

The State of Biodiversity Information



in Canada



Room 2091, 960 Carling Avenue
Ottawa, Ontario
K1A 0C6
www.natureserve.ca

Natureserve Canada contributes to the conservation of Canada's biodiversity by providing scientific data and expertise about species and ecosystems of conservation concern to support decision making, research, and education.

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Natureserve Canada
Room 2091, 960 Carling Avenue
Ottawa, Ontario K1A 0C6
613-759-1861
www.natureserve.ca

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Dwarf Willow, Least Willow, or Snowbed Willow (*Salix herbacea*) - Marilyn Anions

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by

Douglas Hyde

Hans Herrmann

R.A. Lautenschlager

May 22, 2010

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This report was reviewed and approved by the NatureServe Canada Board of Directors. NatureServe Canada, established as a national not-for-profit conservation organization in 1999, also represents the Canadian section of NatureServe. Headquartered in Ottawa, NatureServe Canada represents Canada's conservation data centres (CDCs – located throughout Canada). CDCs use their scientific and data management expertise to serve the conservation information needs of government, corporations, researchers, conservation groups, and the public.

Foreword

Does Canada have the information needed to report effectively about its natural heritage? Do we have the information required to manage pressures such as development, alien invasive species, or climate change - known to affect Canada's species and ecosystems? What information do we need to conserve our biodiversity? This report raises basic concerns about Canada's environmental priorities. Are we meeting national and international obligations and are we focusing on the right things? By focusing on broad-scale issues, some of which we can do little about, have we ignored the need to build basic capacity and establish the foundation needed to adapt, conserve, and protect Canada's natural heritage, its environment? Are we taking action before we have the basic information needed to ensure our efficiency and effectiveness?

Through its network of conservation data centres, NatureServe Canada plays an important role as a steward of natural heritage or "biodiversity" information in Canada. Many other organizations are involved in developing, managing, and sharing such information - as noted in this report. What makes NatureServe Canada unique is the broad scale of its approach, both geographically and taxonomically. Natural heritage methods involve listing known biodiversity "elements" (i.e., species and ecosystems) for all of Canada, developing rarity ranks among those elements, and then focusing further information collection efforts on elements ranked as a conservation priority. Taking such an integrated, national-level (and beyond) approach is unique in Canada.

By looking at sources of accessible data, including those of NatureServe Canada, this report reveals gaps in Canada's information holdings. To enable conservation action and effective reporting about biodiversity, an important new priority for Canada emerges: to survey, inventory, and monitor our biodiversity through the joint efforts of conservation data centres, academics, citizen scientists, industry, and governments. Such science, underpinned by a requirement for data sharing and accessibility, is fundamental to sustainability in the 21st century. It is not the first time such a call has been made in Canada. Perhaps in this *2010 International Year of Biodiversity*, it is time to listen.

Executive Summary

To understand the state of biodiversity in Canada, it is important to understand the state of available biodiversity information.¹ Effective biodiversity information allows assessments of ecosystem health, the state of at-risk species, the location and distribution of invasive species, and changes in species numbers or distributions. Canada needs biodiversity information to manage, respond, and adapt to a variety of environmental changes (e.g., climate) through time. Such information is critical to Canada's Biodiversity Outcomes Framework, and to meeting commitments set out in the Convention on Biological Diversity.

Biodiversity itself has intrinsic, economic, social, cultural, and evolutionary value as well as providing a variety of ecosystem services. Biodiversity occurs at local (fine) through broad scales and encompasses genetic, species, and ecosystem diversity. Primary biodiversity information identifies, locates, and communicates the status of biodiversity at different scales. The biodiversity information required for managing species and ecosystems must be supported by accurate, consistent, science-based data, which is developed by biologists, ecologists, and other experts.

This report, which outlines the state of primary biodiversity information in Canada, is based on (1) a review of available literature including biodiversity-related legislation, policies, and initiatives; (2) known sources of Canadian biodiversity information, in particular data held by the NatureServe Canada network of conservation data centres and the Global Biodiversity Information Facility;² and (3) interviews with selected key experts (Appendix 1).

This review found that Canada's biodiversity information requires dramatic improvement if it is going to serve Canadian needs. Specifically, it found that:

1. Canada does not have ready access to the biodiversity information needed to understand its natural heritage or assess the shared outcomes set out in Canada's Biodiversity Outcomes Framework.
2. Canada has significant data holdings for some taxonomic groups (e.g., birds, mammals), largely developed in response to legislative priorities or opportunistic data gathering efforts, yet, in most cases, that information is inaccessible or inconsistent.
3. Canada lacks both an understanding of its species diversity and a national inventory program designed to develop primary information for known species.
4. Canada does not have a national biomonitoring system that works across scales and builds on existing initiatives, nor the depth of interpretive expertise required to monitor ecological change. Canada needs to invest in biomonitoring and mapping (including remote-sensing and other related technologies).

¹“Biodiversity information” is a combination of consistent, science-based data about species (which encompass genetic diversity) and ecosystems and the biological/ecological expertise required to ensure that data are accurate and consistent.

² There are a large number of biodiversity information holders in Canada; these two sources were chosen because they uniquely aim to capture biodiversity information for all taxonomic groups for all of Canada.

5. Canada lacks investments in taxonomic expertise (capacity) and digitized data (presently held as “hard-copy” in Canadian collections). It is ill-prepared to respond to issues like species extinction potentials, invasive species, and climate change.
6. Canada needs to promote biodiversity information sharing and access, including one or more common repositories, and remove cultural and institutional barriers that keep information fragmented.
7. Canada needs to complete efforts to classify and map ecological communities (wetlands, grasslands, arctic tundra, etc.) as a complement to species data, and as a means of exploring and enhancing its understanding of Canadian ecosystems.
8. Canada’s approach to biodiversity information management must be based on a strategy that recognizes the shared, multi-jurisdictional mandate and responsibility for biodiversity conservation.
9. Canada needs an effective ***national*** biodiversity information partnership among federal, provincial, and territorial agencies that includes non-government, academic, aboriginal groups, and the business community.
10. Institutions in other countries, in particular the United States, publish more primary information about Canadian biodiversity than Canada does.

In the short-term, priority for discovery and biodiversity information development should be given to: (a) regions facing rapid environmental change, where there is a lack of baseline data, particularly in Canada’s North; (b) regions with highly valued ecosystem components, such as wetlands or other areas of high conservation value; (c) regions with rapidly growing human populations and related development; (d) known biodiversity “hot spots; and (e) taxa that are poorly known in Canada.

The growing demands of Canadian society exceed the current supply of biodiversity information required to protect and conserve our natural heritage. To be effective, Canada needs an appropriately funded and staffed primary steward of biodiversity information. It needs a non-advocacy group that gathers, maintains, and provides that information, addresses legislative priorities and emerging policy issues, links economic and social development, and informs decision making.

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Introduction

Biodiversity has intrinsic, economic, social, cultural, and evolutionary value and it provides a variety of ecosystem services³. It ranges from local (fine-) to global broad-scale and encompasses genetic, species, and ecosystem diversity. The United Nations International Year of Biodiversity (2010) is an appropriate time to consider Canada's capacity to report on progress in meeting commitments to the conservation and sustainable use of biodiversity.

Accessing current information about Canada's biodiversity is fundamental to reporting on progress in meeting our international biodiversity commitments. When Canada signed the United Nations Convention on Biological Diversity in 1992, it committed to implementing policies and practices that encourage the conservation and sustainable use of our biological resources.⁴ At that time, Canada and other signatories feared that biological diversity was being significantly reduced by human activities and that there was a general lack of information and knowledge regarding biological diversity. In addition, all recognized the urgent need to develop scientific, technical, and institutional capacities to provide the basic understanding required to plan and implement biodiversity conservation measures.

Since 1992, international reports and organizations have documented the effects of human activities on biodiversity around the world. The Millennium Ecosystem Assessment revealed that approximately 60 percent of the ecosystem services on earth are being degraded or used unsustainably.⁵ In 2009, the International Union for the Conservation of Nature (IUCN)⁶ revealed, through its Red List, that 36% of the more than 47,000 species assessed by the IUCN in the world are threatened, a 14% increase since 1998.⁷ In addition, the third Global Biodiversity Outlook identified similar trends, including that the average abundance of individual species declined by 40% between 1970 and 2000 and ecosystems have been negatively affected by biodiversity loss.⁸

To varying degrees (the exact extent of which is unclear) Canada faces similar challenges. Canada's General Status Program⁹ examines and reports on the status of species in Canada.¹⁰ However, it does not provide detailed data about species abundance, explore reasons why species are of conservation concern, or examine the large variety of taxonomic groups that may be of concern. In addition to exploring the status of species, Canada has only started exploring the status and trends of its ecosystems.¹¹

Recent efforts to assess species at risk, for example, by the Committee on the Status of Endangered Wildlife in Canada, indicate that habitat loss, invasive species, direct or incidental over-harvesting, and changing climate all threaten Canada's biological resources.¹²

³ Services that support life on earth.

⁴ Convention on Biological Diversity, 5 June 1992, Can. T.S. 1993, No 24. The Convention was drafted in June 1992; Canada signed in June and ratified in December of the same year.

⁵ Millennium Ecosystem Assessment, 2005. *Ecosystems and Human Well-being: Synthesis*. Island Press, Washington, DC.

⁶ All acronyms are defined in Appendix 6.

⁷ Information on the Red List is available here: <http://www.iucnredlist.org>.

⁸ Secretariat of the Convention on Biological Diversity, (2006) *Global Biodiversity Outlook 2*. Montreal, 81 + vii pages.

⁹ See: <http://www.wildspecies.ca/> as at March 18, 2010.

¹⁰ Canada has tried to develop an effective reporting tool called the Canadian Biodiversity Index to enable decision makers to foresee and forestall problems; developing such an index has proven to be difficult.

¹¹ See: <http://www.cbin.ec.gc.ca/cadre-framework/ecosysteme-ecosystem.cfm?lang=eng> as at March 18, 2010.

¹² *Threats to Endangered Species in Canada*, Oscar Venter, Nathalie N. Brodeur, Leah Nemiroff, Brenna Belland, Ivan J. Dolinsek and James W. A. Grant, In: *BioScience*, November 2006 / Vol. 56 No. 11, pp 903-910.

Biodiversity management is complicated in Canada by diverse and in some cases, shared responsibility for sustainable outcomes.¹³ For species that move across political boundaries in Canada, the federal government has a leadership role in coordinating conservation efforts and managing Canada's natural heritage. It also has a leadership role in meeting international commitments, a fiduciary responsibility in relation to aboriginal peoples, and a responsibility for managing lands in Canada's North.

Although the federal government has been working toward more coordinated and comprehensive reporting and some biodiversity data collection and sharing, Canada's Commissioner for the Environment and Sustainable Development (CESD) has repeatedly pointed out that there is no overall picture of the state and trends of biodiversity in Canada. In 2001, 2005, and 2008 reports, the CESD observed that commitments to improve Canada's capacity to understand biodiversity and manage biodiversity information have not been fulfilled. For example, the Commissioner noted that a federal commitment to develop a strategy to enhance biological information by the fall of 2002 was not met, even though the Biodiversity Knowledge and Information Network was nearly set in place. The Commissioner also observed that there is no consolidated comprehensive report, underpinned with evidence and a systematic approach to the collection and sharing of biodiversity data, about the state of biodiversity in Canada. The extent to which this lack of information limits Canada's ability to conserve biodiversity, use it sustainably, and reduce its loss affects our ability to address issues such as invasive and endangered species effectively. It also has implications for Canada's ability to understand and adapt to climate change.

Still, the CESD has acknowledged progress in making biodiversity information available through effective technologies and through partnership-based approaches. Examples noted by the Commissioner include NatureServe Canada, a key steward of biodiversity information in Canada, and the Canadian Biodiversity Information Facility.

Provincial and territorial agencies work with NatureServe Canada to capture biodiversity information through its network of conservation data centres. As a result, the NatureServe Canada network has some of the most comprehensive information on biodiversity in Canada. In addition, the Canadian Biodiversity Information Facility (CBIF) hosted by Agriculture and Agri-food Canada facilitates the sharing of observation and specimen data held in collections across Canada and contributes to the Global Biodiversity Information Facility (GBIF).¹⁴ In addition to Agriculture and Agri-food Canada, other departments and agencies involved include Environment Canada, Fisheries and Oceans Canada, Natural Resources Canada, and the Canadian Museum of Nature. Through GBIF, Canadian researchers and decision makers are able to access information from datasets held around the world. Information held by NatureServe Canada and GBIF are used extensively in this report.

¹³ See *Canada's Biodiversity Outcomes Framework* at <http://www.cbin.ec.gc.ca/cadre-framework/default.cfm?lang=eng> as of March 18, 2010.

¹⁴ GBIF contributions in Canada do not occur only through CBIF; there are a number of other direct connections between Canadian biodiversity databases and GBIF. This is explored in "Current Biodiversity Information Holdings", the fifth section in this report.

