). They are also influenced by a multitude of different factors, have different scales (due in part to their self-organizing components which dictate behaviour) and cause a lot of uncertainty in scientific research because of randomness and the issues stated above, which prevent obtaining complete data (Gallopin et al. 2001, 8). These systems are very difficult to understand; a standard model or simulation is insufficient to accurately represent them because they require more than one irreducible description (Gallopin et al. 2001, 7). In other words, a metaphor from a single perspective will not do the system justice – multiple perspectives and context need to be included. This description fits ecosystems well and because humans are a part of the ecosystem, this complexity is significant to environmental work (Gibson 2005, 32). With the recognition of complex systems in environmental work must come a new way of thinking that opposes reductionist and disconnected thinking. This approach recognizes that in the relationships between systems and their components and other systems, most are influenced by more than one connection and that they are always changing (Morin 1992, 371). This is why systems do not effectively divide along disciplinary lines. Also, because humans and the environment are part of the same system, an integrated approach to problem-solving and progress is needed (Berkes 2004, 628). Analyzing these systems requires recognizing and understanding the linkages between different factors and scales because these linkages "originate the possibilities of changes in one component of the system reverberating into other parts of the system" (Gallopin et al. 2001, 6). It is also necessary to comprehend the forces that dictate the system's behaviour; this includes how it adapts and how components and processes act together to control responses and emergent properties (Gallopin et al. 2001, 6). This is a logical approach for dealing with conservation and society, if not the easiest. It may not foster straightforward answers, but an extensive complex answer is much more useful than a narrow and naive one.

One approach to understanding complex integrated social-ecosystems is through resilience thinking (Francis 2005, 4). A very general description would be that it models the cycles and changes of regional scale ecosystems over time. In it, systems are characterized as having a slow development phase, a collapse phase usually triggered by an outside force, and a re-organization phase where the system either repeats the cycle or begins a new one depending on its resilience (Francis 2005, 5). Resilience refers to the speed and degree of recovery during the collapse and re-organization stages (Francis 2005, 5). Resilience thinking recognizes that ecosystems are not static because they are affected by both human and natural forces; that is why the emphasis is on protecting the ecosystem's ability to recover to a healthy system and not its pristine state (which is very subjective). An understanding of complex systems and resilience provides a basis for management of biosphere reserves. Because of the inter-dependency between economic livelihoods and local ecosystems, a lasting relationship between the use of natural resources and maintaining natural resilience is necessary (Francis 2005, 6). This complements sustainability thinking very well because part of its focus is on maintaining healthy ecosystems and social systems for future generations.

3.2 Sustainability

Sustainability is the principle of satisfying current needs without compromising the ability of future generations to do the same (Heinze 2005, 14). It forces decision-makers, planners, scientists, community leaders, etc. to look for the compatible, mutual objectives, between areas so often and so easily seen at odds with each other. Although conflicts do exist, it

is more important to focus on the possibilities for mutually reinforcing benefits (Gibson 2005, 94). To help explain what is meant by sustainability and what that means for these biosphere reserve initiatives, a list of overall requirements for sustainability has been adapted from *Sustainability Assessment: Criteria and Processes* and they are used to analyze the initiatives (Gibson 2005, 116-118):

- Social-ecological system integrity (relationships between society and ecology must be designed to maintain the functions that living things depend on, into the future)
- Livelihood sufficiency and opportunity (people have enough for their well-being and have opportunities to improve their situations)
- Intragenerational equity (reduce disparity between people with different economic means)
- Intergenerational equity (decisions made do not inhibit future generations to live sustainably)
- Resource maintenance and efficiency (reduce material and energy use)
- Socio-ecological civility and democratic governance (increase awareness and collective responsibility in decision making bodies)
- Precaution and adaptation (serious risk should be avoided even if it is not certain and management should learn from previous designs)
- Immediate and long-term integration

