

Learning About Biodiversity:

*A First Look at the Theory and Practice of Biodiversity
Education, Awareness and Training in Canada*



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Minister's Forward :

Our ability to conserve biodiversity and sustainably use our biological resources is at the heart of our ability to achieve sustainable development. Yet, until Canada signed the Convention on Biological Diversity at the Earth Summit in 1992, many of us had not encountered the word biodiversity. Although most Canadians have an instinctive appreciation of nature, its importance to our current and future well-being and to our identity as Canadians, many will respond with quizzical looks when asked to define biodiversity. Fewer still will be able to describe the role that they can play in its conservation.

It is the people closest to biodiversity who perhaps have the greatest role to play in its conservation. That is why education, training and awareness raising is so important. Unfortunately, the role of this kind of education has often been undervalued, with little recognition of education as a key tool for changing behavior.

This report takes a fresh look at the way in which people learn about biodiversity, its importance and the role that they can play in its conservation. It recognizes that people must interpret this new and challenging issue within a context that is both meaningful and familiar to them. In other words, it will mean different things to the farmer, the fisher and the backyard gardener.

The report is both exploratory and illustrative. It uses current educational theory as a backdrop to Canadian practices and provides a range of examples that highlight the need for a diversity of approaches to reach a diversity of audiences.

Learning About Biodiversity was tabled in May 1998 as a background paper at the Global Biodiversity Forum, and at the fourth meeting of the Conference of the Parties to the Convention on Biological Diversity. There, education and awareness were discussed for the first time. It was very well received and, I believe, provided a good example of Canadian leadership in advancing both domestic and international thinking with respect to this critical, yet often undervalued, policy tool.

I hope that this report will become a valuable resource for educational practitioners, community activists, industry associations, conservation organizations and government agencies who are keen to design effective and well targeted biodiversity education, training and awareness policies and programs.



The Honourable Christine Stewart
Minister of the Environment

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1.0 Introduction

The conservation and sustainable use of the earth's biological resources are among the biggest challenges facing the world today. The global community responded to these challenges by creating the Convention on Biological Diversity which was opened for signature at the Earth Summit in Rio de Janeiro, Brazil, in 1992. The Convention is based on three principles: the conservation of biological diversity, the sustainable use of biological resources, and the equitable sharing of the benefits of such use.

The first industrialized nation to sign the Convention, Canada published the *Canadian Biodiversity Strategy* in 1995. The Strategy outlines the nation's vision for the conservation and sustainable use of our biological resources, and defines the major goals and strategic directions that will be used to achieve this vision. As recognized in Article 13 of the Convention, education, training and awareness have an important role to play in these efforts. Education enables us to make informed choices as consumers, landowners, land managers and decision makers. It also provides us with a diversity of perspectives, opening our minds to new ways of thinking and doing.

About This Report

Because biodiversity education is a young field, this report is broadly exploratory. It begins by investigating trends and influences from contemporary educational theory and the implications of various conceptual frameworks on the ways in which biodiversity education is understood and practiced. The second part of the report gives examples of biodiversity education in action in Canada, highlighting a number of innovative and creative initiatives that introduce people to the concept of biodiversity and get them involved in its stewardship. These examples provide a rare and welcome look at what biodiversity education means to those most involved. Education is conceived of in broad terms; we learn by planting a tree, tracking seasonal changes in backyard vegetation, listening for unique bird calls, lending a hand to restore a schoolyard, and drying, saving and swapping heritage seeds. Education, training and awareness are also being pursued by decision makers in industry and at all levels of government.



2.0 Biodiversity Education: A Marriage of Theory and Practice

The Convention on Biological Diversity is the most comprehensive international treaty dealing with life on earth. Ratified by more than 170 countries, it contains a far-reaching agenda for economic, environmental and social changes across the globe. The Convention recognizes the important roles that education, awareness and training play in building the sustainable societies upon which biodiversity goals depend. Yet, too often, biodiversity education is erroneously equated with information dissemination, and included only at the tail end of implementation.



The examples in this report clearly illustrate the power of biodiversity education to accomplish the participation and behavioural change goals of the Convention. Growing recognition that the public is not a homogenous mass, but diverse groups of people with differing perceptions, knowledge, attitudes, interests, and agendas demands policy approaches that are targeted to specific audiences and levels of involvement. Biodiversity education instruments are key to the effective involvement of civil society in policy planning and the implementation and evaluation of biodiversity strategies. Failure to utilize these instruments in combination with economic and legal instruments, or to grant professional educators the authority to design such instruments in all phases of biodiversity policy cycles, seriously inhibits their contribution. Adopting more realistic approaches for engaging various sectors in relevant phases of biodiversity initiatives is essential to bridge the policy-practice gap and enhance the efficacy of government action in reaching communities.

In May 1998, the Canadian government joined the international community at the fourth meeting of the Conference of the Parties to the Convention in Bratislava, Slovakia. The role of biodiversity education, awareness and training, and the infrastructure and resource allocations required to realize their effect, were an important focus of this meeting. Learning About Biodiversity was designed to inform these discussions and inspire further developments in biodiversity education, awareness and training initiatives in Canada and beyond.

Targeting Specific Audiences

Biodiversity conservation and sustainable use are global issues that require broad societal changes. As a result, there is a widespread tendency to try to address them through mass-media campaigns designed to educate the public at large. A significant body of educational research disputes such an approach. Rather than

attempting to reach vast, generalized public audiences, it emphasizes the importance of designing educational initiatives for specific groups within specific contexts. This targeted approach—which has much in common with the concept of market segmentation used in the corporate sector—is supported by contemporary models of learning which argue that knowledge is dependent upon context and actively constructed and reconstructed within the world of real practice (Erickson and MacKinnon, 1991; MacKinnon, 1994; von Glaserfeld, 1995).

In keeping with Rogoff and Lave's (1984) theory that "thinking is intricately interwoven with the context of the problem to be solved", the knowledge implicit in a biodiversity education initiative that is relevant to fisheries workers, for example, will be markedly different than one designed for eco-tour leaders or primary school teachers. Programs designed to create a generalized understanding of biodiversity are, therefore, less effective than those targeted toward a functional understanding of problem-specific biodiversity concepts (Branscomb, 1981; Shen, 1975; Miller, 1983).



These findings also have implications for the ways in which public understanding of biodiversity should be evaluated. A number of researchers have challenged the value of mass surveys designed to test public understanding of environment and science (Shen, 1975; Morgan, 1984; Layton *et al*, 1993). They argue that such testing fails to respect the context-dependent nature of knowledge, and the fact that individuals differ in their selection of issues to which they are prepared to devote time and effort. Rather than use generalized surveys, Layton *et al* (1993) emphasize the importance of measuring how certain segments of the population understand the specific biodiversity issues they are facing. Given that biodiversity learning is strongly related to context, the ways in which we attempt to measure the extent of understanding should also reflect context.

The Social Context of Learning

Whether it be Canadian communities discovering biodiversity through a heritage-seed exchange or lawyers discussing the legal ramifications of conservation easements, examples of educational initiatives in this report illustrate the social nature of learning. This is supported by a body of educational research that recognizes the importance of directing learning toward socially-identifiable goals that yield "actionable knowledge." As detailed in Case Study 1, homeowners engaged in a purple loosestrife exchange, for example, share information in quite a different way than farmers involved in an intensive agroforestry program do. The social circumstances that comprise the experience form an essential part of the learning process (Garnier, Ulanovskay and Bernarz, 1991).

