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**Biosphere Reserves in Canada:
Exploring ideals and experience**

**Guest Editors:
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Research, Monitoring and Education: Exploring the “logistics function” of four Canadian biosphere reserves

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Abstract

Research and monitoring are the fundamental components of the biosphere reserve logistics function, providing information at the local and regional level to move the conservation and sustainable development functions forward. Four Canadian biosphere reserve case examples of logistics activities are examined. Findings confirm that: communities are providing leadership through civil society organization administration of biosphere reserves and their activities; many logistics activities are carried out in the transition area of biosphere reserves where people live, work and interact with the environment; collaborative approaches, with the biosphere reserves providing the neutral forum, are used to develop and implement logistics activities such as monitoring and stewardship; and place is emerging as a framework for information gathering, analysis and reporting. Areas that require attention include: better use of existing research to inform on monitoring design; links between monitoring information and decision making; tracking the “big picture” of research, monitoring and stewardship; extension of proven information sharing activities; and

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promotion of inter-disciplinary and systems research. Biosphere reserves can be viewed as ongoing experiments in sustainability and future tracking and evaluation should provide insights into local and regional sustainability.

La recherche et la surveillance sont les éléments fondamentaux de la fonction logistique de la réserve de biosphère, en procurant de l'information aux niveaux local et régional pour faire avancer les fonctions de conservation et de développement durable. Dans cet article, l'auteur analyse les activités logistiques de quatre modèles de réserves de biosphère canadiennes. Les résultats confirment que les collectivités assurent leur leadership par le biais de l'administration des réserves de biosphère et de leurs activités par un organisme de la société civile; que de nombreuses activités logistiques ont lieu dans la zone de transition des réserves de biosphère où les gens vivent, travaillent et interagissent avec l'environnement; que les approches collaboratives, où les réserves de biosphère constituent une tribune neutre, sont utilisées pour mettre sur pied et implanter des activités logistiques telles que la surveillance et l'intendance; et que la localité est en train de devenir un cadre de travail en matière de cueillette d'information, d'analyse et de signalement. Les champs d'action qui exigent une attention particulière sont les suivants : une meilleure utilisation de la recherche existante pour informer au sujet de l'aménagement de la surveillance; les liens entre l'information tirée de la surveillance et la prise de décision; le suivi de la « vue d'ensemble » de la recherche, la surveillance et l'intendance; la prolongation des activités de partage d'information éprouvées; et la promotion de la recherche interdisciplinaire et de la recherche sur les systèmes. On peut considérer les réserves de biosphère comme des expérimentations continues en matière de durabilité, et les suivis et les analyses ultérieures devraient nous donner un aperçu en matière de durabilité locale et régionale.

Keywords

Biosphere reserves, logistics function, civil society organizations, collaboration, monitoring

Introduction

Biosphere reserves are intended to fulfill three complementary and mutually reinforcing functions: 1) contribute to the conservation of landscapes, ecosystems, species and genetic variation; 2) foster sustainable economic and human development; and 3) provide logistics support for research, monitoring, education and information exchange (UNESCO 2004). Francis (this volume) indicates that research and monitoring are the fundamental components for the logistics function providing “location-specific knowledge of ecosystems, local economies, social organizations and governance. It is this local and regional specificity that provides the knowledge and experience for public information, education and training, and enables biosphere reserves to realize their potentials...”. Civil society¹ organizations (CSOs) play a central role in all Canadian biosphere reserve activities. Funding and staff resources (paid and volunteer) are critical to their success and require constant attention. The logistics function expects biosphere reserve CSOs to seek opportunities to initiate projects and generate the information needed to move the conservation and sustainable development functions forward, and ultimately contribute to the evolution of local and regional governance. Biosphere reserves work with government agencies, the private sector, research and educational institutions, and others to help carry out these functions. This usually entails having to work through a larger and more complicated set of institutional arrangements constituting the governance over the biosphere reserve. These arrangements can both facilitate and frustrate biosphere reserve initiatives. For a discussion of the components and the fluid, dynamic and self-organizing nature of governance, see Pollock (this volume).

This paper explores the logistics function of four biosphere reserves - Long Point, Niagara Escarpment, Mont Saint Hilaire, and Mount Arrowsmith (see Figure 1 in Francis, this volume and Figures 2, 3 and 4 in Dempster, this volume). Case examples exemplify some of the ways biosphere reserves in Canada have gone about fulfilling the logistics function. The case examples were selected for their different governance contexts, organizational structures, geographic location, and length of time functioning as biosphere reserves. Five trends in the logistics function of biosphere reserves were identified by the authors based on observations and experiences:

1. The transition zone of biosphere reserves appears to be emerging as a focus of interest;
2. Communities are providing leadership through biosphere reserve CSOs;

¹ Civil society is described as “the activity of citizens in free association who lack the authority of the State” (Swift, 1999:4) including “the population of organizations trying to change some aspect of society, including government policy, cultural values, corporate practices, and the activities of intergovernmental organizations” (Van Rooy, 1999:9). Swift (1999:5) suggests that “such activities are motivated by objectives other than profit making”.

3. Collaborative approaches are at the core of many biosphere reserve logistics activities;
4. Biosphere reserves are employing innovative fundraising strategies due to meager government support; and
5. "Place" is emerging as a framework for information gathering, analysis and reporting.

These trends were used to explore the logistics function in the context of the four biosphere reserve cases, which are described below.