Purpose

This report identifies the state of primary biodiversity information in Canada, and highlights potential directions required to address identified gaps. It is based on (1) a review of available literature including biodiversity related legislation, policies, and initiatives; (2) known sources of Canadian biodiversity information, in particular data held by the NatureServe Canada network of conservation data centres and the Global Biodiversity Information Facility; and (3) interviews with selected key experts (Appendix 1). Expert input was facilitated by an “interview guide” (Appendix 2) designed to provide interviewees with a standard base of knowledge and outline of the questions that would be discussed.

This report defines biodiversity information in order to clarify scope; explores the quality and level of information needed based on a brief review of policies and legislation; identifies information gaps based on interviews and a review of existing data; and highlights key findings.

Defining Biodiversity Information

To review the state of Canada’s biodiversity information, it is important to define biodiversity information, which consists of three components: ecosystem, species and genetic diversity and the biological/ecological expertise required to gather, review, and understand these. Each of these components represents related domains of information—ecosystems and ecosystem diversity are made up of species and encompass species diversity, and species are a reflection of genetic diversity. Unlike genes, both ecosystems and species can be readily observed. Assemblages of species and their unique relationships to biotic and abiotic components within their physical environment is what allows ecosystems to be distinguished.

This report considers information about observable components of Canada’s biodiversity as “primary biodiversity information”. To manage biodiversity and inform decisions that affect these components, primary biodiversity information addresses the following:

- What are the identities and details of Canada’s observable biodiversity components (species and ecological communities)?
- Where do these biodiversity components occur in Canada?
- What are the status and/or trends of individual components of biodiversity?

Information that addresses these questions is fundamental to the management of biodiversity and must be supported by accurate, consistent, science-based data. The link to data is fundamental—data are simple facts that must be reviewed by experts, processed, organized, and presented in context to make them “information”. For example, an observation of a species in the wild is “data” and to be meaningful information, it must, at a minimum, accurately identify attributes of the observation: species, date, and location. Each of these attributes constitutes data that can be stored but which have no meaning when considered in isolation—to be meaningful, these data must be considered together. Meaning increases when such information is considered in context, for example, with other observations. The process of developing such data and understanding the relationships among data is critical, and is based on biological and ecological expertise. Expertise therefore is a fundamental part of putting biological/ecological data in context and creating biodiversity information.

It is important to note that other aspects of information can be derived from this primary information. For example, best practices such as development offsets or conservation plans, were not considered within the scope of the report.

Demand for Biodiversity Information

In Canada, biodiversity information provides the foundation for legal requirements and policy aimed at the protection and sustainable use of species and ecosystems. To identify gaps in Canada's legal and policy framework, the Convention on Biological Diversity (CBD) stimulated a review of legal and policy tools to support implementation of the CBD, as well as a range of other international commitments made by Canada.

In 1996, the Canadian Institute for Environmental Law and Policy prepared a report¹⁵ that noted that Canada's constitutional framework and mixed responsibilities were ill suited for biodiversity conservation and sustainable use. The report highlighted the policy and legislative initiatives required to meet Canada's commitments under the CBD. Specifically, it cited the following needs:

- Federal and some provincial legislation and policies regarding species at risk;
- Strengthening environmental assessment procedures;
- Comprehensive law and policy for wild, non-commercial, plant species conservation, both in situ and ex situ; and
- Mechanisms to ensure "ecological integrity" within and surrounding protected areas.

Governments of Canada have addressed several of these and have worked towards a cooperative, integrated approach to biodiversity conservation. A foundation for this effort has been the Canadian Biodiversity Strategy (CBS) developed by a federal, provincial, territorial Biodiversity Working Group.¹⁶

A commitment to enhance and manage biodiversity information

Canada's primary response to the CBD was the Canadian Biodiversity Strategy, which outlines research needs and specific commitments designed to enhance and manage biological information. The strategy, under Goal 2, identifies the need to support research, develop traditional knowledge, and conduct inventories; and it outlines the following needs:

Improve and enhance biophysical inventories at ecosystem, species, and genetic levels, by: (1) developing and applying regionally integrated landscape-level classification systems for terrestrial, fresh water, and marine areas and provide a framework for inventories and the management of resources; (2) identifying linkages among biological inventories, soils, climate, and other surveys; and (3) increasing biological inventory efforts, based upon jurisdictional priorities with consideration of: vulnerable, threatened; and endangered species and ecosystems; critical habitats; poorly studied taxonomic groups; taxonomic groups of economic importance; areas of high diversity; and areas where human development and disturbance are significant.

Enhance coordination among government agencies, museums, and other organizations and individuals that conduct biological and biophysical inventories by: (1) developing means to identify sources of funding and determining priorities for inventories; and (2) identifying and developing mechanisms to ensure that there is adequate expertise, including taxonomists,

¹⁵ *Biodiversity Law and Policy in Canada: Review and Recommendations, 1996. Canadian Institute for Environmental Law and Policy, Edited by Ian Attridge.*

¹⁶ *Federal-Provincial-Territorial Working Group, Canadian Biodiversity Strategy: Canada's Response to the Convention on Biological Diversity (Ottawa: Minister of Supply and Services Canada, 1995).*

biosystematists, parataxonomists, museum professionals, ecologists, and genetic biologists, to conduct inventories.

- Develop reliable and cost-effective biological inventory methods and techniques.
- Maintain or enhance the capacity of museums and other institutions, including conservation data centres to scientifically describe, classify, and store collected specimens, and enhance their ability to effectively disseminate data and information.
- Continue to establish networks of conservation data centres to represent all of Canada and to develop and harmonize databases for, among other things, vulnerable, threatened, and endangered species and ecosystems.
- Improve inventories to determine the genetic diversity of domesticated and non-domesticated biological resources and maximize the conservation and economic use of genetic resources.
- Collaborate with other countries to inventory migratory species and their habitats and transboundary species that are at risk.
- Investigate and implement means to enhance the collection, sharing, analysis, scope, and distribution of relevant data and information.
- Promote the continuing development of information management systems such as Geographic Information Systems and other technologies that facilitate the rapid analysis and distribution of biological and biophysical data and information.
- Work towards ensuring that data and information generated by publicly funded studies are made available to potential users through appropriate sharing arrangements.
- Participate in developing and maintaining appropriate international databases.

It is important to note that the CBD and CBS have continued to guide biodiversity conservation efforts in Canada. The CBS was the basis for the “Accord on the Protection of Species at Risk” in 1996, which in turn led to the development of the federal Species at Risk Act (SARA) and the development of Canada’s General Status Program. Commitment to the vision of the CBS was reaffirmed in 2006 with the development of Canada’s Biodiversity Outcomes Framework.

Federal legislation and strategies related to biodiversity

The CBS highlights the broad range of initiatives needed for Canada to manage biodiversity effectively. Federally, a number of legal tools and strategies facilitate the management and protection of biodiversity. They highlight the importance of primary biodiversity information to achieve specific objectives. While most of these predate the Convention on Biological Diversity and the Canadian Biodiversity Strategy, others, like SARA, are responses to identified gaps. A list of key federal legislation, including the information required to support their implementation, is outlined in Table 1.¹⁷

Given the time it takes to develop biodiversity information, and the directions set out by the Canadian Biodiversity Strategy, it is important to note that a number of gaps still exist in Canada’s legislative and policy coverage. Canada’s legislation and policies focus primarily on “mega-fauna” and key species with commercial or economic value.

¹⁷ Details about the mandate of agencies who implement these legislative tools, and/or make up the Federal Biodiversity Information Partnership are provided in Appendix 4.

Table 1: Key federal legislation, purpose/scope/details, information requirements, and responsible agencies/departments.

Federal Legislation	Purpose/Scope/Details	Biodiversity Information Requirements	Key Agencies/ Departments
<p>Species at Risk Act (SARA), 2003</p>	<p>To prevent Canadian indigenous species, subspecies, and distinct populations of wildlife from becoming extirpated or extinct, and contribute to the recovery of endangered or threatened species, and to manage species of special concern to prevent them from becoming endangered or threatened.</p> <p>Establishes the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as an independent body of experts responsible for assessing and identifying species at risk.</p> <p>COSEWIC’s assessments are reported to the Minister of the Environment and to the Canadian Endangered Species Conservation Council. It authorizes the Governor in Council to establish, by regulation, the official list of species at risk.</p> <p>The Act requires that the best available information is used in completing assessments, developing recovery documents, identifying critical habitat, and monitoring progress-achieving recovery.</p> <p>It includes permitting provisions and allows for orders and/or regulations to be set in place.</p>	<p>The identity, location, and distribution of 506 (and growing) listed, species at risk, and the abundance (status) of species and their habitat requirements.</p> <p>Identifying critical habitat based on best available information.</p> <p>(There is some overlap in information needs with the Fisheries Act and the Migratory Bird Convention Act for aquatic and migratory bird species listed as at risk.)</p>	<p>Environment Canada</p> <p>Fisheries and Oceans Canada</p> <p>Parks Canada Agency</p>
<p>Canada National Marine Conservation Areas Act, 2002 (CNMCAA, or NMCA)</p>	<p>Marine areas managed for sustainable use and containing smaller zones of high protection. They include the seabed, the water above it, and any species, which occur there. They may also include wetlands, estuaries, islands, and other coastal lands.</p>	<p>The identity, distribution and abundance of marine species and areas of ecological importance or sensitivity zoned for protection.</p>	<p>Parks Canada Agency</p>
<p>Canada National Parks Act, 2000 (and related Acts and Regulations)</p>	<p>To protect and present outstanding representative examples of natural landscapes and natural phenomena that occur in Canada’s 39 natural regions. These wild places, including: mountains, plains, boreal forests, tundra, lakes, glaciers, and much more, located in every province and territory, protect the habitats, wildlife, and ecosystem diversity representative of - and sometime unique to - Canada’s natural regions.</p> <p>A key focus, and first priority in park management is the maintenance or restoration of “ecological integrity”, through the protection of natural resources and natural processes.</p>	<p>The identity, distribution and status of species within parks and in the greater park ecosystem; the identity, distribution, and status of ecosystem components, including vegetative communities</p>	<p>Parks Canada Agency</p>

Federal Legislation	Purpose/Scope/Details	Biodiversity Information Requirements	Key Agencies/ Departments
Oceans Act, 1997	<p>Establishes authority over an Exclusive Economic Zone (EEZ) covering almost five million square kilometres of the Atlantic, Pacific, and Arctic Oceans. Canada's jurisdiction covers economic activity, scientific research, and protection and preservation of the marine environment.</p> <p>Outlines an ecosystems-based approach to marine resource management, which consolidates federal management of oceans and coasts. Under the Act, Marine Protected Areas may be created for the purpose of conserving living marine resources that are of interest economically, threatened, or endangered and that are areas of high or unique biodiversity.</p>	The identity, distribution and abundance of specifically defined marine species.	Fisheries and Oceans Canada
Migratory Birds Convention Act, 1994; Migratory Bird Regulations	<p>To implement protect and conserve migratory bird populations, individual birds, and their nests.</p> <p>During migrations, many bird species traverse parts of Canada, the United States, and beyond; many of these are used as food or destroy insects which damage forests, forage, and other plants, including agricultural crops; nevertheless a lack of adequate protection results in many being killed during migration or during the nesting season.</p>	Identity, location, and distribution of 726 migratory bird species as listed in the Act; information about abundance (status) of species and the location of their nests (associated with new regulations).	Environment Canada
Canadian Environmental Assessment Act (CEAA), 1992	<p>To establish a federal environmental assessment process to:</p> <p>(a) ensure that projects are considered in a careful and precautionary manner before federal authorities take associated action in order to ensure that such projects do not cause significant environmental damage;</p> <p>(b) encourage responsible authorities to take actions that promote sustainable development and thereby achieve or maintain a healthy environment and a healthy economy;</p> <p>(b.1) ensure that responsible authorities conduct their responsibilities in a coordinated manner, with a view to eliminating unnecessary duplication in the environmental assessment process;</p> <p>(b.2) promote cooperation and coordinated action among federal and provincial</p>	A key element of CEAA, with respect to biodiversity, is its tie, either explicitly (e.g., Species at Risk Act) or through required permits (e.g., Fisheries Act, Migratory Birds Convention Act), to other federal acts. As such, CEAA implementation requires information about affects on migratory birds, aquatic species and species at risk as identified in these other Acts.	The Canadian Environmental Assessment Agency has strong ties to other federal agencies with responsibility for legislation which triggers CEAA assessments.