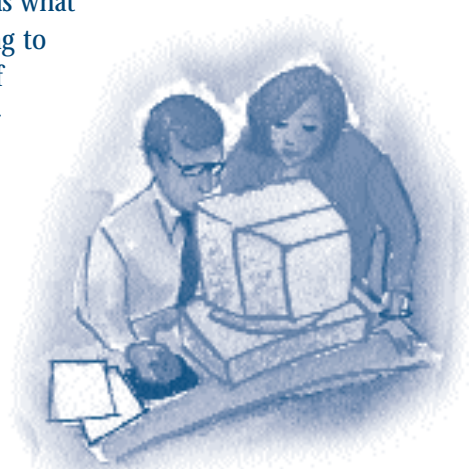
The educational methodologies used to involve families and young children in scientific data collection for biodiversity conservation provide another excellent example of the social context of learning. Whether identifying and counting frogs by the sound of their calls or observing the flowering cycles of plants, the learners are immersed in the real world of science culture. They work on real projects with real scientists. Rather than being passive absorbers of knowledge, these learners are apprentices actively participating and interacting with peers and mentors (Glaser, 1992). Research into the ways families learn science in informal



learning settings reveals the importance of developing educational programs that foster social interactions within the family group (Chase, 1975; Diamond, 1986; Kellert and Dunlap, 1989). In these programs it is the fostering of social learning within the family, as well as within the scientific community, that is essential to the effectiveness of the educational endeavour.

Trusted Sources of Information

The way a message is conveyed and who conveys it is as important as what is being said (Weiss and Tschirhart, 1994; Howlett, 1991). According to Layton *et al* (1993), the interaction of adults with science is rarely, if ever, a narrowly-cognitive one. The public understanding of science-based concepts such as biodiversity is not based on intellectual capability as much as on socio-institutional factors related to social access, trust, and negotiation. Importance is given to the source of the science and, in particular, the extent to which the source is judged trustworthy and understanding of the audience's situation.



Trust plays an important role in educational programs designed to bridge the policy-practice gaps described in Case Study 5. The success of these forestry, fishery and agriculture initiatives is shaped by the extent to which trusted sources are engaged in their development and implementation. In their studies of relationships between farmers and policy makers for example, van Woerkum, van de Poel and Aarts (1995) caution against conceptualizing education as a simple transmission of information and the belief that learning can be managed as long as source, channel, message and receiver factors are considered in a well-presented combination. In their research, the farmers understood the policies, but their lack of trust in the policy makers as a knowledgeable source prevented them from using the information provided. On the other hand, evidence from the studies of Layton *et al* (1993) and Wynne (1991) indicate that, when science is conveyed by a trustworthy source and seen as articulating individuals' concerns, these individuals demonstrate considerable resourcefulness in locating sources and an impressive capability in translating science and other knowledge into forms that support practical action.

4



Attention to Attitudes

There is a general tendency for both laypersons and professionals to act as if the only important thing about learning is the manipulation of information in the learner's mind (Csikszentmihalyi, 1987). This fuels a common but erroneous assumption that biodiversity action can be brought about simply by presenting people with information about animals or environments and explaining the problems that confront them (Borden, 1979; Volk, Hungerford and Tomera, 1984; Hines, Hungerford and Tomera, 1986; McClaren, 1993). Learning involves the whole person, not just the rational mind. "It involves the senses, the desires, the longings, the feeling and the motivations as well" (Csikszentmihalyi, 1987: 81).

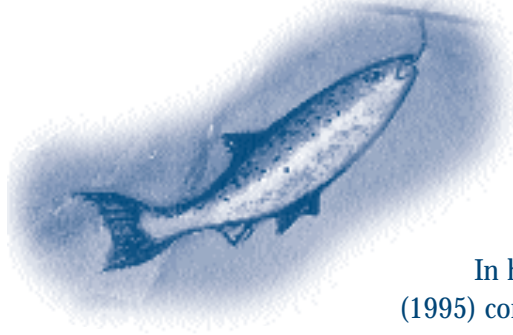
Attitudes, social relationships and social structures all play significant parts in determining the course of practical action that adults deem most appropriate in their particular circumstances. There is significant

evidence that the affective, or emotional, domain is key to environmental education (Iozzi, 1989; Bardwell, 1992). The attitude an individual holds toward a particular issue may be simple or complex, stable or unstable, but is largely determined by the individual's existing values and beliefs. Values are standards held by an individual that influence perceptions of fact and are used to guide choice and action. Beliefs refer to what the individual perceives as knowledge, and may be factual or based on personal opinion (Petty and Cacioppo, 1981; Peyton and Decker, 1987).

The initiatives included in Case Study 2 illustrate the importance of attitude in biodiversity education projects. Members of the community participate in the greening of public spaces, whether they be schoolyards or public corridors, because they value natural landscapes over concrete, and believe that their efforts will yield results. Involvement in the decision-making process is critical, as it is the means by which attitudes toward a proposed project—its design, development, implementation, cost, and participatory approach—can be negotiated, and commitment gained.

Constructing Perceptions of Biodiversity

People are not empty vessels waiting to be filled with new knowledge. Decades of educational research indicate that recipients of scientific knowledge are far from passive, but interact with science, testing it against personal experience, contextualizing it by overlaying it with local knowledge, and evaluating its social and institutional origins (Grimmett and Erickson, 1988; Larochelle and Desautels, 1992; Wynne, 1991; Driver *et al*, 1996). The cognitive-deficit model, with its assumption of a one-way flow of scientific information from scientist to public, is an inadequate description of this relationship.



In her research into children's concepts of biodiversity, Palmer (1995) concluded that children already hold strong beliefs about distant environments and related concepts of biodiversity when they enter school. This knowledge affects how they interpret new information and experiences.

Over the past 25 years, we have learned a great deal about the ideas young people hold about the behaviour of the natural world... This work has revealed many widely shared interpretations and explanations of phenomena and events that differ from the accepted scientific view... Not only are such views widespread, they also prove extremely resistant to change, even through quite carefully constructed teaching programs... The result is that new experience and information are often interpreted by students in ways that differ from those intended by teachers and curriculum planners. Knowing more about these perceptions may help us better understand the processes of science content learning, and hence contribute to more effective teaching (Driver et al, 1996: 2).

Recognizing that individuals—even young children—hold beliefs about biodiversity that they apply to new learning situations demands that education initiatives encourage people to explore and challenge their own knowledge and beliefs about biodiversity in relation to accepted, societally-held views. A number of projects



included in this report provide excellent examples of this approach. In Case Study 4, for example, students examine and contrast their ideas about biodiversity with those of people living in other countries while the *National Environmental Education Program for First Nation Youth* encourages students to explore their understanding of biodiversity through both western science and traditional ecological knowledge. Biodiversity operates in a realm of changing environmental information and contested beliefs. Projects that highlight multiple perspectives provide an important opportunity for learners to challenge their own beliefs and to more critically analyze the various social paradigms that underlie biodiversity debates.

Responsible Treatment of Controversial Issues

Biodiversity issues are, by their very nature, controversial. Competing economic, environmental, social and cultural values shape the ways in which the goals of the Convention on Biological Diversity are understood and realized. Unlike advocacy campaigns that tell people what to think, responsible biodiversity education must be concerned with helping learners to better understand their own values and to develop the processes and skills they need to think critically and to make their own well-informed decisions. In addition to being aware of and understanding issues, people must be able to identify their own values and be able to reason

about moral issues (Kormondy, 1984; Werner, 1989). The difference between indoctrination and education lies, in part, in how value issues and moral questions are dealt with. Learners should be given the skills to make future decisions for themselves rather than merely be persuaded or manipulated. Newhouse (1990: 31) encourages biodiversity educators to join forces with values/moral educators: "Ultimately people need to be able to make their own moral decisions about environmental matters. The job of educators is to ensure that individuals have the tools necessary to make responsible environmental decisions."