Biosphere Reserve Case Examples

Long Point World Biosphere Reserve

Long Point is a 32 km sand spit located on the north shore of Lake Erie, in Norfolk County, Ontario. The Long Point complex is a staging area for migrating waterfowl, renowned for superb bass fishing and birding, and is home to the greatest number of endangered, threatened and species of concern in Canada (Craig et al. 2003). The Long Point complex is subject to many environmental stresses including commercial and residential development, forest fragmentation, exotic species invasions, shoreline alterations, nutrient loading and numerous recreational activities (Craig and Francis, 1993).

The biosphere reserve was designated in 1986 as an example of the Great Lakes coastal ecosystem. The Long Point National Wildlife Area is the core and the Big Creek Wildlife Area is the main buffer zone of the Long Point Biosphere Reserve (LPBR). Both constitute a unique blend of habitats – long uninterrupted beaches, undisturbed sand dunes, grassy ridges, wet meadows, woodlands, marshes and ponds, and together form the largest protected area in southern Ontario. The LPBR recently underwent a UNESCO/MAB ten year periodic review process. The review suggested formally extending the biosphere reserve's zone of transition from the base of the Point to the mainland, using watersheds as boundaries. This extension was made to recognize that the majority of the logistics activities were focused on the mainland.

The biosphere reserve is administered by the Long Point World Biosphere Reserve Foundation (LPWBRF). The Foundation secures resources from various sources including government, private sector, foundations, and from the community through an annual groundhog day dinner and other innovative approaches such as sponsored adventure activities. The management of the Long Point area is complex with some 19 government agencies administering 22 government policy and planning documents. In addition to the LPWBRF, there are also more than 30 related CSOs participating in Long Point governance (Francis, et al, 1985).

Monitoring activities carried out by the LPWBRF include: the establishment and ongoing monitoring of four SI/MAB Forest Biodiversity Monitoring Plots (Tomlinson, 1997) and salamander monitoring (Wilson et al, 1997). Since designation of the LPWBR, the need for a comprehensive state of the environment (SOE) report has been acknowledged, but inhibited by a lack of

capacity.² The UNESCO ten year periodic review raised the issue again and, in response, the LPWBRF identified monitoring as the main focus in its Biosphere Reserve Cooperation Plan (LPWBRF, 2002). The monitoring envisioned would be organized around a "place based" framework that would specifically contribute data necessary to produce periodic Long Point SOE reports. Currently, much research and monitoring in the Long Point area is conducted by government agencies at the federal, provincial, regional, and municipal level, and by CSOs. A survey commissioned by the LPWBRF in cooperation with the Ontario Ministry of the Environment identified 55 predominantly biotic, monitoring programs administered by four federal, four provincial, two municipal, six CSOs, three universities and one local industry association (LPWBRF, 1996). The data and information generated from these monitoring programs is collected for specific purposes relating to the mandates of each agency and organization, and is not readily accessible or usable for SOE reporting because there is no "place based" framework to guide collection, analysis and reporting.

The Foundation and local ecosystem researchers and monitoring specialists have realized that the only possible means of producing an SOE report is to form a partnership. The LPWBRF took the lead in organizing a series of workshops to ascertain the commitment of the relevant government agencies and CSOs in the biosphere reserve to establish a community-based monitoring initiative, share data, and contribute resources to enable effective SOE reporting that is linked to local decision making.³ Fourteen local ecosystem monitoring specialists, local municipal support staff, and stewardship volunteers, representing 10 federal, provincial, and municipal agencies, industry and CSOs were assembled based on a collaborative process to share their experiences and needs with respect to ecosystem monitoring and reporting.

The group reached consensus that a comprehensive, integrated, coordinated, community-based ecosystem monitoring and reporting initiative for the biosphere reserve and Norfolk County was desirable and all offered to serve on an advisory committee (LPWBRF, 2002). Two subsequent meetings were held to identify gaps in present ecosystem monitoring, discuss appropriate monitoring frameworks, and develop a strategy for securing sufficient resources. The LPWBRF supplied funds to complete a comprehensive proposal for use in securing private, foundation and government funding for the initiative. Although a challenge for a volunteer organization, the LPWBRF is optimistic that financial and in-kind resources can be raised in support of

² Recent progress has been made. The Haldimand-Norfolk Health Unit published a state of the environment report on air quality (Tucker, 2003) utilizing a comprehensive data set acquired over a period of 30 years by the Nanticoke Environmental Committee. The Long Point Region Conservation Authority is also completing a state of the environment report for one of the smaller watersheds in the LPWBR.

³ For the purposes of the Long Point initiative, community-based monitoring was defined as "a process where concerned citizens, government agencies, industry, academia, community groups and local institutions collaborate to monitor, track, and respond to issues of common community concern" (Canadian Community Monitoring Network, 2004).

Long Point community-based monitoring. The effort will involve designing a monitoring program that builds on existing information, for example, the Long Point Folio (Nelson and Wilcox, 1996) and existing monitoring programs (LPWBRF, 1996), and that ensures compatibility with existing planning and management processes. The objective is a monitoring program that contributes to decision making through SOE reporting and enhanced understanding of "place." Information sharing and communication will be made a priority involving the broader community once funding has been secured to further develop, implement and carry forward the initiative. A positive aspect of the entire effort has been the participation of Norfolk County. The County has taken the lead on a visioning exercise that describes the community's sustainability vision and valued ecosystem components (Norfolk County, 2003). There are also efforts to embed a comprehensive adaptive ecological monitoring program into the Official Plan that will lead to timely reporting on ecosystem status and trends for informed decision making in the biosphere reserve.