Sustainable strategies must be integrated and take knowledge from more than one area and apply it to multifaceted problems or issues in complex systems. This is a sensible idea because integrative thinking provides more powerful, realistic and flexible solutions (Gibson 2005, 125). It has been acknowledged that to achieve conservation, more integration with ecological and social issues is essential (Rozzi et al. 2006). Many of the different global crises today, including environmental degradation and poverty cannot be "adequately tackled from the sphere of specific individual disciplines" so integrated solutions are necessary (Max-Neef 2005, 5). In the past the dominant opinion of development and conservation was that they were conflicting, antagonistic goals; but a shift in thinking has led to the realization that people around conservation areas can lead fulfilling lives while contributing to conservation (Max-Neef 2005, 15). Integrated solutions give the results needed for conservation and development issues, and can be found in biosphere reserves, where ecological, educational and economic functions are treated as connected and reinforcing processes. Biosphere reserves provide an area that encourages problem solvers to use an integrative approach that results in multiple benefits for those involved (Matysek, Stratford and Kriwoken 2006, 2). These solutions should provide numerous, lasting, and enlightened benefits to the socio-ecological systems they were applied to. The gradual trend towards a more holistic view and willingness to broaden solutions is a good thing, and can be seen within biosphere reserves.

3.3 The Seville Strategy

Sustainability has been intertwined with biosphere reserves since the 1970s but that tie has been strengthened through the Seville strategy. The strategy is a more thorough explanation of the biosphere reserve three inter-connected functions mandate. It stresses that biosphere reserves are more than isolated protected areas. They provide valuable scientific knowledge for future conservation and have the ability to reconcile cultural, economic and ecological needs, and are therefore leaders in the movement towards a sustainable future (UNESCO 1996, 5). The strategy recognizes the complexity of systems in biosphere reserves by emphasizing the

importance of inter-connections (UNESCO 1996, 5). To continue and enhance their contribution, the Seville strategy suggested some new guiding principles, including "strengthen the contribution which biosphere reserves make to the implementation of international agreements promoting conservation and sustainable development… develop biosphere reserves that include a wide variety of environmental, biological, economic and cultural situations… ensure that all zones of biosphere reserves contribute appropriately to conservation, sustainable development and scientific understanding… biosphere reserves should be used to further our understanding of humanity's relationship with the natural world" (UNESCO 1996, 5,6). The practical implementation of these ideas should provide visible advancements towards sustainability.

The Seville strategy also provides recommendations on how biosphere reserves can achieve their overall goals of conserving natural and cultural diversity, being examples of land management and sustainable development, research and education, and implementation of the biosphere reserve concept itself (UNESCO 1996, 7). They list a number of recommendations for individual biosphere reserves to consider, and those that pertain to specific projects are as follows:

- Survey made of stakeholders' interests
- Identify factors leading to environmental degradation
- Survey made of the natural products and services of the biosphere reserve
- Incentives identified for sustainable use by local populations
- Plan prepared for equitable sharing benefits
- Local consultative framework implemented
- Co-ordinated research and monitoring plan implemented
- Strategies developed for mobilizing funds from businesses, NGOs and foundations
- Mechanisms developed for monitoring and assessing the implementation of the Seville Strategy at individual level (UNESCO 1996, 15).

The strategy innately recognizes the complexity of ecosystems and surrounding social systems and the importance of integrated solutions and, considering these issues, gives specific ideas on how to achieve sustainability through biosphere reserves and their initiatives.

3.4 The Rhön Biosphere Reserve

The Rhön Biosphere Reserve in Germany is an excellent example from abroad of how sustainability is interpreted though biosphere reserves and how in turn, their initiatives can provide mutually reinforcing conservation, scientific and livelihood benefits. Although it began before the Seville strategy was created, it exemplifies the concepts and objectives within the strategy. The Rhön was recognized by UNESCO in 1991 and is located near the centre of Germany (Heinze 2005, 159). Around the time it was designated as a biosphere reserve, the Rhön area saw a decrease in population and in economic stability because local producers did not have a large enough market to support themselves (Heinze 2005, 82). This was due to the challenge to their economic livelihoods by modernized agriculture and would eventually lead to a depopulated area as well as lower biodiversity (Gibson 2005, 74). The biosphere reserve designation brought in the importance of conservation. The preservation of the Rhön's unique animal and plant diversity created a niche for tourism and education (Gibson 2005, 75). Over the last few years things have improved for the Rhön due to intervention by government and NGOs, the economy is growing with the increased ability for farmers to sell their products (Heinze 2005, 83). Although the process has been simplified, this is an obvious example of reinforcing

benefits. The conservation of ecologically and economically valued species led to more sustainable livelihoods for the Rhön's population and in turn, the biodiversity is thriving.

