Wild Species 2005


© B. T. Aniskowicz-Fowler: Eastern Newt (*Notophthalmus viridescens)*

Welcome to *Wild Species 2005: The General Status of Species in Canada.*

The intent of the *Wild Species* series is to answer the following fundamental questions about wild species in Canada: which species occur in Canada, in which provinces, territories or ocean regions do they occur, and what is their status? To accomplish this goal, *Wild Species 2005: The General Status of Species in Canada* presents the results of general status assessments for a broad cross-section of Canadian species. General status assessments are made by integrating the best available information on population size, distribution, threats and trends to generate an expert evaluation of the status of each species.

You can navigate this website by using the links on the left-hand side of this page, or by using the Table of Contents. You can also download a copy of the text of *Wild Species 2005* as a pdf document by clicking here (link not yet available). The General Status Search Tool allows you to view and download the general status ranks on which this report is based.

The general status ranks for the Yukon, Northwest Territories and Nunavut are draft ranks until they have been reviewed by the Yukon Fish and Wildlife Management Board, the Wildlife Management Advisory Council (North Slope), the Wildlife Management Advisory Council (NWT), the Sahtu Renewable Resources Board, the Gwich'in Renewable Resource Board and the Nunavut Wildlife Management Board (NWMB).

Canadian Endangered Species Conservation Council (CESCC). 2006 Wild Species 2005: The General Status of Species in Canada
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Executive Summary

The intent of the *Wild Species* series is to answer the following fundamental questions about wild species in Canada: which species occur in Canada, in which provinces, territories or ocean regions do they occur, and what is their status? To accomplish this goal, *Wild Species 2005: The General Status of Species in Canada* presents the results of general status assessments for a broad cross-section of Canadian plants and animals. General status assessments are made by integrating the best available information on population size, distribution, threats and trends to generate an expert evaluation of the status of each species. The strength of the *Wild Species* series lies in providing a common platform for the evaluation of the status of a wide variety of species, from all regions and all ecosystems in Canada, ranging from well known groups like birds and mammals to less well-known groups like freshwater mussels and crayfishes. This information is then made available to a broad audience in the form of the *Wild Species* reports. These reports enable everyone from students to research scientists and from amateur naturalists to resource managers, to place a species in a geographic, taxonomic and ecological context, and gain an impression of the species' general status within that context. In addition, general status ranks are used by COSEWIC (the Committee on the Status of Endangered Wildlife in Canada), to help prioritize species for detailed status assessments.

The *Wild Species* series was created under the auspices of the "Accord for the Protection of Species at Risk". The Accord was established in 1996 by provincial, territorial and federal ministers responsible for wildlife, with the goal of preventing species in Canada from becoming extinct or extirpated because of human impact. This series fulfills a commitment of the Accord to "monitor, assess and report regularly on the status of all wild species". *Wild Species 2005*, the second report in the *Wild Species* series, presents general status assessments for a total of 7736 species from all provinces, territories, and ocean regions, representing all of Canada's vertebrates species (fishes, amphibians, reptiles, birds and mammals), all of Canada's vascular plants, and four invertebrate groups (freshwater mussels, crayfishes, odonates and tiger beetles). Six groups (vascular plants, freshwater mussels, crayfishes, odonates, tiger beetles and marine fishes) are being assessed for the first time. For these groups, *Wild Species 2005* establishes a comprehensive, common platform for examining the general status of species across their Canadian range, as well as a baseline against which future changes in the distribution and abundance of species can be compared. The remaining six groups (ferns and orchids, freshwater fishes, amphibians, reptiles, birds and mammals) were originally assessed in *Wild Species 2000*, the first report of the *Wild Species* series. For these groups, *Wild Species 2005* presents updated general status assessments, which incorporate new information on population sizes, distributions, threats and trends, where available. These updated general status assessments are the first step towards the goal of tracking species' status through time, allowing patterns of improvement or decline in status to emerge.

General status assessments are used to classify species into one of 10 general status ranks; *Extinct*, *Extirpated*, *At Risk*, *May Be At Risk*, *Sensitive*, *Secure*, *Undetermined*, *Not Assessed*, *Exotic* or *Accidental* (Table 1). These categories necessarily represent a coarse-scaled assessment of a species' status in Canada, due to the large number of species assessed, and the variability in the quantity and quality of information available for each species. Nevertheless, general status ranks allow species to be prioritized in terms of the effort and attention needed to prevent their further decline or loss: some species are apparently secure; some show early signs of trouble and may need additional monitoring or management, while others may be prioritized for detailed status assessments. In addition, the general status assessment process highlights

information gaps: for some species, there may not be enough information to assess whether they are secure or of some degree of conservation concern.

The overall results of this report show that the majority of Canada's wild species are ranked *Secure* (Table 1); in fact, of the species ranked *At Risk*, *May Be At Risk*, *Sensitive* and Secure, a total of 70% have a Canada General Status Rank (Canada rank) of *Secure* (Figure 1). This number varies considerably among taxonomic groups; for eight of the 10 groups in this report (vascular plants, crayfishes, odonates, tiger beetles, fishes, amphibians, birds and mammals), at least 65% of species have a Canada rank of *Secure*. However for the two remaining groups this figure is much lower; only 37% of freshwater mussels have a Canada rank of *Secure*, while for reptiles, only 31% of species have a Canada rank of *Secure*.

One of the issues highlighted in this report, is the large number of non-native species in Canada. Of the 7736 species assessed in this report 16% are ranked *Exotic* at the national level, meaning that these species are not native to Canada, but were introduced by humans. Of the groups covered in this report, the vascular plants have the highest proportion of *Exotic* species (24%). *Exotic* species have been brought to Canada, both deliberately and accidentally, from around the world, and can have a number of damaging impacts on native species, including competing for space and resources, preying on native wildlife, breeding with native species and introducing novel diseases and parasites.

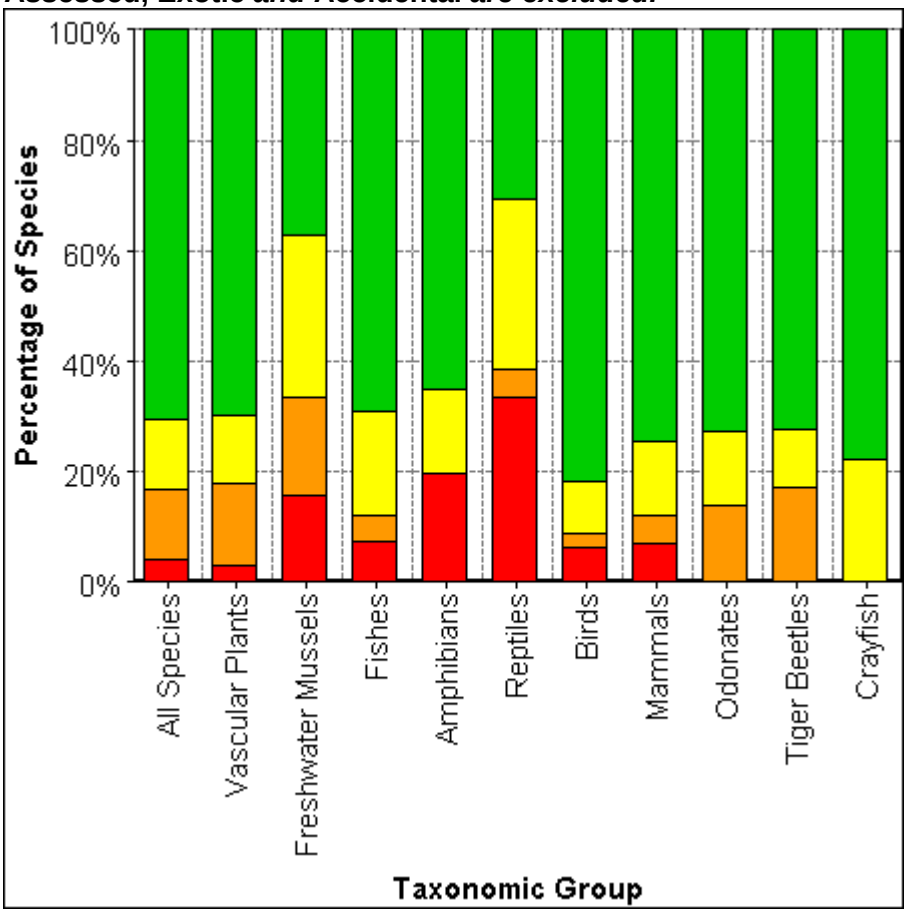
In total, 1330 species were assessed in both *Wild Species 2000* and in this report. Of these, 12% have been assessed with a different Canada rank in 2005. However, changes in Canada ranks primarily reflect attempts to provide a more accurate picture of species' status, and not true biological change (i.e. changes in species population size, distribution or threats) since 2000. The majority of changes in Canada rank were due to changes in process (40%), or to new or updated COSEWIC assessments (33%); only 6% of changes were wholly or partly due to biological change since 2000. In total, 39% of changes involved species moving into a rank with an increased level of risk, 31% of changes involved species moving into a rank with a reduced level of risk, and 30% involved species moving into or out of the *Undetermined*, *Not Assessed*, *Accidental* or *Extirpated* categories. Considering only the species ranked in both 2000 and 2005, changes in Canada rank have not had a significant impact on the proportion of species in each general status category.

Wild Species 2005: The General Status of Species in Canada has greatly increased the number and variety of species assessed nationally, but with total number of species in Canada estimated to be more than 70 000, there are still many species left to be assessed. So far the *Wild Species* series has focused on assessing species groups for which information and experts are fairly readily available. In the future, the program will tackle groups like mosses, lichens, grasshoppers and crickets, for which less information is available. This will make the process of assessing Canada's wild species even more challenging. Future reports will expand the number and variety of species assessed, as well as continuing to update general status assessments, so that trends in species' status can be tracked through time.

Table 1: Summary of 2005 Canada General Status Ranks (Canada ranks) by taxonomic group.

Rank	All species	Vascular Plants	Freshwater Mussels	Crayfish	Odonates	Tiger Beetles	Fishes	Amphibians	Reptiles	Birds	Mammals
Extirpated	30	22	1	0	0	0	2	0	3	1	1
Extinct	5	0	0	0	0	0	1	0	0	3	1
At risk	206	110	8	0	0	0	26	9	13	27	13
May be at risk	634	552	9	0	28	5	16	0	2	12	10
Sensitive	657	460	15	2	27	3	65	7	12	41	25
Secure	3543	2574	19	7	145	21	238	30	12	358	139
Undetermined	534	112	2	0	7	1	395	0	1	5	11
Not assessed	465	30	1	0	0	0	434	0	0	0	0
Exotic	1256	1218	0	2	0	0	12	0	2	11	11
Accidental	406	0	0	0	2	0	200	0	2	195	7
Total	**7736**	**5078**	**55**	**11**	**209**	**30**	**1389**	**46**	**47**	**653**	**218**

Figure 1: Comparison of the 2005 Canada General Status Ranks (Canada ranks), among taxonomic groups. Species ranked* Extinct, Extirpated, Undetermined, Not Assessed, Exotic *and* Accidental *are excluded.



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Section 1: Background

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Introduction

Canada is home to over 70 000 wild species[1] including, but by no means limited to, birds, fishes, vascular plants, butterflies, dragonflies, bees, worms, mosses and mushrooms. These species, and other aspects of nature, are highly valued by Canadians. Canadians recognize that wild species provide a host of resources, such as foods, medicines and materials, as well as services that we often take for granted, such as cleaning the air and water, regulating the climate, generating and conserving soils, pollinating crops, and controlling pests. In addition, Canadians take pride in, and profit internationally from, a reputation for pristine landscapes with abundant wildlife. But perhaps above all else, Canadians value the aesthetic splendour and spiritual nourishment still afforded by the incredible range of wild species living in Canada. For all these reasons, we acknowledge a responsibility to future Canadians and the rest of the world to conserve our nation's natural heritage, by preventing the loss of species due to human actions.

The first step in preventing the loss of species is to know which species we have, where they occur and how they are doing. The aim of the *Wild Species* series is to provide this overview. *Wild Species 2005: The General Status of Species in Canada* presents the results of general status assessments for 7736 species, including all of Canada's vertebrate species, all of Canada's vascular plants and four invertebrate groups. General status assessments integrate the best available information to create a snapshot of each species' status; their population size and distribution, the threats that each species faces in Canada, and any trends in these factors. General status assessments are used to categorize species into coarse-scaled general status ranks; some species will be ranked secure; some will show early signs of trouble and may need additional monitoring or management, while still others will be prioritized for detailed status assessments. General status ranks also highlight information gaps: for some species, there will not be enough information to assess whether they are secure or already in trouble. Each species receives a general status rank for each province, territory or ocean region in which it occurs, as well as a Canada General Status rank (Canada rank), reflecting the overall status of the species in Canada (Figure 1-iii).

One of the strengths of the general status approach is that general status ranks are generated for many species in all regions of the country, allowing patterns of declines or threats to emerge across suites of species. In addition, general status ranks are reviewed and updated periodically. This will allow Canadians to begin to track patterns of improvement or decline through time, revealing which species are maintaining or improving their status and which are declining or facing new threats. Such patterns not only give a better indication of the nature and magnitude of a problem, but may also point the way to improved conservation practices.

This report presents the generals status assessments for 10 groups of species; vascular plants, freshwater mussels, crayfishes, odonates, tiger beetles, fishes, amphibians, reptiles birds and mammals. Six groups of species; vascular plants, freshwater mussels, crayfishes, tiger beetles, odonates and marine fishes, are being assessed for the first time in this report. For these groups, *Wild Species 2005* establishes a comprehensive, common platform for examining the general status of species across their Canadian range, as well as a solid baseline against which future changes in the distribution and abundance of species can be compared. In addition, *Wild Species 2005* provides updated general status ranks for six groups that were first assessed in *Wild Species 2000*; ferns and orchids, freshwater fishes, amphibians, reptiles, birds and mammals.

Assessing this mix of species from all regions of the country presents a considerable challenge - the number of species is large and the area great. More than 70 000 species are known to live in Canada, distributed across the length and breadth of the nation: 10 million square kilometres of land and fresh water, almost 6 million square kilometres of ocean, and 202 080 kilometres of coast (the longest coastline in the world). Across this massive area, the distribution of species is influenced by the staggering array of topography, soil types and habitats found within our borders including boreal forest, tundra, taiga, bogs, temperate rainforests, grasslands, marshlands, alpine meadows, the Atlantic coastline and the Arctic Ocean.

Assessing the general status of Canadian species is challenging, but the process is essential. Our resource-based economy and high standard of living have an impact on the natural world: vegetation is cleared, cities expand, resources are extracted, waste is produced and exotic species are introduced. In altering nature for the benefit of Canadians, our goal must be to ensure that our activities do not imperil the very species that we both celebrate and depend upon. The *Wild Species* series is a tool for all Canadians; a guide indicating where more information is needed, a method of tracking changes in the status of Canada's species over time, an effective tool for improved conservation, and a testimony to the cooperative will of Canadians to protect wild species.

Why a report on species in Canada?

Wild Species 2005: The General Status of Species in Canada is a requirement of the *Accord for the Protection of Species at Risk*, an agreement in principle established in 1996 by provincial, territorial, and federal ministers responsible for wildlife. The goal of the Accord is to prevent species in Canada from becoming extinct or extirpated because of human impact. As part of this goal, parties to the Accord agree to "monitor, assess and report regularly on the status of all wild species" with the objective of identifying those species whose populations are starting to decline, those for which a formal status assessment or additional management attention is necessary, and those for which more information is needed. Each province, territory, and federal agency responsible for wildlife undertakes to assess the species occurring within its jurisdiction. In addition, because the status of species can change over time, information about species is reported every five years.

In anticipation of this new information and changing general status for some species, provinces, territories and federal departments work together to produce a national "snapshot" of this ongoing process at least once every five years: how species are faring at that time across regions, across taxonomic groups, and across the nation. The national product of this agreement is the *Wild Species* series, of which *Wild Species 2005: The General Status of Species in Canada* is the second report.

Organization of this report

This report is divided into seven main sections. You can navigate the report using the links below, by using the Table of Contents, or by using the links on the left-hand side of the pages on this site.

- **Executive summary** - Brief overview of *Wild Species 2005*.
- **Background** - Aim and context of the report and information about the methods, results, and interpretation of general status assessments.
- **General status summaries** - Overview of each group assessed, summary of general status ranks, and comparison to *Wild Species 2000*, where appropriate.
- **Summary of overall results** - Summary of general status ranks for all groups covered in this report.
- **Next steps** - The future direction of the *Wild Species* series.
- **Appendices** - Contact information for provincial, territorial and federal representatives and websites, as well as credits and references.
- **General Status Search Tool** - Contains the provincial/territorial, ocean region and Canada General Status Ranks (Canada ranks). The search tool can be used to search general status ranks by common name, scientific name, rank, year, and region. Where relevant, the search tool contains links to the website of the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and links to the website of the World Conservation Union (IUCN). Additional information on species' status is provided in the comments section, where available. Data can be downloaded from the search tool as an excel spreadsheet.

What this report does

This report summarizes the general status assessments of a large number and variety of wild species[2] occurring in Canada. Almost 7800 species from 10 major groups are covered, including all of Canada's vertebrate species, all of Canada's vascular plants and four invertebrate groups. The report focuses on the general status of *all* species within each of these groups, rather than on the general status of only rare or endangered species. So, for example, one can ask questions like: Are salamanders doing better than frogs in Nova Scotia? Has the general status of salamanders in Nova Scotia changed since 2000? Is this pattern the same in Manitoba, or Canada as a whole? How does the general status of salamanders and frogs compare with that of other groups that are associated with water, like fishes? These and many other questions can be answered because the report draws together information on different types of species, from all provinces and territories and portions of three bordering oceans, and presents general status ranks for species in each region as well as overall Canada General Status Ranks (Canada ranks).