The LPWBRF has focused much of its logistics work on the transition zone (monitoring and stewardship); provides community leadership (especially in the area of monitoring); provides collaborative opportunities through "neutral forums" for the areas organizations and agencies to discuss issues; and has pursued innovative funding through partnerships and community events. The biosphere reserve has also made efforts to collect, analyse and report information through the Leading Edge Conference Series (Niagara Escarpment Commission, 2004), the local newspaper and the biosphere web site. The biosphere reserve is also working toward a "big picture" tracking system and clearing house role to facilitate information sharing (Long Point World Biosphere Reserve Foundation, 2004).

Niagara Escarpment Biosphere Reserve

The Niagara Escarpment Biosphere Reserve (NEBR) includes the area covered by the Niagara Escarpment Plan (NEP), extending some 725 km across southwestern Ontario, from the Niagara River in the south through the Bruce Peninsula in the north. The Escarpment also occurs on Manitoulin Island and in the United States, the entire area now known as the Great Arc, however, these areas are not part of the biosphere reserve (Nelson and Porter, 2002). The Escarpment has developed through differential erosion at the contact zone of resistant dolostone units and recessive shales. In places, it is partially or completely buried by glacial deposits. The landscapes in these areas are usually rolling to hummocky (Chapman and Putnam, 1984; Tovell, 1992).

The abiotic environment creates habitats conducive to high biodiversity levels. Some of the larger tracts of deciduous forest left in southern Ontario occur in the NEBR. These tracts are habitat to many forest-interior wildlife species. A high number of fern species occur on the Escarpment due to unique micro-environments with high moisture levels and calcareous soils (Eaton, 1991; Maher and Kirk, 1996). The escarpment cliffs also support the most significant old growth forest in eastern North America (Larson et al., 1989). More recently, urbanization and resource extraction have had significant impacts on the Escarpment landscape (Whitelaw and Hamilton, 2004).

After extensive public pressure for the protection of the Escarpment, the government passed the Niagara Escarpment Planning and Development Act (NEPDA) in 1973. The purpose of the Act is to maintain the Niagara Escarpment as a continuous natural environment and to ensure compatible development. Objectives address protection and maintenance of the Escarpment's ecology, water, and open landscape character, along with adequate public access. The NEPDA also established the Niagara Escarpment Commission (NEC), a 17 member body including public-at-large and municipal members. In 1973, the Commission assumed land use planning responsibilities from municipalities with lands in the NEP area. The Bruce Peninsula National Park (BPNP) and Fathom Five National Marine Park were established in 1987. The BPNP includes much of the land base of the northern Bruce Peninsula. The Niagara Escarpment was designated a biosphere reserve in 1990 with the NEC assuming administrative responsibilities. The core areas of the reserve include all parks and lands designated as Escarpment Natural in the NEP. The Bruce Peninsula Biosphere Association, a community lead CSO, has recently emerged to assist the NEC with biosphere reserve activities. The Association was established in 2000 and became the first community committee to work solely on NEBR activities. The focus of their efforts is on protection of the community's physical and social environments, and learning from traditional forms of land use. The objective is to improve land management, reduce conflict, and increase local capacity for conservation and development (Reaney, 2001).

Since designation, the NEC and Parks Canada have experienced budgetary cuts. However, both agencies have pressed forward with monitoring initiatives. The BPNP has established a comprehensive Ecological Integrity Monitoring Program (Zorn and Upton, 1997) and the NEC has designed and started to implement the Ontario Niagara Escarpment (ONE) Monitoring Program (Niagara Escarpment Commission, 2004). The ONE Monitoring Program was launched in response to a government-identified need to assess plan effectiveness and to fulfill biosphere reserve logistics responsibilities. Five design principles guided the Program's development: utilize an ecosystem approach; ensure compatibility with existing planning mechanisms; utilize a participatory process; engage a multi-disciplinary team; and utilize existing monitoring and baseline information where possible (Whitelaw et al., 1995). A collaborative process involving a Monitoring Advisory Committee with representatives from various sectors (agriculture, environment, resource extraction, municipal) was employed. The program has been underfunded, however, staff at the NEC have managed to implement portions of it through partnerships with academic institutions, community groups, government agencies and the private sector (Niagara Escarpment Hearing Office, 2001; Whitelaw and Hamilton, 2004; Hounsell, 2001).

The NEC has also put considerable effort into information sharing activities. The Leading Edge Conference Series was established to provide a forum for researchers, policy makers, academics, consultants, CSOs and the public to share their work on the Niagara Escarpment, network and celebrate the Biosphere reserve. A collaborative approach is used to design and organize Leading Edge conferences. The themes for the five conferences from 1994 through 2004 have all dealt with biosphere reserve issues such as con-

ervation, stewardship, monitoring, community and culture (Niagara Escarpment Commission, 2004). A review of the concurrent sessions of the Leading Edge Conferences provides an indication of the areas of interest to researchers, planners, CSOs and the public. Monitoring appears to have gained in popularity as a topic of research. Earlier conferences appear to have received more papers on geology, however, every conference has had at least one paper on this topic. The most popular themes in all years have been environmental planning and sustainability. Tourism, parks, birds, anthropology, archaeology and the cliffs of the Niagara Escarpment are also popular research themes.

The Commission has moved to a web format for publishing the proceedings including all concurrent sessions. The website also contains information on the biosphere reserve, Niagara Escarpment planning process, the ONE Monitoring Program, and key publications. It links to a metadata base administered by Environment Canada's Ecological Monitoring and Assessment Network's Coordinating Office that contains information on Niagara Escarpment monitoring and research activities (Ecological Monitoring and Assessment Network, 2004).

