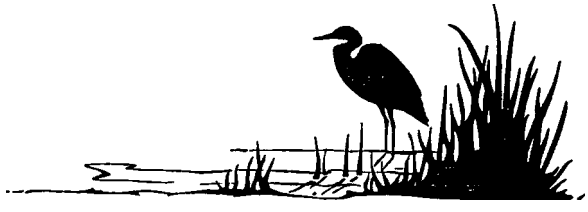
ECOLOGICAL MONITORING AND ASSESSMENT NETWORK

# EMAN's Contribution to the implementation of the Canadian Biodiversity Strategy



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# EMAN's Contribution to the Implementation of the Canadian Biodiversity Strategy

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Report No. 8

Prepared by the
EMAN Biodiversity Science Board

Ecological Monitoring Coordinating Office
Canada Centre for Inland Waters
P.O. Box 5050
Burlington, Ontario, Ontario
L7R 4A6

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The Ecological Monitoring Coordinating Office
Canada Centre for Inland Waters
P.O. Box 5050
Burlington, Ontario
L7R 4A6

tel. (905) 336-4414
fax. (905) 336-4989
e-mail: tom.brydges@cciw.ca
EMAN web site: http://www.cciw.ca/eman/

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## FOREWORD

"EMAN's Contribution to the Implementation of the Canadian Biodiversity Strategy" was prepared by the EMAN Biodiversity Science Board to explain the role sampling protocols, inventories, and monitoring play in the larger picture. The report considers implementation of the Canadian Biodiversity Strategy from the perspective of sustainable management of biodiversity. It does not deal with threatened species or habitat preservation, both of which receive adequate attention by other interested parties.

The document has been reviewed by all members of the EMAN Biodiversity Board. It was distributed for public comment at the third EMAN National Science Meeting held in Saskatoon, January 1997, and was formally presented to the delegates of that meeting by Albert Finnamore, Chair of the EMAN Biodiversity Science Board. It also received a resounding endorsement as a basis for a national biosystematics action plan from John Herity, Director of the Biodiversity Convention Office, in a public statement made at the National Science Meeting.

The Canadian Museum of Nature, in a letter dated January 30, 1997, to the Chair of the EMAN Biodiversity Science Board, has indicated its full support of the activities described in this document. The letter stated that the "Museum therefore intends to participate and collaborate fully in these endeavours, and looks forward to playing an active role as this important Canadian effort moves forward".

# EMAN'S CONTRIBUTION
# TO THE
# IMPLEMENTATION OF THE CANADIAN BIODIVERSITY STRATEGY

## I. INTRODUCTION

The management of biodiversity is an issue that affects the quality of life of all Canadians. Human societies and regional economies are tied to resources produced by ecosystems. The impacts of change in ecosystems are expressed through shifts in biodiversity. Shifts in biodiversity alter the resource base of regional economies often to the detriment of human populations. Sound ecosystem management is key to sustained resource utilization, dynamic regional economies, and long-term maintenance of human populations. Improvement of the quality of life for Canadians demands a national effort to acquire realistic information on our biological diversity.

One of the most revealing indicators of sustainable management of biodiversity resources in Canada is the number of species listed at risk: 256 species in 1996. Policy development and management practise based on inadequate information have resulted in unsustainable management of our biodiversity resources. In extreme cases, inappropriate management has led to ecosystem collapse and devastation of regional economies in Canada. More frequently, chronic symptoms are evident, for instance, land conversion, depletion of resources, or ever-increasing inputs to sustain historical yields. The basic necessities for human society can generally be provided with less input from ecosystems with a high degree of integrity than from modified, biologically-impoverished, ecosystems. Recent studies (see reviews of David Tillman's work by Culotta 1996 and Moffat 1996) indicate that increasing biodiversity in ecosystems boosts stability and productivity. Biodiversity is a cross-cutting issue that can be addressed through strong sector-based research. Realistic information on Canada's biodiversity resources is necessary to assess and manage the impacts of change in ecosystems. Acquisition of that information must form part of a long-term national strategy and be integrated into multi-sectorial policy planning and management practises if ecosystems are to be managed for use by future generations.