4.5 The Integrated Framework

The integrated framework is based on the literature regarding biosphere reserves and related concepts and will guide the information gathered about the case studies and how they are analyzed. In theory, relationships between systems and their components and other systems are influenced by more than one connection and are always changing, and a shift in thinking has lead to the realization that people around conservation areas can lead fulfilling lives while contributing to that conservation by focusing on integrated solutions. The benefits from these solutions are expected to be more likely, numerous, mutually reinforcing, engaging for the community, and long lasting. Biosphere reserves, where ecological, educational and economic functions are treated as connected and reinforcing processes, should make an excellent venue for determining the real world practicalities of these theoretical conclusions.

The key considerations here are sustainable livelihoods, stewardship, research and the linkages between them that provide a basis for integrated initiatives. The information gathered on the three biosphere initiatives pertain to their age, region, purpose, method of achieving their goal, where the integration is, what the reinforcing benefits are, the outcome or progress, difficulties in implementation, general opinions about them from key informants, and what the lessons to be learned are. The key considerations for the analysis have been discussed in the literature review and these headings will provide the structure for the analysis:

- *Integrated Approach to Complex Systems*
- *Eight Sustainability Requirements*
- *Seville Strategy Criteria*

The analysis will consider whether or not the initiative follows these conditions, and how well. This information will be used to provide general conclusions about the expectations of the biosphere reserve three interrelated functions mandate. It will help determine some general areas for improvement and summarize what this means for integration, complex systems and how the interrelated functions work to reinforce each other.

5.0 Initiatives

5.1 Georgian Bay Biosphere Reserve: Education Network

The Georgian Bay Biosphere Reserve was designated by UNESCO in 2004; it covers almost 350 000 hectares of the eastern coast of Georgian Bay and is considered the world's largest freshwater archipelago. It is home to over 100 at risk species in Canada and Ontario (Georgian Bay Biosphere Reserve, 2009a). This biosphere reserve is characterized by its vast wilderness and is a significant part of the local community's identity. It is a means for residents to protect their environment while creating a place that appeals to others and the next generation. This area is also home to members of the First Nations communities who value traditional knowledge and are committed to educating students so they can connect with nature, and to instilling these values in the youth (Pollock 2008, 30). Because of the networking capacity of the local biosphere reserve organization (and its UNESCO standing, which gives the work produced in it added credibility), it is seen as an important international designation for the communities along eastern Georgian Bay (Pollock 2008, 30).

One particular way in which the biosphere reserve is being used is to facilitate an education program. This program is designed to help educators network with one another, and to provide resources to educate people about the biosphere reserve, its ecology and culture, and opportunities for stewardship and sustainable development. It focuses on elementary and high school students but also tries to involve the general community and is centred on networking, educating students and creating a curriculum for the biosphere reserve (Georgian Bay Biosphere Reserve, 2009b). To connect the biosphere reserve to local education, the Georgian Bay Biosphere Reserve has created an Educational Advisory Committee that is comprised of teachers and others interested in education to develop an Educators Network (Georgian Bay Biosphere Reserve, 2009b).

5.1.1 Objectives

The program is committed “to educating staff and students about the international world biosphere reserve in which they live, while also promoting the value of environmental learning opportunities in this region" (Georgian Bay Biosphere Reserve, 2009b). It emphasizes sustainability within biosphere reserve and involving the community. The purpose is to improve and increase biosphere reserve education in the Georgian Bay Biosphere Reserve by facilitating informative and engaging projects and programs (Georgian Bay Biosphere Reserve, 2009c).