Federal Legislation	Purpose/Scope/Details	Biodiversity Information Requirements	Key Agencies/ Departments
	<p>governments with respect to environmental assessment processes for projects;</p> <p>(b.3) promote communication and cooperation among responsible authorities and Aboriginal peoples with respect to environmental assessment;</p> <p>(c) ensure that projects conducted in Canada do not cause significant environmental damage inside or outside the jurisdictions in which the projects are conducted; and</p> <p>(d) ensure opportunities for timely and meaningful public participation throughout the environmental assessment process.</p>		
<p>Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act (WAPPRITA -1992)</p>	<p>Places controls on the illegal trade of wild plants and animals, and prohibits trade or trafficking of endangered species – supporting implementation of CITES.</p> <p>For less threatened species, trade is carefully monitored and regulated through a permit system. In addition to contributing to the conservation of Canadian and foreign wild species, it is designed to protect Canadian ecosystems from the introduction of undesirable species that could harm Canadian species.</p> <p>The Act consolidates existing federal trade controls. No new or additional permits are required for international or interprovincial trade in wild specimens.</p> <p>Under the Act, a person can be prosecuted anywhere in Canada for contravening a provincial law, as well as for violating foreign legislation. In addition, all wild plant and animal species are protected. Previously, only game species and species listed in CITES were protected. The legislation provides for more effective and efficient enforcement and sets higher penalties for failure to comply with the regulations.</p>	<p>The identity, location and distribution of endangered and introduced species.</p>	<p>Environment Canada</p>

Federal Legislation	Purpose/Scope/Details	Biodiversity Information Requirements	Key Agencies/ Departments
Canada Wildlife Act, 1985	<p>Allows for the creation, management and protection of wildlife areas for wildlife research activities, or for conservation or interpretation of wildlife.</p> <p>To preserve habitats that are critical to migratory birds and other wildlife species, particularly those that are at risk.</p> <p>Regulations prohibits all activities that could be harmful to species and to their habitat.</p>	Information about the location and status of target species (birds, aquatic species, species of conservation concern, or species at risk).	Environment Canada
Fisheries Act, 1985 (and related regulations)	<p>Deals with the management of Canada's fisheries resources and the conservation and protection of fish and fish habitat throughout Canada (including private property).</p> <p>Fisheries and Oceans Canada, responsible for conserving and protecting fish and fish habitat throughout Canada, defines fish habitat as: spawning grounds, nursery and rearing areas, food supplies, and migration areas on which fish depend directly or indirectly to live.</p> <p>The habitat protection provisions outlines powers and authorities to protect the unobstructed passage of fish, provide sufficient flow for fish, prevent fish mortality, and prohibit the harmful alteration, disruption or destruction of fish habitat without authorization.</p>	Information about the identity, location, and distribution of fish, and information about abundance (status) of fish species and their habitats.	Fisheries and Oceans Canada

As such, with the exception of the Species at Risk Act, the focus is on mammals, birds and fish, and Canada's federal legal framework does little to support the management of "lesser-known species" such as insects, non-vascular plants, or fungi. For example, although insect species represent approximately 50% of Canada's estimated species richness (roughly 140,000 species)¹⁸, only 26 insect species are listed in the federal Species at Risk Act¹⁹ (about 5% of total listed species).

For species listed under SARA, additional protection is in place, for example, by requiring consideration of listed species under the Species at Risk Act in relation to federal environmental assessment²⁰ irrespective of whether an order to protect such species is in place on either federal or non-federal lands. While this provides some protection to listed species, there has been little effort to address the need for comprehensive law and policy for other wild, non-commercial, species, either in situ and ex situ, as called for by the Canadian Institute for Environmental Law and Policy.²¹

¹⁸ See the Biological Survey of Canada, <http://www.biology.ualberta.ca/bsc/bschome.htm> as at March 19, 2010.

¹⁹ See the SARA Public Registry.

²⁰ The largest impacts on biodiversity currently come from habitat loss, and not climate change or alien invasive species.

²¹ Biodiversity Law and Policy in Canada: Review and Recommendations, 1996. Canadian Institute for Environmental Law and Policy, Edited by Ian Attridge.

It is also important to note that Canada's federal legal framework lacks explicit links between biodiversity and important issues such as climate change and invasive species, although some policy initiatives are in place. For example, in 2004, Canada developed an "Alien Invasive Species Strategy", as a joint federal, provincial, territorial initiative in order to determine identity, location, and distribution of known and suspected alien invasive species. In 2010, the federal budget allocated \$38 million over two years, to reduce the risk of invasive plant and animal species being further introduced to Canada, although the funding does little to address the continued invasion of species already found in Canada. As part of its efforts through the World Conservation Monitoring Centre, the United Nations Environment Program aims to incorporate authoritative knowledge ("expertise") about biodiversity and climate change into its decision making and has outlined the urgent need for accessible information about the likely affects of climate change on biodiversity. As measures to address climate change and cope with its effects are increasingly being developed, analyzing possible benefits and risks to biodiversity and ecosystem services are critical; legal tools have great influence over funding and focusing efforts on these needs. Given that Canada is experiencing effects of alien invasive species (particularly along its southern border) and climate change (particularly in the Far North), linking environmental issues and biodiversity is becoming increasingly important.

The role of international initiatives

A number of important international initiatives have helped to catalyze better information sharing in Canada, create demand for this information and develop an understanding of the state of information in comparison to other countries. One key initiative has been the "Global Biodiversity Information Facility" (GBIF), an international government-initiated and funded initiative focused on making biodiversity data available for scientific research, conservation, and sustainable development.

GBIF provides the following three core services:

- An information infrastructure: an Internet-based index of a globally distributed network of interoperable databases that contain primary biodiversity data (museum specimens, field observations of plants and animals, and results from experiments) so that data providers and users, around the world can access and share them;
- Community developed tools, standards and protocols: the tools data providers and users need to format and share their data; and
- Capacity building: the training, access to international experts, and mentoring programs that national and regional institutions need to become part of a decentralized network of biodiversity information facilities.

It is important to note that international initiatives like GBIF have helped Canada aim for consistency in its data holdings.

Another key initiative is the Integrated Taxonomic Information System (ITIS). To organize its biodiversity information, Canada needs a national list of its biodiversity and staff dedicated to developing and validating Canadian content for all taxonomic groups. ITIS was developed in collaboration with United States and Mexico. ITIS is used by Fisheries and Oceans Canada, which is using it to standardize its regional databases, and by Environment Canada, which recently recommended the use of ITIS Taxonomic Serial Numbers (TSN) as a mandatory data element for trade of wild species under the Convention on International Trade in Endangered Species (CITES). Additionally ITIS is partnering with Species 2000 to produce the "Catalogue of Life", which is published each year and used as the taxonomic foundation for projects such as GBIF, the Encyclopedia of Life (EOL) and others. Although ITIS has potential to become a reference source for Canadian taxonomic information, it is not properly funded, maintained or staffed. It is important to acknowledge, however, that ITIS could provide a foundation for taxonomic consistency across different biodiversity information networks in Canada. This consistency is fundamental to the management and sharing of biodiversity information.

Current Biodiversity Information Holdings

Primary information helps Canada understand its biodiversity, and underpins the planning and implementation of effective legal tools and management actions designed to conserve and sustainably use Canada's biodiversity. For example, when combined with data about land-use patterns, biodiversity information contributes to understanding human-environment interactions at local through broader-scales (including national, international, and global). Understanding the conditions under which an invasive species colonizes a new area can be used to forecast the spread of that species, and understanding disturbance effects on terrestrial ecosystems allows better forecasts of responses of terrestrial ecosystems to land management. The foundation for such analyses is information about the location, status, and distribution of Canada's biodiversity.

For the past decade, rapidly advancing information technologies, digitized data, and databases have revolutionized the way that biodiversity information is created, maintained, distributed, and used. While there are many databases, Canada currently has two fundamental repositories for such data on a national basis: (1) NatureServe Canada, which acquires significant amounts of new observational data annually, captures data held in collections across Canada and beyond, and publishes its data to the GBIF through the NatureServe network, and (2) the Canadian Biodiversity Information Facility (CBIF) which also captures data from collections and observations in Canada and contributes, on a regular basis, to the Global Biodiversity Information Facility (GBIF).

An enormous amount of information about Canada's biodiversity, presently held in individual biological collections, has already been collected. The Alliance of Natural History Museums is formulating a "National Collection Development Plan" to better understand what specimens collections hold and how they can be best stored and used.²² Specimens in these collections are regularly accessed and used in initiatives outside of these institutions. However, to date most of the information associated with these specimens has not been digitized, captured, or shared in a common repository. Based on numbers of specimens held²³, Canada could have in excess of 70 million records, many of which could be geo-referenced. This would represent a majority of the data held for Canadian species diversity, data that is currently functionally inaccessible.²⁴ When biodiversity information is not immediately at hand, it is generally not applied in policy or management decisions that affect the organisms and ecosystems involved.

Summary of GBIF/CBIF data holdings

Although it does not capture all data, the Global Biodiversity Information Facility (GBIF) has much of the data held in association with digitized biological collections and observations from around the world. The GBIF portal provides some basic information about Canadian data. It records 6,361,336 occurrences (observations and specimen data from collections) for 51,209 species²⁵ recorded in Canada. However, many of these may be duplicates or fossil records (GBIF does not attempt to ensure taxonomic information is accurate, unique, or consistent). By comparison, Mexico has 2,995,331 occurrences recorded for 82,687 species, and the United States has 57,387,678 occurrence records for 262,376 species; mostly species found outside of the United States. Although Canada's data holdings may seem impressive, institutions located outside Canada hold the majority, indicating that other countries have greater capacity for biodiversity information gathering and management than Canada has itself. For example, of the more than 6.3 million Canadian occurrence records approximately 60 percent are held in the United States. Indeed, more than 80 percent of the Canadian data held in GBIF is held outside Canada.

²² See http://www.naturalhistorymuseums.ca/index_e.htm as at March 31, 2010.

²³ *ibid.*

²⁴ A recent biodiversity science panel, established by the Council of Canadian Academies, has been conducting a survey of biodiversity collections in Canada in support of an effort to understand the state of biodiversity science in Canada. See <http://www.scienceadvice.ca/biodiversity.html> as at March 19, 2010.

²⁵ See the Canadian Biodiversity Information Facility at <http://www.cbif.gc.ca>. These data are current as of March 5, 2010.

Interestingly, of the 51,209 unique species for which data are recorded by GBIF as being in Canada, less than 20% are insects, roughly 14% are plants and ~6% are vertebrate species. These proportions do not accurately reflect biodiversity in Canada, as insects represent ~50% of known species, plants ~11%, and ~vertebrates 2%, of known species.²⁶ When taken with the fact that ~56% of all GBIF records of Canadian occurrences are for bird species and roughly 75% of all records are for animal species, GBIF data indicates that Canada has an over-representation of data on vertebrate taxonomic groups, not surprising given that Canada’s legal and policy tools are focussed (for the most part) on vertebrate species.

Summary of NatureServe Canada data holdings

Data held by NatureServe Canada provides further insights into Canada’s data holdings; it has data for 48,630 unique taxa (species, taxonomic subspecies, varieties and hybrids) in 10 provinces and one territory (the Yukon), with limited data to date for the Northwest Territories and Nunavut. NatureServe Canada’s network of conservation data centres develops conservation status ranks for these taxa, and actively tracks (gathers observational and specimen data for) those considered to be of conservation concern.

Table 2: A summary of taxa (species, subspecies, varieties and hybrids), tracked taxa and element occurrences held by NatureServe Canada. May 2010

Province/ Territory	Number of Taxa	Number of Tracked Taxa	Total Number of Element Occurrences
YT	3,469	421	185
BC	8,477	1,031	6,726
AB	5,784	1,486	12,559
SK	4,963	1,053	10,395
MB	6,206	974	4,096
ON	13,184	1,819	18,968
QC	7,636	543	10,362
NB	4,178	1,182	16,789
NS	4,271	999	12,180
PEI	2,502	770	4,814
NF	2,415	974	15,864
LB	1,713	660	1,211

Table 2 (above) provides a summary of the number of taxa currently with data and indicates the number of taxa actively tracked by each conservation data centre. Table 2 also provides the total number of element occurrences, a representation of spatial data based on observations developed by each conservation data centre following standards created by NatureServe and implemented by all members of the NatureServe network in Canada, the United States, the Caribbean, Central America, and South America.

²⁶ The exact number of species in Canada is unknown, although estimates place the number at approximately 140,000 species, twice the number of currently known species.

The fact that element occurrences are developed in a consistent manner across the NatureServe network allows cross-border comparisons. For example, a comparison of data holdings between Canada and the United States demonstrates that the United States has much higher densities of spatial data associated with species of conservation concern. Figure 1 (below) provides a map of the distribution of element occurrences held by NatureServe in Canada and the United States.

Figure 1: Distribution of spatial data held by NatureServe in Canada and the United States, as of March 2008.