Within Canada, the ability to detect changes in the functioning of our ecosystems is the founding principle upon which to build a national monitoring and assessment program. The ability to scale from species point data through ecoregion to national levels and to understand the cumulative diversity, processes, and interactions is a formidable challenge facing the science and monitoring communities in Canada and worldwide. By adopting an ecological framework, the relative contribution of the

sector approach is encapsulated and advanced towards an integrated, multiagency, multisectoral response agenda. Species diversity assessments and species inventories at the ecoregion level then become integral parts of the cumulative assessment methodologies leading to development of a monitoring technology that can identify change in our ecosystems and, more importantly, help determine why the changes are taking place.

The implementation of Canada's Biodiversity Strategy (Environment Canada 1995) is the result of a series of international events and national initiatives which over the past few years have laid the groundwork to make its success possible. Those events and initiatives were summarized in the Framework for Monitoring Biodiversity Change (Roberts-Pichette 1995). The implementation of a national biodiversity strategy leading to development of a monitoring technology is a huge undertaking that can only become operational over the long-term. It entails the development of highly skilled human resources, the integration of volunteers, the enhancement of national infrastructure, information gathering and analysis, and development and implementation of a national monitoring program. The Biodiversity Science Board has identified a series of key elements that are already in place and a number of elements that should be established to enable a biodiversity monitoring capability called for in the national biodiversity strategy. These key elements suggest that a fundamental realignment of working relationships across the federal sectors and with the regions is desirable if any national biodiversity strategy is to be implemented. The EMAN Biodiversity Science Board considers a multisectoral approach to be a critical ingredient in the implementation of a Canadian Biodiversity Strategy. The key elements are presented below.

## II. ELEMENTS IN PLACE

### The United Nations Convention on Biological Diversity

Principal among the key elements identified by the EMAN Biodiversity Science Board is the United Nations Convention on Biological Diversity (UNEP 1992) to which Canada is signatory. As such, Canada has legal obligations and moral responsibilities to its citizens and to other signatories of the Convention to develop national strategies and action plans to conserve and use sustainably the biological diversity within its jurisdiction.

### The Canadian Biodiversity Strategy

As required by the United Nations Convention, the Canadian Biodiversity Strategy has been developed. It is Canada's formal response to the Convention. The Canadian Biodiversity Strategy has been ratified by all territorial and provincial governments.

The strategy stresses the need for an understanding of the current status of species and their populations, population trends, and the causes of population and species changes in order to develop sound biodiversity conservation and sustainable use strategies.

### The National Ecological Framework

The National Ecological Framework (Ecological Stratification Working Group 1995) represents another key achievement in Canada's capability to address scale issues and integrate the multisectoral information necessary to implement a Canadian Biodiversity Strategy. The National Framework was developed by Environment Canada's State of the Environment Directorate and Agriculture and Agri-Food Canada's former Centre for Land and Biological Resources Research in cooperation with the provinces and territories. The National Ecological Framework is endorsed by the EMAN Biodiversity Science Board and has been adopted as the basic framework of EMAN organization and activity.

### A National Network of Monitoring Sites

EMAN's national network is approaching 100 sites (Roberts-Pichette and McKellar 1996) and is the only comprehensive national network with ongoing ecological (biotic and abiotic) research and monitoring across terrestrial and marine ecozones. The network provides secure, instrumented, and accessible sites; these sites have the flexibility to arrange for interested and qualified people to undertake specific studies of interest; they allow access to data, biological inventories, past research results, and synthesis on site and at distance; they permit access to other disciplines and data sets, nationally and internationally; and they integrate data into the ESC/site databases.

## III. ELEMENTS NEEDED

Full implementation of a National Biodiversity Strategy is beyond the capability of EMAN, but nonetheless EMAN can make a significant contribution, particularly with respect to Goal 2 of the Canadian Biodiversity Strategy dealing with Ecological Management and the sections on Inventories, Data and Information Management, and Monitoring. There are three stages evident to full implementation. They are presented as a consecutive sequence but in practice can be implemented concurrently. The stages are Stage I — five- year capacity building; Stage II — information gathering, analysis, and technology development (long term up to 25 years); and Stage III — fully implemented monitoring program.