5.1.2 Methods

The Education Advisory Committee was created in May of 2008 and consisted of educators representing elementary, secondary, and post-secondary education, as well as administrators, Aboriginal educators, and others interested in this type of program. These people, from the Georgian Bay area, had the responsibility to develop the main topic and opportunities for biosphere reserve education. A partnership was developed with the Near North District School Board to bring awareness of the biosphere reserve to teachers and school administrators. The biosphere reserve also put together useful online resources including blogs, newsletters, a searchable database, and a virtual museum; curriculum tools including a study guide, audio-visual materials, and lesson plans; as well information for field trips (Georgian Bay Biosphere Reserve, 2009d). A place-based curriculum, beginning with elementary schools and considering local ecological knowledge, will adapt materials from the Niagara Escarpment Biosphere Reserve, Clayoquot Biosphere Trust and Frontenac Arch Biosphere Reserve (Pollock 2008, 30). Further plans include bringing ecotourism classes to the secondary and post-secondary levels, integrating biosphere reserve concepts into community events, and an academic field campus or research institute to increase scientific study of the area for more wide-ranging education (Pollock 2008, 30). The Educators Network will promote and share environmental educational materials, resources, and curriculum ideas in a cohesive manner to engage the most people possible and provide them with local and hands-on learning experiences in support of stewardship and sustainability.

5.1.1 Integration

This initiative promotes hands-on learning about the environment and encourages people to work to protect it. By assisting residents to learn more about their environment, it also involves the community. It promotes socio-ecological system health by emphasizing the unique cultural, aesthetic and scientific characteristics in Georgian Bay. However, the initiative is still in

its early stages and more time is needed to determine the implications and significance of the benefits.

5.2 Niagara Escarpment Biosphere Reserve: Bruce Trail

In 1990 the Niagara Escarpment, which stretches across Southern Ontario, was designated as an UNESCO biosphere reserve because of its unique nature (Ontario's Niagara Escarpment, 2008b). The Niagara Escarpment is made up of varied geographical regions along its 725 km and includes scenic views of gently rolling hills, forested valleys, cliffs, deep caves, rivers, streams, waterfalls (Ontario's Niagara Escarpment, 2008c). One can also find towns, cities and farms among the wildlife habitats and mineral resources, and it is home to hundreds of varieties of interesting and beautiful flora and fauna (Ontario's Niagara Escarpment, 2008c). The unique features of the Escarpment are due in part to neglected agricultural land which has led to vast areas of forests and wetlands, and the high levels of biodiversity, as well as ancient geological formations (Whitelaw 2006, 71). Recreation opportunities and these characteristics attract more than 400,000 visitors to the Escarpment each year (Ontario's Niagara Escarpment, 2008d).

The Bruce Trail is one offering in the Niagara Escarpment and is Canada's longest footpath (Ontario's Niagara Escarpment, 2008d). It opened in 1967, and spans the length of the biosphere reserve from Tobermory to St. Catherine's (Ontario's Niagara Escarpment, 2008d). It was conceptualized in 1960 when two field naturalists, Raymond Lowes and Robert Bateman, began talking about a footpath that would allow and encourage the public to experience the Escarpment's unique features up close, just like they did (Whitelaw, 2009).

5.2.1 Objectives

The Bruce trail gives people the chance to get away from urban areas and developed land and to reflect on and enjoy the natural environment (The Bruce Trail Conservancy, 2008). Lowes and Bateman wanted for people to realize what was in their backyard and hoped to get them to want to protect it (Whitelaw, 2009). Through awareness and donations from these visitors, the Bruce Trail Conservancy works to protect the natural landscape with restoration and monitoring projects and the tourism also helps to support the economies of communities surrounding the Niagara Escarpment (Ontario's Niagara Escarpment, 2008d).