The projects in Case Study 6 are examples in which individuals are engaged in making decisions in the midst of competing economic, environmental and social values. The decisions made have an impact on personal, cultural and biodiversity sustainability.

In recent years, a number of researchers have focused their attention on values issues and the development of values frameworks for education for sustainability. As concepts of sustainable development underpin the Convention on Biological Diversity, readers may wish to look more closely at the work *Education for Sustainability* (Huckle and Sterling, 1996) which provides useful guidance to those interested in exploring this field.

Trans-Disciplinary, Trans-Boundary

Biodiversity education is based on the premise that no subjects, factors or issues exist in isolation. Trans-disciplinary means breaking free of disciplinary perceptions and traditions to create new meanings, understandings and ways of working (Sterling, 1996). The projects included in Case Study 5, for example, challenge the



invisible barriers that often exist between business, non-government organizations and industry. Case Study 1 highlights the strength of crossing policy barriers to marry economic incentives or legislative regulations with educational methodologies in order to achieve a targeted response. Case Study 4 features projects that transcend local, national and international boundaries and cultural divides.

The *Frogwatch*, *Plantwatch* and *Great Canadian Bio-Blitz* programs described in Case Study 3 illustrate the value of bridging the boundary between expert and amateur enthusiast when it comes to building capacity in biodiversity data collection. Less than 40 per cent of all the species found in Canada have been identified, and of these, little is known of their distribution, ecosystem function, needs, value or security. At the same time, there is a national and international shortage of professional scientists working in the fields of systematics and taxonomy. Developing educational programs in which scientists and members of the lay public work cooperatively to ensure that data is scientifically valid and accessible contributes to the goals of the Convention on a number of important levels.

Engaging Communities Through Participation

Actions arising from the Convention on Biological Diversity will touch all communities, rich and poor, in both hemispheres. To be globally viable, concepts of sustainable development must foster public involvement in environmental management at the local level. This will come from a citizenry that feels truly involved in its own local community. A growing body of evidence reveals that the weakness of environmental policy implementation is a result of a failure to directly involve people who are intimately involved with the areas or activities the policy seeks to address (French, 1996). The London Review of the Operations of the Convention on Biological Diversity held in January of 1998 drew the same conclusion, and recommends that effective implementation of the Convention requires the active involvement of civil society, including private sector, local and indigenous communities and non-governmental organizations.

A number of projects in this report focus on the participation of communities in planning, designing, restoring, creating and maintaining biodiverse habitats in local school, highway and inner-city areas. Critical to the success of these biodiversity education projects is their commitment to meaningful participation. They meet the criteria for “authentic” participation, in which local people control project decision making in a democratic manner, rather than “pseudo” participation in which projects are carried out according to prior decisions made by outsiders (Brohman, 1996).

Participation in decision-making forums is as important to biodiversity education as participation in ecological-monitoring or habitat-restoration projects. Canada is recognized worldwide for its leadership role in utilizing multi-stakeholder forums for the discussion and resolution of environmental disputes. Given the importance of meaningful public participation in biodiversity decision making, a growing body of research



has attempted to identify factors that inhibit or enhance its achievement (Rayner, 1995; French, 1996). Eden (1996: 197) suggests that the dependence of policy formulation on scientific and expert discussions alone perpetuates a situation in which members of the public are excluded. She calls for an extended notion of expertise that includes philosophy, ethics, religion, community and social responsibility: "I suggest that if we want to make environmental policy successful, we need to look not only at the element of understanding and scientific awareness that is discussed in the notion of extending expertise, but also at how people connect their own lives to the environment."

Many innovative projects strive to provide forums through which the multiple values and knowledge held by stakeholders about a biodiversity issue may be debated and a common course of action established. The *Model Forest Network* and *UNESCO Biosphere Reserve Program* discussed in Case Study 6 provide clear examples of multi-stakeholder processes based upon participatory approaches to biodiversity education. The National Round Table on the Environment and the Economy has created a *Model Round Table for Youth Kit* which explores different positions, interests and values surrounding land use decisions and biodiversity conservation. Those interested in theories and practices of involving young citizens in community development and environmental care are encouraged to consult Hart's (1997) book *Children's Participation: the Theory and Practice of Involving Young Citizens in Community Development and Environmental Care*.



3.0 A Transformative Agenda for Biodiversity Education

Biodiversity Education is a very new field. The case study examples that follow provide a first look at how people working in various locations and sectors across Canada define and practice biodiversity education. They alert us to the danger of stereotyping education as schools, children and teachers, for not only does this greatly oversimplify the complexity of effective schooling, but also, more fundamentally, it prevents biodiversity planners and decision makers from seeing the contribution that educational theory and practice can make to the myriad of contexts and initiatives the Convention seeks to address.

The projects detailed in this report reveal biodiversity education at work in the pulp and paper industry, between fishers, at government round tables, among farmers and producers, at scientific conferences, between businesses and within communities. Biodiversity education takes place in our homes, at our jobs, in our communities, on our vacations *and* in our schools.

Overcoming restrictive stereotypes is one of the greatest challenges facing biodiversity education. If biodiversity education is to transform the ways in which we interact with the diversity of life on earth, restrictive conceptions of education must themselves be transformed. As Sterling (1996: 18) puts it:

A society faced with an imperative to achieve a socially, economically and ecologically sustainable basis within a historically short time needs to reappraise most aspects of its organization; education—as the main means of social reproduction—has to be at the centre of the task, both as subject and agent.



Case Study 1

Linking Landowners with the Land: Helping Private Landowners Discover their role in Biodiversity Conservation

From productive woodlots to urban backyards, private landowners have an integral role to play in the stewardship of our biological resources. Across Canada, there are a number of organizations, resources and initiatives in place to educate landowners about steps they can take to conserve biodiversity on their lands.

A beautiful plant with large purple blossoms, purple loosestrife is an invasive, non-native plant that, if left to spread, has a severe impact on indigenous biodiversity. *The Purple Loosestrife Plant Exchange*, an innovative initiative of the Bow River Project in Alberta, promotes awareness about invasive, non-native plants while introducing gardeners to alternative, ecologically-sound perennials. In 1998, eighteen garden centers will offer one four-inch perennial to each customer who brings in a purple loosestrife plant, roots and all, from his or her home garden.

Taking action in our own backyards is the theme behind the *Purple Loosestrife Plant Exchange*, and the involvement of the local business community opens doors to future partnerships. Other educational resources targeting biodiversity conservation in backyards include *Naturescape B.C.*, a partnership between Wildlife Habitat Canada, Environment Canada, the BC Ministry of Environment, Lands and Parks, and the Habitat Conservation Fund; and *Winnipeg Wild: Bring Biodiversity Home*, an initiative of the Fort Whyte Centre in Manitoba. Both programs conceive of urban green spaces as potential links of interconnected wildlife habitat, and see private landowners as playing a significant role in biodiversity conservation. With a bit of knowledge and energy, households can plant indigenous species, construct bird boxes, and design gardens and spaces that welcome indigenous butterflies and amphibians.

The *Landowner Resource Centre* in Manotick, Ontario, provides landowners with educational resources and technical advice on all aspects of land management. Through the regular publication of their user-friendly fact sheets, *Extension Notes*, the Centre provides educational material on such diverse topics as agroforestry, the financial aspects of owning rural property, pest management, water, wetlands, and wildlife. By linking people with appropriate municipal and provincial authorities, the Centre also helps landowners



The National Round Table on the Environment and the Economy established the Private Woodlot Harvesting Program to examine key issues affecting the sustainability of current harvesting practices and levels in Canada's Maritime provinces. "Private Woodlot Management in the Maritime" is the product of research and consultations among key stakeholder groups. The report has been prepared as a reference tool and educational resource for all concerned with policy and decision making for sustainable woodlot management, from the private woodlot owner to the policy maker.