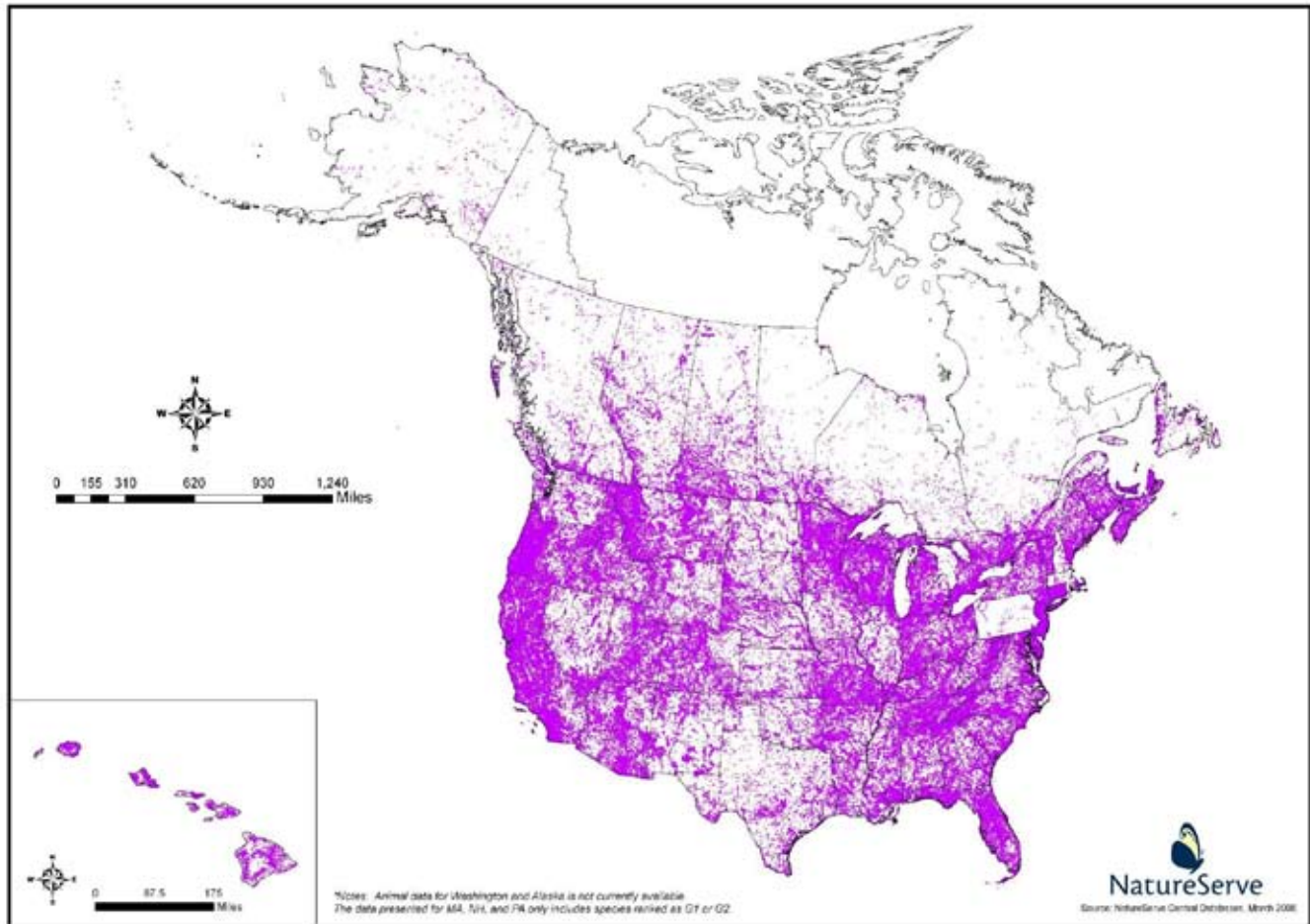


Table 3 (following page) provides, by taxonomic group, a breakdown of data provided in Table 1 (it includes only limited data held by NatureServe Canada for Nunavut and the Northwest Territories).

Table 3: Data by taxonomic group held by NatureServe Canada as of March 2010

Taxonomic Group	Percentage of all species held	Percentage of species tracked in this class
Dicots	34.93	29.60
Insects	22.17	8.28
Monocots	14.55	34.21
Birds	6.75	43.44
Mosses	5.90	37.17
Fungi	5.08	27.04
Fish	2.01	44.01
Ferns and Fern Allies	1.97	44.07
Mammals	1.78	36.38
Gastropods	1.51	23.99
Liverworts and Hornworts	1.02	27.94
Hepatics	0.09	34.29
Hepatics	0.00	0.00
Hornworts	0.02	21.43
Spiders	0.66	1.89
Bivalves	0.39	30.25
Conifers	0.37	37.84
Amphibians	0.28	40.53
Reptiles	0.17	46.67
Branchiopods	0.10	0.00
Turtles	0.10	40.51
Crustaceans	0.07	18.18
Algae	0.06	0.00
Centipedes	0.02	6.25
Sponges	0.01	0.00
Bryozoans	0.01	27.27
Sea Stars	0.00	0.00
Sea Cucumbers	0.00	0.00
Brittle Stars	0.00	0.00
Polychaetes	0.00	0.00
Sea Squirts	0.00	0.00
Diatoms	0.00	0.00
Sea Urchins	0.00	0.00
Worms	0.00	100.00
Chitons	0.00	100.00
Flatworms	0.00	0.00

As for GBIF, these data indicate that Canada has large amounts of data for animal species, vertebrates in particular, as well as plant species. Plant species, including vascular and non-vascular plants, make up more than 53% of the species data held by NatureServe Canada and more than 30% of those are tracked. However, other groups seem unrepresented. Insects for example, which make up greater than 50% of Canada’s known species, represent only 22% of the species data held by NatureServe Canada, and only 8% of those are tracked.

In addition to species diversity, Canada is beginning to track ecosystem diversity, as represented by ecological communities. Table 4 (below) indicates the data on ecological communities held by the NatureServe Canada network. The tracking of ecological communities is a component of biodiversity that is not documented elsewhere, including GBIF or ITIS. As an example, NatureServe Canada, working with NatureServe and based on funding from Suncor Energy Foundation, developed maps of ecological communities in mid-western Alberta, one of the first of such maps developed in Canada. This classification and mapping effort has been completed across the continental United States, and these data inform a range of decisions about forest and grassland management (e.g., fires and pests), and models for predicting species distributions.

Table 4: NatureServe Canada ecological community data as of May 2010.

	Number of Ecological Communities	Number of Tracked Communities	Number of Community Element Occurrences
YT	0	0	0
BC	755	272	255
AB	278	227	109
SK	84	0	0
MB	188	50	70
ON	469	469	293
QC	740	144	668
NB	130*	50	0
NS	108	Incomplete	0
PE	80	72	0
NF	0	0	0
LB	0	0	0

*These numbers are for forests and dunes in NB, and forests only in NS and PE.

Overview and implications

Biodiversity is complex and therefore, having perfect information to inform decisions is likely impossible. Having that information for any one species would be prohibitively expensive and provide diminishing returns to decision makers. In part as a reflection of this reality, the current approach to gathering and sharing biodiversity information in Canada is for the most part piecemeal and opportunistic. Stewards of biodiversity information, both within and outside government agencies, often rely on entrepreneurial approaches to gathering data and attracting resources (e.g., short-term contracts) to generate or manage data. Some of these efforts are captured in existing databases, such as the NatureServe Canada network of conservation data centres or the Canadian Biodiversity Information Facility. New databases are coming online, for example those being developed by Canadensys.²⁷ However, much data is generated in association with conservation projects, local land-use decisions, or environmental assessments, and is not captured by these networks. Support for even this piecemeal approach has been reduced as the recent recession resulted in federal, provincial, and territorial government agencies reducing discretionary spending. This has led to decreased support for effective conservation science and the management of biodiversity information in Canada. The balance between supporting effective economic development while investing in conservation science and biodiversity information collection and management is being lost. Understanding what this balance should be is fundamental to understanding the state of biodiversity information in Canada.

²⁷ Canadensys aims to unlock the specimen information held by Canadian university-based biological collections and share this via a network of distributed databases, compatible with other biodiversity information networks like CBIF and GBIF. For more information visit: <http://www.biodiversite.umontreal.ca/canadensys/>.

Understanding the state of biodiversity information

Understanding the state of biodiversity information in Canada requires the input of experts positioned to assess key questions associated with for instance, information required to inform species and ecosystem-related discussions. It is important to note that information which meets today's needs may not meet tomorrow's needs because of changes: priorities, abundance and distribution of species (relative to human use and the environment), and improved scientific understanding. To understand if Canada has enough information to inform decisions about the conservation and sustainable use of biodiversity, 19 experts were interviewed, chosen for their familiarity with primary biodiversity information in Canada and abroad. A list of these interviewees (Appendix 1) and the interview guide (Appendix 2) are provided at the end of this report. Insights gained from these interviews are presented in the following section.

Perspectives on the state of biodiversity information in Canada

In the first set of questions, interviewees were asked to comment on the current state of biodiversity information in Canada. They indicated that Canada lacks the information required to develop an accurate picture of the state of biodiversity or of the health of Canada's ecosystems. Most indicated that although extensive information about some of Canada's species and ecosystems exist, with the exception of information developed and shared (e.g., CBIF, GBIF) biodiversity information is generally inconsistent, maintained in different formats, uncoordinated, difficult to access, and inadequate.

Interviewees suggested that there is an important gap between the information that decision makers need and the information that is currently available. They indicated that most decision making is currently based on Delphi approaches²⁸, on expert advice, or on old and/or inconsistent data. Some argued that continuing to make decisions on this basis would undermine support for more systematic approaches to the development of needed information.

Most interviewees thought that the current approach to gathering and sharing biodiversity information was, for the most part, piecemeal and opportunistic. There was, however, consensus about the importance of knowing the condition and location of existing data and information. They indicated that systematic inventories of species or ecological communities were lacking. As one interviewee stated, in Canada "we don't know what we don't know". Interviewees indicated that most of the data collected is not uniform in the context of Canada's unique geographic conditions. More information has been gathered in regions where there is some degree of human activity or economic interest, mostly along the southern border of Canada. Information holdings decrease and become more scattered northwards.²⁹

The available biodiversity information was mostly viewed as insufficient for comparisons across Canada. Additionally, interviewees thought information was, for the most part, insufficient for answering basic questions about the effectiveness of strategies, policies, and legislation designed to sustain biodiversity, achieve the outcomes set out in the Biodiversity Outcomes Framework, or

²⁸ The Delphi method is a systematic, interactive forecasting method, which relies on a panel of experts. The experts answer questions in rounds, review an anonymous summary of the results with reasons then rescore earlier answers. During this process the range of the answers decreases and the group converges towards the "correct" answer.

²⁹ The Canadian Museum of Nature is an exception in this regard with a long-term program of species discovery in the North and therefore largest collection of Arctic flora and fauna data in Canada, with extensive digital databases available through GBIF.

meet international commitments. For example, interviewees indicated that there is not a complete list of species and ecosystem elements for Canada. In addition, they noted significant differences in the quantity and quality of existing information among: taxonomic groups, different geographic regions, and the relative importance given to those groups or ecosystems. Canada's most complete biodiversity information occurs for mammals, birds, butterflies, reptiles, freshwater fishes, amphibians, and to a lesser extent, vascular plants. Information for most invertebrates, other species, or ecological communities (which make up the bulk of Canada's biodiversity) is far from complete.

For species that have been inventoried or sampled, interviewees indicated that a large portion of that information (e.g., specimens held in biological collections) has not been digitized and therefore it is basically inaccessible. To make that information more readily accessible, this information needs to be digitized. As biological collections may include a number of unidentified specimens, Canada's taxonomic capacity presents a major constraint. Although they noted exceptions for species of conservation concern, invasive alien species, some other very well known groups, and species of economic interest, interviewees thought that available information for higher level taxonomic groups (Kingdom, Phylum, Class) was better than that at the genus and species level.

Some indicated that Canada's information about terrestrial species was better than that for marine and freshwater species, although data about Canada's marine biodiversity is available through GBIF (about 1.16 million records) and the Ocean Biodiversity Information System. For example, the few systematic surveys and biological characterizations of the eastern and northern coastal biodiversity corridors, has resulted in some primary marine biodiversity information, while primary marine biodiversity information for the rest of the Canada remains scattered and localized.³⁰ With the exception of marine species, listed under the federal Species at Risk Act and other economically important species, there is a general lack of accessible information about the current distribution and abundance of marine species and related ecological communities.³¹

Although a complete list of freshwater fishes was presented in Wild Species 2005, up-to-date freshwater fish abundance and distribution data are currently lacking or represents older data from the 1970s and 1980s. With the exception of the monitoring efforts in Alberta, some scattered sampling in northern Ontario, and an ongoing monitoring program for the St. Lawrence corridor in Quebec, there has not been a systematic survey of Canada's freshwaters in 25 years. The lack of a systematic approach to aquatic species such as fish, similar to terrestrial species, implies that most of the currently available information comes from accident more than design. Canada's information about aquatic invasive alien species has increased dramatically during the last five years, and as a consequence, Fisheries and Oceans Canada is currently leading a nation-wide effort to develop a consolidated database for invasive aquatic species.