5.2.2 Methods

The promise of a relaxed walk or invigorating hike through visually stimulating country attracts people looking for vacation or recreation and often visitors leave with a better awareness of the need for conservation. Charitable donations from these visitors provide resources for stewardship of the land and their tourism and trail membership partially funds the local economies (Ontario's Niagara Escarpment, 2008d). Enhanced stewardship then encourages more people to visit. The Bruce Trail also encourages interested parties to get involved with decisions regarding the footpath.

5.2.3 Integration

The Bruce Trail was created before UNESCO designated the Niagara Escarpment a biosphere reserve. However, the integration seen in the biosphere reserve mandate can be seen in this initiative because it was designed with the same ideals in mind. The designation of a

biosphere reserve comes after some attention has been paid to sustainability in an area; effort has to be put forth for UNESCO to consider it (Whitelaw, 2009). The creators of the Bruce Trail wanted it to educate people about this environment to help stewardship efforts and it has gone on to do this and benefit the local economy (Whitelaw, 2009). Businesses and residents now really appreciate that the trail has brought millions of dollars to their local economy (Whitelaw, 2009). This indicates that linking the functions the biosphere reserve's mandate do have reinforcing benefits.

In the 1960s the trail was a visionary step towards sustainability, and its brilliance has not diminished over the years (Whitelaw, 2009). It played an important role in getting people into conservation and has inspired some NGOs, like the Coalition on the Niagara Escarpment (CONE), to do the same (Whitelaw, 2009). The process has not been a simple one and, especially in the beginning, there was an issue with the relationships between landowners and the trail. They had handshake agreements with landowners to let the trail go over their private land and because they were informal agreements and not all the hikers respected the private land, they had issues with the path (Whitelaw, 2009). It took a lot of effort working with the residents to create the trail that is enjoyed today.

5.3 Long Point Biosphere Reserve: ALUS Program

Long Point is found along 26,250 hectares of the North shore of Lake Erie in the Norfolk county area, and it was designated a biosphere reserve in 1986 (Long Point Biosphere, 2008). This biosphere reserve is an example of the Great Lakes coastal ecosystem and a unique blend of habitats including savannahs, beaches, marshes, and dunes, which have been formed and rearranged over the past few thousand years by sediment transportation and erosion (Buck and Edge 2006, 8). Towns and agricultural land can also be found around the area and are an important part of the biosphere reserve (Buck and Edge 2006, 8).

Farming makes up a significant part of people's livelihoods in this area but it has become a struggling industry (Norfolk Land Stewardship Council, 2008). The ALUS (Alternative Land Use Services) program addresses this issue as well as the need for stewardship within the biosphere reserve. ALUS is a plan designed to pay farmers for the ecological goods and services their land provides the rest of the ecosystem and community (Mackenzie 2008, 11). The initiative is driven by farmers and the community and is completely voluntary for the participating farmers (Norfolk Land Stewardship Council, 2008). It was created by Keystone Agricultural Producers (KAP), a farm group in Manitoba and the Delta Waterfowl Foundation, a not-for-profit conservation organization and is supported by agricultural, conservation, and government organizations, as well as farmers (Mackenzie 2008, 54). The program in the Long Point Biosphere reserve began in September 2007 (Norfolk Land Stewardship Council, 2008).

5.3.1 Objectives

The initiative's goals are to contribute to farmers' livelihoods by providing significant financial compensation for ecological goods and services, and to conserve the natural environment by protecting soil, water, and biodiversity, and enhancing recreation and carbon sequestration (Mackenzie 2008, 54). ALUS is designed to address stakeholder interests and empower the people most directly involved to maintain the agricultural industry in this area for future generations while fostering stewardship.

5.3.2 Methods

ALUS provides financial compensation to farmers for their ecological goods and services to promote more of those goods and services. For example, restoring and enhancing wetlands will purify the community's water supplies (Norfolk Land Stewardship Council, 2008). Farmers are encouraged to register any ecologically sensitive, natural, wetland or riparian areas, which are then either left alone or subjected to a minimally disruptive level of farming, and this determines the payment per acre the farmer receives (Mackenzie 2008, 54). The funding for the financial compensation comes from many different interested parties including the Ministry of Natural Resources, the Ontario Trillium Foundation, the Agricultural Adaptation Council, the Norfolk Land and Stewardship Council, the Ontario Federation of Anglers and Hunters, Delta Waterfowl, and Ontario Stewardship (Norfolk Alternative Land Use Services, 2008). The initiative relies on the ideas that farmers understand that a healthy environment is necessary to maintain farming and to provide important environmental services like clean water and clean air; and that an economic value can be placed on these ecological goods and services (Norfolk Land Stewardship Council, 2008).