Legislation is an important tool that can contribute to achieving the conservation of biodiversity and the sustainable use of biological resources. Legislation is most effective when it is developed and used as part of an overall strategy that includes planning systems, education and incentives.

— *The Canadian Biodiversity Strategy*

take advantage of legislative tools in place for biodiversity conservation, such as the province's conservation tax credit. Resources found in the Centre are rooted in the principles of sound ecological management and decision making, making the *Landowner Resource Centre* an excellent and comprehensive classroom for private landowners who want to nurture their lands with the objective of biodiversity conservation in mind.

Taking advantage of recent legislative changes, a number of organizations in Canada, such as the Muskoka Heritage Foundation and the Nature Conservancy of British Columbia, are educating private landowners about the benefits of entering into legal agreements called conservation covenants or easements. Legal agreements such as these ensure that a specific parcel of land will be managed as defined under the agreement, often with the goal of biodiversity and habitat conservation in mind. The agreement becomes registered on the title to the land and, as a result, is passed on to future owners of the land. The activities of these organizations involve a significant amount of public education, which touches on biodiversity conservation and stewardship for the private landowner.

Education, when working in concert with legislative tools and economic incentives, creates comprehensive and well-rounded initiatives that can point to relatively simple and economically-feasible actions that landowners can take to make a positive contribution to the conservation of biodiversity.



The crucial role that private property owners can play in biodiversity conservation is now widely recognized and many significant natural areas have been protected via land trusts and other legal devices.

- Ken Towle

The Role of Ecological Restoration in Biodiversity Conservation: Basic Issues and Guidelines, 1996.

Case Study 2

Taking Action Together:

The Community's Role in Biodiversity Conservation

Throughout Canada's history, communities have long been focal points of activity and action for change. Rural communities, often built around a school and meeting place, are still home to a significant portion of Canada's population, while larger urban centers are increasingly home to diverse groups of people who strive to retain their sense of community within the city.

A number of initiatives across Canada focus on involving individuals in larger community efforts for biodiversity conservation. Through education, organizations such as the Evergreen Foundation and Green Links involve communities in the greening of public spaces, be they schoolyards or utility corridors, while *Seedy Saturday* educates communities about biodiversity by introducing them to indigenous seeds that can be planted in home gardens. The Ontario Federation of Naturalists is working to build capacity in local communities so that an environmental and community-based voice is heard when land-use decisions are made at the municipal level. All of these programs draw on community resources such as time, knowledge, skills and energy, while at the same time coordinating individual efforts to achieve a larger community vision.


The educational value of restoration and naturalization is deeply rooted in the actual process of restoring. Rarely a simple task, the naturalization of a highly-eroded riverbank or an asphalt schoolyard surrounded by chain-link fence is a complex learning experience. A number of seasons, months or years may pass from the early planning stages to the continued nurturing of a successfully-restored site. During this time, the message of biodiversity is never far from the task at hand.

Since 1993, *Learning Grounds* has been supporting Canadian communities in their efforts to transform schoolyards from sterile asphalt and turf grass to complex, dynamic environments. A national program of the Evergreen Foundation, *Learning Grounds* supports schools in creating an outdoor classroom while using the very process of restoration as a tool for experiential learning. *Learning Grounds* includes more than 1100 partner schools to date, found in every corner of Canada. The Ecology Action Center (EAC) of Halifax,

The smallest piece of urban green space in your neighborhood, even if it is crowded by concrete, is an active and thriving ecosystem. These urban ecosystems invite us to imagine what this part of the world looked like before the pavement came. What plants and animals naturally thrived here? Was it once a forest or grassland, a swamp or a riverbed? ... The benefits of these urban green spaces are enhanced when each of the isolated pockets is connected. If birds, bugs and other creatures are able to pass from one isolated green space to another, all species gain from the interaction and exchange of a healthy ecosystem.

- the Green Link, January 1997

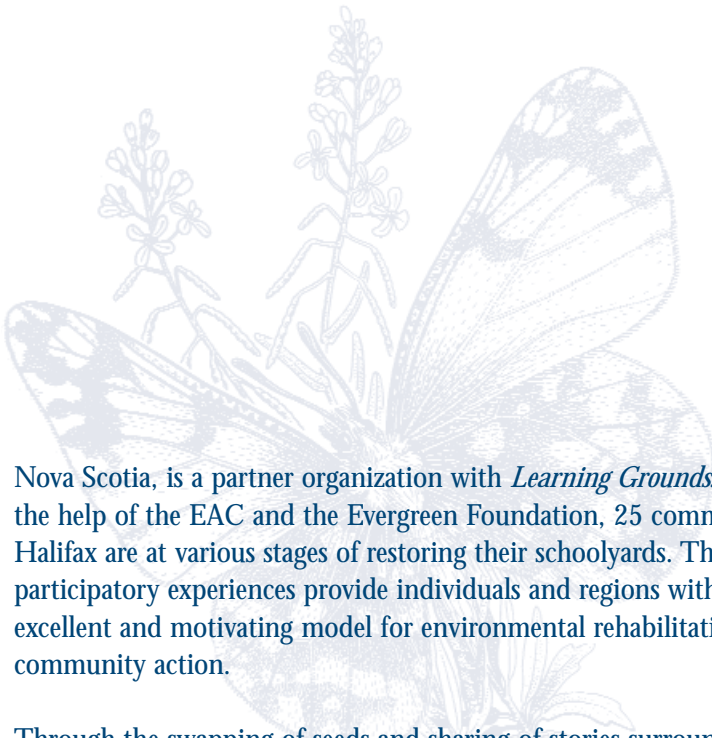




A dictionary tells us that participation means sharing in common and taking part, but it still means different things to different people. For some, participation means:

“I tell you what to do and you participate”. For others, local participation means villagers planting trees on a Food for Work Scheme. Yet the dictionary definition implies something much more profound than this, involving real control over decisions, and power to carry through with what has been decided.

- Camilla Toulmin in *Empowering the People, Our Planet*, a publication of UNEP, 1994



Nova Scotia, is a partner organization with *Learning Grounds*. With the help of the EAC and the Evergreen Foundation, 25 communities in Halifax are at various stages of restoring their schoolyards. These participatory experiences provide individuals and regions with an excellent and motivating model for environmental rehabilitation and community action.

Through the swapping of seeds and sharing of stories surrounding biodiversity conservation, *Seedy Saturday* is an educational initiative that brings diverse regional interests together to work toward biodiversity conservation in local communities. A one day engagement that takes place in communities and towns across Canada in early March, *Seedy Saturday* gives people a chance to swap and sell open-pollinated seeds grown in the region, and to talk to other growers. At any *Seedy Saturday*, you may meet native plant groups, plant breeders, small seed companies that sell open-pollinated seeds, historic site and heritage garden

representatives, organic-gardening associations, and agriculture-biodiversity conservation groups such as Rare Breeds Canada and Seeds of Diversity Canada—all working in concert to create an educational experience for those involved.

Recent changes to Ontario's Planning Act vest local municipalities with greater decision-making powers over regional land-use decisions. As part of a larger initiative to build skills and tools within local communities, so they can effectively respond to the powers now delegated to them in legislation, the Federation of Ontario Naturalists have produced a booklet called *Protecting Nature Close to Home: A Guide to Municipal Environmental Advisory Committees in Ontario*. Environmental advisory committees advise the municipal council on environmental issues of local interest and importance and are made up of local citizens with special interests and skills. This educational booklet details the role of the environmental advisory committee in the local region, and outlines four success stories from across the province. Finally, the booklet suggests how to set up a new environmental advisory committee in your own municipality.