At the broad ecoregional (ecozones) level, Canada has scalable ecological classification systems for the terrestrial, marine, and freshwater realms. These system classifications could work to create a seamless ecological framework across North America, and would allow collaborative approaches for ecosystem management to be formulated. These systems are commonly used and consulted by many organizations, particularly those interested in transboundary environmental issues. As an example, in the marine environment, there are general descriptions of large ecosystem units known as Large Ocean Management Areas (LOMAs), which are regions established for planning and implementing integrated-management plans.

While there seems to be good information at the large ecosystem scale, there are major knowledge gaps at the ecological community level, particularly in the classification and mapping

³⁰ Note there are repositories of west coast marine species at the University of British Columbia and the Royal BC Museum.

³¹ A good example of a systematic approach to developing biodiversity information is the Alberta Biodiversity Monitoring Institute. It demonstrates that addressing our deficiencies will be take time and require persistent investment.

of community types. Ironically, throughout Canadian legislation the terms “critical habitat” is used without a standardized means to identify those habitats, establish conservation offsets, or support mitigation initiatives to prevent habitat loss. Having primary information about both species and ecosystems is fundamental to identifying “critical habitat”.

The lack of any standardized ecological community classification and systematic, comprehensive broad-scale inventory and monitoring programs for freshwater ecosystems was a major concern. Presently, there is insufficient information to adequately report on status and trends of freshwater biodiversity at the ecological community level (where management and conservation decisions are made). In light of rapidly changing environmental conditions, particular in the North, there is an urgent need for a national long-term inventory and monitoring program that adopts consistent ecological community definitions and is designed to provide results that can be scaled-up to ecoregions.

Canada also lacks quantitative information about how biodiversity elements support ecosystem functioning and long-term “ecosystem integrity.”³² Further work is required to classify and characterize Canada’s ecosystems, as most of the data about ecosystems and their services is sectoral (forests, agro-ecosystems). While useful for specific purposes, the lack of fine-scale definitions, and an inability to move from fine- to broader-scales (“scaling up”), limits ecosystem management efforts. Priority, in this regard, should be on trans-boundary and cross-jurisdictional ecosystems, where bi-national and provincial cooperation is critical to developing common ecosystem management approaches, avoiding duplication, or working at cross-purposes.

Interviewees indicated that improved biodiversity information collection should focus on: (1) “areas of rapid land-change” (including corridors, development, and fragmentation), (2) “hot spots” (where biodiversity levels are high, or where endemism is high), (3) areas or regions with rapidly growing human populations and associated development, (4) areas where Canada has little data, including the near North (the northern portion of most provinces) and the Far North (north of the 60th parallel), and (5) taxa that are grossly under represented and not understood in Canada.

Perspectives on challenges facing biodiversity information management in Canada

In general, interviewees indicated that challenges related to the collection, management, and use of biodiversity information stem from poor public understanding of the importance of, or threats to, Canada’s biodiversity—our “natural heritage”. Along with its environment and wild and seemingly untouched areas, Canada’s biodiversity is being affected by human activities and environmental changes. The public has generally not made this connection and tends to be focused on issues that affect nature, rather than on nature itself. Therefore, biodiversity receives less attention than issues such as industrial activities, accidents, and climate change even though one reason Canada invests in understanding these specifics is to protect its natural heritage. As a consequence, government has given relatively low priority to biodiversity in relation to other more pressing concerns (e.g., economic recession). This has in turn affected funding for all aspects of biodiversity information: a declining roster of taxonomists; the lack of systematic monitoring; a lack of field work; and inadequate inter-governmental coordination.

³² See <http://www.pc.gc.ca/eng/progs/np-pn/ie-ei.aspx> as at March 31, 2010. It is defined as: “a condition that is determined to be characteristic of its natural region and likely to persist, including abiotic components and the composition and abundance of native species and biological communities, rates of change and supporting processes”³². A good example of a systematic approach to developing biodiversity information is the Alberta Biodiversity Monitoring Institute. It demonstrates that addressing our deficiencies will take time and require persistent investment.

This point is reinforced in the following list of the most significant biodiversity information challenges identified by interviewees, organized by different challenge types.

Challenges related to leadership and governance:

- Politicians and decision makers do not really understand or use primary biodiversity information. They tend to rely on expert advice. Therefore, they place little value on primary information, the foundation (hopefully) for the advice they receive.
- The government's need for biodiversity information is mainly associated with specific legislative or policy requirements (for example, the Fisheries Act, the Migratory Birds Convention Act, the Species at Risk Act, and the Invasive Alien Species Strategy), but biodiversity is much broader than the few species these cover.
- The economics of biodiversity and biodiversity information are not clear. What would be the economic, social, cultural, and environmental effects if Canada lost 10 percent of its endemic biodiversity? Being able to answer a question like that could help justify investing in biodiversity information systems.
- In spite of investments by governments, non-governmental organizations (NGOs), and the private sector in biodiversity information, duplication of efforts remains among many collecting and storing such information. For example, in 2007, the Federal Biodiversity Information Partnership (FBIP) found that there were three independent efforts to develop a checklist of Canada's vascular plants. In addition, the gap between what exists and what is needed continues to grow.
- Biodiversity information is a key federal cross-sectoral issue, and while strong leadership, or effective convening responsibility is seen to be a responsibility of the federal government, the federal government has not yet catalyzed action to ensure systematic, comprehensive approaches to developing and sharing of such information. With some exceptions³³ effective biodiversity information partnerships have not been established among federal and provincial agencies. However, some inter-provincial partnerships have been developed and some key NGOs (e.g., NatureServe Canada, Nature Conservancy of Canada, Bird Studies Canada) have established partnerships in key areas (species of conservation concern, landscape plans, bird species).

Challenges related to collecting information:

- There is no systematic program in place to inventory Canada's species, even on a priority basis. Some interviewees believed this was a more important initiative than digitizing legacy information held in biological collections, although others saw efforts to digitize legacy information as an important complement. All current efforts are opportunistic or in response to a specific, short-term legislative need.
- Declining government spending since the mid 1990s has had a profound effect on Canada's capacity to collect, share, and store primary biodiversity information. The country appears to be losing research expertise and experienced taxonomists across all taxonomic groups. This problem is exacerbated by the widening succession gap created with the retirement of key specialists and the declining recruitment of new professionals in light of limited career opportunities and job prospects.³⁴
- The lack of common collection protocols and the need to adopt international data standards to ensure systematic documentation and interoperability of biodiversity information was seen as one urgent issue limiting effective collaboration. In addition, limited conversion of "hard-copy" ("analog") data stored in museums, universities, etc. to digital format (the bulk of historic data remains analog), and the lack of incentives to digitize the remaining data, limit access to existing data, its sharing, and effective use.
- Reporting on status and trends of ecosystem diversity is hindered by the lack of a national systematic and comprehensive monitoring program that crosses scales and jurisdictions, and the lack of a plan to create such a program.
- There is insufficient investment and support for Canadian biodiversity information management and storage, such as the need to develop and maintain technologies, archiving systems, and support experts from the Canadian biodiversity information management community.

³³ AC CDC (includes three key federal agencies; four provinces; and two NGOs); Quebec CDC (involves one).

³⁴ A recent study assessing botanical capacity in the United States has noted the decline of botanical expertise (as per other disciplines) as a critical challenge of economic and environmental importance. See "Addressing botanical capacity to address grand challenges in the United States", report in brief, by Havens, K, Kramer, A, and Zom-Arnold, B, 2010.

Challenges related to sharing and access:

- The prevailing view of interviewees was that the major problems associated with the sharing and access of information are currently cultural and institutional, not technical, although technology continues to evolve.
- Although some indicated that the situation might be improving, many believe that there is a default mindset (personal and institutional) that restricts access to biodiversity information. With a reward system based on competition and not collaboration, researchers get credit for publishing papers, not for sharing data or making information more available. Interviewees noted this reward system must be reviewed and changed to support data sharing and publishing.
- There are rules and policies in place that implicitly or explicitly restrict the sharing of data assets in many related areas. For example, in areas where the government relies on industry to gather both baseline and monitoring information (e.g., environmental assessments), industry often considers that to be “proprietary information”. Government policy should remove such restrictions, particularly where public funding is involved.
- Current efficient means that ensure that environmental information is available and shared among providers and users does not exist, and information is located in a fragmented universe of non-interoperable repositories.
- Government agencies and departments tend to work independently and they commonly have different biodiversity-related mandates, resulting in different needs and approaches. Some are interested primarily in taxonomy (e.g., Canadian Museum of Nature); while others focus on land management (e.g., Parks Canada Agency); and others focus on resource management (Fisheries and Oceans Canada). This makes interest in and coordination of their various information management systems challenging; organizations are commonly “locked into” their own information management systems, and the underlying data models can limit interoperability.
- Environmental information, even when it is in place, is grossly under-used for decision making. For example, it took 20 years to ban the insecticide carbofuran. It was banned not because of the overwhelming evidence that it was killing millions of birds in North America, but because its use was correlated with increased breast cancer rates in humans.

Perspectives on how to manage biodiversity information in Canada

While interviewees held somewhat different views about how and who should coordinate and lead biodiversity information management efforts in Canada, there was consensus that any management system should be built as a decentralized network of existing databases, where primary information is shared via a central repository. Efforts in Canada to support both CBIF and GBIF represent elements of potential consistency, as does the NatureServe Canada network of conservation data centres. Such a central digital repository could provide geospatial integration of all relevant layers (species, occurrences, range, distribution maps, species assemblages, and ecological community information) and could act as authoritative records about species, communities, or ecosystems. This authoritative record could inform priorities for research and program implementation, and many other decisions. Interviewees also thought that a central repository should be used to support other science-based analysis perhaps drawing on other sources, such as information on stressors or economic activities. The implied vision was to create a focal point for sharing and accessing biodiversity information that would allow multi-relational, dynamic, depictions of information, and that would allow key partners to explore and add value to information as needed.

Regarding the coordination and leadership required to support such a vision, interviewees were split into two distinct groups: several thought that a central, national, perhaps federally led organization (e.g., Environment Canada) would be best suited to lead and coordinate this effort, while others proposed that a coordinating institution separate from the federal government, although funded and supported by many levels of government in Canada, would be less expensive, more responsive, and better reflect the shared interest of different levels of Canadian governments. Interviewees attributed success of “government-led” models, like the National

Commission for the Knowledge of Biodiversity (CONABIO) in Mexico, and to a lesser extent the National Biological Information Infrastructure (NBII) in the United States (Appendix 3 describes the international biodiversity information initiatives), to three fundamental factors: (1) policy relevancy—effectively addressing specific needs with reliable information “products”; (2) sustainability—ensuring long-term, stable public funding; and, (3) good practices—having a focused mandate, and effective management of information through time. Others felt that an arms-length approach could address these same factors.

Interviewees indicated that where they exist, Canada should rely on existing international standards to facilitate biodiversity information management, and develop, and as appropriate, influence standards where they do not exist or are emerging. For example, the available species-based information positions Canada to share information with the world. Most organizations in Canada have already adopted standards that facilitate the exchange of information on a Canadian basis and support Canadian partnerships. Specifically, Canada has adopted the standards promoted by the Biodiversity Information Standards working group or TDWG (“Darwin core”). As Canadian universities work to digitize collections in Canada through Canadensys, they will be able to exchange information with the Canadian Biodiversity Information Facility (which also uses Darwin Core) to share this information within Canada and internationally.

Partnerships are already growing in Canada among members of the NatureServe Canada network, federal agencies, industry, universities, and non-governmental organizations, although resources remain limited. For example, interviewees noted that CBIF, a project of the Federal Biodiversity Information Partnership, has expanded its influence by establishing relationships recently with NatureServe Canada, the Biological Survey of Canada (a not-for-profit organization that helps to coordinate scientific research among specialists on the Canadian fauna), Canadensys (universities working together to unlock the specimen information held in university-based biological collections and share this via a network of distributed databases), and the Barcode of Life (a Canadian-based initiative that provides rapid taxonomic assessments based on genetic information).

Partnerships with existing networks were seen by all interviewees as fundamental to information sharing, and to addressing both short- and long-term biodiversity information needs. Long-term partnerships would clearly be required to govern and operate a national biodiversity information system. Short-term partnerships (e.g., driven by the need to conduct a rapid ecological assessment, or to address a specific policy question) would still be required. Examples of other effective information networks in Canada identified by interviewees include the Canadian Healthy Oceans Network, Alberta Biodiversity Monitoring Initiative, and the Canadian Aquatic Invasive Species Network.