5.3.3 Integration

Compensation for stewardship, rather than a penalty for degradation, facilitates a positive, long-term relationship between conservation and livelihoods. The ALUS project in the Long Point Biosphere Reserve area is anticipated to improve the environment by increasing biodiversity, increasing trees planted for windbreakers, enhancing wildlife habitat and corridors, reduce erosion, improve soils and protect water resources (Norfolk Land Stewardship Council, 2008). It is also expected to provide income to the landowners (Norfolk Land Stewardship Council, 2008). The link between these two benefits is obvious and proving to be strong. These benefits have been seen in other similar programs and those programs have indicated that the financial gains do outweigh the costs (Mackenzie 2008, 56). Specifically, the estimate is an annual cost reduction of over 61 million government dollars, and an annual total benefit to society of over $820 million (Mackenzie 2008, 56). The voluntary aspect of the program is also a benefit to farmers because it empowers them with the role of stewards of the environment and with financial compensation (Mackenzie 2008, 111).

However there are some issues with the initiative that need to be addressed if it is to provide effective, long-term benefits. For significant benefits to the farmers' livelihoods, the payments will have to be increased from $10 (being used in the pilot project) to $150 per acre (Mackenzie 2008, 138). Because of the project's size and its intricacies, there may be administration difficulties. The county's ability to administer the banking, the Conservation Authority's ability to provide extension, and the Ministry of Natural Resources' ability to supply GIS services would all have to be increased for the project to move beyond the pilot scale (Mackenzie 2008, 120). Also, there is a challenge to organize the different sources of funding for ALUS (Mackenzie 2008, 120). These drawbacks to the large-scale, integrated initiative need to be dealt with before significant benefits can be seen but the motivation is there because of the potential that those benefits have.

6.0 Analysis

6.1 Georgian Bay Biosphere Reserve: Education Network

6.1.1 Complex Systems

Educating the community on what is found in their biosphere reserve enhances conservation. The approach addresses the issue of complex systems by integrating conservation and education. Currently the outcomes are unknown but the design is strong and there is no indication that this approach has produced problems.

6.1.2 Sustainability Criteria

Socio-ecological System Integrity: The Education Network promotes integrity within these systems by encouraging stewardship through education to protect resilience and reduce stress on the environment. It also works toward changing the relationship between people and the environment, especially with younger generations, by providing an education that encompasses more than just the traditional Western, anthrocentric ideals.
Livelihood Sufficiency and Opportunity: Although the network does not directly affect this area, its focus on research has the ability to provide economic livelihood for some.
Intragenerational Equity: Although the network does not directly affect this area, through education all members of the Georgian Bay community have the chance to learn more about their environment and have equal opportunity to express informed opinions.
Intergenerational Equity: Conserving the environment for future generations and teaching them about what not to do, is fundamental to this program.
Resource Maintenance and Efficiency: Interacting with the environment in ways that conserve resources is also valued and taught by the program.
Socio-ecological Civility and Democratic Governance: The Education Network is designed to include all interested parties to help form a desirable curriculum and programs. Engaging the community through education gives them a basis for participating in decision making processes.
Precaution and Adaptation: The program also has a research aspect to it, which will help fill in gaps and uncertainties regarding scientific information from the area which can aid in precautionary measures and help the program adapt.
Immediate and Long Term Integration: Educating the community on what is found in their biosphere reserve enhances conservation and instils these values in the next generation; all the objectives here are linked. This initiative promotes hands-on learning about the environment and encourages people to work to protect it.