In summary, the transition zone comprising the agricultural and rural areas of the NEP has received some attention e.g. ecological restoration activities. However, the NEBR ten year periodic review suggestion that the transition zone be extended "to related watersheds and to the Upper Bruce Peninsula" has yet to materialize. Community leadership is evident through the activities of the Bruce Peninsula Biosphere Association. Unfortunately, no efforts are ongoing by the NEC to facilitate establishment of similar groups in other areas of the Escarpment. Collaborative approaches are common to Niagara Escarpment logistics activities e.g. ONE Monitoring Program and the Leading Edge Conference Series, and the NEC has managed to raise funds for biosphere reserve activities even in times of budget cuts. The NEC has also pursued information collection, gathering and reporting (Leading Edge Conferences, Web Site) but has yet to establish a comprehensive "big picture" tracking system.

Mount Arrowsmith

The Mount Arrowsmith Biosphere Reserve (MABR) is located on the southeast side of Vancouver Island in British Columbia, Canada, just north of Nanaimo. The reserve was designated in 2000 and includes the City of Parksville, Town of Qualicum Beach, portions of the District of Nanaimo; five substantial watersheds that drain Mount Arrowsmith and Mt. Moriarty; the Nanoose Peninsula; and the Ballenas/Winchelsea Island Archipelago. The reserve includes about 800 square km of land and 400 square km of marine area.

The core area of the biosphere reserve includes six provincial parks, the Parksville/Qualicum Beach Wildlife Management Area and two components of the Qualicum National Wildlife Area. Most of the reserve land is managed for forestry (about 70%) and is in private ownership (about 99%) as a result of the Esquimalt and Nanaimo Railway Company Land Grant in 1871. The Reserve is administered by the Mount Arrowsmith Biosphere Foundation (MABF 2004) which was formed in 1996 to seek biosphere reserve designa-

tion and to form the subsequent biosphere reserve management committee. The Committee is made up of both interested community residents, and local elected, First Nation and forest industry representatives (MABF 2004).

The biosphere reserve has not to date received any government funding. Logistics efforts have thus focused on three areas: 1) implementation of initiatives to increase awareness and support among the general public and corporations, such as obtaining charitable tax status; 2) soliciting funds on a project by project basis from corporations and foundations for conservation and achievement of sustainable development; and 3) development of new imaginative initiatives that may over the long-term provide a source of ongoing funding. Three examples of logistics activities, illustrating different aspects of these areas, are discussed below.

The first is focused on increasing public awareness about conservation and sustainability issues. For example, while the MABR is located in one of the wetter parts of Canada on an annual basis, most of the rain falls in the winter, and the area typically experiences a two to four month summer drought. Water demands and changing water flow patterns from the short (29-54 km) watersheds arising from urbanization are now exacerbating drought-related stresses experienced by even drought-tolerant local species. Human-induced world-wide climate change will likely make the summer drought longer. The relatively mild winter climate is attracting people to the area. The combined result has been a stress increase on many species, particularly on those least drought tolerant such as red cedar (*Thuja plicata*) and fish. To increase public awareness of the nature of the summer drought, its causes and the stress on species, a three-part television series, titled "Liquid Assets", on water issues in the MABR is being produced. Two parts have been completed.

The second initiative was the creation of the Oceanside Monetary Foundation (OMF), a registered provincial society that produces and distributes Oceanside dollars. The objective was to develop a world-class "community currency" exchangeable at par with the Canadian dollar that would over time be increasingly used locally. Each issue of Oceanside dollars has an expiry date about one year after its date of issue, after which the bills lose monetary value. The first issue expired on October 31, 2004, and consisted of \$1, \$2, \$5, \$10 and \$20 bills. Funds will be realised by the foundation from three primary sources: 1) bills that are purchased as collectable mint sets at a value higher than their face value; 2) bills in circulation that were not redeemed by that issue's expiry date; and 3) interest earned from the Canadian dollar reserve that is held until issue expiry in registered financial institutions (the reserve equals the face value in circulation of an issue). Benefits to business through acceptance of Oceanside dollars are reduced credit card fees, and advertising of the Oceanside area. Their cost is in the handling of a different currency and the need to take Oceanside dollars to financial institutions to redeem them for Canadian dollars. The benefit to the general public is increased community pride and awareness, and profits will fund activities that benefit the community overall (Jamieson, 2004).

The third activity is an attempt to develop a world-class nature interpretation facility in the biosphere reserve. Apart from the Royal BC Museum, situated in downtown Victoria about 100 km south-east, there are presently

no world-class environmental interpretative centres on Vancouver Island. To increase awareness of regional environmental attributes, MABF personnel approached local elected bodies and environmental groups and proposed the building of a world-class nature interpretative centre in the MABR. The mission developed was to “reduce human impacts on the natural environment in Central Vancouver Island”, and the goal was “to interpret, exhibit, explore, and celebrate Vancouver Island and the Mount Arrowsmith Biosphere Reserve, in order to encourage a better appreciation and understanding about the relationship between people and Vancouver Island ecosystems.” The proposed centre would: directly, or indirectly, assist in local fund-raising for the appropriate management of existing protected areas in the MABR; provide facilities to promote regional environmental awareness and knowledge; provide significant local economic growth through direct and indirect employment; increase local community pride and confidence; and demonstrate to other communities, and biosphere reserves world-wide, that through imaginative action and hard work, renewable resource conservation and economic development can go hand in hand. Concept evaluation studies to date have been positive, and the broader community is now being approached in an effort to establish a more formal, structured Vancouver Island Biosphere Centre Steering Committee (Jamieson, 2004).

Despite the MABR's recent designation, significant progress on logistics activities is being achieved. Both the Oceanside dollar initiative and interpretive centre proposal are community led and have required development of partnerships and buy-in from the community. The reserve has developed information sharing initiatives, such as the video series “Liquid Assets”, and has recently agreed to participate in an international effort to monitor climate change and its implications in mountain biosphere reserves.