Interviewees were asked to consider priorities for investments in order to achieve effective biodiversity information management in Canada. Many focused on the need for more complete observational data and capturing that and other information more effectively. Specifically, interviewees suggested:

- Canada needs to examine existing information, and identify regional, thematic, taxonomic, and geospatial information gaps, in order to inform national priorities. To empower effective data retrieval and priority setting, the federal government, working with provincial and territorial governments, should initiate a national effort to compile existing and future biodiversity information in a central standardized repository.
- Canada needs to rebuild its taxonomic capacity in university programs and government (federal, provincial, and territorial).
- Canada needs to invest in the digitization of information held in a variety of Canadian collections. Taxonomic capacity and digitized information are critical to identifying and controlling invasive alien species, identifying and conserving species at risk, and understanding the effects of climate change.

- Canada needs to improve its understanding of species diversity by enhancing investments in biological/ecological expertise, and inventories. Therefore, it needs to develop a cost-effective biomonitoring strategy (including remote-sensing technologies, as appropriate) that works across scales and jurisdictions. Finally, it needs to launch a national inventory program at the species level. Results will improve Canada's capacity to report on the "health" and status of species and ecosystems, and contribute to monitoring habitat and a variety of ecological changes.
- In addition to improving knowledge of species diversity, Canada needs nationally consistent efforts to classify and map broad ecological systems and/or finer-scale ecological communities (specific types of wetlands, grasslands, arctic tundra, etc.).

Interviewees indicated that priority should be given to meeting legislative and emerging policy (e.g., climate change, alien invasive species) needs, and understanding ecosystems. On this, interviewees believed that attention is needed on the specifics required to maintain ecosystem functions, in particular understanding the role that key species play in these systems. They noted that basic information about the distribution of species is critical to understanding ecosystem functioning and "services" (social, health, economic) provided to Canadians. One interviewee noted that investments in the process of establishing such priorities would be fundamental.

In support of this, other interviewees indicated that Canada should pursue something equivalent to the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) to better understand the links among biodiversity, "ecosystem services", and human well-being. It was thought that this could trigger action related to governance and government investments in biodiversity information management. Interviewees also indicated that investment should be directed to basic research into ecosystem "resilience" and adaptation (e.g., how species respond to climate change). One interviewee suggested that modelling the relation between a changing climate and species distributions would help to determine potential effects. Another mentioned the role and importance of Traditional Ecological Knowledge in decision making at a variety of scales.

Several interviewees discussed establishing appropriate incentives and rewards for the Canadian biodiversity science and information management community. Given the importance of making existing information readily accessible, interviewees noted that Canada needs to do more to recognize and support field-focused conservation scientists. In addition, Canada needs to provide incentives for information development and sharing. As an example, several interviewees suggested that Canada should follow the example of the National Science Foundation which has a digitization incentive program for biological collections. Others suggested that federal funding agencies should develop information management review criteria (e.g., storage, access, sharing) as part of the requirement for scientific funding and as a basis for performance evaluations. Many mentioned the lack of personal and institutional accountability for sharing primary biodiversity information as an important hurdle to collaboration, especially within and among federal agencies.

Summary of Findings

Understanding the state of biodiversity information in Canada requires the input of experts positioned to assess key questions associated with for instance, information required to inform species and ecosystem related discussions. It is important to note that information which meets today's needs may not meet tomorrow's needs because of changes: priorities, abundance and distribution of species (relative to human use and the environment), and improved scientific understanding. To understand if Canada has enough information to inform decisions about the conservation and sustainable use of biodiversity, 19 experts were interviewed, chosen for their familiarity with primary biodiversity information in Canada and abroad. A list of these interviewees (Appendix 1) and the interview guide (Appendix 2) are provided at the end of this report. Insights gained from these interviews are presented in the following section.

Perspectives on the state of biodiversity information in Canada

Canada's biodiversity information requires dramatic improvement if it is going to inform national priorities and serve the needs of Canadians. Specifically:

- Canadians do not have the information needed to develop an accurate picture of the state of biodiversity or of the "health" of Canada's ecosystems. The current approach to both gathering and sharing biodiversity information is, for the most part, piecemeal, opportunistic, and short-sighted;
- Canada has significant information holdings for some species, largely developed in response to legislative priorities, or based on opportunistic approaches to gathering associated information;
- Canada has not taken stock of existing biodiversity information, nor has it identified the regional, thematic, taxonomic, and geospatial information gaps that need to be addressed in order to better inform national priorities. Canada needs a national initiative that compiles existing information in a central standardized repository in order to facilitate querying and priority setting;
- Institutions and organization in other countries, in particular the United States and countries in Europe, hold more primary information about Canadian biodiversity than does Canada itself. While this has enhanced access to such information by Canadians, it highlights other shortfalls in Canada to make Canadian information accessible;
- Canada lacks a clear understanding of the information it needs to manage its biodiversity, and it currently has no mechanisms in place to ensure that such information is developed;
- The biodiversity information available in Canada is insufficient to answer basic questions. For instance, questions about the effectiveness of strategies, policies, and legislation related to achieving specific results, or about Canada's ability to achieve the outcomes set out in the Biodiversity Outcomes Framework and meet its commitments to the Convention on Biological Diversity cannot be answered with existing information;
- Canada needs to launch a national inventory program for observable components of biodiversity that is informed by legislative priorities, existing information, and known conservation risks to ensure a complete understanding of its biodiversity;
- Biodiversity in general has received less attention than issues such as climate change or toxic chemicals, even though a primary reason Canada invests in these is to protect our natural heritage and well-being. The problem is that biodiversity and the information to manage it are exceedingly complex. Governments in Canada have given relatively low priority to biodiversity in relation to other concerns. As a consequence, funding for all aspects related to biodiversity information are affected, as seen in the declining roster of taxonomists, the lack of systematic monitoring, and inadequate inter-governmental coordination;
- Problems associated with sharing and accessing of information are cultural and institutional, not technical. Specifically, government groups tend to work independently, and federal and provincial departments have different mandates related to biodiversity, which lead them to different approaches, making coordination of information systems difficult. There is also a default mindset among researchers (personal and institutional) to restrict access to biodiversity information holdings;

- Canada needs to invest in taxonomic capacity (university programs and within federal, provincial, and territorial governments) to generate accurate and useful biodiversity information;
- Canada needs to allocate the funds required to digitize the specimen information presently held in Canadian collections. Access to that information, complemented by needed field work and monitoring, is critical if Canada hopes to respond to threats like habitat loss, invasive alien species, and climate change;
- Canada needs to complete efforts on a nationally consistent basis, to classify and map ecological communities (e.g., wetlands, grasslands, arctic tundra, etc.) as a complement to broad-scale ecosystem information and to species information, and as a means to enhance its ecosystem-related understanding, such as land-management decisions;
- Canada needs a national biomonitoring strategy that works across scales and across jurisdictions, and that leads to enhanced investments in inventories, mapping, and remote-sensing technologies (as appropriate). It should build on existing initiatives and improve the interpretive expertise required to monitor ecological change;
- Canada must gather more data and support a more systematic biodiversity information management approach. Basic information should be developed for: (1) “areas of rapid land-change” (including corridors, development, and fragmentation), (2) “hot spots” (where biodiversity levels are high, or where endemism is high), (3) areas or regions with rapidly growing human populations and associated development, (4) areas where Canada has little data, including the near north (the northern portion of most provinces) and the Far North (north of the 60th parallel), and (5) taxa that are grossly under represented and not understood in Canada;
- To address these gaps, Canada needs to address challenges related to leadership and governance, communications and public engagement, insufficient inventories, the digitization of existing collections, and information sharing and access;
- Only one region (Atlantic Canada), and one province (Quebec) have established biodiversity information partnerships among federal and provincial agencies, industry, and NGOs. However, although some NGOs (e.g., NatureServe Canada, Nature Conservancy of Canada, Bird Studies Canada) have established effective partnerships (related to landscape plans, species of conservation concern, bird species respectively) among federal, provincial, and territorial agencies, in general these partnerships across Canada are generally lacking;
- Partnerships with existing networks were seen by all interviewees as fundamental to information sharing, and to addressing both short- and long-term needs. Long-term partnerships will be required for the governance and operation of a national biodiversity information system; however, short-term partnerships will also be required, for example, to conduct a rapid ecological assessment, or to address a policy question; and
- Canada’s final approach needs to be supported by a broad strategy that acknowledges the broadly distributed interest and mandate for the conservation and protection of biodiversity in Canada.

The need to develop a vision and implement a coordinated strategy and the principles required to ensure that biodiversity information is in place to support decision making is not new in Canada. In 2001, more than 300 representatives of governments, universities, zoological and botanical gardens, museums, environmental and wildlife NGOs, aboriginal groups, and sectoral and high technology industries met at the Canadian Biodiversity Network Conference with that in mind. Their common purpose was to ensure that such a strategy was developed and that a “Biodiversity Knowledge and Information Network” (BKIN) would be built. The principles around which such a system/network would be designed are outlined in Appendix 5. In the same year, the Minister of the Environment was presented with a blueprint for the design and implementation of a national environmental information system. This “Canadian Information System for the Environment” was a national initiative based on a network of partnerships aimed at ensuring easy and timely access, by a diverse array of users, to reliable environmental information. Unfortunately in both cases, the vision was not realized and Canada remains without much of the information required to implement the Canadian Biodiversity Strategy fully and meet its commitments under the Convention on Biological Diversity.

The federal government has recognized the need for coordination and the importance of preparing for challenges inherent to the management of biodiversity information. In 1998 after significant program reductions, several science-based departments and agencies, seeking to protect their remaining biodiversity information assets, established the Federal Biosystematics Partnership (FBP), which included: Natural Resources Canada (Canadian Forestry Service), Fisheries and Oceans Canada, Environment Canada, Agriculture and Agri-Food Canada, the Canadian Museum of Nature, and Parks Canada Agency. The purpose of the partnership was to collaborate on research initiatives, undertake technology and knowledge transfer, raise awareness within government and the public of the importance of biosystematics, and ensure that biodiversity information was effectively managed in Canada.

The Federal Biodiversity Information Partnership (FBIP), borne from the FBP, has tried on several occasions to address these fundamental issues and to create support for biodiversity information development and management in Canada. Although it has had limited success, it successfully launched the Canadian Biodiversity Information Facility (CBIF) and contributes to the Global Biodiversity Information Facility. However, resources to support CBIF have dwindled and Canada's ability to support information sharing have also been limited. For the most part, the fundamental issues that led to the development of FBIP remain. In 2002, FBIP undertook an assessment of gaps and capacities of its membership. The assessment concluded that (1) there has been a significant loss of human capacity and expertise, on average departments reported having less than half of the expertise required to fulfill their mandate, and (2) there were virtually no dedicated resources to capture/convert existing information into digital format, furthering risk of deterioration, preventing enhancement and sharing, and presenting an obstacle to working with partners. Essentially, most mechanisms and protocols were not in place to facilitate national/departmental cooperation, a key strategy to compensate for weaknesses in the federal program. Those interviewed during the preparation of that report did not perceive significant improvements since FBIP began work to address these issues in 2002.

This consistent inability to address the need for a comprehensive approach to biodiversity information prompted Canada's Commissioner for the Environment and Sustainable Development (CESD) to state, in the 2005 report and the 2008 update, that federal commitments to improving Canada's capacity to understand its biodiversity and manage biodiversity information were not being fulfilled, despite numerous calls for improvement in these areas.³⁵

In May 2009, the Minister of Canadian Heritage asked the Council of Canadian Academies to assess the state and trends of biodiversity science in Canada.³⁶ Subsequently that Council initiated an expert panel to evaluate whether Canada is equipped to understand the challenges of its biodiversity resources. The panel is reviewing: (1) the state of expertise in biodiversity science, (2) the condition of and access to relevant data and information, (3) the state of biodiversity infrastructure, (4) financial resources available for biodiversity research, and (5) key gaps and associated risks. The report, due in November 2010, will provide another evidence-based overview of biodiversity information related findings and potential opportunities.

The growing demands of Canadian society, including recent investments in infrastructure to help stimulate the economy and efforts to address issues like invasive species and climate change, now exceed the capacity of Canada's biodiversity information (data and expertise) to support timely, efficient, and effective decision making that works to protect and conserve biodiversity. Linking social, including economic development, to a clear understanding of: status and trends of ecosystems, effects on species, including species at risk; and the specifics required to protect and conserve biodiversity is fundamental to long-term sustainability. Without that link it will be

³⁵ The 2008 report states: In 2001, the OAG found that there was a need for better baseline information to enable the government to effectively manage species at risk. In 2008 despite the progress noted at Parks Canada, the federal government as a whole had made unsatisfactory progress in responding to the 2001 recommendations relating to the development of a comprehensive inventory of species at risk and of recovery strategies. Ongoing improvements to data quality and data consistency are needed.

³⁶ See: <http://www.scienceadvice.ca/biodiversity.html>.

impossible to develop integrated and strategic approaches to land-use and management. Specifically, that link is critical for: species at risk and alien invasive species identification and management; protection for newly listed species; environmental assessments and the time required to complete those assessments; recovery and conservation plans; and habitat restoration efforts.