6.1.3 The Seville Strategy

Survey Made of Stakeholders' Interests: Stakeholders consulted
Identify Factors Leading to Environmental Degradation: Possibly to come with curriculum
Survey Made of the Natural Products and Services of the Biosphere Reserve: Possibly to come when curriculum developed
Incentives Identified for Sustainable use by Local Populations: Possibly to come when curriculum developed
Plan Prepared for Equitable Sharing Benefits: Encouraged through broad participation
Local Consultative Framework Implemented: Stakeholders consulted
Co-ordinated Research and Monitoring Plan Implemented: Research facilities to be implemented with education program
Biosphere Reserve is used for Developing Indicators of Sustainability Relevant to Local Populations: Possibly to come when curriculum developed
Strategies Developed for Mobilizing Funds from Businesses, NGOs and Foundations: Partially

Mechanisms Developed for Monitoring and Assessing the Implementation of the Seville Strategy at Individual Level: Not as of yet

6.2 Niagara Escarpment Biosphere Reserve: Bruce Trail

6.2.1 Complex Systems

The mutually reinforcing benefits between stewardship of a resilient ecosystem and sustainable livelihoods in the Bruce Trail have been occurring for decades as a response to complex systems. The extensive amount of club memberships and volunteers and appreciation by local businesses indicate that the initiative has had overwhelmingly positive results.

6.2.2 Sustainability Criteria

Socio-ecological System Integrity: By encouraging people to experience the features of the Escarpment, the trail informs people first hand about the need for enhancing ecological health and helps them connect with nature and re-evaluate the relationship between society and the biophysical environment.
Livelihood Sufficiency and Opportunity: Due to the tourism the Bruce Trail attracts every year, it has become an integral part of the economy for the communities it runs near. This means it provides great livelihood opportunities for citizens in the area.
Intragenerational Equity: Although the trail does not address this issue directly, it is a fair initiative by providing business and free learning and recreational opportunities to people who are interested.
Intergenerational Equity: Enhancing the environment and conserving the Niagara Escarpment experience for future generations is a focus of the trail.
Resource Maintenance and Efficiency: Although the trail does not directly affect this area, encouraging people to reconnect with nature brings awareness to this issue.
Socio-ecological Civility and Democratic Governance: The extensive amount of club memberships and volunteers indicate that the initiative engages the community and considers stakeholder input in decision-making.
Precaution and Adaptation: The trail's management approach has shown it is adaptive through the effort put forth to improve relations with private landowners.
Immediate and Long Term Integration: Although economic gains were not part of the original purpose of the Bruce Trail, the integration between the economy and stewardship efforts has proved to be very beneficial and long term – as the trail has been here for over 40 years and still persists.

6.2.3 The Seville Strategy

Survey Made of Stakeholders' Interests: Stakeholders consulted at times
Identify Factors Leading to Environmental Degradation: Described by the Bruce Trail Conservancy as urban sprawl
Survey Made of the Natural Products and Services of the Biosphere Reserve: Described by the Bruce Trail Conservancy as unique natural landscapes and features
Incentives Identified for Sustainable use by Local Populations: Preservation of unique natural landscapes and features
Plan Prepared for Equitable Sharing Benefits: The trail is open to all and encourages participation by all

Local Consultative Framework Implemented: Stakeholders consulted at times
Co-ordinated Research and Monitoring Plan Implemented: Monitoring plans after conservation initiatives implemented
Strategies Developed for Mobilizing Funds from Businesses, NGOs and Foundations: Yes, mostly through donations
Mechanisms Developed for Monitoring and Assessing the Implementation of the Seville Strategy at Individual Level: Not yet

6.3 Long Point Biosphere Reserve: ALUS Program

6.3.1 Complex Systems

ALUS empowers farmers and the community to make positive decisions for themselves and the environment. It addresses the complex connections between the agricultural industry and its impact on the environment as well as the benefits to farming practices from a resilient environment, and creates a solution that financially benefits farmers. The financing issues here have been shown to be outweighed by the benefits and because of this, the program has the ability to continue long-term.