Participating in the greening of urban spaces, growing your own seeds to swap with neighbours or taking a role in a municipal, decision-making body—all of these initiatives build knowledge and capacity in our communities, enabling an increased, synergistic effort toward biodiversity conservation and stewardship.



Case Study 3

Cultivating the Amateur Expert: Public Involvement in Scientific Data Collection for Biodiversity Conservation

Across Canada, ladybugs, birds, flowering plants and frogs have all become the vectors of significant educational messages about biodiversity. What better time to learn about the importance of amphibian populations than while out listening for the frog calls of summer? Programs such as *Frogwatch* in Nova Scotia, *Plantwatch* in Alberta, and the *Great Canadian Bio-Blitz* in Ontario, all focus on the messages of biodiversity and conservation ecology, educating volunteers through hands-on experience and supplemental materials. As well as the educational benefit of these programs, the scientific data they provide contribute to our understanding of the complexity inherent in populations of biological resources and their elaborate webs of interaction.

Comprehensive and reliable inventories of our biodiversity are a fundamental precursor to the sustainable use of biological resources. Inventories of flora and fauna and their monitoring over time allow us to paint site-specific, regional and national pictures of the status of our biodiversity. Although we still know very little about the complexity of ecosystems, the role of genetic resources, and the importance of Canada's diverse flora and fauna, the information from these initiatives informs all levels of decision making and aids in assessing the impact of resource-management practices.

Phenology is the study of the seasonal timing of life-cycle events. Studying the phenology of flowering plants involves closely watching and recording the blooming times of certain species from year to year. *Plantwatch*, a program of the Devonian Botanic Garden at the University of Alberta, enlists volunteers in observing the flowering times of "key indicator" plant species each spring, including the lilac and two native plants—the prairie crocus and the Saskatoon. Phenological studies such as *Plantwatch* provide land managers and decision makers with sound data, allowing the successful timing of planting, fertilizing, integrated pest-management activities, and harvesting. Taken over a number of years, phenological studies can also help to determine trends in the biotic effects of climate change and weather variability. *Plantwatch* contributes to the volunteer's understanding of biodiversity and the linkages between all components of our ecosystems, including weather events and flora and fauna.

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Many monitoring initiatives make the collection of scientifically-reliable data their main focus. In 1986, the Smithsonian Institute joined with UNESCO's Man in the Biosphere Program to create the SI/MAB biodiversity plots. Sprinkled throughout Canada and globally, the SI/MAB plots focus on the collection of reliable and usable data over the long term. One Canadian monitoring plot is situated at the Macphail Woods Ecological Forestry Project on Prince Edward Island. Joining an established network of plots found throughout the world in places such as Bolivia, Peru, Guyana, Puerto Rico and Tennessee, the Macphail plot is one of several Canadian plots gathering long-term scientific data.



The Breeding Bird Survey, an initiative of Environment Canada designed to detect and measure year-to-year and long-term changes in breeding bird populations, utilizes the skills of experienced birders. As volunteers, these avid birders survey the same roadside route year after year and report their findings to the Canadian Wildlife Service.

A similar program in Nova Scotia involves the public in monitoring amphibian populations. The Nova Scotia Museum of Natural History's *Frogwatch* enlists the help of families in the monitoring and reporting of frog choruses throughout the spring and summer. Because frogs are found near our homes, *Frogwatch* is a program that young children can participate in with their parents. Frogwatch has thousands of participants across the province, and has successfully raised the awareness of issues relating to the global decline in amphibian populations—thought to be an early indicator of overall ecosystem health.

Effective monitoring programs link scientific skills with local enthusiasm and participation. *The Great Canadian Bio-Blitz* does exactly this. Coordinated by the Canadian Institute of Biodiversity, the *Bio-Blitz* is an annual event based in Ottawa, Ontario, which combines the efforts of specialists in taxonomy, ecology and natural history with the enthusiasm of local volunteers in an intensive, 24-hour period of flora and fauna inventorying. Held along the banks of the Rideau River in June 1997, the first Ottawa *Bio-Blitz* recorded 700 species, including trees, shrubs, herbs, mosses, lichens, fungi, algae, spiders, insects, molluscs, fish and birds. One species of fungi, *flahaultia hyalina*, had never been documented in this hemisphere before it was found during the *Bio-Blitz*.

Initiatives that link scientific resources with community curiosity and energy can go far in bringing about a deeper understanding of biodiversity to all involved. These initiatives also ground people's individual experiences in the larger effort of inventorying, monitoring and assessing our biological resources—a necessary precursor to their sustainable use.



The Global Biodiversity Monitoring Network for Indigenous Peoples is a project that links grassroots indigenous organizations worldwide with the objectives of monitoring and annually reporting on the state of biodiversity in critical ecosystems inhabited by indigenous people, and providing indigenous peoples, scientists and governments with reliable first-hand data on ways in which indigenous peoples can contribute to government and private-sector decisions on conservation and development.

Case Study 4

Learning at Home and Away: Sharing Across Cultures and Borders

Cross-cultural exchanges and intercultural programming, both within Canada and across nations and borders, explore different ways of knowing, perceiving, and conceptualizing our biophysical and cultural environments. Canada World Youth, Crossroads, and CUSO (Canadian University Students Overseas) are all examples of organizations that place Canadian youth and professionals overseas with the mandate of working toward greater social justice and environmental sustainability. At the end of their placements, participants return to Canada recognizing the importance of different cultures working together for global sustainability and biodiversity conservation.


There are a number of Canadian programs that reach beyond our borders, linking Canadian communities with those from different cultures which share common environmental concerns. *Communities Restoring Habitat*, a project of the West Coast Ecological Youth Alliance, and the Canadian Museum of Nature's *Monarch Butterfly Student Exchange* examine the different perspectives cultures bring to global environmental challenges, including biodiversity and habitat conservation. These exchanges are excellent educational vehicles, both at home and away.

The Canadian Museum of Nature and la Fundacion Mexicana para la Educacion Ambiental, a Mexican non-governmental organization, have partnered to promote the scientific and cultural exchange between their two countries. The monarch butterfly is a common concern to both Canada and Mexico, as it relies on a healthy habitat in each country at different times of the year. Each year, a number of Canadian youths are selected to travel to Mexico, where they investigate threats—such as water and air pollution—to the life cycle of the butterfly. Mexican students travel to Canada and investigate summer habitat conservation strategies, learn to raise, tag and release monarchs, and visit the Insectarium in Montreal. Both groups return to their countries and communities with an increased understanding not only of the life cycle of the monarch, but also of the interconnectedness of nations and the global nature of many conservation issues.

The West Coast Ecological Youth Alliance is an active member of an international network of communities along the west coast of North and South America that monitor, compare and help to protect and conserve biodiversity in their respective regions. The network has approximately 150 people involved internationally. A particularly strong link in the network has been forged between Victoria, British Columbia, and Mexico City, Mexico where youth groups have created the *Communities Restoring Habitat* program. This initiative, which focuses on environmental issues of mutual significance and importance, works to increase biodiversity in both cities and to create a series of maps detailing the social and biophysical aspects of both regions as a tool for learning and sharing.

The diversity of environmental perspectives can be found within Canada as well. In the early 1990s, the Centre for Indigenous Environmental Resources saw the need to incorporate different ways of perceiving, experiencing and learning about biological resources into more mainstream environmental-studies curricula.