Appendix 1

List of Interview Participants (Winter 2010)

Guy Baillargeon, Database Manager, Biodiversity, Agriculture and Agri-food Canada

Roger Baird, Director, Canadian Museum of Nature

Anne Bruneau, Montreal Biodiversity Centre

Peter Desmet, Biodiversity Informatics Manager, Montreal Biodiversity Centre

James Duncan, Co-Chair, General Status Working Group, Manitoba

Mark Graham, Director of Research, Canadian Museum of Nature

Tom Hammond, Biodiversity Conservation Program Manager, Commission for Environmental Cooperation

John Herity, Former Director, Biodiversity Convention Office

Ole Hendrickson, Scientific Advisor, Ecosystem & Biodiversity Priorities, Environment Canada

Meredith Lane, Senior Advisor, Partnerships, Science & Networks, National Biological Information Infrastructure (NBII), United States

R.A. Lautenschlager, Executive Director, Atlantic Canada Conservation Data Centre

Benoit Limoges, Coordonnateur à la biodiversité, Ministère du Développement durable, de l'Environnement et des Parcs du Québec

Jim Mackenzie, Coordinator, Ontario Natural Heritage Information Centre

Camille Mageau, Director, Oceans Policy and Planning, Fisheries and Oceans Canada

Nick Mandrack, Executive Director, Centre of Expertise for Aquatic Risk Assessment, Fisheries and Oceans Canada

Robert McFetridge, Coordinator, Federal Biodiversity Information Partnership

Risa Smith, Senior Science Advisor, Environment Canada

Jorge Soberon, Former Executive Director, National Commission for the Knowledge of Biodiversity (CONABIO), Mexico

Stephen Woodley, Chief, Ecosystem Scientist, Parks Canada Agency

Note: the following individuals were invited to participate but were unable to in the time provided:

Jeff Hutchings, Chair, Committee on the Status of Endangered Wildlife in Canada

Kaaren Lewis, Director, Ecosystems Branch, British Columbia Ministry of the Environment

Appendix 2

Interview Guide

The State of Biodiversity Information in Canada

Context

As a party to the United Nations Convention on Biological Diversity, Canada has committed to implement practices that encourage the conservation and sustainable use of biological resources. In Canada, legislative and policy tools such as the Species at Risk Act, the Fisheries Act, the National Parks Act, and the Alien Invasive Species Strategy have been set in place to ensure the conservation and sustainable use of Canada's biodiversity. The management of our biological resources and the effective implementation of these tools require reliable, evidence-based information. Canada's Biodiversity Outcomes Framework makes this clear in its assess-plan-do-track approach to achieving results - reliable information is critical to assessing and tracking, and underpins planning and effective action. Understanding the current state of this information in Canada is therefore critical to achieving outcomes and will support identifying any potential gaps and guiding priorities to address these gaps.

Many different types of information could be considered "biodiversity information." For the purposes of this study, biodiversity information is considered to be primary information and supporting data that is fundamental to the management of biodiversity. Specifically, the study considers the components that make up Canada's ecosystem and species diversity, where these components occur in Canada, and particularly the status of information and data assets for these elements as primary information needed to support the effective management of biodiversity. The study considers primary biodiversity information to be:

- Information about the identity and details of Canada's species and community biodiversity elements;
- Information needed to determine where the biodiversity element is known to or may occur; and
- Information needed to determine the status and trends of the biodiversity element.

Information that is derived from this primary information, for example management experiences, best practices or conservation plans, is not considered within the scope of the study.

The purpose of this interview is to gather your views about the state of biodiversity information in Canada to inform the preparation of a report. The report will develop a broad understanding of Canada's biodiversity information, the magnitude of information gaps and identify potential directions to be taken to address these gaps. The interview is expected to last approximately 45 minutes.

Interview Questions

A. Defining the state and gaps:

- How would you characterize the current state of biodiversity data and information in Canada?
- To what extent has Canada systematically identified its biodiversity elements? Do we have a complete list of species and ecosystem elements? Is a complete list needed? If not, how would you set priorities?
- For known elements, to what extent does Canada have information about where these elements occur? Is more information needed? What type of information does Canada need to understand where elements occur and manage biodiversity effectively?
- Does Canada have sufficient information to report effectively on the status and trends of biodiversity and inform management and policy decisions? How much and what type of information is needed? Where are there gaps in Canada's primary information holdings?
- What information do decision makers currently use to make decisions regarding biodiversity in Canada? Is this information sufficient?
- How does Canadian data compare with the United States or other countries, based on international data protocols?

B. Identifying obstacles/barriers:

- What do you see are the major obstacles to developing and sharing biodiversity information in Canada?
- In your experience, where are the most significant barriers along an information value chain?
 - Are there obstacles to basic information/data collection? If yes, what are they (e.g., technical, administrative, policy)? How can they be overcome?
 - Are there obstacles to information/data sharing and publication? If yes, what are they? How can they be overcome?
 - Are there obstacles to the effective use and access to data and information (i.e., improving the value chain in the use of these assets)? If yes, what are they? How can they be overcome?

C. Path forward:

- What is your vision for how biodiversity information could be most effectively managed in Canada?
- How can data and information be shared most effectively?
- What institutional partnerships are needed?
- What investments are needed?
- Are investments in priority elements (taxonomic groups, ecosystems) needed?
- Are investments in key geographic areas needed?
- Are data standards required, or can Canada build on international efforts?

Appendix 3

International Biodiversity Information Initiatives

CONABIO

Mexico <http://www.conabio.gob.mx/> -- the governmental agency in charge of biodiversity information management which depends on national networks and specimen custodians. CONABIO's efforts are primarily focused on three major areas: research, sustainable use, and public awareness.

Mission: "To co-ordinate conservation and research efforts designed to preserve biological resources. CONABIO promotes and develops scientifically based activities whose aim is to explore, study, protect or find a sustainable use for biological resources. The intention of these activities is to conserve the nation's resources and to generate criteria for sustainable development."

Convention on Biological Diversity - Clearing-House Mechanism (CHM)

<http://www.biodiv.org/> -- established a "clearing-house mechanism" to ensure that all governments have access to the information and technologies they need for their work on biodiversity.

Mission: To promote and facilitate technical and scientific co-operation, within and among countries; develop a global mechanism for exchanging and integrating information about biodiversity; and develop the necessary human and technological network

Environmental Resources Information Network (ERIN)

Australia <http://www.environment.gov.au/> -- the governmental agency in charge of environmental, (includes biodiversity), information management which depends on national networks and specimen custodians.

Mission: "To contribute to improved environmental outcomes by developing and managing a comprehensive, accurate, and accessible information base for the government's environmental decisions and for community use."

European Platform for Biodiversity Research Strategy

Made up of scientists and policy makers who meet to discuss strategic issues relating to biodiversity research in Europe and ways to improve the effectiveness and relevance of that research. Reports under the European Community Research Area, a program of the European Union.

Mission: "To work together to give strategic direction to European biodiversity research and discuss strategic biodiversity research issues." Such discussion topics include research strategies and priorities, sharing knowledge (i.e., best practices), exchanging information about biodiversity activities, systematic examination of research issues, and improved plans for protected areas.

List of National Biodiversity Platforms in European Member States:

Austria (Biodiversity Research Netnode)

Belgium (Belgian Biodiversity Platform)

Finland (Finnish Biodiversity Research Programme)

France (Institut Français de la biodiversité)

Sweden (Swedish Biodiversity Centre)

United Kingdom (Biodiversity Research Working Group)

Global Biodiversity Information Facility (GBIF)

World-wide <http://www.gbif.org/> -- an interoperable, distributed network of scientific biodiversity databases and information technology tools which provide current data about genes, species, and ecosystems. It is freely and readily available to all.

Mission: “To work in close cooperation with established programmes and organizations that compile, maintain and use biological information resources. Participants working through GBIF establish and support a distributed information system that enables users to access and use vast quantities of new and existing biodiversity information to generate new knowledge, wealth, and ecological sustainability.”

National Biological Information Infrastructure (NBII)

U.S. <http://www.nbii.gov/> -- a “Biological Resources Division-led initiative dedicated to developing an electronic “federation” of biological data and information sources. Its success rests on a growing network of partners who share biological information.”

Mission: “To provide swift user access to biological databases, information products, directories, and guides maintained by federal, state, and local government agencies, non-government institutions, and private sector organizations.”

The Instituto Nacional de Biodiversidad (INBIO)

Costa Rica <http://www.inbio.ac.cr/> -- a scientific institution with social orientation which is non-profit and for the public good. This non-governmental agency also manages biotic data but relies heavily on foreign institutions to manage its information network.

Mission: “To promote a new awareness of the value of biodiversity, and thereby achieve its conservation and use to improve the quality of life.”

Appendix 4

Federal Agencies With a Biodiversity Mandate, including Participants in the Federal Biodiversity Information Partnership³⁹

Federal Agency or Department	Mandate related to Biodiversity Information	Data	Collections	Resources
<p>The Canadian Museum of Nature</p>	<p>The Canadian Museum of Nature (CMN) is mandated to increase interest in, knowledge of and appreciation and respect for nature, by establishing, maintaining and developing a collection of natural history objects for research and posterity.</p>	<p>The Museum has an established programme of data capture (from non-digital formats) and conversion (from various digital forms) for biosystematic data. They are using a modified version of Multy MIMSY 2000. Presently (2002), 467,000 records of a total 1.9 million have been converted to the new CSM standard.</p>	<p>In total the Museum cares for 24 major science collections of more than 10 million specimens. Paleontological specimens, minerals and all major taxa of plants and animals (vertebrates and invertebrates) are included in the holdings.</p>	<p>CMN has an extensive working collection, located at its research and storage facility on Pink Road in Aylmer, Quebec. This 20,478-square-metre facility includes 42 separate collection rooms and nine documentation rooms. There is also a permanent display collection located in the Victoria Memorial Building, 240 McLeod Street, in Ottawa.</p>
<p>Natural Resources Canada (Canadian Forestry Service - CFS)</p>	<p>Research objectives for programming include research at the landscape, ecosystem, species, and genetic level. Special attention is paid to effects of human activity and natural catastrophes, ecosystems at risk, alien forest pests and effective conservation measures of forest biodiversity.</p>	<p>Data management is a significant challenge. When the Forest Insect / Disease Survey of Canada Database was recently moved from Petawawa to Fredericton the data was moved to an Oracle platform which identified numerous "broken links" between specimen holdings and data. Lack of full-time bioinformatics staff make timely up-dates and on-going validation impossible.</p>	<p>Specimen collections of diseases, pathogens, pests, and their hosts are extremely important for research activities and provide information that is not easily stored in written or digital format. Regional collections are located at the Forestry Centres in BC, AB, ON, QC, NB, and NF. The CFS also contributes to the national entomological, mycological, and fungal culture collections, located at the Eastern Cereal and Oilseed Research Centre of Agriculture and Agri-Food Canada (AAFC) in Ottawa.</p>	<p>CFS has a decentralized research programme with five principle research facilities, including:</p> <ul style="list-style-type: none"> - Pacific Forestry Centre (BC) - Great Lakes Forestry Centre (ON) - Northern Forestry Centre (AB) - Laurentian Forestry Centre (QC) - Atlantic Forestry Centre (NB) <p>Other centres include the Corner Brook Research Division (NF), with links to: the National Forest Insect and Disease Collection (ECORC), and the Petawawa Research Forest (ON)</p>

³⁹ This table is based on a report, "Capacity Gap Analysis and Statement of Requirement", prepared in 2002 by Delaney and Associates (or Associates?) for the Federal Biosystematics Partnership. Updating the table was outside of the scope of this report.