General status assessments focus on establishing what information and expertise already exist and using these to develop general status ranks for as many species as possible. This allows existing knowledge to be presented to the public rather than delaying a report until complete scientific information is available. In the case of updated general status assessments, for the six species groups that were first evaluated in *Wild Species 2000*, this meant drawing upon previously established information networks as well as new sources of information to determine which species showed evidence of status change since 2000.

The exceptional number and variety of species covered in the *Wild Species* series requires that this report focuses on distilling detailed information into broad general status categories. Accordingly, while in some cases the report draws upon the information available from initiatives devoted to particular species groups, regions, or functions, it is not a replacement for these efforts, which have a narrower focus and more specific aims. In particular, general status

assessments do not replace comprehensive scientific evaluations by COSEWIC or provincial and territorial equivalents, which provide in-depth, targeted assessments of individual species that may be at risk. General status assessments also differ in methods and scope from bird conservation plans (e.g. *Partners in Flight* for landbirds; *Canadian Shorebird Conservation Plan* for shorebirds; and *Wings Over Water* for seabirds and colonial waterbirds), which have developed their own priority-setting systems tailored to their unique program objectives. Links to information about these programs can be found in Appendix III.

The following is a summary of some of the achievements of *Wild Species 2005* and the *Wild Species* series. This series:

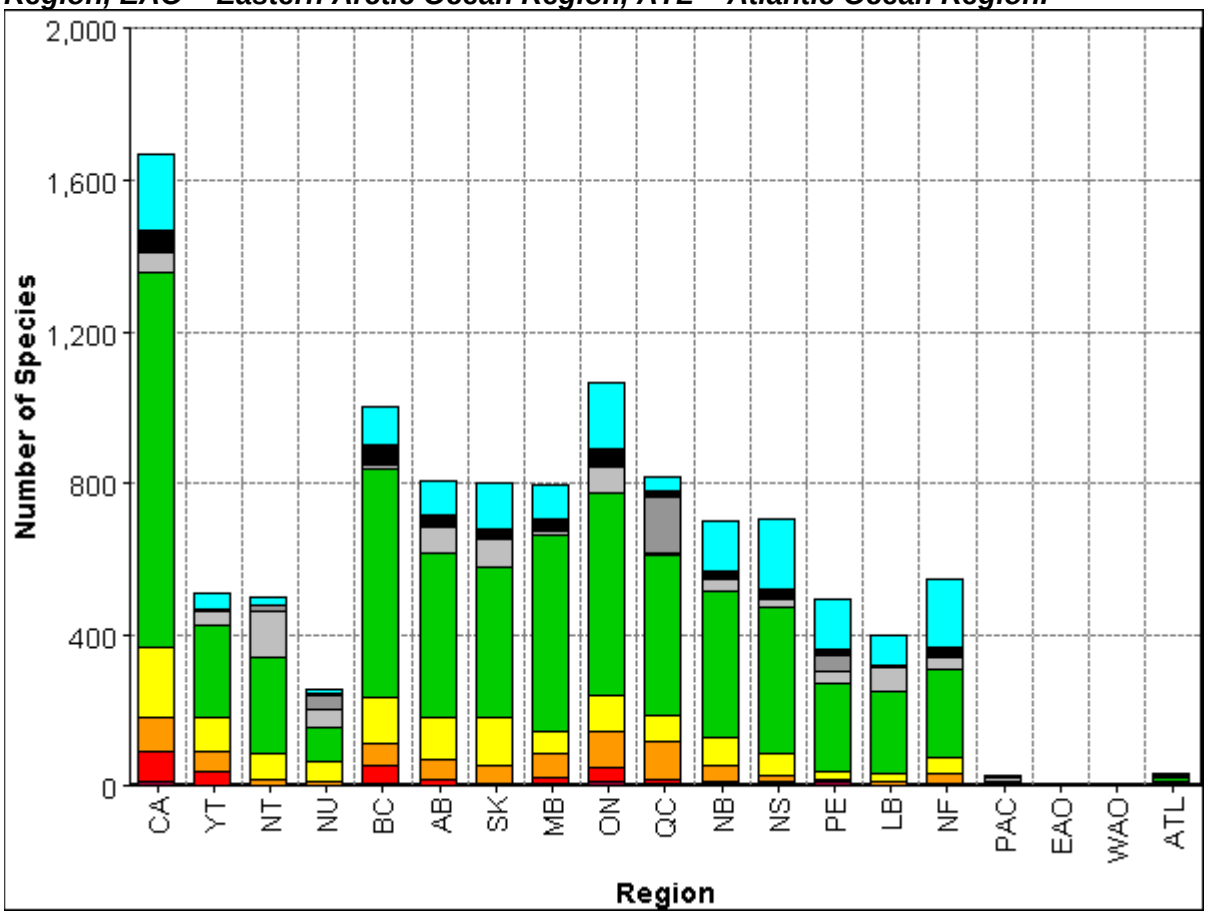
- **Integrates** information on a large number and variety of Canada's wild species (almost 7800 species in 10 groups), including all vertebrates and all vascular plants that have been found in Canada. This allows comparison of general status between individual species, as well as comparison within and between groups of species, based on taxonomic or regional boundaries.
- **Alerts** Canadians to species that may require attention to prevent their extinction, before the species reach a "critical condition." Early warning of a species in trouble increases the success and cost-effectiveness of conservation programs. General status assessments also help to prioritize which species are in most urgent need of a more detailed status assessment, additional management attention, or basic research into population size, distribution, threats or trends.
- **Updates** the general status of 1330 species in six groups, which were assessed for the first time in 2000. This comparison highlights species whose general status is declining or improving, shows where information gaps have been filled, and where further information is still required.
- **Summarizes** the identity and distribution of select non-native wild species (*Exotic* species) across Canada. Few Canadians are aware of fauna and flora that is introduced, or the potential impacts of exotics on native species.
- **Identifies** gaps in our knowledge about wild species in Canada. Directing resources and expertise towards filling these gaps is essential for a more accurate and comprehensive picture of the general status of Canadian wild species.
- **Establishes** or enhances local networks of people with information to share about Canada's wild species. People identified during this process form part of a coordinated knowledge base critical to this, and future, *Wild Species* reports.
- **Shares** information with Canadians about the diversity and general status of wild species across the country. Consolidating information about wild species in Canada lets everyone from schoolchildren to resource managers, farmers, and developers know what species are present in Canada and how they are doing.

Summary of Wild Species 2000

Wild Species 2000 was the first report on the general status of species in Canada, and summarized the provincial/territorial/oceanic region and Canada General Status Ranks (Canada ranks) of species in eight groups: ferns, orchids, butterflies, freshwater fishes, amphibians, reptiles, birds and mammals. The completed Canada ranks for freshwater fishes and butterflies were published in 2002. Once the 2002 Canada ranks for freshwater fishes and butterflies are combined with the 2000 Canada ranks for the other groups, the following results emerge for the 1670 species ranked; the majority (59%) of species had Canada ranks of *Secure*, while 5% had Canada ranks of *At Risk* and 5% had Canada ranks of *May Be At Risk* (Figure 1-i, Table 1-i).

Wild Species 2000 has been used by a wide variety of groups and individuals, from students learning about Canada's wildlife, to government agencies, wildlife managers and naturalists.

Figure 1-i: Summary of overall species' general status from Wild Species 2000, and updated freshwater fishes and butterfly Canada ranks from 2002. Includes the following taxa; ferns, orchids, butterflies, freshwater fishes, amphibians, reptiles, birds and mammals. PAC = Pacific Ocean Region, WAO = Western Arctic Ocean Region, EAO = Eastern Arctic Ocean Region, ATL = Atlantic Ocean Region.



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	CA	YT	NT	NU	BC	AB	SK	MB	ON	QC	NB	NS	PE	LB	NF	PAC	EAO	WAO	ATL
Extirpated or extinct	14	0	0	0	6	4	3	9	13	6	6	6	11	1	3	0	0	0	3
At risk	77	40	3	1	51	12	7	16	35	15	9	5	1	2	4	3	1	0	4
May be at risk	89	54	15	11	55	54	47	60	98	99	43	18	8	11	25	0	0	0	0
Sensitive	187	86	69	55	122	112	123	63	96	66	74	56	21	19	47	3	1	1	5
Secure	992	244	255	89	607	432	402	517	535	426	384	389	231	217	231	9	6	3	13
Undetermined	49	37	123	49	10	73	72	11	65	3	31	20	32	65	32	9	2	1	2
Not assessed	6	5	12	37	6	6	3	4	0	147	5	2	44	0	0	2	0	1	2
Exotic	53	4	4	2	47	22	22	27	52	18	19	27	17	7	27	0	0	0	0
Accidental	203	38	21	14	99	94	124	91	174	35	129	183	131	79	177	5	0	4	6
Total	1670	508	502	258	1003	809	803	798	1068	815	700	706	496	401	546	31	10	10	35

Users of *Wild Species 2000* include:

- **Committee on the Status of Endangered Wildlife in Canada (COSEWIC)** - general status ranks are used by some of the Species Specialist Subcommittees (SSCs) to help prioritize species for detailed COSEWIC status assessments.
- **Wildlife managers, land-use planning committees and co-management boards** - general status ranks used to provide lists of species in a given area, and a guide to species' status.
- **Industry and consultants** - general status ranks provide information used to conduct environmental impact assessments.
- **Funding programs** - general status ranks used to help prioritize which research and conservation projects are funded.
- **Research scientists** - general status ranks used to obtain lists of *Exotic* species, and distributions of species in Canada.
- **General public** - general status ranks used to provide lists of species in a given area, as a guide to species' status, and to provide information used to check the accuracy of environmental impact assessments.
- **Educators and students** - general status ranks and the *Wild Species 2005* report have been used as an educational resource and a research tool.

Changes in the Wild Species 2005 *report*

Several important changes have been made in *Wild Species 2005* compared with the previous report. The changes are designed to improve both the data on which the report is based, and the way in which the data are presented. It is expected that the *Wild Species* reports will continue to evolve over time, but it is important to record changes in methodology so that data can be compared between reports.

Firstly, *Wild Species 2005* is being released only on the web and not as a printed publication. This allows the presentation of interactive graphs and charts which can be tailored to the needs of individual users. It is hoped that the new format will make the report easily accessible and user-friendly for a wide audience, as well as reducing the environmental impact of producing multiple copies of the report.

The single rank of *Extirpated/Extinct* has been split into two separate categories, *Extirpated* and *Extinct*. This change allows clear identification of species that are no longer found in Canada, but are still found in other countries (*Extirpated*) and those that no longer exist anywhere in the world (*Extinct*).

In *Wild Species 2000*, the province of Newfoundland and Labrador provided two ranks, one for the island of Newfoundland and a separate rank for mainland Labrador. For this report, and in the future, Newfoundland and Labrador will provide one combined rank per species, in a similar manner to the other provinces and territories. This change will be most obvious when using the general status search tool to compare ranks between *Wild Species 2000* and this report. For further information on the Newfoundland and Labrador ranks, please visit the provincial website or contact the provincial representative (contact information provided in Appendix I).

Freshwater fishes were first ranked in *Wild Species 2000*. At that time, freshwater fishes were ranked in all the provinces and territories in which they occur. However, some of these species also occur in marine waters. Similarly, some primarily marine fish, do also occur in freshwater. Therefore, in this report, some fishes are given ranks in the provinces, territories, as well as the ocean regions in which they occur.

Finally, a Parks Canada representative has been added to the National General Status Working Group (NGSWG), to provide expertise on species living within Canada's national parks.

Species diversity in context

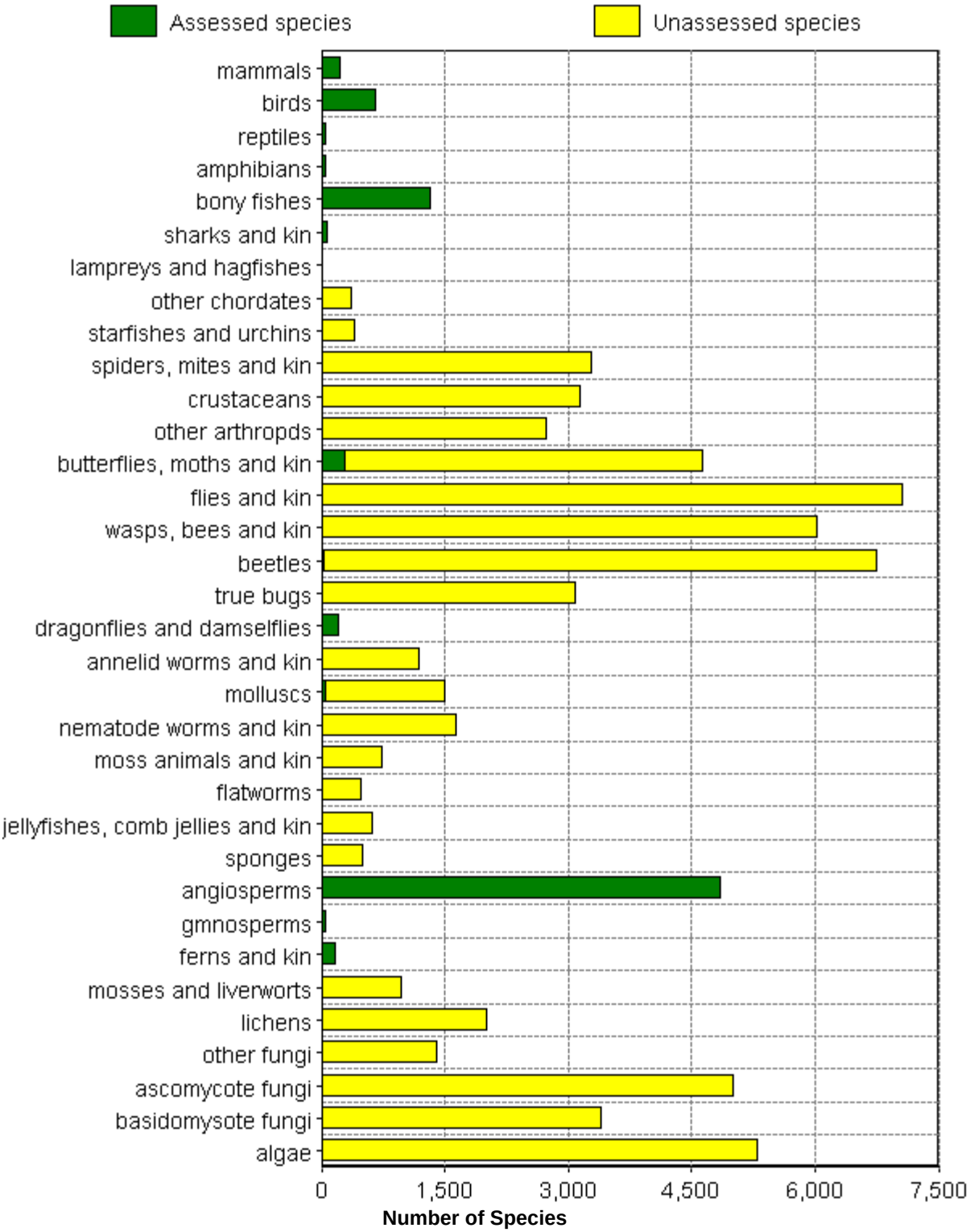
Life is variable at every conceivable scale. From the DNA that makes up an organism's genes to the composition and behaviour of entire ecosystems, a seemingly endless and complex array of living things surrounds us. The most familiar measure of diversity is the number and type of species, and this report focuses on that perspective of biodiversity (Figure 1-ii). However, the species perspective is not the only valuable viewpoint. For example, Canada's Arctic has relatively few species, but many of the species occurring there have special adaptations to extremes of climate that allow them to persist there and nowhere else. Variety in types of organisms is at least as important as their numbers, because different types of organisms have important, often irreplaceable, functions in nature. For example, certain species of fungi live in association with plant roots and provide the plant with vital minerals. Without their inconspicuous fungal partners, many species of vascular plants could simply not grow!

Data sources and methods

This report is the responsibility of the National General Status Working Group (NGSWG), under the direction of the Canadian Wildlife Directors Committee (CWDC). The NGSWG is composed of representatives from all provinces and territories and three federal government agencies: Canadian Wildlife Service, Parks Canada and Fisheries and Oceans Canada (DFO). Prior to *Wild Species 2000*, the NGSWG established the guidelines for the criteria that would be used to derive general status ranks. The NGSWG also established which taxonomic groups of species were ranked in each report. A list of NGSWG members appears at the end of this report (Appendix I).

General status ranks were created at two scales; regional and national (Figures 1-iii and 1-iv). At the regional scale, ranks were created for each province and territory. Since marine species (e.g. whales) are often difficult to associate with a particular province or territory, ranks were also generated in four ocean regions; Pacific Ocean Region, Western Arctic Ocean Region, Eastern Arctic Ocean Region and Atlantic Ocean Region. Provincial and territorial representatives hold the primary responsibility for establishing lists of species that occur in their region, as well as for sourcing, compiling, storing and interpreting the information that informs their region's ranks for a given species. DFO holds the primary responsibility for establishing lists of species that occur in each oceanic region and compiling ranks for each marine species.