Mont Saint-Hilaire

The Mont St. Hilaire Biosphere Reserve (MSHBR) was the first created in Canada. It is situated 30 km east of Montréal in the Monteregian Hills and includes the Gault Nature Reserve (GNR). Belonging to McGill University, this is a 1000 ha property that now also enjoys protection under a provincial law governing conservation of private lands. The GNR occupies the upper elevations of Mont St. Hilaire, one of the Monteregian Hills that originated in the Cretaceous era as a plutonic intrusion into the local sedimentary bedrock. The core reserve protects one of the largest remaining remnants of the primeval forests of the mixed plain ecoregion. In 1960, soon after its acquisition by the university, this property was designated a migratory bird refuge under the Migratory Convention Act of Canada, and that protection has recently been reinforced significantly under Quebec's Natural Heritage Conservation Act. Three organizations contribute to the MSHBR logistics function – McGill University, the Centre de la Nature du Mont Saint-Hilaire, and the Perimeter Committee (a collaborative group made up of representatives from the town council, urban planners, agricultural producers, the Nature Centre and University that deal with issues in the transition zone). The Nature Centre is the primary group playing a role in the transition area through regional conservation and promoting the concept of the biosphere reserve. The Nature Centre has emerged as a leader in establishing discussion, collaboration and sharing

of information among the diverse actors influencing conservation policy in the region. The Centre is financed primarily by entrance (parking) and membership fees.

Four logistics activities are described. The first is research that dates from 1859. Today over 400 scientific articles, 125 graduate theses, more than 50 government reports and about 30 book chapters have been written based on research at Mont St. Hilaire. McGill University has made great use of the reserve for research and teaching, while also supporting public access to this exceptional site. The reserve now has over 150 000 visitors annually. A team of McGill researchers carried out a comprehensive inventory and mapping of plant biodiversity in the reserve to test fundamental ideas in community ecology, particularly the conflict between neutral theory and niche theory in explaining species diversity in plant communities (Bell 2003; Gilbert and Lechowicz, 2004). While such investigations have important scientific value in their own right and may lead to new paradigms and strategies for conservation, the data collected in the studies have also proved immediately useful for biosphere reserve managers. Their detailed surveys of the distribution of plant species provided compelling evidence for the status of endangered species in the reserve. Research by Bol (2003) and Ouellet *et al.* (2000) gave similarly detailed inventories of reptile and amphibian populations in the reserve, identifying the rare species and mapping ephemeral ponds critical for breeding. These studies revealed that two species known from the reserve 35 years ago are now lost, raising questions about land use change around the reserve. Similar work has been done, or is being done, on bird and invertebrate diversity, including spiders, butterflies, ants, flies and coleopterans.

These data were put in a spatial context using geographic information systems (GIS). With this tool, the biosphere reserve managers were able to make the exceptional ecological value of the reserve come alive for the public, shifting discussions from fussy statistical tables to maps that everyone could understand immediately. This had an important impact on regional conservation and land management. Two messages came through very clearly to the general public and to local governments: the reserve is exceptionally important for regional biodiversity and that forest corridors spread out from the reserve toward other Monteregian Hills in the region. As these ideas and the ecological concepts related to them were communicated by the Nature Centre, regional managers started to think in terms of conservation corridors and landscape connectivity. The maps have clearly shown the importance of the core of the reserve as a biodiversity refuge, and have encouraged discussion of a variety of other conservation initiatives such as land acquisition, stewardship, and green urban planning.

The second logistics activity deals with monitoring, which is essential for gauging the ecological integrity of the core reserve. Monitoring networks in the reserve also can be part of experimental designs for tracking larger scale events such as the spread of exotic species and the impacts of climate change. The MSHBR has worked with the university to establish several long term monitoring stations in the GNR, mostly associated with vegetation. The original two SIMAB plots were installed in 1996, and proved invaluable in documenting the impact of the 1998 Ice Storm (Duguay *et al.* 2001). Subsequently eight other biodiversity plots were established and equipped with

weather stations that continuously monitor the forest microclimate. Another 244 permanent forest monitoring plots have been surveyed and will be used to track forest dynamics. Recently, eight water quality stations were installed along streams, four within the reserve and four downstream on the settled landscape outside the reserve; these include monitoring of aquatic macroinvertebrates. In the future, the GNR would like to initiate a regular monitoring program for vertebrate populations as well, particularly mammals and birds. As records accumulate from these monitoring programs there will be an ever increasing potential for public education and for raising awareness of environmental change.

The third activity deals with suburban development in the transition area. The transition zone has significant natural diversity but is under suburban development pressure. The pressure on natural areas near the core reserve is increasing as a result of housing development and land use change for agriculture. In fall 2002, the municipality of Mont-Saint-Hilaire, aware of conflict between conservation and development, created the Perimeter Committee to address a recommendation to the town on how to best protect habitat on the periphery of the core reserve through collaboration. The committee reviewed provincial and municipal laws and regulations, met experts in a variety of related fields, organized a public consultation, evaluated the ecological value of the surrounding ecosystem and finally, tabled a set of specific recommendations. Based on the committee's recommendations, in March 2004, the town of Mont St. Hilaire passed a set of municipal regulations to maximize the protection of the perimeter and its biodiversity (VMSH 2004).

The Nature Centre and the university played lead roles in making this possible. The Nature Center drew data from earlier university research but augmented it by contracting additional surveys off the reserve to identify potential forest corridors, the presence of exceptional forest ecosystems and rare plants in the perimeter zone. The university secured an extremely precise topographic survey of the reserve and its surroundings using LIDAR technology, and created a digital elevation model from which local hydrological and biogeochemical flows could be predicted (cf. Fowler 2000). The integration of all this biological, ecological, geophysical and land zoning data let the municipality create an urban plan with better protection and conservation of the forest ecosystems in the perimeter of the reserve.