Federal Agency or Department	Mandate related to Biodiversity Information	Data	Collections	Resources
Fisheries and Oceans Canada (DFO)	Does not currently have a biosystematics Programme. However biosystematics expertise is required as part of the overall science programme within the department. The purpose of the science programme is to better understand the marine environment and to inform conservation, protection, and fisheries management decisions.	Does not have a bio-informatics standards, although species codes have been standardized and work is underway to develop one. Data is maintained in both hard-copy and digital formats, scattered throughout individual offices, central filing systems, central servers and personal computers. A significant amount of pre-1980 data is likely still in hardcopy. The DFO Science Sector has recently undertaken a "Data Rescue" project that will identify data holdings, and prioritize data that needs to be secured electronically.	Does not have a collections policy and retains several scattered collections. There is currently no A-based programme for care and enhancement of these collections. Most collections are created through on-going research and retained within inadequate and increasingly scarce storage facilities. The department is currently facing difficult questions about to how to deal with its current collection inventory.	Operates 12 regional research facilities including: Pacific Biological Station Institute of Oceans Sciences Laboratory, West Vancouver, BC.; Cultus Lake Salmon Research Laboratory; Freshwater Institute; Bayfield, MN. Institute (ON); Experimental Lake Area (ON); Maurice Lamontagne Institute (QC); Gulf Fisheries Centre (NB); St. Andrews Biological Station (NS); Bedford Institute of Oceanography (NS); and Northwest Fisheries Research Centre (NF) Facilities range from field stations, with a small central laboratory, to extensive research facilities, which include offices, laboratories, collection storage facilities, and permanent collections. No special bioinformatics hardware, periphery or networking.
Environment Canada (EC)	Biodiversity related goals relate mostly to regulation, national coordination, and administration of international agreements. The migratory bird programme monitors bird populations for the purpose of determining their overall health status for management decisions, and to regulate incidental take and hunting under the Migratory Bird Convention Act. The species at risk programme maintains similar objectives of monitoring the health status of endangered species, and may in the future assume legal status under the proposed Species at Risk Act.. Management of alien species is an emerging issue for which EC provides national coordination in the absence of any existing coordination mechanism or overarching legislation. The department also oversees the Canada Wildlife Act.	Retains many "legacy" datasets, which are difficult or impossible to use, as they typically lack data dictionaries. Much biosystematics research data, mostly accumulated through research projects, is contained in hardcopy files, hand-written field notes and on PCs. Without a comprehensive data conversion initiative these data are at risk of being lost over time.	Several reference collections exist, however, most specimens collected for toxicology research purposes are not suitable for preservation. Species at risk are taken alive and released. However, an extensive collection of migratory birds is maintained. Most research specimens are offered to museums as "gifts". In addition to the bird collections, EC scientists maintain small research collections of crayfish, aquatic parasites, and small forage fish (cyprinids, darters). The Canadian Wildlife Service in the past accumulated a major collection of parasites from northern ungulates (e.g., dall sheep) and snow geese. This well-documented collection was donated to the Canadian Museum of Nature, including all the original data sheets, as well as specimens.	Extensive research facilities are located across Canada including at the National Wildlife Research Centre in Hull, National Water Research Institute in Burlington. Saskatoon Hydrology Lab, St. Lawrence Centre in Montreal, Pacific Environmental Science Centre (Environmental Toxicology Section) in North Vancouver and the Toxicology Lab at the Environmental Science Centre in Moncton.

Federal Agency or Department	Mandate related to Biodiversity Information	Data	Collections	Resources
<p>Parks Canada (PCA)</p>	<p>Responsible for legislation such as the Canada National Parks Act, and the Canada National Marine Conservation Areas Act. Responsible for ensuring “ecological integrity” in parks and marine conservation areas.</p>	<p>A comprehensive review of PC capacity to ‘conserve “ecological integrity”’ was conducted in 2000. It identified serious gaps in the areas of data collection and management. Since that time PC has established an automated inventory system, called Species in Parks System (SIPS). SIPS presently contains 40% of the PC species inventory. Records are kept at the population level. Data is a key input to management decisions.</p>	<p>The park holds both research and display collections. However, research collections are generally “left over” from research projects and not granted any official status and hence no on-going funds are in place to maintain or enhance these collections. Typically these research collections are offered to museums or universities once the project has been completed, as there is usually not adequate storage facilities at the park level to protect against deterioration. Display collections are typically for park-level interpretive programmes and are limited in number and documentation. There are also about 20 herbariums through the parks system.</p>	<p>Research facilities are decentralized at the park level. Six “service centres” have been created (in some instances at different parks) to pool resources and provide support. Each park has a scientific advisory committee to draw in external expertise.</p>
<p>Agriculture and Agri-food Canada (AAFC)</p>	<p>Relies heavily on biodiversity for crop and livestock productivity, sources of genetic advancement (e.g., disease resistance) and ecosystem services (e.g., soil building). At the same time agriculture can have a significant effects on the local environment and biodiversity levels. However, economic sustainability is not incompatible with conserving biodiversity in agricultural production systems. In keeping with both the Convention on Biological Diversity and Canada’s Biodiversity Strategy, AAFC has included sustainable use of biological resources and conservation of biodiversity as key components of its Agriculture Policy Framework (APF). Under the framework, a number of programs, such as the National Farm Stewardship Program, Environmental Farm Planning, Prairie Shelterbelt Program, and Greencover Canada, include incentives for conserving or enhancing biodiversity at the farm</p>	<p>Has a bioinformatics programme for capturing, storing and managing data. The programme is new and evolving. Protocols for data capture and conversion, which include the Darwin Core as a baseline standard, are in place. Consolidation of biosystematics data holdings will be a challenge. About 1.5 million collection records have been digitized but are in a number of formats and scattered among the various research centres. About 300,000 records include Darwin Core data, but presently many are not georeferenced. Approximately 2 FTEs, technical staff are currently dedicated to data capture and conversion. Metadata development will be a high priority in the coming years.</p>	<p>Cares for 26 distinct collections containing approximately 17-20 million specimens. These collections consist of crop cultivars, other vascular plants, insects and nematodes. The collection is incomplete and evolving year-to-year. As an example, only one in seven mites have been classified and are represented in the AAFC collection.</p>	<p>Operates 19 research centres and research at each centre reflects industry in the agro-ecological region where they are located. Centres across Canada including:</p> <ul style="list-style-type: none"> Atlantic Cool Climate Crop Research (NF) Crops and Livestock Research (PEI) Atlantic Food & Horticulture Research (NS) Potato Research (NB) Soils & Crops Research & Development (QC) Dairy & Swine Research & Development (QC) Horticulture Research & Development (QC) Food Research & Development (QC) Eastern Cereal & Oilseed Research (ON) Food Research Program (ON) Southern Crop Protection and Food Research (ON) Greenhouse and Processing Crops Research (ON) Cereal Research (MN) Brandon Research (MN) Saskatoon research (SK)

Federal Agency or Department	Mandate related to Biodiversity Information	Data	Collections	Resources
	level. The APF, which expires in 2008, AAFC is currently developing the next generation of agriculture and agri-food policies in consultation with the provinces, the ag-sector, key stakeholders and the general public.			Semiarid Prairie Agricultural Research (SK) Lethbridge Research (AB) Lacombe Research (AB) Pacific Agri-food Research (BC)

Other agencies with a mandate participating in FBIP meetings include:

Canadian Food Inspection Agency

Responsible for border controls, and has a role to play in relation to invasive species. Its focus is on non-native plants, animals, and micro-organisms that spread when introduced outside of their natural distribution and cause serious and often irreversible damage to Canada's ecosystems, economy and society. It works to prevent and manage invasive species to strengthen Canada's long-term competitiveness, protect its natural environment, and contribute to the well-being of its citizens.

Public Health Agency of Canada

Responsible for coordinating public health issues in Canada, including the control of zoonotic infectious diseases, or diseases that can move from wildlife to humans (west Nile virus, avian flu).

Appendix 5

Guiding Principles for Managing Biological Information

In 2002, Ministers responsible for forests, wildlife, endangered species, and fisheries from across Canada endorsed a set of guiding principles. Those principles were intended to provide guidance for collecting, managing, sharing, analyzing, and accessing biological information. <http://www.cbin.ec.gc.ca/science/principes-principles.cfm?lang=eng>.

Those principles are:

Data will be distributed, not centralized. A network will be built by connecting existing databases in situ, rather than centralizing them in a clearinghouse. The network values, and is designed by linking, local efforts thereby acknowledging the distributed nature of the biodiversity community in Canada. Control over content provided to the network will remain localized.

The network will be inclusive, in recognition of the fact that it will serve a broad range of needs. Data quality will be the responsibility of the data provider and providers will not be restricted; however, sources will be carefully identified.

Data will be freely available. We expect the network will stimulate commercial activity as secondary services arise to repackage data for custom applications. However, as a fundamental principle, primary data will be widely accessible to users at no charge.

Data sharing will be facilitated. Tools to enable the interoperability of biological information, including on-line data access, taxonomic nomenclature standards, search engines, and common analytical software, are becoming increasingly available. Common metadata standards for describing the content of biological data sets are a key tool for data sharing and access, and their use will be promoted.

Efforts will be made to ensure that species are correctly identified. Adequate capacity in biosystematics (scientific identification and description of species) is essential to assure the quality of biological information.

Efforts will be made to standardize ecosystem classification. A standard classification of ecosystems and biological communities allows biodiversity change to be tracked at landscapes/seascape levels, particularly if used in conjunction with tools such as remote sensing and geographic information systems.

Applications to decision making will be facilitated. Knowledge about biodiversity, including traditional knowledge, is central to a variety of decision-making processes (e.g., environmental assessment). The design of the network will take into account the needs of specific user communities.

Use of traditional knowledge will be promoted. A continuing dialogue with holders of traditional knowledge will promote the wider application of their knowledge for conservation and sustainable use of biodiversity.

Biological and socioeconomic data will be linked. Mechanisms that link biological information to socioeconomic and cultural information at varying scales are essential for sound decision-making.

Biological information will be shared with other countries. Involvement in international initiatives for sharing of biological information speeds the development and implementation of standards, and enables effective action for cross-border issues such as invasive alien species.

The network will include the general public. Involvement of citizen scientists in acquiring biological information will extend the scope of the network, and will help raise awareness of the value of goods and services provided by biodiversity.

All levels of government will help sponsor the network. Broad participation in a national-level network is needed to promote action consistent with these guiding principles.

Appendix 6

List of Acronyms

- BKIN. Biodiversity Knowledge and Information Network
- CBD. Convention on Biological Diversity
- CBIF. Canadian Biodiversity Information Facility
- CBS. Canadian Biodiversity Strategy
- CDC. Conservation Data Centre, the information foundation for NatureServe Canada
- CESD. Canada's Commissioner for the Environment and Sustainable Development
- CONABIO. National Commission for the Knowledge of Biodiversity (Mexico)
- COSEWIC. Committee on the Status of Endangered Wildlife in Canada
- FBIP. Federal Biodiversity Information Partnership
- GBIF. Global Biodiversity Information Facility
- IPBES. Intergovernmental Platform on Biodiversity and Ecosystem Services
- IUCN. International Union for the Conservation of Nature
- LOMAs. Large Ocean Management Areas
- MEA. Millennium Ecosystem Assessment
- NBII. National Biological Information Infrastructure (United States of America)
- SARA. Canada's Species at Risk Act



NATURESERVE CANADA NETWORK OF CONSERVATION DATA CENTRES

Alberta Conservation Information Management System

Alberta Tourism, Parks and Recreation
2nd Floor, Oxbridge Place
9820-106 Street
Edmonton, Alberta T5K 2J6
780-427-0350
[http://tpr.alberta.ca/parks/heritageinfocentre/
default.aspx](http://tpr.alberta.ca/parks/heritageinfocentre/default.aspx)

Atlantic Canada Conservation Data Centre

P.O. Box 6416
146 Main Street
Mount Allison University
Sackville, New Brunswick E4L 1G6
506-364-2661
<http://www.accdc.com>

Centre de données sur le patrimoine naturel du Québec

Flora/Flore
Ministère du Développement durable, de
l'Environnement et des Parcs
Edifice Marie-Guyart, 4e étage, Bte 21
675 René-Lévesque Est, Québec, Québec G1R 5V7
418-521-3907 x4794
www.cdpmq.gouv.qc.ca/

Fauna/Faune

Ministère des Ressources naturelles et de la Faune
du Québec
Direction du développement de la faune
Edifice Marie-Guyart, 11e étage, Bte 92
675 René-Lévesque Est, Québec, Québec G1R 5V7
418-521-3875 x4915
www.cdpmq.gouv.qc.ca

NATURESERVE CANADA

K.W. Neatby Bldg, 960 Carling Ave.
Ottawa, Ontario K1A 0C6
www.natureserve.ca
1-888-277-5265

British Columbia Conservation Data Centre

Biodiversity Branch
Ministry of Environment
P.O. Box 9358
Station Provincial Government
Victoria, British Columbia V8W 9M2
250-356-0928
<http://env.gov.bc.ca/cdc>

Manitoba Conservation Data Centre

Biodiversity, Habitat and Endangered
Species Section
Wildlife and Ecosystem Protection Branch
Manitoba Conservation
Box 24, 200 Saulteaux Crescent
Winnipeg, Manitoba R3J 3W3
204-945-7775
<http://www.gov.mb.ca/conservation/cdc/>

Saskatchewan Conservation Data Centre

Saskatchewan Environment
3211 Albert Street
Regina, Saskatchewan S4S 5W6
306-787-9038
www.biodiversity.sk.ca

Yukon Conservation Data Centre

Fish and Wildlife Branch
Yukon Department of the Environment
P.O. Box 2703
Whitehorse, Yukon Y1A 2C6
867-667-3684
www.environmentyukon.gov.yk.ca

Ontario Natural Heritage Information Centre

Ministry of Natural Resources
P.O. Box 7000 (300 Water Street, 2nd Floor, North
Tower)
Peterborough, Ontario K9J 8M5
705-755-1960
http://nhic.mnr.gov.on.ca/nhic_.cfm



NatureServe
Canada 

www.natureserve.ca