***Figure 1-ii: Diversity and number of species assessed in* Wild Species 2005.**



It has been estimated that there are roughly 70 000 recorded species in Canada, and an additional 68 000 species that are undescribed or unrecorded (i.e. species that are new to science or species that are already known to science but that have not yet been documented as occurring in Canada, Mosquin et al. 1992). For each major group, the names of some common or recognizable members are provided, along with the number of species ranked in this report (green bars), and the number of species left to be ranked (yellow bars).

Figure 1-iii: Map of Canada, showing the 13 provinces and territories and the four ocean regions for which general status ranks are generated. [computer map]. 1:1 000 000. National Scale Frameworks. Ottawa, ON: Government of Canada, 2003. Using ArcGIS [GIS software]. Version 9.1. Redlands, CA: Environmental Systems Research Institute. 1995-2006.

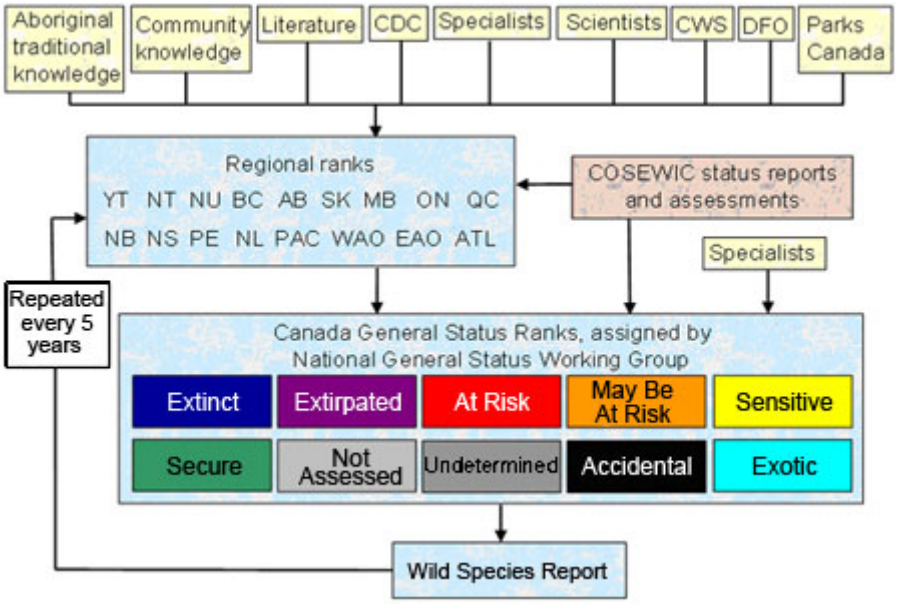


Figure 1-vi: Diagram outlining how regional ranks (i.e. provincial, territorial and ocean region ranks) and Canada ranks are generated. Regional ranks are generated by provincial/territorial representatives or by DFO (ocean region ranks). Canada ranks are then generated by the NGSWG, based on the regional ranks and additional input from specialists.

Once regional (i.e. provincial, territorial, and oceanic) general status ranks are completed, the NGSWG is responsible for assigning a Canada General Status Rank (Canada rank); a national rank that interprets the overall state of the species in Canada based on the information provided by each province, territory, or ocean region where the species occurs.

The remainder of this section provides more detailed information on the methods and sources of information used in *Wild Species 2005: The General Status of Species in Canada*. Included are definitions of general status categories (Box 1) and underlying criteria (Box 2), as well as a description of the process used to derive ranks and some generalized examples of general status assessments (Box 3).

The species concept

The general status assessment process assigns ranks to *species*, commonly defined as populations of organisms that do not usually interbreed with other populations, even where they overlap in space and time. Species are the most common and recognizable units of biological classification used in conservation, but they are not the only one. Subspecies (genetically distinct populations that may look and behave differently) and stocks (population divisions of harvested species, that may require different management approaches because they experience different ecological pressures) are examples of divisions below the species level. While these divisions have merit, there tends to be more disagreement over the precise limits and biological significance of differences observed at this finer scale. Moreover, relatively few species have been examined closely enough to distinguish whether or not subspecies or discrete stocks exist. Accordingly, only species were assigned general status ranks. However, where additional information is available for particular subspecies or stocks (particularly for birds), it can be found in the comments field, accompanying the general status rank for the species, available through the search tool. For further information about the general status of species for a particular province or territory, or about the general status of a particular species, see the list of contacts at the end of this report.

Sources of information

Achieving the most accurate overall impression of a species' status requires compiling local information to generate regional and then national pictures of a species' general status. This makes assessing the general status of Canada's species a complicated and challenging task, because there are many species, and most are distributed across a vast area. Fortunately, there are many sources of information about Canada's species, some in published documents, but much in the accumulated knowledge and expertise of people. For example, amateur naturalists, museum specialists, government biologists, and holders of community knowledge or aboriginal traditional knowledge are often key to determining which species occur within a region and what their status is. In many provinces, some of this local knowledge was already maintained by NatureServe within its network of Conservation Data Centres (CDCs) and Natural Heritage Information Centres (NHICs). Still, even in provinces and territories with a CDC or NHIC, previously unrecognized sources of knowledge were often identified.

Involving a great variety of people with knowledge to share about species ensures that the best and most comprehensive picture of a species' general status is achieved. An added benefit is that the extensive consultation required to collect data for species' general status assessments fosters a network of expertise that is an enduring resource for wildlife management and conservation within each province or territory. The products of these knowledge networks were current lists of species in a given region and, in most cases, sufficient information for the province or territory to establish a general status rank for each species. In addition, gaps identified in this network point to where investment may be necessary to develop expertise in particular species groups, and highlight the need to capture the knowledge currently held by today's experts in a lasting form.

New general status assessments

Over 6000 species in six groups (vascular plants, freshwater mussels, crayfishes, odonates, tiger beetles and marine fishes) were assessed for the first time for this report, and many sources of information were used to guide the establishment of general status ranks for each species. Although the details of the general status assessment process varied somewhat between jurisdictions, the process was relatively standardized. The most common process was for informal or formal committees to distil the available information into scores for the set of seven criteria (see Box 2) that underlie general status ranks (for examples, see Box 3). Criteria were scored according to the strength of information (e.g. empirical versus anecdotal) that was available. General status ranks were the result of a further weighting of all criteria for which information was available. Another common method for generating general status ranks, was for provinces and territories to convert existing sub-national conservation status ranks (S ranks), developed by their Conservation Data Centre or Natural Heritage Information Centre, into general status ranks.

Updated general status assessments

Updated general status assessments were conducted for 1330 species that were first assessed in *Wild Species 2000* (ferns and orchids, freshwater fishes, amphibians, reptiles, birds and mammals). Provinces and territories relied on information sources used to generate ranks in *Wild Species 2000*, as well as new sources of information, and looked for changes that had occurred since 2000. The first step was to check for changes to the species list. These could include new species, taxonomic changes and correction of errors. Additional species were assessed using the criteria for new general status assessments, described above.

The next step was to assess species that occurred in the region in both 2000 and 2005. For each species, if no major change in abundance, distribution, trends or threats was found to have occurred, or if no new information was available, the species usually retained the rank it was given in 2000. If major changes were believed to have occurred, or if new information was available (e.g. a new COSEWIC status assessment, or a new survey showing a broader distribution), the species was reassessed using the same criteria as for a new general status assessment (see Box 3 for an example).

From regional to national general status assessments

A Canada General Status Rank (Canada rank) was assigned for each species in order to provide a coarse-scale picture of national general status. Canada ranks were assigned by the NGSWG through a review of ranks and associated information from provinces, territories, and ocean regions. In general, where ranks vary across the country, the regional rank that represents the lowest level of risk (excluding ranks of *Undetermined*, *Not Assessed*, *Exotic* or *Accidental*) was used as the Canada rank. For example, Smooth Greensnake (*Opheodrys vernalis*) is ranked *Undetermined* in Prince Edward Island, *Sensitive* in Saskatchewan, Manitoba and Quebec, and *Secure* in Ontario, New Brunswick and Nova Scotia. Therefore, Smooth Greensnake received a Canada rank of *Secure*. However, the geographic distribution of the species was also taken into account so that a region harbouring the majority of a species' range carried more influence in determining the Canada rank, than did a region in which the species was only marginally represented. For example the Barrenground Shrew (*Sorex ugyunak*) is ranked *Sensitive* in the Yukon and *Undetermined* in the Northwest Territories and Nunavut. If the usual guideline was followed, the Canada rank for this species would be *Sensitive*. However, since only a small portion of this shrew's range is in the Yukon, the Barrenground Shrew was given a Canada rank of *Undetermined*. Finally, for species with restricted breeding range (especially shorebirds), status within the breeding range was particularly important in determining the Canada rank. For example, within Canada, the Ruddy Turnstone (*Arenaria interpres*) breeds primarily on the tundra in northern Nunavut. Here it is ranked *Sensitive* due to population declines. However, the Ruddy Turnstone is a common migrant in suitable habitat throughout much of southern Canada, and is ranked *Secure* in every province except Saskatchewan, where it is ranked *Accidental*. If the normal procedure of assigning the rank with the lowest level of risk as the Canada rank was followed, the Canada rank would be *Secure*. However, Ruddy Turnstone received a Canada rank of *Sensitive*, due to concerns within its breeding range. For more information on this type of exception, please see the Birds section.

The general status search tool

National and regional general status ranks for each species assessed can be found by using the general status search tool. Information presented includes English and French common names, scientific name, taxonomic group, Canada rank, regional general status ranks, and year of assessment. In addition, a comments section is available which supplies relevant additional information, and links to COSEWIC and IUCN webpages where applicable. The general status search tool can be used to search the general status ranks by common name, scientific name, region, rank, taxonomic group or year.

Box 1 - General status categories

Each species assessed in *Wild Species 2005* received a rank (often represented by a numerical code) that summarizes its general status. Each general status assessment was based upon a series of criteria (see Box 2) that capture information, where available, on population size and distribution, threats to individuals or their habitat and trends (increases or decreases) in these factors. Species received a general status rank in each province, territory, or ocean region in which they are known to be present, as well as an overall Canada General Status Rank (Canada rank).

General status categories are necessarily broad, both because the large number of species covered precludes the detailed and intensive species assessments that would inform a finer-scaled system, and because of variation in the amount of information available for different species. The reader should also note that all general status categories refer only to a species' status in Canada. Where the species also occurs outside of Canada (as most of our species do), the situation for those populations of the species may be different. For example, a species that is abundant elsewhere (e.g. USA, Europe) may exist in Canada in very low numbers. In this case, it could be ranked as *May Be At Risk*, reflecting the Canadian general status and level of concern for its future here, while being of lesser conservation concern in other parts of its range.

The general status categories used in this report are as follows:

0.2 ***Extinct***

Species that are extirpated worldwide (i.e., they no longer exist anywhere). This rank partially replaces the rank of *Extirpated/Extinct*, used in *Wild Species 2000*.

0.1 ***Extirpated***

Species that are no longer present in a given geographic area, but occur in other areas. This rank partially replaces the rank of *Extirpated/Extinct*, used in *Wild Species 2000*.

1 ***At Risk***

Species for which a formal, detailed risk assessment (COSEWIC status assessment or provincial or territorial equivalent) has been completed and that have been determined to be at risk of extirpation or extinction (i.e. Endangered or Threatened). A COSEWIC designation of Endangered or Threatened automatically results in a Canada General Status Rank (Canada rank) of *At Risk*. Where a provincial or territorial formal risk assessment finds a species to be Endangered or Threatened in that particular region, then, under the general status program, the species automatically receives a provincial or territorial general status rank of *At Risk*.

2 ***May Be At Risk***

Species that may be at risk of extirpation or extinction and are therefore candidates for a detailed risk assessment by COSEWIC, or provincial or territorial equivalents.

3 ***Sensitive***

Species that are not believed to be at risk of immediate extirpation or extinction but may require special attention or protection to prevent them from becoming at risk.

4 ***Secure***

Species that are not believed to belong in the categories *Extirpated*, *Extinct*, *At Risk*, *May Be At Risk*, *Sensitive*, *Accidental* or *Exotic*. This category includes some species that show a trend of decline in numbers in Canada but remain relatively widespread or abundant.

5 ***Undetermined***

Species for which insufficient data, information, or knowledge is available with which to reliably evaluate their general status.

6 ***Not Assessed***

Species that are known or believed to be present regularly in the geographic area in Canada to which the rank applies, but have not yet been assessed by the general status program.

7 ***Exotic***

Species that have been moved beyond their natural range as a result of human activity. In this report, *Exotic* species have been purposefully excluded from all other categories.

8 ***Accidental***

Species occurring infrequently and unpredictably, outside their usual range.

Box 2 - Criteria underlying general status assessments

The general status of a given species was reached by considering available information relating to a set of seven criteria that collectively reflect the status of a species' population within specific geographic areas - that is, provinces, territories, ocean regions, and Canada as a whole. These criteria were based on definitions developed and applied by the World Conservation Union (IUCN), the Criteria for Amendment of Appendices I and II (Res. Conf. 9.24) of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and the Natural Heritage Program and Conservation Data Centres of NatureServe. Criteria were used as a guide to help determine the appropriate general status category for a species. Where possible, representatives from each province, territory, and federal agency followed the following definitions of the seven criteria:

- Number of occurrences is defined as the estimated number of sites where the species currently occurs. A site occurrence is described ecologically as a location representing a habitat that sustains or otherwise contributes to the survival of a population. A site occurrence will be defined differently for different species, depending on its natural history. When a species' distribution is extremely limited and there are very few site occurrences, the species is very susceptible to any number of disturbances, both predictable and unpredictable. Therefore, when the number of occurrences is few, this criterion is usually the single most important factor influencing overall rank.
- Geographic distribution is defined as the area contained within the shortest continuous imaginary boundary that can be drawn to encompass all known, inferred, or projected sites of occurrence, excluding outlier occurrences (i.e. chance occurrences, unlikely to be repeated). The area within the imaginary boundary should, however, exclude significant areas where the species does not occur. For migratory species, the geographic distribution is the smallest area essential at any stage for the survival of the species.
- Trend in population is defined as an estimate of the change (if any) in the number of mature individuals over time. Where declines are indicated, rapidly declining is defined as a decrease of 50% in the last 10 years or three generations, whichever is longer. Declining is defined as a decrease of 20% in the last 10 years or three generations, whichever is longer. Natural fluctuations will not normally count as part of a decline, but an observed decline should not be considered part of a natural fluctuation unless there is evidence for this interpretation.
- Trend in distribution is defined as the change (if any) in the geographic distribution of the species over time. Where declines in distribution are indicated, rapidly declining is defined as a decrease of 50% in the last 20 years or six generations, whichever is longer. Declining is defined as a decrease of 20% in the last 20 years or six generations, whichever is longer.

- Threats to population are defined as observed, inferred, or projected direct exploitation, harassment, or ecological interactions with predators, competitors, pathogens, or parasites that may result in population declines. Extreme threats are significant, could affect more than half the population, and are unmitigated. Moderate threats are also serious but affect less than half the population or are mitigated by some level of human protection. Limited threats are less significant to population viability or are being mitigated through protective measures.
- Threats to habitat are defined as observed, inferred, or projected habitat alterations (loss, conversion, degradation, or fragmentation) that may result in population declines. Extreme threats are significant, affect more than half the population, and are unmitigated. Moderate threats are also serious but affect less than half the population or are mitigated by some level of human protection. Limited threats are less significant to population viability or are being mitigated through protective measures.

Box 3 - Profile of regional general status ranks

The following examples show criteria scores that could inform a general status rank for a given species in a province, territory, or ocean region. Each score is a relative assessment based on available data, since for most species, definitive, qualitative data are rare. Therefore, thresholds between scores are not absolute. The amount and type of information (e.g. empirically versus anecdotally based) were used as factors in weighting the contribution of each score to the final overall rank. Thus, each general status rank is not a simple average of component criteria scores but depends on the particular character of the information underlying each criterion.

The first example, Lake Whitefish (*Coregonus clupeaformis*), represents a species that was first assessed in *Wild Species 2000*, but whose criteria scores and oceanic rank has not changed since that time. The second example, Chimney Swift (*Chaetura pelagica*), represents a species which was first assessed in *Wild Species 2000*, but that has since faced declines in population and distribution, resulting in a change in its regional rank.

Lake Whitefish (*Coregonus clupeaformis*)

CRITERION	SCORES
I. Abundance and distribution	
Population size in prov./terr. • more than 10 000	Large
Number of occurrences in prov./terr. • more than 100; throughout the mainland	Large
Geographic distribution (% of prov./terr.) • 88%	Widespread
II. Trend scores	
Trend in population • Trend in population	Stable
Trend in distribution • Trend in distribution	Stable
III. Threat scores	
Threats to population • commercial fishing; limited threat in prov./terr.	Limited
Threats to habitat • limited in prov./terr.	Limited
GENERAL STATUS RANK (prov./terr.)	***Secure***

Chimney Swift (*Chaetura pelagica*)

CRITERION	2000 SCORES	2005 SCORES
I. Abundance and distribution		
Population size in region	Medium	Medium
Number of occurrences	Large	Large
Geographic distribution	Medium	Medium
II. Trend scores		
Trend in population	Stable	Decreasing
Trend in distribution • migratory	Stable	Decreasing
III. Threat scores		
Threats to population • Severe weather including hurricanes can cause reverse migration and massive die offs as was evidenced in Atlantic Canada in the fall of 2005	Limited	Medium
Threats to habitat • Loss of large hollow trees and chimneys suitable for nesting poses a threat in northern portions of the breeding range.	Medium	Medium
GENERAL STATUS RANK (prov./terr.)	***Secure***	***Sensitive***

Results and interpretations

In Section II of this report, General status summaries, an overview is provided for each of the 10 groups of species assessed (i.e. vascular plants, freshwater mussels, crayfishes, odonates, tiger beetles, fishes, amphibians, reptiles, birds, mammals). Each overview gives some background information on important characteristics of that group of species, their role in the environment, status of knowledge of the group in Canada, and, most importantly, some key statistics gleaned from the general status ranks for that group. Overviews for groups with updated ranks also provide a comparison with ranks presented in 2000, along with a brief discussion of the reasons for changes. General status ranks for individual species at the national level, or for a particular province, territory, or ocean region, can be found by consulting the General Status Search Tool. The general status ranks present the best estimate of the general status of these species at the time of assessment. However, the situation for species is dynamic: some populations will fare better or worse in the time between this report and the next.