The fourth activity is focused on apple production, in which the region has a long history. As the biosphere reserve has slowly passed from an entirely rural area to a suburban edge of greater Montréal, developers have speculated on agricultural land and orchard owners are under pressure to sell. The biosphere reserve is keen to preserve these orchards around the reserve, for both conservation and patrimonial reasons. Three studies were produced by students under the direction of Dr. Steve Maguire: 1) the Mont Saint Hilaire Apple Orchard Project – an Opportunity Assessment (Foster and Mehta 2002); 2) a Strategic Plan for the Orchards (Schwartz 2003a); and 3) a Marketing Plan for the Orchards (Schwartz 2003b). The students were able to identify problems that the growers were facing, the risks to their enterprises, and their potential for opening new markets. In the end they suggested concrete solutions to help resolve the often precarious financial situations of the orchards.

The MSHBR benefits from the presence and the active use of the reserve by McGill University. While the university concentrates on its research and teaching missions, the Nature Center uses the knowledge created by university activities to further the conservation of the core reserve and contribute to sustainability of the transition zone. The Centre is also employing an innovative funding strategy through fees for access and membership. While some of the university research goals have no immediate relevance to biosphere reserve management, the data, knowledge and scientific expertise inherent in university involvement have proved useful in pursuing its objectives. The biosphere reserve has successfully utilized research with the assistance of new information management technologies (GIS) in the transition zone. The spatial and visual integration of information has been an especially important element in promoting sustainable development. The biosphere reserve is providing community leadership through both the Nature Centre and the Perimeter Committee and employing collaborative processes. Long term monitoring, which depends on university expertise, has just begun but shows real potential for use by managers. The biosphere reserve is providing an effective framework to organize and integrate monitoring data and information. The role of tracking the “big picture” of research, monitoring and stewardship has been ongoing and will become more useful as long term monitoring develops.

Observations, directions to pursue and future research

The case examples discussed indicate that CSOs are at the core of logistics activities, for example, LPWBRF, Bruce Peninsula Biosphere Association, MABRF and the Centre de la Nature du Mont Saint-Hilaire. These groups are providing community leadership on issues which governments may be neglecting or approaching in a fragmented way, for example, Long Point monitoring coordination; Bruce Peninsula community well-being; Mount Arrowsmith local sustainable economic development; MSHBR land use conservation. The collaborative approach is also at the core of many biosphere reserve logistics activities, for example, ONE Monitoring Program; the Long Point SOE and monitoring initiative; MABR Oceanside dollars; and MSHBR Perimeter Committee.

Many of the logistics activities described are taking place in the transition zone where people live, work and interact with the environment. The emerging focus on the transition zone is appropriate as most core areas in biosphere reserves are managed by government agencies. Biosphere reserves appear equipped to carry out work in the transition zone based on their successful use of collaborative approaches. The focus on the transition zone is also encouraging inter-disciplinary studies in some biosphere reserves, however most research remains disciplinary in nature.

Research and monitoring capacity differs among the four cases, but all are pursuing integrated monitoring. Information sharing is an important activity for all reserves (videos, web sites, conferences, GIS formats, etc.), although biosphere reserves are still rather weak in linkages and networks that could relate biosphere reserve functions throughout the biosphere and foster the communications needed to maintain a “big picture” overview of conservation and sustainability matters of interest (Francis and Whitelaw, 2002).

Lerner (this volume) challenges the Canadian Biosphere Reserves Association to play a leading role here and to assist in developing a “learning-network capability” where the CBRA website would “evolve into a self-sufficient, CBRA-managed information and learning site which could provide for the exchange of community-development success stories not only among Canadian biosphere reserves but from biosphere reserves and other locales worldwide.” Furthermore, software development is occurring specifically to service the needs of community based information management using open system standards that will allow CSOs to maintain and report on their own information through the web without the need of experts (McGary, pers. com. 2004).

The lack of government funding appears to be driving biosphere reserve entrepreneurialism. Biosphere reserves have pursued project and partnership funding from foundations, government and the private sector, along with innovative resource securement strategies, such as sponsorship of adventure activities, fundraising dinners, and dedicated parking fees. The CBRA is also working to secure long term support from the Federal government. Should the Association succeed, the biosphere reserve program in Canada will receive a substantial boost.

Final thoughts

Biosphere reserves can be viewed as ongoing experiments in sustainability. The increasing role of civil society in biosphere reserve administration and logistics is noteworthy. Civil society organizations appear to be making gains through their ability to collect, evaluate and share “place based” information, and to provide neutral forums for collaboration that may promote sustainability. The four reserves discussed in this paper are appropriately institutionalized, that is, have access to various decision-making processes that allow each to influence local governance. Furthermore, biosphere reserves are in the business of building trust, improving information flows and networking, and as such are sources of social capital. This helps explain the success biosphere reserves have been able to achieve despite poor funding.

A number of areas do require attention including: better use of existing research to inform monitoring design; links between monitoring data and information and decision-making; tracking the “big picture” of research, monitoring and stewardship; extension of proven information sharing activities like the Niagara Escarpment Leading Edge Conference series to other biosphere reserves; and promotion of inter-disciplinary and systems research. The Biosphere Reserve Program in Canada is evolving rapidly with new reserves receiving designation and capacity developing nationally to facilitate individual biosphere reserves. Future tracking and evaluation of biosphere reserve progress through their logistics activities should provide insights into how communities and local, provincial and National governments can steer governance in support of sustainability.