## Stage I: Capacity-building

### *Regional Cooperation with the Museum Community*

Museums are the repositories of the national biodiversity database. In some cases they have a legislated mandate to document biodiversity. Part of that mandate entails the long-term curation and storage of specimens, maintenance of electronic databases that document biodiversity and the dissemination of knowledge derived from specimens and databases. Analysis of change depends on comparison of monitoring data with baseline data collected in the past and stored by museums. Cooperative agreements should be developed between regional museums and EMAN with respect to voucher specimens, provision of synoptic collections, maintenance of georeferenced data, and data interpretation within the National Ecological Framework for Canada.

### *Initiation of Species Diversity Assessments at the Ecozone Level*

Species diversity assessments provide a realistic overview of existing biodiversity in broadly selected groups where adequate knowledge and expertise exist. They provide a breakdown of species by ecoregion (within the 20 ecozones) and habitat, where possible, and indicate numbers of endangered species, the percentage exotic species, and point to overall trends of change in individual species or in species assemblages. They are accomplished through retrospective capture of existing data from specimens in museums, from databases, and from published sources. They are, in effect, the "literature search" that is performed so that resources can be committed to acquiring new data in the most effective manner possible. The Species Diversity Assessments can also contribute to the development of species checklists and distributional atlases for Canada. EMAN has completed one Species Diversity Assessment (Mixedwood Plains ecozone). Realistic costing of the assessments is about $150,000 per ecozone. Multisectoral agreements to proceed with an implementation plan could target completion of Species Diversity Assessments for all ecozones within five years.

### *Development of Sampling Protocols and Integration With International and Multinational Programs*

Among the recommendations arising from the Halifax National EMAN meeting (ESC News, spring 1996) was a call for continued development of long-term biodiversity monitoring methodologies and protocols. Draft protocols have been prepared for most groups of organisms in marine, freshwater, and terrestrial ecosystems and will be made available as a manual through the EMAN Biodiversity Science Board. EMAN and the Biodiversity Science Board encourage integration of biodiversity

information across international boundaries by using the National Framework and by adopting, where applicable, sampling protocols used in international projects. Most of the protocols used in the ITEX (International Tundra Experiment) have been incorporated into the protocols mentioned above. SI/MAB plots, the key element of the Smithsonian Institution/UNESCO Program on Man and the Biosphere Biodiversity Program, are already in place at many of the forested EMAN sites across Canada.

### *Training of Highly Skilled Personnel in Systematics*

There is an urgent need to produce highly skilled personnel in systematics if a national biodiversity strategy is to be implemented. Systematists are the human resource component that allow us to identify, organize, and communicate biodiversity in a meaningful way. There has been a steady erosion of systematists in Canada over the past 30 years to the point where expertise is available for only about 15% of our biodiversity. Currently, Canada cannot adequately meet its international obligations with respect to biodiversity. This is further compounded by the demographics of the existing personnel (a large percentage approaching retirement or retired) and by the phasing out of systematics programs in universities, government departments, and museums, thereby largely devastating our training capability.

Partnerships need to be developed between the federal departments, provincial departments, the museum community, private sector, universities, and colleges to develop training programs. A series of Biodiversity Chairs, administered through NSERC, could be established in Canadian universities to address the deficit in skilled personnel. Chairs could be established to specialize in different areas like soil invertebrates, higher plants, arthropods, mycology, vertebrates, marine invertebrates etc., so as to ensure a broad base of expertise. If the parallel of the NSERC Industrial Chair Program is followed, Senior Chairs could be established at universities and Junior Chairs at the same or in partner institutions (museums). Funding requirements per Senior Chair for each of five years are about $200,000, and for Junior Chairs about $100,000 per year. Cost of the training program over a five-year period for five Senior Chairs and five Junior Chairs would be about $7,500,000.