The reader is cautioned against over-interpreting differences in general status ranks; general status ranks are best viewed as a coarse-scaled guide, based on the best information available at the time of assessment, to allow comparison among species and regions. Variability in general status ranks is introduced when we try to compare the status of groups with widely different life histories and habitat requirements. For example, if you imagine trying to compare the number of occurrences, the distribution and the population size of a tiger beetle, a bear and a migratory, marine fish, you will see why general status categories must necessarily be broad and somewhat flexible. In addition, while general status ranks are based on the best available information at the time of completion, the quality of information varies widely among species, and among regions, and definitive, quantitative data are simply not available for many species, nor likely to be available in the near future. Variation in general status ranks does not diminish their value as guides to a species' status, but it does necessitate a conservative approach to their interpretation.

In *Wild Species 2005*, we present species richness values as a proportion of the total species richness within the region of interest, whereas in *Wild Species 2000*, species richness values were presented primarily as a proportion of resident species richness. "Resident species" refers

to regularly occurring, extant (still found in Canada) species (i.e. species ranked *Extinct*, *Extirpated* and *Accidental* are excluded). Within the results section of each general status summary, species richness values are presented as a proportion of total species richness, so the numbers given in the text cannot be directly compared with numbers given in the text of *Wild Species 2000*. However, wherever relevant, a footnote in the results section gives species richness values from *Wild Species 2000* as a function of total species richness, to allow a direct comparison. This difference does not apply to graphs, which can be compared directly between the two reports.

In *Wild Species 2000*, all butterflies and freshwater fishes were ranked *Not Assessed* at the national level, and in some instances at the provincial/territorial level also. These groups were assessed nationally in 2002, at which time, some of the provincial/territorial ranks for butterflies were also updated; these ranks are available on the *Wild Species* website. *Wild Species 2005* contains an updated assessment of freshwater fishes, but butterfly ranks will not be updated until the next *Wild Species* report.

References

Accord for the Protection of Species at Risk (1996, revised 1998). http://www.speciesatrisk.gc.ca/recovery/accord_bac_e.cfm (Accessed March 17, 2006).

Canadian Endangered Species Conservation Council (CESCC). 2001. Wild Species 2000: The general status of species in Canada. Ottawa: Minister of Public Works and Government Services Canada. http://www.wildspecies.ca/wildspecies2000/ (Accessed March 17, 2006).

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). http://www.cosewic.gc.ca/ (Accessed March 17, 2006).

Fisheries and Oceans Canada. 2005. Canada's oceans action plan. Department of Fisheries and Oceans, Ottawa. http://www.dfo-mpo.gc.ca/canwaters-eauxcan/oap-pao/index_e.asp#toc (Accessed March 17, 2006).

IUCN. (2001). IUCN Red List categories and criteria: Version 3.1. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK. ii + 30 pp. http://www.iucn.org/themes/ssc/redlists/RLcats2001booklet.html (Accessed March 17, 2006).

Mosquin, T., Whiting, P. G. and McAllister, D. E. 1992. Canada country study of biodiversity: Taxonomic and ecological census, economic benefits, conservation costs and unmet needs. Draft report for delegations to the International Convention on Biological Diversity, Brazil, 1992. Ottawa: canadian Museum of Nature.

NatureServe Canada. http://www.natureserve-canada.ca (Accessed March 17, 2006).

Species At Risk Act Public Registry. http://www.sararegistry.gc.ca/ (Accessed March 17, 2006).

The Atlas of Canada. http://atlas.gc.ca/ (Accessed March 17, 2006).

Section II: General Status Assessments

Taxonomic Groups Assessed

Vascular Plants

© B. T. Aniskowicz-Fowler: Tamarack, (*Larix laricina*)

Vascular plant: Higher plants; characterized by the possession of true roots, shoots and leaves containing specialized vascular tissue through which liquids are conducted - Dictionary of the Environment.

Quick facts

- There are over 260 000 species of vascular plants in the world. More than 95% of vascular plants are flowering plants, also called angiosperms (e.g. grasses, orchids, maple trees). The other types of vascular plants are gymnosperms (cone-bearing trees, e.g. pine trees, spruce trees) and seedless plants (e.g. ferns, horsetails).
- 5078 species of vascular plants have been found in Canada, of which 51% have Canada General Status Ranks (Canada ranks) of *Secure*, 11% have Canada ranks of *May Be At Risk*, 9% have Canada ranks of *Sensitive* and 2% have Canada ranks of *At Risk*.
- 24% of vascular plant species have a Canada rank of *Exotic* (not native to Canada), the highest proportion of *Exotic* species of any group covered in this report.
- 194 species of ferns and orchids were ranked in both 2000 and 2005. The Canada ranks of 18 of these species (9%) have been changed since 2000; 11 species have been moved into categories with a higher level of risk, six species have been moved into categories with a lower level of risk and one species has been moved into the *Extirpated* category. The majority of changes were due to improved information; none of the changes were due to biological changes in species distribution, abundance or threats.

Background

Green plants play a critical role in maintaining life on earth, because they are one of the few groups of organisms that can make their own food. Through the chemical process of photosynthesis, green plants use energy from the sun to convert water and carbon dioxide into oxygen and sugar, which is used as a food source by plants, and by plant-eating animals. Therefore, green plants produce two of the resources that all animals need to survive; food and oxygen. In addition, plants play important roles in the environment by helping to regulate climate, providing habitat for wildlife, contributing to nutrient cycles and soil creation, improving air and water quality, and reducing soil erosion.

Most familiar plants, such as ferns, orchids, herbs, grasses, shrubs and trees are vascular plants. All vascular plants have roots, leaves and a vascular system, which transports water, sugars and nutrients throughout the plant. Vascular plants are the largest group of green plants in the world, and form the dominant vegetation over much of the earth's landmass.

The oldest vascular plants are the seedless plants, including the ferns, club mosses, and horsetails. Seedless plants dominated the world in the Carboniferous period, approximately 300 million years ago. Dead plants from this period formed some of the coal beds from which coal is still mined today. All seedless plants reproduce using spores. For more information about seedless plants, please visit the Ferns section in *Wild Species 2000*.

From the seedless plants evolved two groups of seed plants; the cone-bearing plants (the gymnosperms, e.g. pine trees, spruce trees) and the flowering plants (the angiosperms e.g. grasses, orchids, maple trees, oak trees). As their name suggests, seed plants use seeds rather than spores for reproduction. Seeds are simply embryos surrounded by a seed coat, which protects the embryo from drought, extreme temperatures and other harsh conditions. Most seeds also contain a food source for the developing plant. Angiosperms surround their seeds with an additional layer of protection, the fruit. The fruit protects the seeds, and often provides a mechanism for spreading them over long distances. Fruits can be fleshy (e.g. blueberries, cranberries) or dry (e.g. the keys of the Sugar Maple, *Acer saccharum*, are actually a type of fruit!).

vascular plants are literally rooted to one spot. So, how do plants find a mate and reproduce? Gymnosperms produce pollen (male sex cells) and eggs in separate male and female cones. The pollen is released into the air and carried by the wind to a female cone, where it will fertilize the eggs. The process of transporting pollen from the male cone to the female cone is called pollination. The chance of successful pollination is fairly small, so gymnosperms produce large amounts of pollen to increase the chance that some of it will meet with a female cone of the same species.

In angiosperms, all the sex organs are located within the flowers (although male and female organs are not necessarily found within the same flower, or even on the same plant). While some angiosperms rely on wind pollination (e.g. grasses), most rely on animal pollinators such as insects, birds and even bats, to carry pollen between their flowers. Angiosperms attract potential pollinators with brightly coloured petals, sweet fragrances, or by producing nectar. Some species of angiosperms have evolved to attract very specific pollinators. For example, the main pollinators of the Cardinal Flower (*Lobelia cardinalis*) are hummingbirds, which are attracted to the plant by the bright red flowers. The long, narrow cardinal flowers are the perfect shape for a hummingbird to insert its bill and retrieve the nectar. As the hummingbird feeds, pollen is deposited on its head; the pollen will be brushed off at the next flower, where it will fertilize the eggs. By attracting specific types or species of pollinators, plants can increase the chances that their pollen reaches another flower of the same species.

Plants are amazing chemical factories that make a variety of different products, from defensive chemicals that protect the plant from predation, disease and parasites, to hormones that control the plant's growth. Humans have long known that many of the chemicals that plants produce have useful medicinal properties. For example, Common Yarrow (*Achillea millefolium*) is a well-known traditional cure for staunching wounds and treating fevers, colds and other ailments. Today, Common Yarrow can be found in more than 20 pharmaceutical products sold in Canada.

Status of knowledge

Even before plants were first domesticated, roughly 10 000 years ago, they provided humans with food and raw material. Today, plants form the basis of our agricultural and forestry systems, provide raw materials for clothing, buildings, paper products and medicines and play an important role in the biotechnology industry.

The study of plants has a long history in Canada, from Aboriginal Peoples who relied on plants for food, shelter, clothing, raw materials and medicines, to the early European settlers, some of whom became famous botanists (e.g. Catherine Parr Trail, John Macoun). Much of today's research is centered on plants that are important for agriculture, forestry or medicine, using new genetic and molecular tools to study a huge variety of topics including plant physiology, genetics, and interactions between plants and pests.

Relative to other species groups covered in this report, such as marine fishes, the distribution and status of many vascular plant species in Canada is fairly well known, particularly in southern Canada. Nevertheless, systematic surveys are still uncovering new information, such as the discovery of a new tree species for Canada, the Swamp Cottonwood (*Populus heterophylla*, see species spotlight for more details). As well as discovering new species, systematic surveys improve information on the distribution and abundance of vascular plants. For example, in New Brunswick, the first systematic rare plant survey of the upper St. John River in 2001 and 2002, showed that two species of grasses, Mat Muhly (*Muhlenbergia richardsonis*) and Little Bluestem (*Schizachyrium scoparium*), thought to be rare in the province, were actually more common than previously believed. Within New Brunswick, these species are ranked *Secure* and *Sensitive* respectively.

The distribution of vascular plants in remote areas, and in northern Canada is less well known than that of plants in southern Canada. This is partly because fewer people (both amateurs and professionals) are studying plants in these regions, despite the presence of unique plant communities and endemic species found nowhere else on earth. In addition, many plant specimens from northern Canada have been housed in national collections in southern Canada. While some of these collections have been well documented and catalogued (e.g. the National Herbarium at the Canadian Museum of Nature), others have only recently been fully catalogued to reveal new information about northern vascular plants.

Plant ecology is the study of how plants interact with, and are affected by, the world around them; both the physical world (e.g. temperature, soil type, light levels) and the 'biological' world (interactions with other plants, animals, fungi etc). This is important for understanding a variety of problems including plant distribution, how plants survive in different environments, and plant productivity. Plant ecology also helps researchers understand how changes in the environment (e.g. climate change, invasion of exotic species) might affect plant communities. For example, researchers in Quebec, working on grasses in pastureland, have shown that exposure to increased levels of carbon dioxide can influence plant succession (changes in community composition through time) and species richness. Knowledge of plant ecology can also help conserve and restore native plant communities. For example, Canadian researchers are working on restoring surface vegetation to bogs that have been mined for peat. This is the first step in restoring mined bogs back to a functioning ecosystem.

Richness and diversity in Canada

Relative to other groups covered in this report, the species richness of vascular plants is high across the country (Figure 2-1-i, Table 2-1-i), peaking in British Columbia (2133 native species). The flora of British Columbia is particularly diverse within a Canadian context, because 557 species of native vascular plants found there are found nowhere else in Canada. Other regions of Canada known for being local centers of vascular plant species diversity, and for concentrations of endemic plants include the Central Yukon Plateau, Ellesmere and Baffin Islands, the sand-dune region of Lake Athabasca, Saskatchewan, and the Gulf of St Lawrence.

The proportion of *Exotic* plant species is high across the country, but tends to be highest in the provinces of eastern Canada (22% to 36%) and lowest in the territories (2% to 11%).

Species Spotlight - Showy Lady's-slipper, Cypripedium reginae

Known as the 'queen' of the orchids, the Showy Lady's-slipper, *Cypripedium reginae*, has beautiful pink and white flowers, and grows up to 80 cm tall. Each flower has three petals, the lowest of which is folded into a pouch. This pouch is said to resemble a slipper, giving the lady's-slipper orchids (genus *Cypripedium*) their name. Showy Lady's-slippers require very nutrient-rich soil and are found in fens and wet, open forests throughout eastern and central Canada.

Like all orchids, Showy Lady's-slippers have an intriguing and complicated life cycle. Orchid seeds are very small, almost microscopic, and do not contain a food source to nourish the germinating seed. In order to survive and grow, the seed must come in to contact with a specific soil fungus, which provides enough nutrients for it to grow into a small plant. Once the plant produces leaves, it can make its own food through photosynthesis. However, it can take up to 12 years for this slow-growing plant to produce flowers! To protect the plant from hungry predators during its long life cycle, the shoots and leaves of Showy Lady's-slippers are covered in stinging hair-like structures. The stinging 'hairs' strongly discourage invertebrates, and larger predators, such as White-tailed Deer (*Odocoileus virginianus*), from eating the plant.

Showy Lady's-slippers are pollinated by insects, typically small bees or flies. However, unlike many other angiosperms, lady's-slipper orchids do not produce nectar to attract visiting insects. Instead, insects are thought to be attracted to the flower by the colours and patterns of its petals, and by its scent. Once an insect enters the flower, it becomes trapped within the folded lower petal, or slipper. To escape, the insect must push past the pistil (the female part of the flower), where pollen is brushed off the insect's body, to fertilize the eggs. Finally, the insect pushes past the stamen (the male part of the flower), where it picks up more pollen, before leaving the flower.

Due in part to its long, complicated life cycle, this species is particularly vulnerable to increases in rates of adult mortality. For example, harvesting by gardeners and other collectors has led to the loss of entire populations, despite the fact that this species does not grow well in artificial settings. Other concerns include habitat loss, changes in the abundance or distribution of insect pollinators or soil fungi, and trampling of the inconspicuous young shoots by humans attracted by the beauty of the adult plants.

Showy Lady's-slipper is widespread and locally common in much of eastern Canada, and has a Canada rank of *Secure*. This rank has not changed since *Wild Species 2000*, although, of the eight provinces in which it is found, two provinces have changed its rank to reflect a lower level of risk and

one province has changed its rank to reflect a higher level of risk.

Species spotlight - Carnivorous plants

Carnivorous plants have the fascinating ability to capture and kill insects and other small animals. Carnivorous plants live primarily in nutrient-poor bogs and other habitats with acidic or wet soils. In these habitats, essential nutrients such as nitrogen, are difficult to obtain, so carnivorous plants supplement their nutrient supply by digesting the insects that they capture. Interestingly, the ability to capture and digest prey has evolved separately in several different plant families, so modern carnivorous plants are quite varied in structure and the methods they use for capturing insects.

There are 20 different species of carnivorous vascular plants in Canada, representing four different groups; pitcher plants (genus *Sarracenia*, one species), sundews (genus *Drosera*, five species), butterworts (genus *Pinguicula*, three species) and bladderworts (genus *Utricularia*, 11 species). Each group has its own unique method of capturing and digesting prey. For example, sundews have modified leaves covered in red, hair-like structures, each topped with a glistening drop of sticky mucus. Insects are attracted by the sundew's colourful appearance and sweet-smelling secretions, but once they step onto a leaf, they quickly become stuck. As the insect struggles, more hairs are drawn inwards to help secure the insect. Glands on the hairs secrete enzymes, which digest the prey, allowing the leaf to absorb the nutrients.

The most complicated active traps developed by carnivorous plants are found in the bladderworts, which capture tiny aquatic prey. Aquatic bladderworts float freely in shallow water, without the benefit of roots to draw nutrients from the soil. Their leaves are very finely divided and contain numerous tiny chambers or bladders. Each bladder operates as a vacuum trap, whose door is triggered by hair-like structures. When a prey item brushes against the 'hairs', the door of the bladder flips open and the prey is sucked into the trap along with the surrounding water. Once inside, the prey is digested and the water is pumped back outside, re-creating the vacuum and leaving the trap ready for the next victim. Amazingly, the door of the bladder trap opens in less than 0.002 seconds, one of the fastest response-times in the plant world!

The majority of Canada's carnivorous plants are ranked *Secure* or *Sensitive*, but one species (Yellowish-white Bladderwort, *Utricularia ochroleuca*) has a Canada rank of *May Be At Risk* and one species (Thread-leaved Sundew, *Drosera filiformis*) has a Canada rank of *At Risk*. Carnivorous plants are an important component of nutrient-poor wetlands across the country. The most important threat to carnivorous plants is habitat destruction through peat mining, wetland drainage and succession, although collecting for the commercial plant trade is also a concern for all species of carnivorous plants.