References

- Bell, G. 2003. The Interpretation of Biological Surveys. *Proceedings of the Royal Society of London, Series B-Biological sciences* 270(1533): 2531-2542.
- Bol, Leslie D. 2003. *Amphibian Recruitment Success at a Landscape Scale*. McGill Thesis, Biology Department.
- Canadian Community Monitoring Network, Environment Canada. <http://www.ccmn.ca> [Accessed in August 2004].
- Chapman, L. J. and D.F. Putnam. 1984. *The Physiography of Southern Ontario*, 3rd Ed. Ontario Geological Survey, Ontario Geological Survey Special Volume. 2.
- Craig, B. and G. Francis: 1993, *Long Point Ecosystem Stresses*, Department of Environment and Resource Studies, University of Waterloo, unpublished.
- Craig, B., G. Whitelaw, J. Robinson, and P. Jongerden, 2003. Community-Based Ecosystem Monitoring: A Tool for Developing and Promoting Ecosystem-Based Management and Decision Making in the Long Point World Biosphere Reserve, In: *Making Ecosystem Based Management Work: Connecting Managers and Researchers*, N.W.P. Munro, P. Dearden, T.B. Herman and S. Bondrup-Nielson, eds. Proceedings of the Fifth Science and Management of Protected Areas Association Conference, May 11-16, 2003. Victoria, Canada: SAMPAA.
- Duguay, S., K. Arie, M. Hooper and M.J. Lechowicz. 2001. Monitoring the Impact of a Major Ice Storm on an Old-growth Forest. *Environmental Monitoring and Assessment* 67: 97-108.
- Eaton, K.D. 1991. Ferns. In: *Guide to the Natural History of the Niagara Region*, J.C. Lewis, ed. Welland Printing Company Limited, Welland, Ontario. pp. 381-386.
- Ecological Monitoring and Assessment Network. 2004. *Terrestrial Vegetation Monitoring Protocols*. <http://www.eman-rese.ca/eman/ecotools/protocols/terrestrial/> [Accessed in August 2004].
- Ecological Monitoring and Assessment Network. 2004. *EMAN's Global Ecological Data Library Search*. <http://metadata.cciw.ca> [Accessed in October 2004].
- Foster, D. and A. Mehta. 2002. *Mount Saint Hilaire Apple Orchard Project, Opportunity Assessment*. Undergraduate thesis, McGill University.
- Fowler, R. A. 2000. The Low Down on LIDAR. *Earth Observation Magazine*. Volume 9 (3).
- Francis G. and G. Whitelaw. 2002. *Niagara Escarpment Biosphere Reserve Periodic Review*, Canadian Biosphere Reserves Association, Reviewers on Behalf of the Canadian Commission for UNESCO and Canada/MAB, Unpublished.
- Francis, G.R., A.P. Grima, H.A. Regier, and T.H. Whillans. 1985. *A Prospectus for the Management of the Long Point Ecosystem*. Ann Arbor, Michigan: Great Lakes Fishery Commission. Technical Report 43.
- Gagnon, P., M. Brock and S. Hounsell. 2004. Long Point World Biosphere Reserve Foundation Forest Corridor Project: An Effective Means of Ensuring Biodiversity Conservation, *Leading Edge: The Working Biosphere*, March 3-5, St. Catharines, Ontario.

- Gilbert, B., and M.J. Lechowicz. 2004. Neutrality, Niches, and Dispersal in a Temperate Forest Understory. *PNAS* 101: 7651-7656.
- Hounsell, S. 2001. Ontario Power Generation's Carbon Sequestration and Biodiversity Monitoring Program – Working With Nature to Mitigate Greenhouse Gas Emissions, In: *Leading Edge 2001*. http://www.escarpment.org/leading_edge/LE01/index-le01.htm [Accessed in October 2004].
- Jamieson, G. 2004. Efforts to fund and empower local communities in conservation of existing protected areas: examples from Mount Arrowsmith Biosphere Reserve, British Columbia. In: *Making Ecosystem Based Management Work: Connecting Managers and Researchers*, N. Munro, P. Dearden, T. Herman, K. Beazley, S. Boddrup-Nielsen, eds. Proceedings of the Fifth Conference on the Science and Management of Protected Areas, University of Victoria, Victoria, British Columbia.
- Larson, D.W., S. Spring, U. Mattes-Sears and R.M. Bartlett. 1989. Organization of the Niagara Escarpment Cliff Community. *Canadian Journal of Botany* 67:2731-2742.
- Lechowicz, M.J. 1987. Mont St. Hilaire, Montréal's Scientific Reserve. *Collection Forum* 3: 23-24.
- Long Point World Biosphere Reserve Foundation. 1996. *Monitoring at Long Point, Ontario*. Port Rowan, Ontario, Canada.
- Long Point World Biosphere Reserve Foundation. 2002. *Long Point Cooperation Plan to Establish Comprehensive Community Environmental Monitoring and Reporting Mechanisms*. Port Rowan, Ontario, Canada.
- Long Point World Biosphere Reserve Foundation. 2004. *Long Point World Biosphere Reserve Foundation Director's Retreat*, October 20-30, Simcoe, Ontario.
- Maher, N. and M. Kirk. 1996. Ferns and Rare Wild Flora. In: *Leading Edge '95 Conference Proceedings*, Ministry of Environment and Energy, Niagara Escarpment Commission and Ontario Heritage Foundation, Toronto, Ontario. pp. 79-81.
- Maycock, P.F. 1961. Botanical studies on Mont St-Hilaire, Rouville Co. Quebec. I - General description of the area and a floristic survey. *Canadian Journal of Botany* 39 : 1293-1325.
- McGill University. 2004. <http://www.mcgill.ca/gault/> [Accessed in October 2004].
- Mount Arrowsmith Biosphere Reserve Foundation. 2004. <http://www.mountarrowsmithbiosphere.ca> [Accessed in October 2004].
- Nelson, J.G. and J. Porter, eds. 2002. *Building the Great Arc: An International Heritage Corridor in the Great Lakes Region*. Heritage Resources Centre, Occasional Paper 29, University of Waterloo, Waterloo, Ontario.
- Nelson, J.G. and K. Wilcox. 1996. *Long Point Folio*, Heritage Resources Centre, University of Waterloo, Waterloo, Ontario. <http://www.kwic.com/~longpointbio/folio/content/content.htm> [Accessed in October 2004].
- Niagara Escarpment Commission. 2004. *Leading Edge Conference Series Proceedings*. http://www.escarpment.org/leading_edge/leadingedge.htm [Accessed in October 2004].
- Niagara Escarpment Commission. 2004. *Ontario Niagara Escarpment Monitoring Program*. <http://www.escarpment.org/monitoring/onemonitoring.htm> [Accessed in October 2004].