6.3.2 Sustainability Criteria

Socio-ecological System Integrity: This program disputes the current assumption that agriculture has to impact the environment negatively. It reconciles this industry and stewardship to the point where they actually improve each other.
Livelihood Sufficiency and Opportunity: ALUS provides struggling farmers an opportunity to improve their livelihood, but increased compensation amounts are probably necessary to provide the desired level of income.
Intragenerational Equity: In light of the poor performance of the agriculture industry in Long Point, this program aids people with lower incomes.
Intergenerational Equity: ALUS is especially beneficial because not only does it help current economic livelihoods, it is expected to revive the industry in this area, making it more desirable for next generations. The ecological goods and services it protects will also make the environment resilient for future generations.
Resource Maintenance and Efficiency: ALUS encourages maintaining resources, like water and soil, and using them efficiently through compensation.
Socio-ecological Civility and Democratic Governance: Because this is a program by farmers for farmers, it encourages community involvement in decision-making.
Precaution and Adaptation: ALUS takes precaution against current agricultural practices that harm the environment.
Immediate and Long Term Integration: This integration between sustainable livelihoods and stewardship has the potential to be long-term because the anticipated benefits from the pilot program should be very compelling.

6.3.3 The Seville Strategy

Survey Made of Stakeholders' Interests: Stakeholders consulted
Identify Factors Leading to Environmental Degradation: Described as poor agricultural practices
Survey Made of the Natural Products and Services of the Biosphere Reserve: The ecological goods and services described earlier
Incentives Identified for Sustainable use by Local Populations: Financial compensation

Plan Prepared for Equitable Sharing Benefits: Directed at struggling farmers
Local Consultative Framework Implemented: Stakeholders consulted
Co-ordinated Research and Monitoring Plan Implemented: Not yet
Strategies Developed for Mobilizing Funds from Businesses, NGOs and Foundations: Yes
Mechanisms Developed for Monitoring and Assessing the Implementation of the Seville Strategy at Individual Level: Not yet

7.0 Conclusions

Biosphere reserves are able to implement projects that address the specific needs of an area and are based on the framework of sustainability and complex systems. The early stages of this research indicates that the benefits from these three integrated initiatives have more than one mutually reinforcing benefit; they engage for the community, and are, or are likely to be, long lasting. The cases examined here support the conclusions made in complex systems and sustainability theory and the advantages of fulfilling the biosphere reserve mandate seem to outweigh the difficulties in doing so. More time is needed to reveal the outcomes of the Education Network and ALUS program but the preliminary examination indicates that these initiatives are promising. Biosphere reserve initiatives apply sustainability and integration concepts to practical applications and provide significant benefits in multiple areas.

One issue is that the Seville recommendations seem underused in these cases, and although there is no evidence to say that these initiatives would have produced better results, it is suggested that biosphere reserve initiatives do their best to explicitly follow these recommendations by laying out all steps and important considerations. This would ensure that initiative goals and methods are consistent with the biosphere reserve mandate and make it easier to ascertain where improvements can be made. This framework can also make the process of designing biosphere reserve initiatives more efficient because it indicates what the important aspects are and how they need to be addressed.

These trends suggest that a sustainable world is possible and biosphere reserves and their initiatives are practical and effective instruments that not only create resilient ecosystems and sustainable livelihoods, but also challenge the current relationships between society and the environment which cannot be maintained, by encouraging individuals to re-examine their situation in the socio-ecological environment.

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Appendices

Appendix A

Questions regarding the Education Network:
What were the difficulties with this project?
Are you seeing the results you anticipated?
Do you have any general comments about the biosphere reserve project?

Questions regarding the Bruce Trail:
How and why did the trail get started?
What aspects of the biosphere reserve mandate are being integrated here and how?
What are the outcomes of the trail?
What are the practical benefits and drawbacks of it?
Are they mutually reinforcing?
Do you have any general comments about the biosphere reserve project?

Appendix B
Map of Georgian Bay, Niagara Escarpment, and Long Point Biosphere Reserves in Ontario

Google Maps