Species spotlight - Tamarack, Larix laricina

Tamarack (*Larix laricina*), also known as Hackmatack or Eastern Larch, is found in every province and territory of Canada, and is the official tree of the Northwest Territories. Tamaracks are unusual in the plant world because they are deciduous conifers! Like other conifers, Tamaracks have cones and needle-like leaves, but each autumn their soft, flexible needles turn a beautiful golden colour and fall off, to be replaced again in spring.

Tamaracks grow in a range of soil conditions, but are typically found in cold, poorly drained soils, in bogs and other peatlands. A small to medium sized tree, mature plants are typically 15 to 23 m tall, up to 40 cm in diameter and can live for about 150 to 180 years. Tamaracks are common in the boreal forest and are considered a very cold-hardy tree. In order to survive the cold winter, Tamararks take advantage of a process called extracellular freezing. As water freezes, ice-crystals are formed which can damage cells irreparably. However, during extracellular freezing, water is squeezed out of the tree's cells and stored in the air spaces between the cells. This prevents the cells from being damaged when ice crystals form, allowing Tamaracks to survive as far north as the tree line.

Although Tamaracks are not an important commercial species, they are harvested and sold to make pulp products. The hard, rot-resistant wood is also used to make poles, fence posts and railway ties, while in the past its roots were prized for shipbuilding. Aboriginal Peoples have used Tamarack for many purposes including food, medicine, and construction of canoes and snowshoes. The roots can be used for weaving bags and for sewing bark canoes together. Tamarack branches and twigs are

variety of animals feed on the leaves, cones, seeds or bark of Tamarack trees, such as Sharp-tailed Grouse (*Tympanuchus phasianellus*), American Black Bear (*Ursus americanus*), Snowshoe Hare (*Lepus americanus*), North American Porcupine (*Erethizon dorsatum*), and Red Squirrel (*Tamiasciurus hudsonicus*). Major pests of the Tamarack include Larch Sawfly (*Pristiphora erichsonii*) and Eastern Larch Beetle (*Dendroctonus simplex*).

Tamarack has a Canada rank of *Secure* and is also ranked *Secure* in each of the provinces and territories. Its native cousins, Subalpine Larch (*Larix lyallii*) and Western Larch (*Larix occidentalis*), found only in Alberta and British Columbia, also have Canada ranks of *Secure*.

Species spotlight - Swamp Cottonwood, Populus heterophylla

In 2002, while carrying out a biological survey of Bickford Woods in southern Ontario, researchers were amazed to discover a new species for Canada. This new species is not small or easily overlooked, but is in fact a stand of over 60 mature trees, growing up to 27 m tall! The new species is Swamp Cottonwood, *Populus heterophylla*, a deciduous tree belonging to the willow family (family Salicaceae) and closely related to the poplars, aspens and other cottonwoods (genus *Populus*). Swamp Cottonwood occurs fairly commonly in the southeast United States, but is rarer in the northeast United States.

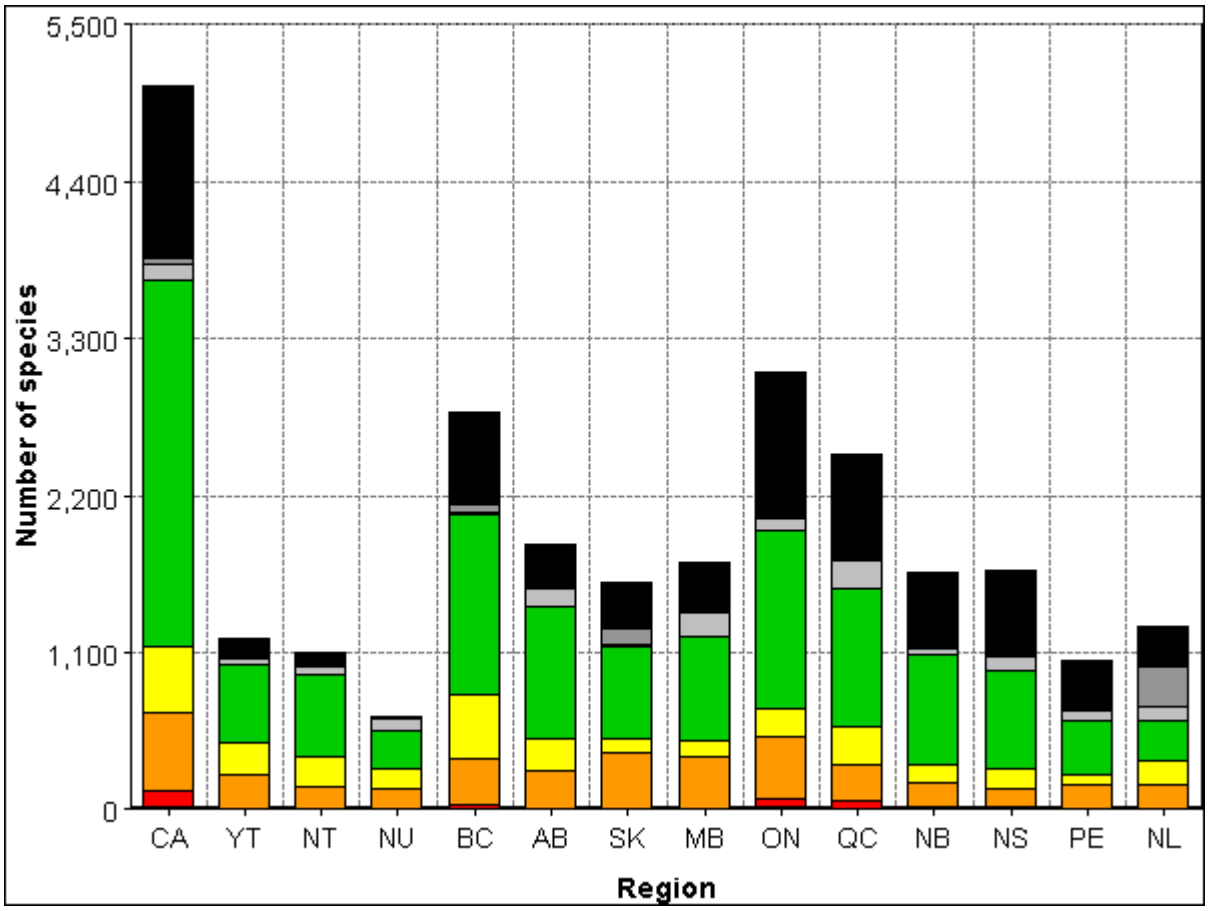
This medium-sized deciduous tree grows up to 40 m in height, in wet soils of swamps and floodplains. Its leaves are large and rounded, and the bark is thick and rough with a reddish colour. As with other poplars, Swamp Cottonwood flowers grow very early in the spring, even before the leaves appear. The flowers grow in the form of dangling catkins and each tree has either male or female flowers, never both. Pollen is carried by the wind from the male flowers to the female flowers, where the eggs are fertilized and seeds begin to develop. The seeds are light with hair-like tufts, so they can be carried by wind or float on water. The Swamp Cottonwood's habitat is often flooded early in the spring, when the seeds are produced. The seeds fall into the water and float until water levels decrease, at which time the seeds are deposited on the wet soil where they can germinate and grow. Swamp Cottonwoods grow best in open areas with little shade, and they are often found along the edges of swamps and rivers. Mature trees occur in low numbers throughout the species' range and are not a major component of any forest-type.

The story of the discovery of the Swamp Cottonwood in Canada reminds us that there are many discoveries still to be made about Canadian wildlife, even in densely populated regions like southern Ontario. Due to its highly restricted Canadian distribution and small population size, Swamp Cottonwood has a Canada rank of *May Be At Risk*.

Results of assessment

51% of Canada's 5078 species of vascular plants have Canada ranks of *Secure* (2574 species), while 11% have Canada ranks of *May Be At Risk* (552 species), 9% have Canada ranks of *Sensitive* (460 species) and 2% have Canada ranks of *At Risk* (110 species, Figures 2-1-i and 2-1-ii, Table 2-1-i). Less than 1% of vascular plant species have Canada ranks of *Extirpated* (22 species), and none have Canada ranks of *Extinct*. 24% of vascular plant species have a Canada rank of *Exotic* (1218 species), the highest proportion of *Exotic* species of any species group covered in this report. Finally, 2% of Canada's vascular plant species have Canada ranks of *Undetermined* (112 species), and 1% have Canada ranks of *Not Assessed* (30 species).

Figure 2-1-i: Summary of the species richness and 2005 general status ranks of vascular plants in Canada.



Percentage

Table 2-1-i: Summary of the 2005 general status ranks of vascular plant species in Canada.

	CA	YT	NT	NU	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL
Extirpated	22	0	0	0	2	1	0	0	22	11	9	14	6	0
Extinct	0	0	0	0	0	0	0	0	0	0	0	0	0	0
At risk	110	0	0	0	37	6	7	11	55	48	8	8	1	4
May be at risk	552	249	167	148	323	269	396	364	441	259	168	127	168	173
Sensitive	460	227	199	137	440	220	90	110	184	259	126	136	70	161
Secure	2574	542	576	269	1265	924	650	732	1256	974	774	694	383	291
Undetermined	112	36	63	86	10	136	16	161	81	191	41	96	65	88
Not assessed	30	20	3	0	56	1	104	0	0	5	2	0	0	280
Exotic	1218	132	95	13	657	298	330	353	1020	746	536	596	359	284
Accidental	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	5078	1206	1103	653	2790	1855	1593	1731	3059	2493	1664	1671	1052	1281

Comparison with Wild Species 2000

Two groups of vascular plants, the ferns and the orchids, were assessed in *Wild Species 2000*. At that time, there were 122 species of ferns and 78 species of orchids known to occur in Canada. Since 2000, three new fern species have been added to the national list, all belonging to the Moonwort genus (genus *Botrychium*); Narrow-leaved Moonwort (*Botrychium lineare*), Tunux Moonwort (*Botrychium tunux*) and Yaa Xu da Keit Moonwort (*Botrychium yaaxudakeit*). In addition, California Sword Fern (*Polystichum californicum*), ranked *May Be At Risk* in 2000, has been removed from the national list since the single Canadian collection was re-identified to another species, meaning that this species has never been documented in Canada. Therefore, the total number of fern species ranked in 2005 is 124.

No new species of orchids have been added to the national list since 2000, but some taxonomic changes have occurred, resulting in the merging of two sets of species; *Dactylorhiza fuchsia* with *Dactylorhiza majalis*, and *Platanthera leucostachys* with *Platanthera dilatata*. Therefore the total number of orchids ranked has changed from 78 in 2000, to 76 in 2005. Species that have undergone changes in taxonomy or that have been added to or removed from the species list since 2000 are not included in further discussions of rank changes.

A total of 195 species of ferns and orchids were ranked in both 2000 and 2005. Of these, changes in Canada rank were made for 18 species (9%). Eleven species moved into categories with an increased level of risk (61%), six species moved into categories with a reduced level of risk (33%) and one species moved to the *Extirpated* category (6%). Changes in Canada rank were due to improved knowledge (67%, 12 changes), process changes[1] (17%, three changes) or detailed status assessments by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (17%, three changes) and not to biological changes in species distribution, threats or population (Tables 2-1-ii and 2-1-iii). Changes in Canada ranks had very little effect on the overall proportion of species ranked in each category.

***Table 2-1-ii: Comparison of the Canada General Status Ranks (Canada ranks) of fern and orchid species in* Wild Species 2000 *and* Wild Species 2005.**

Canada rank		Number and percentage of species in each rank in 2000	Number and percentage of species in each rank in Wild Species 2005	Summary of change	Reasons for change
0	Extinct/Extirpated	0	--[a]		
0.2	Extinct	--[a]	0		
0.1	Extirpated	--[a]	1 (1%)	↑	Improved knowledge[b]
1	At Risk	10 (5%)	13 (7%)	↑	COSEWIC assessment[c]
2	May Be At Risk	28 (14%)	29 (15%)	↑	Improved knowledge[b], Species added[d]
3	Sensitive	26 (13%)	25 (13%)	↓	Improved knowledge[b], Process change[e]
4	Secure	129 (65%)	127 (64%)	↓	Improved knowledge[b], Process change[e], Taxonomy change[f]
5	Undetermined	0	0	=	
6	Not Assessed	0	0	=	
7	Exotic	6 (3%)	5 (3%)	↓	Taxonomy change[f]
8	Accidental	1 (1%)	0	↓	Improved knowledge[b]

Key to symbols:

↑ Number of species in this category has increased.

↓ Number of species in this category has decreased.

↔ An equal number of species have been added and removed from this category; no net change.

= No species have been added or removed from this category.

[a] *The single category of Extinct/Extirpated in Wild Species 2000, was replaced with two separate categories in 2005; Extinct and Extirpated. See the Background section for details.*

[b] *New information has been collected or brought to light, and used as evidence for a change in rank. A biological change (i.e. a change in species population, distribution or threats) since 2000 is not suggested.*

[c] *A formal COSEWIC assessment has been conducted, and used as evidence for a change in rank. A biological change (i.e. a change in species population, distribution or threats) since 2000 is not suggested.*

[d] *Three new species have been added to the national list.*

[e] *Rank change is due to a change in the process of assigning Canada ranks; the provincial/territorial rank with the lowest level of risk is used as the Canada rank.*

[f] *A change in taxonomy has lead to the merging of two species. For details see the 'Comparison with Wild Species 2000' section of the Vascular Plants General Status Summary.*

***Table 2-1-iii: Summary of Canada General Status Rank (Canada rank) changes, for individual vascular plant species, between* Wild Species 2000 *and* Wild Species 2005.**

2005 Canada rank	2000 Canada rank	English name	Scientific name	Reason for change[a]
Extirpated	*Accidental*	Yellow Fringed Orchid	*Platanthera ciliaris*	I
At Risk	*May Be At Risk*	Lemmon's Holly Fern	*Polystichum lemmonii*	C
		Mountain Holly Fern	*Polystichum scopulinum*	C
		Eastern Prairie Fringed Orchid	*Platanthera leucophaea*	C
May Be At Risk	*Sensitive*	Mountain Moonwort	*Botrychium montanum*	I
		Gastony's Cliff-brake	*Pellaea gastonyi*	I
		Alaska Holly Fern	*Polystichum setigerum*	I
		Upswept Moonwort	*Botrychium ascendens*	I
		Stalked Moonwort	*Botrychium pedunculosum*	I
May Be At Risk	*Secure*	Hairy Water Fern	*Marsilea vestita*	I
Sensitive	*May Be At Risk*	Large Round-leaved Orchid	*Platanthera macrophylla*	I
		Yellow Ladies'-tresses	*Spiranthes ochroleuca*	I
Sensitive	*Secure*	Giant Chain Fern	*Woodwardia fimbriata*	I
		Hillside Rein Orchid	*Piperia elegans*	I
Sensitive	*May Be At Risk*	Ram's-head Lady's-slipper	*Cypripedium arietinum*	P
		Bog Adder's-mouth	*Malaxis paludosa*	P
Secure	*Sensitive*	Nahanni Oak Fern	*Gymnocarpium jessoense*	I
		Large Purple Fringed Orchid	*Platanthera grandiflora*	P

[a]C: change due to new COSEWIC assessment
I: change due to improved knowledge of the species.
P: change due to procedural change.

[1]For all groups covered in this report, national ranks are generally given based on the regional rank with the lowest level of risk. For example if the provincial and territorial ranks for a species are a mixture of Sensitive and Secure, the default Canada rank is Secure (see main background section for more details and some exceptions to this generalisation) This rule-of-thumb was not followed for all species, when Canada ranks for ferns and orchids were finalized in 2000. Therefore, some of the Canada rank changes for ferns and orchids are due primarily to the different procedures followed in 2000 and 2005 and are therefore classified as procedural changes. These changes help to ensure that Canada ranks are comparable both within and among taxa.

Threats to Canadian vascular plants

With such a wide diversity of vascular plant species in Canada, it is not surprising that the threats to vascular plants are similarly varied. As with other species groups, habitat loss and degradation are major problems. Habitat loss occurs when natural habitats are replaced with human land-uses such as agriculture or housing, or as a result of natural processes such as succession, fire or flooding. Habitat degradation can occur in many forms, including pollution, changes in drainage patterns, or trampling by humans or animals. Over-harvesting is another threat for some species, particularly for plants that are valued for their beauty (e.g. Showy Lady's-slipper), or for medicinal properties.

In recent years, the impact of *Exotic* species has become recognized as a serious threat to native wildlife. *Exotic* plants can compete with native plants for space to grow and for resources. A well-known example of this is Purple Loosestrife (*Lythrum salicaria*), which was introduced from Europe in the 1800s and has altered many wetlands from systems of high plant diversity to systems dominated almost entirely by a small number of *Exotic* species. This change affects many species including the mammals, reptiles, amphibians and invertebrates that rely on wetlands for survival. For example, Muskrats (*Ondatra zibethicus*) will not eat Purple Loosestrife, and many birds will not nest in it. *Exotic* species can also introduce new diseases, which can reduce the health of native plants. Another problem is hybridization, in which an *Exotic* plant interbreeds with a native plant, weakening its gene pool. The native Red Mulberry (*Morus rubra*), ranked *At Risk*, has declined partly due to hybridization with the *Exotic* White Mulberry (*Morus alba*). Every year, millions of dollars are spent on trying to control *Exotic* species like Purple Loosestrife, Spotted Knapweed (*Centaurea biebersteinii*) and European Buckthorn (*Rhamnus cathartica*) in natural habitats.