### *Integration of Volunteer Programs within EMAN*

The human resources required to implement a national biodiversity strategy are beyond the collective capability of all the institutions in Canada. Volunteer programs must be integrated with existing resources particularly in labour intensive areas like sampling, specimen processing, and routine monitoring. Care should be taken to ensure that the volunteer contributions be of a substantive nature through use of appropriate sampling and processing protocols that will acquire scientifically useful data and with guidance by qualified personnel.

### *Enhancement of National Infrastructure*

The responsibility for specimen storage, curation, and database management ultimately falls to the museum community. Specimens in museums form the primary national biodiversity database. Electronic databases are derived from specimens and are secondary to them. The museum databases are required for analysis of changes detected by monitoring programs. Stage II of this implementation strategy proposes an unprecedented gathering of baseline data on the species in our ecosystems. It is aimed at developing the collective national database to a level where it functions as a powerful tool in the analysis of ecosystem change.

There is a general need for enhancement of the capacity of museums, in universities and governments across the country, to house and curate specimens and to manage the information generated through the implementation of a national biodiversity strategy. This entails funding to increase storage capacity, for data management, and for provision of skilled human resources in the form of laboratory assistants and parataxonomists for curatorial support. There is also a need to establish national and regional centres of biodiversity that have a mandate as museums over the long-term to coordinate the gathering of baseline data, house specimens, absorb orphan collections, and manage and disseminate information. Some museums are already functioning as regional centres of biodiversity, and many of the provincial museums have a legislated mandate to perform those functions. These institutions could, with expansion of their facilities, function as regional centres of biodiversity in a national biodiversity strategy.

### *Development of a Core Biodiversity Capability within EMAN*

Implementation of a national biodiversity strategy requires a core group of biodiversity specialists with the sole mandate to coordinate and effect the national strategy, including the setting of standards for baseline data collection, data analysis, synthesis, the development of monitoring technology, the implementation of the monitoring program, and communication of results. The group should be unencumbered by other mandates and contain a broad range of systematic and ecological expertise assembled with specialists from the various federal sectors, universities, and from the regions. The group falls logically under the auspices of EMAN because of its monitoring mandate and network of sites.

### *Development of a Comprehensive Communications Strategy*

The implementation of a national biodiversity strategy must be clearly articulated to all levels of government and to the public as a long-term national priority. The sectors, regions, and public should be made repeatedly aware of the overall picture and the role they contribute to it. The public should be routinely informed of results and

discoveries arising from this program and be made aware of opportunities to participate through volunteer programs.

**Stage II: Information Gathering, Analysis, and Development of Monitoring Technology**

***Species Baselines of the Ecoregions and the EMAN Sites***

It is not possible to monitor all species, nor is it possible to assess changes in a few species without a baseline reference to the appropriate natural system. The acquisition of biodiversity baselines from unmodified sites in all ecoregions and for all EMAN sites is the single most important component of a national biodiversity strategy. Baselines are data sets against which similar, usually smaller, collections of data can be viewed in perspective to provide an interpretation that reflects ecosystem reality. The existence of baselines is a prerequisite for the analysis of change. The inventory of species sets the stage for development of monitoring technology while acquiring a national database that functions as a powerful tool in the analysis of ecosystem change. The implementation of monitoring programs can then be based on a broad and detailed knowledge of species in our ecosystems. The acquisition of baseline inventories is costly and limited by the availability of skilled people. Acquisition of baselines will have to be coordinated across sectors and regions, and prioritized; it should be viewed as a long-term exercise. Long-term stable funding will be required to produce the baseline species inventories for the ecoregions and at all EMAN sites across Canada.

***Development of Biodiversity Monitoring Technology***

The information from the species baselines can be used to develop monitoring technology. In order to be cost-effective biodiversity monitoring must use a subset of species as a proxy for total biodiversity in an ecosystem. Species will be selected for monitoring for a number of reasons. From the baseline, a central suite of species should be selected, that provides representation of all levels and functions within each size class of biota existing across major physical and chemical gradients in the ecosystem. The approach can be experimentally tested and customized for each ecozone prior to implementation of a monitoring program.