- Niagara Escarpment Hearing Office. 2001. Niagara Escarpment Plan Five Year Review Report of the Hearing Officer. http://www.ert.gov.on.ca/HO/ho_NEPR.htm [Accessed in October 2004].
- Norfolk County. 2003. *Norfolk County 2020* Simcoe, Ontario.
- Ouellet, M., I. Mikaelian, B. Pauli, J. Rodrigue, and D.M. Green. 2000. *Amphibian diseases: Old pathogens rediscovered*. Presented at the 80th Annual Meeting American Society of Ichthyologists and Herpetologists. Autonomous University of Baja, California, June 2000.
- Reaney, C. 2001. Advisory Committee of the Niagara Escarpment Biosphere Reserve, In: *Biosphere Reserves in Canada Newsletter*, J. Birtch, ed. No.13, March.
- Schwartz, A. 2003a. *Strategic Plan, Mont Saint-Hilaire Apple Growers Association*. McGill University, Faculty of Management.
- Schwartz, A. 2003b. *Marketing Plan, Mont Saint-Hilaire Apple Growers Association*. McGill University, Faculty of Management.
- Swift, J. 1999. *Civil Society in Question*, Between the Lines, Toronto.
- Tomlinson, L. 1997. The Analysis of Baseline Data Collected in the Long Point World Biosphere Reserve's Biomonitoring Plots, In: *Leading Edge 97 The Edge and the Point Niagara Escarpment and Long Point*, S. Carty, R. Murzin, S. Powell and D. Ramsay, eds. Conference Proceedings, October 16-18, 1987, Burlington, Ontario.
- Tovell, W.M. 1992. *Guide to the Geology of the Niagara Escarpment*, Niagara Escarpment Commission, Georgetown, Ontario.
- Tucker, W. 2003. *Haldimand and Norfolk State of the Environment Report - Part 1 - Air Quality*. Haldimand-Norfolk Health Unit, Simcoe, Ontario.
- United Nations Educational Scientific and Cultural Organization. 2004. *The Seville Strategy for Biosphere Reserves*. <http://www.unesco.org/mab/docs/stry-1.htm> [Accessed in October 2004].
- Van Rooy, A. 1999. Why civil society? In *Civil Society and Global Change, Canadian Development Report*, Van Rooy, A., ed. Ottawa: The North South Institute.
- Van Wieren, J. 2003. *Long Point World Biosphere Reserve Plethodon cinereus Monitoring Program: Data Analysis*. University of Waterloo, 2003. Unpublished Undergraduate Thesis.
- VMSH (Ville de Mont-Saint-Hilaire). 2004. *Rapport sur la protection et la mise en valeur du périmètre de la montagne*. http://www.ville.mont-saint-hilaire.qc.ca/vie_muni/p%20E9rim%20E8tre.htm [Accessed in October 2004].
- Wilson N., S. Vanbeers, J. Morse, J. Petefi and M. Koteles. 1997. Determining and Testing Amphibian Monitoring Protocol For Smithsonian Institution/Monitoring and Assessment of Biodiversity (SI/MAB) Forest Biodiversity Monitoring Plots, In *Leading Edge 97 The Edge and the Point Niagara Escarpment and Long Point*, S. Carty, R. Murzin, S. Powell and D. Ramsay, eds. Conference proceedings, October 16-18, 1987, Burlington, Ontario.
- Whitelaw, G., D. Neufeld and S. Carty. 1994. The Design of a Monitoring System for the Niagara Escarpment, Ecosystem Monitoring and Protected Areas, In: *Proceedings of the Second International Conference on Science and the Management of Protected Areas*, T.B. Herman, S. Bondrup-Nielson, J.H. Martin Willison and N.P. Munro, eds. Dalhousie University, Halifax, Canada, 16-20 May 1994.

- Whitelaw, G. and J. Hamilton. 2004. Evolution of Niagara Escarpment Governance : Making Ecosystem Based Management Work, In: *Connecting Managers and Researchers*, N. Munro, P. Dearden, T. Herman, K. Beazley, S. Boddrup-Nielson, eds. Proceedings of the Fifth Conference on the Management and Science of Protected Areas, University of Victoria, Victoria, British Columbia.
- Zorn, P. and D. Upton, 1997. Ecological Integrity Monitoring Plan, Part 1: Ecological Indicators, Parks Canada, Bruce Peninsula National Park, Tobermory, Ontario.
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