Conclusion

This general status assessment of all Canada's 5078 species of vascular plants is an important achievement, involving input from botanists across the country using the most current information to assess the distribution and general status of Canada's vascular plants. This compilation of knowledge will form a platform for further monitoring and research, as well as highlighting areas where knowledge is lacking. The results of this general status assessment indicate that the majority (51%) of vascular plant species in Canada are considered *Secure*, although 11% of vascular plants have Canada ranks of *May Be At Risk* and 2% have Canada ranks of *At Risk*. The results also highlight the large proportion of *Exotic* species; 24% of Canada's vascular plants are ranked *Exotic*, a much higher proportion than for any other group covered in this report. Finally, the update of the fern and orchid ranks demonstrates the importance of improved knowledge in increasing our understanding of the status of vascular plants in Canada.

Further information

Adrian, S. 2000. Carnivorous plants. Marston House, England. 240 pp

Agriculture and Agri-food Canada. The vascular plant herbarium. http://res2.agr.gc.ca/ecorc/dao/index_e.htm (Accessed February 1, 2006).

Ames, D., Bainard Acheson, P., Heshka, L., Joyce, B., Neufeld, J., Reeves, R., Reimer, E. and Ward, I. 2005. Orchids of Manitoba. Native Orchid Conservation Inc., Canada. 158 pp

Bruce-Grey Plant Committee. 1997. A guide to the orchids of Bruce and Grey counties, Ontario. 2nd edition. Stan Brown Printers, Owen Sound, Ontario. 105 pp

Burchill, C. 2005. Vascular flora of Manitoba. http://home.cc.umanitoba.ca/~burchil/plants/ (Accessed February 9, 2005).

Canadian Botanical Association. http://www.cba-abc.ca/ (Accessed February 1, 2006).

Cody, W. J. 2000. Flora of the Yukon Territory. National Research Press, Ottawa. 669 pp

Davis, S. D., Heywood, V. H., Herrera-MacBryde, O., Villa-Lobos, J. and Hamilton, A. (eds.). 1997. Centres of plant diversity: A guide and strategy for their conservation. Volume 3: The Americas. IUCN Publications Unit, Cambridge, England. http://www.nmnh.si.edu/botany/projects/cpd/ (Accessed March 2, 2006)

E-Flora BC. http://www.geog.ubc.ca/~brian/florae/index.shtml (Accessed February 1, 2006).

Eastman, J. 1992. The book of forest and thicket. Trees shrubs and wildflowers of eastern North America. Stackpole Books, Harrisburg, Pennsylvania, USA. 212 pp

Farrar, J. L. 1995. Trees in Canada. Fitzhenry & Whiteside, Ontario and Natural Resources Canada, Ottawa. 502 pp

Flora of North America. http://www.fna.org/FNA/ (Accessed February 1, 2006).

Foss, K. 2004. Our lady of the bog. Canadian Geographic Jul/Aug 2004. http://www.innovationcanada.ca/18/en/articles/krysta-f.html (Accessed March 14, 2006).

Henry, J. D. 2002. Canada's boreal forest. Smithsonian natural history series. Smithsonian Institute Press. 176 pp

Hinds, H. R. 2000. Flora of New Brunswick: A manual for the identification of the vascular plants of New Brunswick. University of New Brunswick, Fredericton. 699 pp

Johnston, W. F. 1990. Tamarack. In Burns, R. M., and Honkala, B. H. (technical coordinators). 1990. Silvics of North America: 1. Conifers; Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC. vol. 2, 877 pp http://www.na.fs.fed.us/spfo/pubs/silvics_manual/Volume_1/larix/laricina.htm (Accessed December 22, 2005).

L'Union des prodcuteurs agricoles. Gaspé Peninsula's Non-Timber Forest Products Fact Sheets. Common Yarrow. http://www.gaspesielesiles.upa.qc.ca/fhtm/pfnl/en/PFNL%20anglais/1926226-Common%20Yarrow.pdf (Accessed April 5, 2006).

Library and Archives Canada. 2001. Susanna Moodie and Catherine Parr Traill. http://www.collectionscanada.ca/3/1/index-e.html (Accessed April 5, 2006).

Maunder, J. E. 2001. A digital flora of Newfoundland and Labrador vascular plants. http://www.digitalnaturalhistory.com/flora.htm (Accessed February 1, 2006).

McMaster, R. T. 2003. *Populus heterophylla* L. Swamp cottonwood. Conservation and research plan for New England. New England Wild Flower Society, Massachusetts. http://www.newfs.org/conserve/pdf/Populusheterophylla.pdf (Accessed January 10, 2006).

Morris, A. 2003. New tree for Carolinian Canada. Carolinian Canada Newsletter. Winter 2003-4. http://www.carolinian.org/Publications/newslet-dec2003.pdf (Accessed January 10, 2006).

National herbarium of Canada. http://www.nature.ca/collections/botany_e.cfm (Accessed February 1, 2006).

PlantWatch. http://www.naturewatch.ca/english/plantwatch/ (Accessed February 1, 2006).

Prindle, T. 2000. NativeTech: Native American technology and art. An introduction to tamarack trees & traditions. http://www.nativetech.org/willow/tamarack/tamarack.html (Accessed December 22, 2005).

Rice, B. A. 2004. Carnivorous Plant FAQ v10.0. http://www.sarracenia.com/faq.html (Accessed February 1, 2006).

Roland, A. E. 1998. The flora of Nova Scotia. Nimbus, Halifax. 1350 pp

Scoggan, H. J. 1978. The flora of Canada. National Museum of Natural Sciences, National Museum of Canada, Publications in Botany 7(1-4)

The Nature Trust of New Brunswick. Rare flora of the Upper St. John River. http://www.naturetrust.nb.ca/st-john-rare-plant-communities.php (Accessed April 5, 2006).

Victorin, M. and Rouleau, E. 1964. Flore Laurentienne, 2nd ed. University of Montreal Press, Montreal. 925 pp http://florelaurentienne.com/ (Accessed March 13, 2006).

Waldron, G., Ambrose, J. and Rodger, L. 2003. Swamp cottonwood (Populus heterophylla), another new tree for Canada. Ontario Natural Heritage Information Centre Newsletter 8(1):6. http://nhic.mnr.gov.on.ca/MNR/nhic/documents/newsletter.cfm (Accessed January 10, 2006).

White, D. J., Haber, E. and Keddy, C. 1993. Invasive plants of natural habitats in Canada: an integrated review of wetland and upland species and legislation governing their control. Canadian Wildlife Service, Ottawa, Canada. 121 p http://www.cws-scf.ec.gc.ca/publications/inv/index_e.cfm (Accessed April 5, 2006).

References

Allaby, M. 1989. Dictionary of the environment. New York University Press, New York. 423 pp

Nature Trust of New Brunswick and Atlantic Canada Conservation Data Centre. 2003. Rare plant survey of the Upper St. John River with focus on Furbish's Lousewort. The Nature Trust of New Brunswick, INC. Fredericton, NB. 61 pp.

Smith, D. 2001. Documenting plant domestication: The consilience of biological and archaeological approaches. PNAS 98(4):1324-1326

Vasseur, L. and Potvin, C. 1997. Natural pasture community response to enriched carbon dioxide atmosphere. Plant Ecology 135:31-41

Freshwater Mussels

©Dwayne Sabine: Yellow Lampmussel

Freshwater mussels: Freshwater mussels are molluscs belonging to the order Unionoida, class Bivalvia. Like other bivalves, freshwater mussels are soft-bodied, non-segmented invertebrates, with a pair of hinged shells and a muscular foot. - Adapted from Metcalfe-Smith et al, 2005.

Quick facts

- Worldwide, there are nearly 1000 species of freshwater mussels, 55 of which have been found in Canada.
- Freshwater mussels live in lakes and rivers throughout Canada where they improve water clarity and quality by filtering algae and bacteria from the water.
- Just over a third (35%) of Canadian freshwater mussels have Canada General Status Ranks (Canada ranks) of *Secure* while 27% have Canada ranks of *Sensitive*, 16% have Canada ranks of *May Be At Risk* and 15% have Canada ranks of *At Risk*.
- Over two-thirds of freshwater mussels in the United States have gone extinct or are currently vulnerable to extinction, according to 'Rivers of Life', a NatureServe report that summarizes the status of freshwater species.
- Freshwater mussels have a unique life cycle, during which the larvae must attach to the fins or gills of a host species, usually a fish, before they can mature into adults.

Background

Freshwater mussels (order Unionoida) are fascinating animals with a unique method of reproduction and an important role in maintaining water quality. Freshwater mussels are molluscs belonging to the class Bivalvia; other bivalves include oysters and scallops. Like all bivalves, freshwater mussels are soft-bodied invertebrates living within a shell made of two halves joined by a hinge. Freshwater mussels live in the bottom of streams, rivers and lakes throughout Canada, reaching their greatest diversity in the lower Great Lakes region.

The simple body of a freshwater mussel includes a mantle, which produces the hard, calcareous shell, a muscular foot, used for moving around in the sediment, and gills which are used to obtain oxygen from the water. Freshwater mussels feed on plankton and other organic particles suspended in the water by filtering water through their gills and extracting food particles. Waste is deposited on the sediment around the mussel, providing food for bottom-feeding invertebrates and fishes. By removing algae and bacteria from the water during feeding, freshwater mussels improve the clarity and quality of the water. Freshwater mussels also play important roles in nutrient cycles, food webs and in mechanically oxygenating the sediment in which they live, making them an important component of freshwater ecosystems.

The reproductive cycle of freshwater mussels is unique, firstly because the female broods fertilized eggs within her shell, rather than releasing them to drift on the current, and secondly because the specialized larvae, or glochidia, are parasitic, meaning that they require a vertebrate host to reach maturity. Once the glochidia have hatched and been released by the female, they find a host and clamp onto its gills or fins, forming a small cyst where they will develop into juvenile mussels. When development is complete, the juvenile mussels drop from the host down to the sediment, where they grow and mature into adult mussels. Each species of freshwater mussel has specific host species necessary for completion of its life cycle. For example, the Alewife Floater (*Anodonta implicata*), found in Quebec, New Brunswick and Nova Scotia, relies on the Alewife fish (*Alosa pseudoharengus*) for development of its young. One freshwater mussel, the Salamander Mussel (*Simpsonaias ambigua*), can only mature on the gills of a Mudpuppy (*Necturus maculosus*), an aquatic salamander.

Many freshwater mussel species have developed unique strategies to increase the chances of their young finding a suitable host. For example, the female Wavyrayed Lampmussel (*Lampsilis fasciola*) tempts a potential host close using a lure made of a special flap of tissue that resembles a small fish.

Kidneyshell (*Ptychobranchus fasciolaris*) uses a slightly different kind of lure; the Kidneyshell's glochidia are wrapped in packages that resemble small fish. Each package is released into the water, and when a real fish bites into the package, the glochidia are released to attach to the new host.

Many freshwater mussel species have developed unique strategies to increase the chances of their young finding a suitable host. For example, the female Wavyrayed Lampmussel (*Lampsilis fasciola*) tempts a potential host close using a lure made of a special flap of tissue that resembles a small fish. When a larger fish tries to bite the lure, the glochidia are released to attach to the host. The Kidneyshell (*Ptychobranchus fasciolaris*) uses a slightly different kind of lure; the Kidneyshell's glochidia are wrapped in packages that resemble small fish. Each package is released into the water, and when a real fish bites into the package, the glochidia are released to attach to the new host.

Freshwater mussels are an important tool for monitoring the health of aquatic systems because they are sensitive to a wide range of environmental factors including the health and diversity of local fish communities and levels of dissolved oxygen in the water. Therefore, a reduction in the diversity or abundance of freshwater mussels, or a shift in the freshwater mussel community towards species that are tolerant of poor water quality can indicate a negative change in the ecosystem. Freshwater mussels have also been used to study contaminants in aquatic systems. For example, the Eastern Elliptio (*Elliptio complanata*) has been used to examine the spatial patterns of polychlorinated biphenyls (PCB) contamination in the Detroit River, Ontario.

Status of knowledge in Canada

Much of our knowledge of the life cycle of freshwater mussels comes from attempts to propagate mussels for the pearl button industry, which was important in the United States in the early 1900s. While this early research provided an outline of the typical life cycle of freshwater mussels, relatively little is known about the life cycle of specific freshwater mussel species. For example, the host(s) of many Canadian freshwater mussels remain unknown. Also, little is known about the juvenile stage of the life cycle, between the time that the mussel first drops from its host until the time when it reaches sexual maturity.

Recent research into freshwater mussels has focused on the impacts of Zebra Mussels (*Dreissena polymorpha*) and Quagga Mussels (*Dreissena bugensis*), on native freshwater mussels.[1] Zebra Mussels and Quagga Mussels are native to Europe, but both species have been accidentally introduced into the Great Lakes in recent years. Zebra Mussels fasten onto the shells of native freshwater mussels, sometimes in huge numbers, interfering with normal functions such as feeding and burrowing. This can eventually lead to the death of the infested mussel. Since the introduction of Zebra Mussels, the abundance and distribution of native freshwater mussel communities in the Great Lakes system has declined rapidly. In fact, Zebra Mussels have seriously undermined the population stability of several native freshwater mussel species including the Northern Riffleshell (*Epioblasma torulosa*), the Kidneyshell and the Round Pigtoe (*Pleurobema sintoxia*), all of which have Canada General Status Ranks (Canada ranks) of *At Risk*. The Quagga Mussel is thought to adversely affect native freshwater mussels, but less is known about the impacts of the Quagga Mussel than the Zebra Mussel.

Recent concerns over declines in freshwater mussels have stimulated new research into the distribution and abundance of native freshwater mussels, particularly in the Great Lakes region. Historical records of freshwater mussel occurrence within this area have been compiled into a single database to facilitate the comparison of current and historical distribution patterns, while new surveys of mussel habitat in this region have highlighted the critical importance of certain rivers and lakes in supporting populations of *At Risk* species. For example, the Sydenham River, Ontario, is a major refuge for several freshwater mussel species that are protected under Canada's endangered species legislation, the *Species At Risk Act*, including the Snuffbox (*Epioblasma triquetra*), Rayed Bean (*Villosa fabalis*) and the Salamander Mussel.

Systematic surveys in other parts of the country have also improved our knowledge of freshwater mussel abundance and distribution. For example, a recent survey in southern Manitoba showed evidence of declining diversity and abundance of freshwater mussels in a range of habitats, while surveys of the Saint John River system in New Brunswick in 2001 and 2002 revealed the existence of large populations of the Yellow Lampmussel (*Lampsilis cariosa*), previously thought to be extirpated from the province.

[1] Like native freshwater mussels, Zebra Mussels and Quagga Mussels belong to the class Bivalvia, but they belong to a different order (order Veneroida) than native freshwater mussels, and are not ranked in this general status assessment.

Richness and diversity in Canada

A total of 55 species of freshwater mussels has been found in Canada. Freshwater mussels are found in every province and territory of Canada, but species richness is highest from Manitoba east to Nova Scotia (Figure 2-2-i, Table 2-2-i). Within Canada, 18 species of freshwater mussels are found only in Ontario, including 14 species with Canada General Status Ranks (Canada ranks) of *At Risk* or *May Be At Risk*. The high diversity of freshwater mussels in Ontario, particularly in the Lake St. Clair and western Lake Erie region, is related to patterns of recolonization since the last period of glaciation.

Species richness of freshwater mussels in the west and northwest is generally low (Figure 2-2-i, Table 2-2-i), but five of the six species of freshwater mussels in British Columbia are found nowhere else in Canada. Similarly, the only freshwater mussel in the Yukon, the Yukon Floater (*Anodonta beringiana*), is found nowhere else in Canada.

Species spotlight - Yellow Lampmussel

Yellow Lampmussels, *Lampsilis cariosa*, are recognised by their waxy, egg-shaped, yellow shells. As is typical of many mussel species, the females tend to have fatter, more rounded shells than the males, providing space for the female to brood eggs within her shell. Yellow Lampmussels are found in medium to large rivers along the east coast of North America from Georgia to Nova Scotia. Like other freshwater mussels, they feed on plankton and other organic matter filtered from the water. The host fishes for their parasitic larvae are probably White Perch (*Morone americana*) and Yellow Perch (*Perca flavescens*).

Yellow Lampmussels are only known from two river systems in Canada; the Sydney River on Cape Breton Island, Nova Scotia and the Saint John River drainage system in New Brunswick. Until recently, it was feared that Yellow Lampmussels had been lost from New Brunswick but surveys of the lower Saint John River drainage and its tributaries in 2001 and 2002 found a large, well-established population, potentially numbering more than 1 million individuals. The size of this population contrasts sharply with the status of the species elsewhere, as it is listed as Threatened or Endangered throughout much of its range in the United States. Due to its limited occurrence, this species has a Canada rank of *Sensitive*.

Species spotlight - Round Hickorynut

Round Hickorynuts are medium-sized freshwater mussels, with distinctive round, brown shells. Once widespread in the lower Great Lakes, Round Hickorynuts were probably extirpated from Lake Erie as early as 1950, due to declining water quality. Following the invasion of the Zebra Mussel in the late 1980s, Round Hickorynuts also disappeared from off-shore waters of Lake St. Clair. In 1999, a previously unknown population of Round Hickorynuts was discovered in a shallow-water refuge on the north shore of Lake St. Clair. This refuge harbours 22 species of freshwater mussels, several of which were feared to have been lost from the lake. Zebra Mussel densities in this refuge are relatively low, probably due to the harsh conditions in this shallow area of the lake, where mussels are exposed to fluctuating water levels and ice scour. The only other known Canadian population of Round Hickorynuts is in the Sydenham River, where they exist in very low numbers and are exposed to the negative effects of poor water quality and siltation. In all, Round Hickorynuts have been lost from approximately 90% of their former Canadian range.