**Stage III: Implementation of Long-Term Biodiversity Monitoring**

***Full Implementation of Monitoring Programs***

Sustainable management of biodiversity depends on the availability of realistic information about ecosystems. Monitoring programs assembled within the context of baseline inventories can provide that information. EMAN has implemented or

assisted with a number of monitoring programs across Canada. These include the SI/MAB plots established to monitor change in woody plant communities; plantwatch programs to monitor flower phenology; and earthworm monitoring to assess change in the macroinvertebrates of soil ecosystems. Unless these monitoring programs can be linked to ecosystem baselines, all they do is describe change without context. The baseline provides the contextual reference to the appropriate natural ecosystem that is necessary to assess the rates of change or stability in the biodiversity in our ecosystems.

## IV. CONCLUSION

The management of biodiversity for use by future generations is one of the guiding principles of the United Nations Convention on Biodiversity to which Canada is signatory. Canada's response to the Biodiversity Convention is embodied in the Canadian Biodiversity Strategy, which, among other things, calls in Goal 2 for inventories, information management, and monitoring as a means to sustainably manage biodiversity in our ecosystems. EMAN's Contribution to the Implementation of the Canadian Biodiversity Strategy outlines the elements in place and sets forth the elements needed to implement Goal 2 of the Canadian Biodiversity Strategy. Full implementation of the Canadian Biodiversity Strategy Goal 2 is beyond the capability of EMAN. It requires multisectoral support and encouragement across the federal government departments, the support and encouragement of provincial, regional and municipal governments in partnership with First Nations, universities, industry, environmental organizations, and the Canadian public if the Canadian Biodiversity Strategy is to be implemented. The implementation of the full monitoring program called for in the National Biodiversity Strategy is a huge undertaking. It is only with the full cooperation and coordination of all stakeholders that the baseline information on natural ecosystems can be acquired. This information is essential as it provides the context for long term monitoring programs in answering the question — what is changing in our ecosystems and why?

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## BIODIVERSITY SCIENCE BOARD MEMBERSHIP 1996/1997

Keith Egger
Natural Resources & Environmental Studies
University of Northern British Columbia
333 University Way
Prince George
British Columbia V2N 4Z9

Albert Finnamore (Chair)
Provincial Museum of Alberta
12845 102 Avenue
Edmonton, Alberta T5N 0M6

Lynn Gillespie
Canadian Museum of Nature
P.O. Box 3443, Station D
Ottawa, Ontario K1P 6P4

Ole Hendrickson
Natural Resources Canada
Canadian Forest Service
580 Booth St.
Ottawa, Ontario K1A 0E4

Greg Henry
Department of Geography
University of British Columbia
Vancouver
British Columbia V6T 1Z2

Tom Hutchinson
Trent University
Watersheds Ecosystem Graduate Program
Peterborough, Ontario K9J 7B8

Don MacIver
Atmospheric Environment Service
Science Assessment & Policy Integration
4905 Dufferin St.
Downsview, Ontario M3H 5T4

Henri Ouellet
175 avenue de la Citadelle
Hull
Québec J8Z 3L9

Gerhard Pohle
Huntsman Marine Science Centre
Atlantic Reference Centre
Brandy Cove
St. Andrews, New Brunswick E0G 2X0

Patricia Roberts-Pichette (Secretariat)
Ecological Monitoring Coordinating Office
7th Floor, Place Vincent Massey
351 St. Joseph Blvd.
Hull, Quebec K1A 0H3

David Rosenberg
Department of Fisheries and Oceans
Freshwater Institute
501 University Crescent
Winnipeg, Manitoba R3T 2N6

Geoff Scudder
Department of Zoology
University of British Columbia
6270 University Boulevard
Vancouver
British Columbia V6T 1Z4

Ian Smith (Special Advisor)
Biological Resources Division,
ECORC, Agriculture and Agri-Food Canada, Research Branch
K.W. Neatby Building
C.E.F. Ottawa
Ontario K1A 0C6