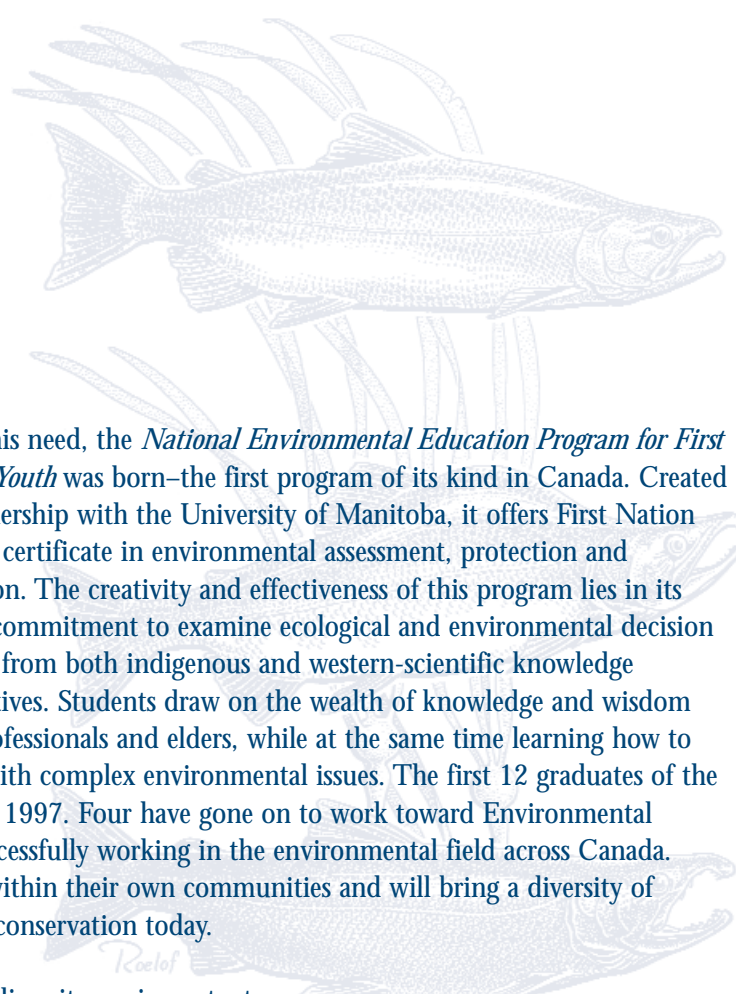




Canadians recognize that the protection of the global environment is the common concern of all nations.


The international dimension of the Convention on Biological Diversity addresses the need for countries to coordinate and organize efforts on a global scale while respecting each country's own priorities and sovereignty over its biological resources.

— the Canadian Biodiversity Strategy



From this need, the *National Environmental Education Program for First Nation Youth* was born—the first program of its kind in Canada. Created in partnership with the University of Manitoba, it offers First Nation youth a certificate in environmental assessment, protection and education. The creativity and effectiveness of this program lies in its overall commitment to examine ecological and environmental decision making from both indigenous and western-scientific knowledge perspectives. Students draw on the wealth of knowledge and wisdom from both aboriginal and non-aboriginal professionals and elders, while at the same time learning how to empower and organize communities faced with complex environmental issues. The first 12 graduates of the program received their certificates in August 1997. Four have gone on to work toward Environmental Science degrees, while the remainder are successfully working in the environmental field across Canada. Many are ready to take on leadership roles within their own communities and will bring a diversity of perspectives to the challenge of biodiversity conservation today.

Global and intercultural perspectives on biodiversity are important because they inform our decisions as stewards of land and resources at home, as well as our consumer choices in an increasingly-globalized economy. Programs such as *Communities Restoring Habitat*, the *National Environmental Education Program for First Nation Youth*, and the *Monarch Butterfly Student Exchange* help to open the minds of our future decision makers by providing them with fresh and different perspectives on the diversity of cultures, experiences and environments—both at home and away.



If our students are to succeed in developing a broader consciousness, we — global educators — must help create schooling that is more in touch with the realities of the present global system... We must prove to ourselves that education can have a significant role to play in the creation of a more just and sustainable world.

— Graham Pike, *Global Education: Reflections from the Field*, *Green Teacher*, Winter 1997 - 98.



Case Study 5

Getting Down to Business:

Biodiversity Education and Training within Resource Sectors

The daily interaction of fishers, loggers, farmers and ranchers with the environment has the capacity to greatly affect Canada's biodiversity. Policy makers also have an influence, because their decisions and directives shape how people and industries interact with the environment. Several biodiversity education, training and awareness programs across Canada reach people where they work: in fields and forests, on boats, and at their desks. Rural extension programs for agriculturists and ranchers, biodiversity guidelines for forestry practices that build capacity in the industry, and codes of conduct across sectors all target different decision makers in the cycle of resource use, and rely on significant extension and outreach to get the message of biodiversity conservation across to their target audiences.


The Grazing and Pasture Technology Program, a Saskatchewan-wide initiative, is a multi-party program with the overall goal of improving and sustaining range-land and pasture resources. This goal is achieved through comprehensive extension activities and services, including participation in conferences, workshops, seminars, field days and field tours. During the active phase of the program (1993-97), the staff of the *Grazing and Pasture Technology Program* made over 3000 contacts with individual producers through farm visits, phone calls and information sent by mail. Demonstration sites, such as the Crystal Springs Community Pasture Project, allow ranchers to visit and interact with other ranchers and learn, for example, how planned grazing management can benefit both livestock and indigenous wildlife.

Cows and Fish is another integrated and innovative program that focuses on ensuring that the riparian habitat found on ranchland in Southern Alberta is healthy, biodiverse and stable. The success of the *Cows and Fish* program lies in the fact that it takes a proactive and cooperative approach to ranch management that involves landowners, producer and conservation groups and government agencies in problem solving—right from the start. *Cows and Fish* does not ignore the valuable knowledge that ranchers already have regarding their land, but educates around that knowledge, supplementing it when necessary, and filling it out into an integrated management plan. Finally, the ranchers themselves become teachers involved in helping to spread the word of biodiversity in the riparian zone to other livestock producers across the region.

Beyond individuals are companies whose operational decisions have a great capacity to impact biodiversity. The *Forest Biodiversity Program* led by Wildlife Habitat Canada, a national, non-profit organization, is helping forest companies become better stewards of biodiversity. The main goal of the *Forest Biodiversity*

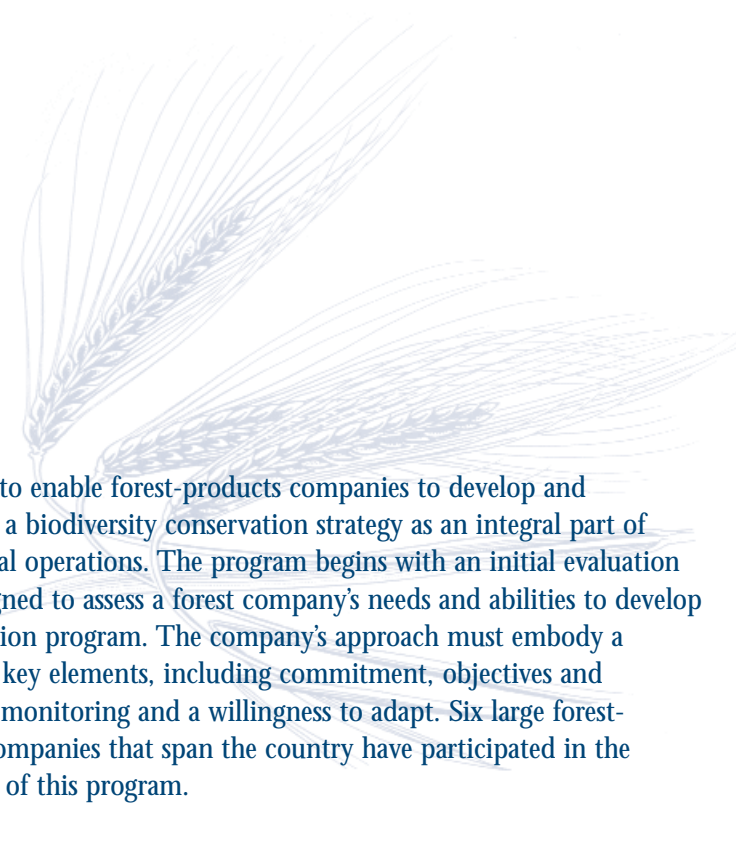


In Newfoundland, humpback whales are nothing but trouble to local fishers. A whale caught and startled in nets can cause thousands of dollars of damage to a boat's gear. The Entrapment Assistance Program operated by the Whale Research Group of Memorial University responds to these tangled emergencies by helping fishers to free the whales and get their gear back in working order. It's good for the whales, and good for the fishers.