The host fish for the Round Hickorynut is suspected to be the Eastern Sand Darter (*Ammocrypta pellucida*), although this has not been confirmed. Eastern Sand Darters (Canada rank: *At Risk*) have declined in number in recent years, due to declining water quality and increased siltation, but still exist in both Lake St. Clair and the Sydenham River.

The long-term prospects for Round Hickorynuts in Canada are uncertain, due to the abundance of Zebra Mussels in Lake St. Clair and the apparent sensitivity of Round Hickorynuts to poor water quality. In addition, further population declines or range reductions of the suspected host fish, the

Eastern Sand Darter, may also prove detrimental to the Round Hickorynut. Round Hickorynuts have a Canada rank of *At Risk*.

Results of general status assessment

A total of 55 freshwater mussels has been found in Canada, of which just over one-third (35%, 19 species) have a Canada rank of *Secure* (Figures 2-2-i and 2-2-ii, Table 2-2-i). A further 31% have Canada ranks of *At Risk* (eight species) and *May Be At Risk* (nine species) and 27% have Canada ranks of *Sensitive* (15 species). One species, the Dwarf Wedgemussel (*Alasmidonta heterodon*) has a Canada rank of *Extirpated* (2%). Finally, 4% have Canada ranks of *Undetermined* (two species) and 2% have Canada ranks of *Not Assessed* (one species).

Figure 2-2-i: Summary of the species richness and 2005 general status ranks of freshwater mussel species in Canada.

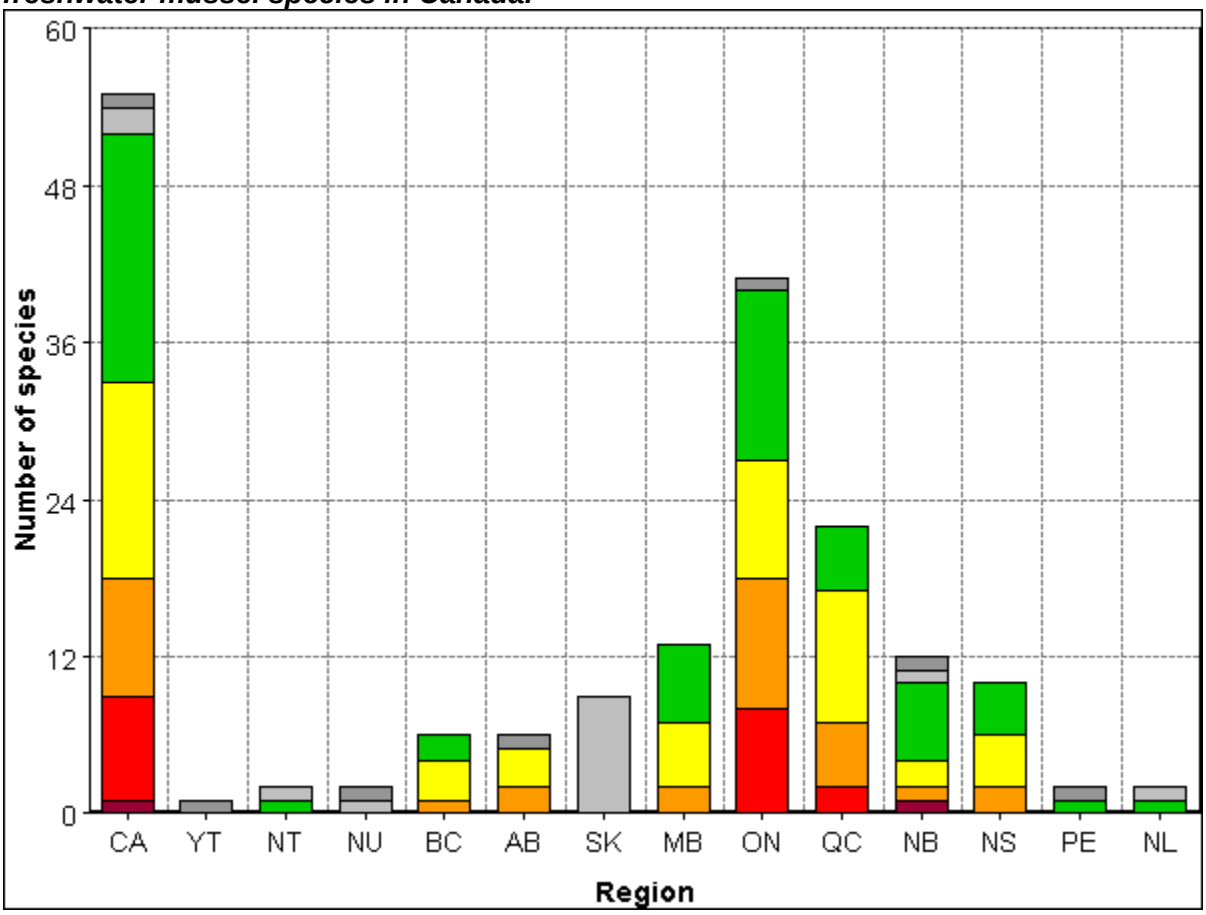


Table 2-2-i: Summary of 2005 general status ranks of freshwater mussels in Canada.

	CA	YT	NT	NU	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL
Extirpated	1	0	0	0	0	0	0	0	0	0	1	0	0	0
Extinct	0	0	0	0	0	0	0	0	0	0	0	0	0	0
At risk	8	0	0	0	0	0	0	0	8	2	0	0	0	0
May be at risk	9	0	0	0	1	2	0	2	10	5	1	2	0	0
Sensitive	15	0	0	0	3	3	0	5	9	10	2	4	0	0
Secure	19	0	1	0	2	0	0	6	13	5	6	4	1	1
Undetermined	2	0	1	1	0	0	9	0	0	0	1	0	0	1
Not assessed	1	1	0	1	0	1	0	0	1	0	1	0	1	0
Exotic	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Accidental	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	55	1	2	2	6	6	9	13	41	22	12	10	2	2

Threats to Canadian freshwater mussels

Freshwater mussels are potentially susceptible to a number of threats including habitat destruction, poor water quality, siltation, damming and channelization of streams and rivers, riparian and wetland alterations, and agricultural run-off. These threats may act directly on the mussel population or have an indirect impact through declines in the host fish species that are required to complete the mussel's life cycle.

The introduction of the Zebra Mussel has had a dramatic impact on native freshwater mussel populations in recent years, causing sharp declines in the numbers and diversity of native freshwater mussels in the Great Lakes-St. Lawrence system and in other rivers and inland lakes that have been colonized by this invasive species. Although the affected drainages represent only a portion of the range of freshwater mussels in Canada, they are nonetheless host to some of the most abundant and diverse assemblages of freshwater mussels in the country. Therefore, although the affected area is small, the negative impact of Zebra Mussels on native freshwater mussels in Canada has been dramatic.

Conclusion

Freshwater Mussels are less well known than many other groups of freshwater animals and there are few Canadian freshwater mussel experts. Nevertheless, recent declines in abundance and diversity have stimulated increased interest and research into Canadian freshwater mussels. New surveys have improved knowledge of the distribution and abundance of freshwater mussels and demonstrated the importance of key lake and river refuges for maintaining the diversity of freshwater mussels in Canada. This is a group containing a high proportion of species with Canada ranks of *At Risk*, and protecting the diversity of Canadian freshwater mussels will be a major challenge.

Further information

Armstrong, M. 1996. Freshwater mussels. Biodiversity Associates Report No. 4. Biodiversity Convention Office, Environment Canada, Ottawa. 16 pp
http://www.cbin.ec.gc.ca/search/ViewMISearch.cfm?Metainfo_id=1884&lang=e (Accessed August 24, 2005).

Clarke, A. H. 1981. The freshwater molluscs of Canada. National Museums of Canada, Ottawa. 446 pp

U.S. Fish and Wildlife Service. 2003. Freshwater mussels of the Upper Mississippi River system. http://www.fws.gov/midwest/mussel/index.html (Accessed August 24, 2005).

Lee, J. S. 2000. Freshwater molluscs. British Columbia Conservation data centre, Victoria, British Columbia. 6 pp
http://wlapwww.gov.bc.ca/wld/documents/mollusc.pdf (Accessed August 24, 2005).

Master, L. L., Flack, S. R. and Stein, B. A. Eds. 1998. Rivers of life: Critical watersheds for protecting freshwater biodiversity. The Nature Conservancy, Virginia. 77 pp
http://natureserve.org/library/riversoflife.pdf (Accessed August 24, 2005).

Metcalfe-Smith, J. L., MacKenzie, A., Carmichael, I. and McGoldrick, D. 2005. Photo field guide to the freshwater mussels of Ontario. St. Thomas Field Naturalist Club Inc., St. Thomas, Ontario. 60 pp

Graf, D. and Cummings, K. 2004. The MUSSEL project.
http://clade.acnatsci.org/mussel/m/about/index.html (Accessed August 24, 2005).

Canadian Museum of Nature. 2004. The nature of the Rideau River: Native freshwater mussels. http://www.nature.ca/rideau/b/b6-e.html (Accessed August 24, 2005).

Cummings, K. S. and Mayer, C. A. 1992. Field guide to freshwater mussels of the Midwest. Illinois Natural History Survey Manual 5. 194 pp
http://www.inhs.uiuc.edu/cbd/collections/mollusk/fieldguide.html (Accessed August 24, 2005).

The Tree of Life. 1995. Mollusca. http://tolweb.org/tree?group=Mollusca (Accessed August 24, 2005).

References

Barr, D. W. 1996. Freshwater Mollusca (Gastropoda and Bivalvia). In Assessment of species diversity in the mixedwood plains ecozone. *Edited by* I. M. Smith, Ecological Monitoring and Assessment Network, Environment Canada.
http://www.naturewatch.ca/Mixedwood/molluscs/intro.htm (Accessed August 24, 2005).

Clarke, A. H. 1973. The freshwater molluscs of the Canadian interior basin. Malacologia 13(1-2):1-509

COSEWIC. 2003. COSEWIC assessment and status report on the kidneyshell *Ptychobranchus fasciolaris* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Ontario. vi + 32 pp

COSEWIC. 2003. COSEWIC assessment and update status on the round hickorynut *Obovaria subrotunda* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Ontario. vi + 31 pp

COSEWIC 2004. COSEWIC assessment and status report on the yellow lampmussel *Lampsilis cariosa* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Ontario. vii + 35 pp

Locke, A., Hanson, J. M., Klassen, G. J., Richardson, S. M. and Aubé, C. I. 2003. The damming of the Petitcodiac River: species, populations and habitats lost. Northeastern Naturalist 10(1):39-54

Metcalfe-Smith, J. L. and Cudmore-Vokey, B. 2004. National general status assessment of freshwater mussels (Unionacea). NWRI Contribution No. 04-027.

Metcalfe-Smith, J. L., Staton, S. K., Mackie G. L. and Lane N. M. 1998. Biodiversity of freshwater mussels in the lower Great Lakes drainage basin. NWRI contribution No.97-90. http://www.eman-rese.ca/eman/reports/publications/nm97_mussels/intro.html (Accessed August 24, 2005).

Metcalfe-Smith, J. L., Staton, S. K., Mackie, G.L. and West, E. L. 1998. Assessment of the current conservation status of rare species of freshwater mussels in Southern Ontario. NWRI contribution No. 98-019.

Metcalfe-Smith, J. L., Staton, S. K., Mackie, G. L. and Lane, N. M. 1998. Changes in the biodiversity of freshwater mussels in the Canadian waters of the lower Great Lakes drainage basin over the past 140 years. Journal of Great Lakes Research 24(4):845-858

Metcalfe-Smith, J. L., Staton, S. K., Mackie, G. L. and Lane, N. M. 1998. Selection of candidate species of freshwater mussels (Bivalva: Unionidae) to be considered for national status designation by COSEWIC. Canadian Field-Naturalist 112(3):425-440

Metcalfe-Smith, J. L., Staton, S. K., Mackie, G.L. and Scott, I. M. 1999. Range, population stability and environmental requirements of rare species of freshwater mussels in southern Ontario: a 1998 Endangered Species Recovery Fund Project: final report to the World Wildlife Fund Canada. NWRI Contribution No. 99-058

Nalepa, T. F. and Gauvin, J. M. 1988. Distribution, abundance and biomass of freshwater mussels (Bivalvia:Unionidae) in Lake St. Clair. Journal of Great Lakes Research 14(4):411-419

Nalepa, T. F., Hartson, D. J., Gostenik, G. W., Fanslow, D. L. and Lang, G. A. 1996. Changes in the freshwater mussel community of Lake St. Clair: from Unionidae to *Dreissena polymorpha* in eight years. Journal of Great Lakes Research 22(2):354-369

Nalepa, T. F., Manny, B. A., Roth, J. C., Mozley, S. C. and Schloesser, D. W. 1991. Long-term decline in freshwater mussels (Bivalvia: Unionidae) of the western basin of Lake Erie. Journal of Great Lakes Research 17(2):214-219

O'Rourke, S. M., Balkwill, K., Haffner, G. D. and Drouillard, K. G. 2003. Using *Elliptio complanata* to assess bioavailable chemical concentrations of the downstream reaches in the Detroit River system - Canadian and American shorelines compared. Global Threats to Large Lakes: Managing in an Environment of Instability and Unpredictability p181-182

Pip, E. 2000. The decline of freshwater molluscs in southern Manitoba. Canadian Field-Naturalist 114(4):555-560

Zanatta, D. T., Mackie, G. L., Metcalfe-Smith, J. L., and Woolnough, D. A. 2002. A refuge for native freshwater mussels (Bivalvia: Unionidae) from impacts of the exotic zebra mussel (*Dreissena polymorpha*) in Lake St. Clair. Journal of Great Lakes Research 28(3):479-489

Crayfishes

Crayfish: Freshwater crayfishes are a globally common and diverse crustacean group, occurring naturally on all continents except for Africa and Antarctica. Hamr 1998.

©Parks Canada/ J. Pleau, 1996: Virile Crayfish

Quick facts

- There are more than 540 species of crayfishes worldwide, of which 11 are found in Canada.
- Almost two-thirds (64%) of Canadian crayfishes have Canada General Status Ranks (Canada ranks) of *Secure*, while 18% have Canada ranks of *Sensitive*, and none have Canada ranks of *At Risk* or *May Be At Risk*.
- Two crayfishes species have Canada ranks of *Exotic*, the Rusty Crayfish and the Obscure Crayfish. Both were introduced into Ontario as fish bait and now also occur in Quebec. The Rusty Crayfish has spread rapidly in Ontario and has eliminated native crayfishes from many lakes and rivers. Little is known about the Obscure Crayfish in Canada.
- One-third of native crayfish species in the United States are Endangered or Threatened, according to the American Fisheries Society Endangered Species Committee.

Background

Crayfishes belong to the subphylum Crustacea, together with the crabs, lobsters and shrimps. All crayfishes have a jointed exoskeleton and breathe with gills. Canada's crayfishes are found in an amazing variety of freshwater habitats including wetlands, wet meadows, stagnant water, ponds, ditches, streams, rivers and lakes. Although all of Canada's crayfishes are also found in the United States, some Canadian populations show unique life history and ecology patterns compared to more southerly populations. There are two families of crayfishes in Canada, Astacidae and Cambaridae. Astacidae is represented by one species, the Signal Crayfish (*Pacifastacus leniusculus*), found in British Columbia. The other 10 species of crayfishes found in Canada all belong to the family Cambaridae.

The crayfishes' most noticeable feature is the large claws, found on the first of their five pairs of legs. These large claws, also called giant chelipeds, are used in feeding, mating, defence and burrowing. The other four pairs of legs are used for walking and searching for food. Although crayfishes usually walk slowly across the bottom of streams, rivers and lakes, they can escape from predators by flicking their strong tail and zooming backwards out of danger. On the front of their head, crayfishes have a pair of compound eyes, on short, flexible stalks. Crayfishes cannot turn their heads around, but the flexible stalks allow them to see in different directions. Crayfishes also have a pair of long antennae, which are used to sense food and chemicals in the water.

Crayfishes typically live for only a few years, so they must reproduce rapidly and at a high volume to maintain their populations. Most species mate during the fall or early spring. During mating, the male crayfish deposits his sperm in a sperm receptacle on the underside of the female. The female stores the sperm until she is ready to fertilize her eggs in the spring. When she is ready to lay her eggs, the female creates a pocket by curling her tail underneath her abdomen. This pocket is filled with a sticky substance, called glair, which will hold the eggs in place. As eggs are laid, they pass through the sperm receptacle and then down into the glair, where they remain until they are ready to hatch. Once hatched, the young crayfish remain attached to their mother for several weeks, until they have moulted twice. Finally, the young crayfish leave the mother to fend for themselves. In some species, crayfishes are ready to mate within a few months of hatching, whereas other species can take several years to mature.

Crayfishes can be divided into two major types: open-water species and burrowers. Open-water crayfishes rarely or never leave the water and are mainly active at night. During the day, they hide in crevices under rocks or other cover, to escape predation. Burrowers are less dependent

on aquatic habitats than open-water species. They live in ditches, wet meadows and other areas where the water table is not far belowground. Burrowers dig tunnels under the ground and live in the moist soil, probably only emerging to hunt for food and to mate. Like other crayfishes, burrowers breathe with gills, but they are able to extract oxygen from moist air as well as from water.