Training is a critical first step of both devising and implementing biodiversity conservation. In Canada, forestry companies are teaching staff how to prepare biodiversity strategies and implement them in the field. At the site-specific level, foresters are learning to recognize habitat attributes critical to wildlife and to the successful implementation of biodiversity strategies.

*-The Biodiversity Challenge,
Canadian Pulp and Paper Association*



Program is to enable forest-products companies to develop and implement a biodiversity conservation strategy as an integral part of their normal operations. The program begins with an initial evaluation phase designed to assess a forest company's needs and abilities to develop a conservation program. The company's approach must embody a number of key elements, including commitment, objectives and indicators, monitoring and a willingness to adapt. Six large forest-products companies that span the country have participated in the pilot phase of this program.

Industry-wide initiatives such as the recently-created *Canadian Code of Conduct for Responsible Fishing Operations* involve different stakeholders in both creation and implementation. The *Code of Conduct* is designed to reduce by-catch, undersized catch, post-harvest spoilage, wastage, poor handling practices and discarding by setting out standards and practices to which the whole industry is expected to adhere. Implementing the principles and the practicalities of the Code will only be achieved through a significant amount of awareness raising and public education based on the goals of sustainable fisheries and marine biodiversity.



As the company learns how its activities and operations affect biodiversity, it must be prepared to adjust its practices.

*- Forest Biodiversity Program,
Wildlife Habitat Canada, 1997*

As these examples show, education for biodiversity conservation is not just for children and classrooms. Instead, education, training and awareness for biodiversity conservation is taking place at the levels of forest, field, farm and beyond. Some initiatives involve meeting land managers on the ground, while others, through guidelines and codes of conduct, work to build capacity within companies and across industries to integrate biodiversity objectives into daily practices.



Case Study 6

Partnerships and Dialogue:

Learning from Multi-Stakeholder Processes and Round Tables

In Canada and globally, recent decades have seen a level of complexity emerge in governmental and non-governmental decision making that is unparalleled in our past. The integration of biodiversity conservation objectives in land-use planning and resource stewardship necessitates the consideration of multiple values and voices. In Canada, round tables and multi-stakeholder processes have been the primary institutional responses to the interdisciplinary, intercultural and international nature of the challenges facing decision makers, government and land managers today.

A round table is a forum to which diverse voices voluntarily come, explore different points of view and, often through consensus, arrive at solutions acceptable to all. By their very nature, round tables consist of the representatives of groups with diverse, divergent and sometimes competing interests. Participants, through extended and focused dialogue, learn from the round table process and then return to their own constituencies and share this newly-acquired knowledge.

In 1990, Natural Resources Canada and the Canadian Forest Service responded to the need to integrate multiple values and diverse voices into Canadian forest management with the creation of the Model Forest Network. A national network consisting of 10 sites and totaling nearly 8.3 million hectares of forested land, the model forests build working partnerships among individuals and organizations who have an interest in their local forests. Model forests involve First Nations, academia and educational institutions, community and public interest groups, government, industry, private woodlot owners and youth in management decisions largely through round-table processes.

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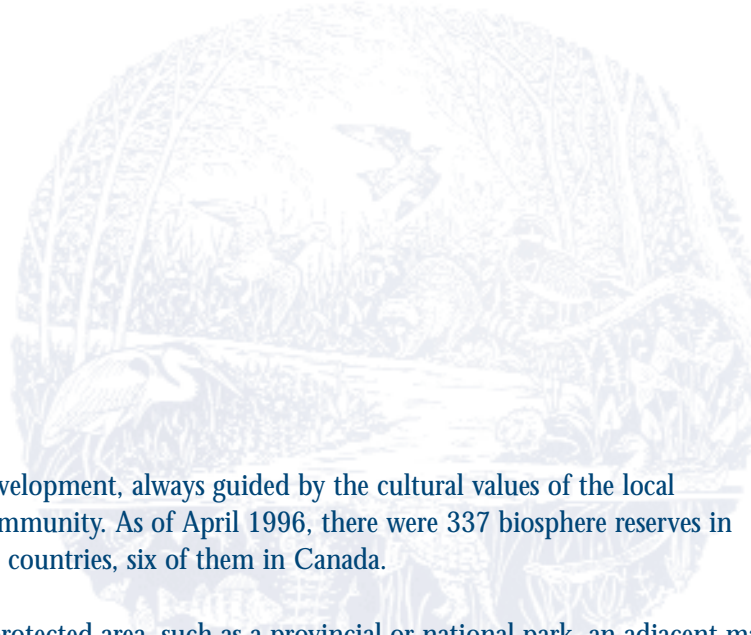


The educational value inherent in the model forest approach grows from the sharing and partnerships that are allowed to develop throughout the process. Industry learning from environmentalists, academics learning from First Nations, and private landowners learning from government—all of these relationships are forged, nurtured and strengthened by the model forest program.

Another program involving diverse interests in resource management decisions and biodiversity stewardship is *UNESCO's Biosphere Reserves*. Like the model forest initiative, the Biosphere Reserves program creates a structure in which various interests come together, and strives to link conservation and economic

Everywhere people are demanding more meaningful input into decisions that directly affect them or the place where they live. In making these decision we will have to find ways to accommodate deeply held and differing values. Nowhere is this more evident than in coping with the complexities that issues of sustainability present.

- National Roundtable Review, Winter 1995



The human dimension of Biosphere Reserves makes them special, since the management of a Biosphere Reserve essentially becomes a “pact” between the local community and society as a whole.

- World Network of Biosphere Reserves, US MAB Program Secretariat

development, always guided by the cultural values of the local community. As of April 1996, there were 337 biosphere reserves in 85 countries, six of them in Canada.

A biosphere reserve consists of a core protected area, such as a provincial or national park, an adjacent managed area that could involve forestry operations, grazing, fishing and other resource activities, and a broader zone of cooperation that includes the larger regional context in which the biosphere reserve exists. Like the model forest, the biosphere-reserve concept emphasizes cooperation between landowners and local residents in the creation of research, conservation and development programs.

A common goal of all biosphere reserves is the conservation of landscapes, ecosystems, species and genetic resources. Combining the knowledge, skills and talents of park officials, landowners, farmers, local conservation groups, governments and others results in biodiversity conservation initiatives that enjoy widespread public and government support. Furthermore, the very process of developing these conservation strategies exposes stakeholders to the variety of perspectives that people bring to land-use planning and resource-stewardship decisions.

Round table and multi-stakeholder processes are being increasingly integrated into resource and conservation strategies—from the local level to the international scene. What we can learn from these processes and share with our own communities—be they industry, environmental groups or others—makes the round table approach of significant educational value.

Just as sustainable development has emerged as a new way of thinking about the relationship between human needs and the natural environment, the round table process represents a new approach to resolving economic-environmental issues. It brings together all the stakeholders in each issue or conflict and provides a setting and a framework for these stakeholders to work towards a resolution based on consensus rather than on political or economic power. - Model Round Table Kit for Youth, NRTEE



4.0 Growing Together

Individuals in all sectors of Canadian society have voiced a desire to collaborate with others involved in biodiversity education. To respond to this enthusiastic demand, the Biodiversity Convention Office of Environment Canada has created the Canadian Biodiversity Information Network (CBIN) web site at www.cbin.ec.gc.ca. This site is the national World Wide Web node of the Clearing-House Mechanism, an international, information-sharing device created under the Convention on Biological Diversity. The purpose of the CBIN site is to provide efficient and effective access to many types of information related to biodiversity. The network details numerous projects and ideas, and provides contact information for the individuals involved in their development and implementation. It is hoped that this clearing house of current practices will serve as both a catalyst for others to contribute and a forum to debate and influence the rapidly-evolving field of biodiversity education.

The efforts and enthusiasm of many individuals, organizations and governments across Canada lie behind this report. It is hoped that these pages not only introduced many of them to you, but also provided a conceptual framework that will encourage you to build upon their energies.



5.0 References

- Bardwell, L. (1992). Success Stories: Imagery by Example. *Journal of Environmental Education*, 23 (1), 5-10.
- Borden, R. J. and S., A. (1979). Determinants of environmentally responsible behavior; Facts or feelings? *Journal of Environmental Education*, 10 (4), 35-37.
- Branscomb, A. W. (1981). Knowing how to know. *Science, Technology and Human Values*, 6 (36), 5-9.
- Brohman, J. (1996). *Popular development: Rethinking the theory and practice of development*. Oxford: Blackwell Publishers.
- Chase, R. A. (1975). Museums as learning environments. *Museum News*, 5, 37-43.
- Csikszentmihalyi, M. (1987). *Human Behaviour and the Science Center*. Paper presented at the Science Learning in the Informal Setting, Chicago.
- Diamond, J. (1986). The behaviour of family groups in science museums. *Curator*, 29 (2), 139-155.
- Driver, R., Leach, J., Millar, R., and Scott, P. (1996). *Young People's Images of Science*. Buckingham, Philadelphia: Open University Press.
- Eden, S. (1996). Public participation in environmental policy: considering scientific, counter-scientific and non-scientific contributions. *Public Understanding of Science* (5), 183-204.
- Erickson, G. and MacKinnon, A. (1991). Seeing classrooms in new ways: On becoming a science teacher. In D. Schon (Ed.), *The reflective turn: Case studies in professional practice*, (pp. 15-36). New York: Teachers College Press.
- French, H. (1996). The Role of Non-State Actors. In J. Werksman (Ed.), *Greening International Institutions*, London: Earthscan Publications Ltd.
- Garnier, C., Ulanovskay, I., and Bernarz, N. (Ed.). (1991). *Après Vigotski et Piaget: Perspectives sociale et perspective constructiviste*. Bruxelles: De Boeck.: Ecoles russe et occidentale.
- Glaser, R. (1992). Expert knowledge and processes of thinking. In D. Halpen (Ed.), *Enhancing thinking skills in the sciences and mathematics*, Hillsdale, N.J: Lawrence Erlbaum.
- Grimmett, P. and Erickson, G. (1998). *Reflection in Teacher Education*. Vancouver: Pacific Educational Press.
- Hart, R. A. (1997). *Children's Participation: The Theory and Practice of Involving Young Citizens in Community Development and Environmental Care*. London: Earth Scan.
- Hines, J. M., Hungerford, H. R. and A.N. Tomera. (1986). Analysis and Synthesis of Research on Responsible Environmental Behavior: A Meta-Analysis. *The Journal of Environmental Education*, 18 (2), 1-8.
- Howlett, M. (1991). Policy instruments, policy styles, and policy implementation: national approaches to the theory of instrument choice. *Policy Studies Journal*, 19 (2), 1-21.
- Huckle, J. and Sterling, S. (Eds.). (1996). *Education for Sustainability*. London: Earthscan.
- Iozzi, L. A. (1989). What Research Says to the Educator. Part One: Environmental Education and the Affective Domain. *Journal of Environmental Education*, 20 (3).
- Kellert, S. R. & Dunlap, J. (1989). *Informal Learning at the Zoo: A Study of Attitude and Knowledge Impacts*. Philadelphia: Zoological Society of Philadelphia.
- Kormondy, E. J. (1984). Human Ecology: An Introduction for Biology Teachers. *The American Biology Teacher*, 46 (6), 325-329.
- Larochelle, M., and Desautels, J. (1991). Of course, it's just obvious: Adolescents' ideas of scientific knowledge. *International Journal of Science Education*, 13 (4), 373-89.



Layton, D. J., Jenkins, E., Macgill, S., and Davey, A. (1993). *Inarticulate Science? Perspectives on the Public Understanding of Science and Some Implications for Science Education*. Nafferton: Studies in Education Ltd.

MacKinnon, A. (1994,). *Examining practice to address policy problems in teacher education. Paper presented at the Institute for Studies in Teacher Education*. Collaborative research in teacher education: The SFU experience, Burnaby, BC.

McClaren, M. (1993). *Model for Environmental Literacy*. Paper presented at the National Marine Educators Association Western Regional Conference, Vancouver Island, BC.

Miller, J. (1983). Science literacy: A conceptual and empirical review. *Daedalus*, 112 (2), 29-48.

Morgan, J. (1984). Effect of antenatal education on expectant parents' knowledge and attitudes regarding infant nutrition. *Health Education Journal*, 43 (4), 104-7.

Newhouse, N. (1990). Implications of Attitude and Behavior Research for Environmental Conservation. *Journal of Environmental Education*, 22 (1), 26-32.

Palmer, J. (1995). *Children's Concepts of Biodiversity*. Paper presented at the Education and Communication for Biodiversity Workshop, Valsain, Spain.

Petty, R. E. and Cacioppo J. T. (1981). *Attitudes and Persuasion: Classical and Contemporary Approaches*. Dordrecht, MA: William C. Brown.

Peyton, R. B and Decker, D. J. (1987). The Role of Values and Valuing in Wildlife Communication and Education. In D. J. G. Decker, G.R. (Ed.), *Valuing Wildlife: Economic and Social Perspectives*, Boulder, CO: Westview Press.

Rayner, S. (1995). Governance and the Global Commons. In M. R. Desai, Paul (Ed.), *Global Governance: Ethics and Economics of the World Order*. London and New York: Pinter.

Rogoff, B and Lave, J. (Eds.) (1984). *Everyday cognition: its development in social context*. Cambridge, Massachusetts: Harvard University Press.

Shen, B. (1975). Scientific literacy and the public understanding of science. In S. B. Day (Ed.), *Communication of Science Information*, (pp. 44-52). Basel: Karger.

Sterling, S. (1996). Education in Change. In J. Huckle, and S. Sterling (Eds.), *Education for Sustainability*, (pp. 18-40). London: Earthscan.

van Woerkum, C. M. J., van de Poel, M. M, and Aarts, M. N. C., (1995). *Communication in Policy Processes: Reflections from the Netherlands*.

Volk, T. R., Hungerford, H. R., and Tomera, A. N. (1984). A National Survey of Curriculum Needs as Perceived by Professional Environmental Educators. *The Journal of Environmental Education*, 16 (1), 36-40.

von Glasersfeld, E. (1995). *Radical constructivism. A way of knowing and learning*. London: Falmer Press.

Weiss, J. A. and Tschirhart, M. (1994). Public information campaigns as policy instruments. *Journal of Policy Analysis and Management*, 13 (1), 82-119.

Werner, W. (1989). *What is Global Education?* Paper presented at the The School's Role in Global Education Conference, Vancouver.

Wynne, B. (1991). Knowledges in Context. *Science, Technology and Human Values*, 16 (1), 111-21.



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