Crayfishes have a diverse diet of aquatic and terrestrial vegetation, dead and decaying plant and animal material, and small aquatic invertebrates. By eating dead and decaying plant and animal matter, crayfishes release trapped energy and nutrients back into the food chain, where they are available to crayfish predators. This makes crayfishes an important link in aquatic food webs. Crayfishes are eaten by a wide range of animals including invertebrates, fishes, amphibians, reptiles, birds and mammals. They can also be an important food item for sport fishes, such as sunfishes and basses (family Centrarchidae).

Richness and diversity in Canada

Ontario (nine species) and Quebec (eight species) have the highest species richness of crayfishes in Canada (Figure 2-3-i, Table 2-3-i). Of the 11 Canadian crayfishes, the only two that do not occur in Ontario are the Spineycheek Crayfish (*Orconectes limosus*), found in Quebec and New Brunswick, and the Signal Crayfish found in British Columbia. Three provinces (Newfoundland and Labrador, Prince Edward Island and Nova Scotia) as well as the three territories have no crayfishes.

Species spotlight - Chimney Crayfish

The Chimney or Digger Crayfish, *Fallicambarus fodiens*, (hereafter Chimney Crayfish) is one of two burrowing species found in Ontario. Chimney Crayfish live in wetlands, creek beds, ditches and in dry ground far from permanent surface water. To survive in these habitats, Chimney Crayfish dig burrows into the ground. Burrows usually consist of one to three entrance tunnels connecting with a vertical shaft. The shaft ends below the water table in a flooded chamber where the crayfish spends much of its day. The burrow entrance is marked by a pile (or chimney) of mud pellets, collected during excavation. Chimney Crayfish are thought to be omnivorous; they probably eat any vegetation or invertebrates encountered in their burrows.

Within Canada, Chimney Crayfish are found only in southern Ontario. Recent surveys found small populations as far north as south-eastern Georgian Bay and as far east as the northeast shore of Lake Scugog. This species seems to prefer to build its burrows in clay soil, so the thin soil and hard rock of the Canadian Shield may prevent it from expanding its range northwards. Although the Chimney Crayfish has a wide distribution within southern Ontario, it is never locally common and often lives in small habitat patches within a sea of agriculture or urban development. The highly developed nature of this region means that habitat loss is a major threat to the Chimney Crayfish.

Little is known about the life history of the Chimney Crayfish in Canada, but it is thought to breed in May and June and live for three to four years. Although further study into the life history of the Chimney Crayfish is needed, it has been suggested that Canadian populations have unique life history patterns, compared to more southerly populations.

Although the Chimney Crayfish is never locally common and is negatively impacted by habitat loss, there are many occurrences of this species in southern Ontario. Therefore Chimney Crayfish has a Canada General Status Rank (Canada rank) of *Sensitive*.

Species spotlight - Virile Crayfish

The Virile Crayfish, *Orconectes virilis*, is an open-water crayfish found from Alberta, east to New Brunswick, and is the most widely distributed crayfish in Canada. Although it is frequently found in rivers or streams with a rocky substrate, it is also found on mud or silt substrates, and in lakes. The Virile Crayfish spends the day sheltering in a shallow excavation under a rock. At night, it ventures out to feed on aquatic plants, algae and aquatic invertebrates.

The Virile Crayfish is widespread and common in most of its range. However, in Ontario and Quebec, the Virile Crayfish faces competition from the *Exotic* Rusty Crayfish (*Orconectes*

rusticus). The Rusty Crayfish, which is native to Ohio, Kentucky, Michigan and Indiana, has eliminated the Virile Crayfish from many aquatic systems in Ontario due to its superior competitive abilities and faster reproductive cycle. However, the Virile Crayfish is not likely to face immediate widespread population declines, as it still has many stable populations in areas where the Rusty Crayfish has not yet been introduced.

Several studies in Ontario have shown declining populations of Virile Crayfishes in lakes on the Canadian Shield. These population declines have been linked to acid rain, since increased acidity of the water can lead to reduced reproductive success in Virile Crayfishes.

The situation is quite different in the western part of the Virile Crayfish's range. In Alberta, the Virile Crayfish is native to the Beaver River drainage, but has been introduced into other Alberta rivers, probably as fish bait. The rivers into which it has been introduced have no native crayfishes, so the Virile Crayfish faces little competition and has the potential to spread rapidly. Experiments have shown that the Virile Crayfish could alter aquatic systems in Alberta by reducing the abundance of native aquatic plants and invertebrates.

Although the Virile Crayfish is facing population declines and local extirpation in some parts of its range, it is a common, widespread species, with many occurrences in Canada. Therefore it has a Canada rank of *Secure*.

Status of knowledge in Canada

Crayfishes are often used as study animals in laboratory experiments and classrooms because they are easy to obtain and maintain, so their basic biology is fairly well known. However, much less is known about crayfishes in the wild. In Ontario, several life history studies have been conducted on native and *Exotic* species, but life history has not been studied extensively in other areas of the country. Similarly, their distribution is fairly well known in Ontario but less well known in the rest of the country. In particular, distributions at the northern edges of crayfishes' ranges and in areas where *Exotic* species have been introduced need further research. Recent studies are starting to address these information gaps. For example, a recent study in British Columbia showed that the distribution of the Signal Crayfish is much larger than previously thought.

One of the leading concerns of crayfish biologists is the impact of introduced crayfishes on native communities. There are two species of crayfish that have Canada ranks of *Exotic*; the Rusty Crayfish and the Obscure Crayfish (*Orconectes obscurus*), both of which were probably introduced to Canada as fish bait. The Rusty Crayfish has spread rapidly in Ontario and Quebec. It is a large, aggressive crayfish that can exclude native crayfishes such as the Northern Clearwater Crayfish (*Orconectes propinquus*) and the Virile Crayfish through aggressive interactions and higher reproduction rates. The Rusty Crayfish can also reduce the diversity and abundance of aquatic plants and invertebrates, compete with fish for food, and reduce fish reproduction by eating fish eggs. The Obscure Crayfish was also introduced into Ontario. Little is known about the Obscure Crayfish in Canada, but it is thought to exclude native crayfishes through competition. It is also believed to hybridize with Northern Clearwater Crayfish.

Crayfishes are used as biological indicators for several types of pollution. For example, in British Columbia, Signal Crayfish kept in cages at locations downstream of agricultural and residential land use areas showed increased levels of contaminant accumulation in their tissues. In Ontario, crayfishes have been used to study heavy metal contamination and acidification of lakes and streams.

Results of general status assessment

The general status assessment for crayfishes was completed in December 2004, and ranks are based on data available up to that time.

Crayfishes are the only group assessed for which no species has a Canada rank of *At Risk* or *May Be At Risk*. Seven species (64% of all species) have Canada ranks of *Secure* and two species (18% of all species) have Canada ranks of *Sensitive* (Figures 2-3-i and 2-3-ii, Table 2-3-i). In addition, two species (18% of all species) have Canada ranks of *Exotic*.

Figure 2-3-i: Summary of the species richness and 2005 general status ranks of crayfish species in Canada.

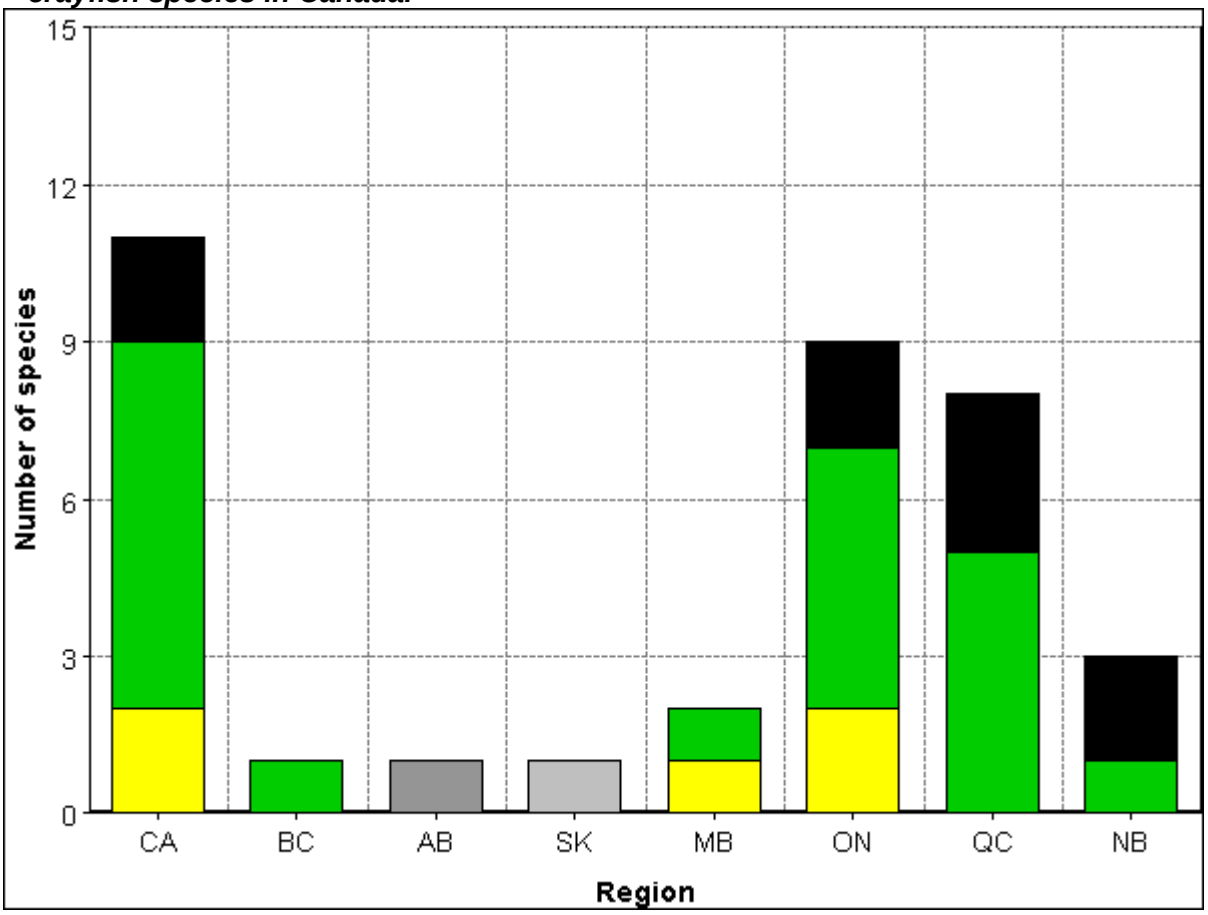


Table 2-3-i: Summary of 2005 general status ranks of crayfish species in Canada.

	CA	BC	AB	SK	MB	ON	QC	NB
Extirpated	0	0	0	0	0	0	0	0
Extinct	0	0	0	0	0	0	0	0
At risk	0	0	0	0	0	0	0	0
May be at risk	0	0	0	0	0	0	0	0
Sensitive	2	0	0	0	1	2	0	0
Secure	7	1	0	0	1	5	5	1
Undetermined	0	0	0	1	0	0	0	0
Not assessed	0	0	1	0	0	0	0	0
Exotic	2	0	0	0	0	2	3	2
Accidental	0	0	0	0	0	0	0	0
Total	11	1	1	1	2	9	8	3

Threats to Canadian crayfishes

The two major threats to Canadian crayfishes are competition from *Exotic* crayfishes and habitat loss. *Exotic* crayfishes have already caused local extirpation of native crayfishes in Ontario, but no native crayfishes are currently in danger of extirpation at a provincial or national level, due to the widespread distribution of the affected species. Habitat destruction due to damming and channelling, wetland loss, siltation and development of riparian habitat can all impact crayfishes. Habitat loss may have a greater impact on burrowing species, which occur in low densities in isolated habitat patches.

In addition, air and water pollution, including acidification of lakes and rivers due to acid rain, can all impact crayfishes.

Conclusion

There remains much to be learned about Canadian crayfishes, including the limits of crayfish distribution, life histories in all regions of the country, and the impacts of introduced crayfishes on aquatic communities. Monitoring of crayfish populations, especially to document the spread of *Exotic* species, will be important in determining future status changes. Canada's crayfishes play an integral role in the freshwater systems in which they occur naturally and have the potential to alter systems into which they are introduced. Increasing our knowledge of crayfishes will help preserve healthy freshwater ecosystems throughout southern Canada.

Further information

Crandall, K. A. and Fetzner, J. W. 2006. Crayfish home page. http://crayfish.byu.edu/ (Accessed September 20, 2005).

Crandall, K. A. and Fetzner, J. W. Jr. 1995. Astacidea, freshwater crayfishes. http://tolweb.org/tree?group=Astacidea&contgroup=Decapoda (Accessed September 20, 2005).

Crocker, D. W. and Barr, D. W. 1968. Handbook of the crayfishes of Ontario. Life Sciences Miscellaneous Publications, Royal Ontario Museum, University of Toronto, Toronto, Ontario. 158 pp

Fetzner, J. W. Jr. 2005. Global crayfish resources. http://iz.carnegiemnh.org/crayfish/ (Accessed September 20, 2005).

Hamr, P. 1998. Conservation status of Canadian freshwater crayfishes. World Wildlife Fund Canada and the Canadian Nature Federation, Toronto. 87 pp

Hamr, P. 2003. Conservation status of burrowing crayfishes in Canada. Upper Canada College, Toronto. 35 pp

Royal, D., Thoma. R., Lukhaup, C., Aniceto, E., De Almeida, A. O., Doran, N., McCullogh, C. and Royal, J. Y. 2005. Crayfish world. http://www.crayfishworld.com/ (Accessed September 10, 2005).

References

Berrill, M. 1978. Distribution and ecology of crayfish in the Kawartha Lakes region of southern Ontario. Canadian Journal of Zoology 56:166-177

Bondar, C. A., Zhang, Y., Richardson, J. S. and Jesson, D. 2005. The conservation status of the freshwater crayfish, *Pacifastacus leniusculus*, in British Columbia. British Columbia Ministry of Water, Land and Air Protection. Fisheries Management Report No. 117.

Butler, R. S., DiStefano, R. J. and Schuster, G. A. 2003. Crayfish: An overlooked fauna. Endangered Species Bulletin. XXVIII(2):10-12

Garvey, J. E., Stein, R. A. and Thomas, H. M. 1994. Assessing how fish predation and interspecific prey competition influence a crayfish assemblage. Ecology 75(2):532-547

Hamr, P. and Berrill, M. 1985. The life histories of north-temperate populations of the crayfish *Cambarus robustus* and *Cambarus bartoni*. Canadian Journal of Zoology 63:2313-2322

Lodge, D. M., Taylor, C. A., Holdich, D. M. and Skurdal, J. 2000. Nonindigenous crayfishes threaten North American freshwater biodiversity: lessons from Europe. Fisheries 25(8):7-20

Taylor, C. A, Warren, M. L., Fitzpatrick, J. F., Hobbs III, H. H., Jezerinac, R. F., Pflieger, W. L. and Robinson, H. W. 1996. Conservation status of crayfishes of the United States and Canada. Fisheries 21(4):25-30

Williams, D. D., Williams, N. E. and Hynes, H. B. N. 1974. Observations on the life history and burrow construction of the crayfish *Cambarus fodiens* (Cottle) in a temporary stream in southern Ontario. Canadian Journal of Zoology 52: 365-370

Odonates


©Bev Wigney: The River Jewelwing damselfly (*Calopteryx aequabilis*)

Odonata - order of insects that includes the dragonflies and damselflies. They are winged, carnivorous insects with brilliant metallic colouring, whose eggs are laid in water and which develop through an aquatic nymph (larval) stage - Henderson's dictionary of biological terms.

Quick facts

- There are about 6500 species of odonates in the world, of which 209 can be found in Canada.
- The majority (69%) of odonates in Canada have Canada General Status Ranks (Canada ranks) of *Secure*, while 13% have Canada ranks of *May Be At Risk* and 13% have Canada ranks of *Sensitive*. No odonates have Canada ranks of *At Risk*, because COSEWIC has not yet assessed any odonate species.
- Odonates first emerged over 300 million years ago, about the same time as the reptiles first appeared, making the Odonata one of the oldest orders of insects alive today.
- The fossil dragonfly *Meganeura*, which lived about 250 million years ago, had a wingspan of over 50 cm, making it the largest odonate known!
- Dragonflies can have more than 25 000 lenses in each eye, giving them almost 360 degree vision.

Background

The order Odonata is divided into three sub-orders, the damselflies or Zygoptera, the dragonflies or Anisoptera, and the Anisozygoptera, which is represented by two living species, both found in Asia. Canada has a total of 209 species of odonates, including 57 species of damselflies and 152 species of dragonflies. All odonates have two pairs of wings, long, slender bodies and large eyes. Dragonflies are usually larger and sturdier than damselflies, and tend to spread their wings horizontally at rest, whereas damselflies hold their wings pressed together over their back or only partly spread. Odonates depend on freshwater for successful reproduction and are found close to freshwater habitats of many different types, from tiny streams to bogs, marshes, fens, swamps and large rivers and lakes.

The odonate life cycle has three distinct phases; egg, larva and adult. Eggs are laid in or close to freshwater and hatch into aquatic larvae, which breathe using gills. The gills of dragonfly larvae are located in the rectal chamber, at the end of the digestive system. By squirting water through their gills, dragonfly larvae can use jet-propulsion to travel through the water. Damselfly larvae are more slender and appear more elegant than dragonfly larvae. They breathe with external gills, which look like feathers extending from the tip of the abdomen. One of the most unusual features of odonate larvae is the large, hinged lower lip, or labium. The labium acts rather like a grappling hook, shooting out at lightning speed to capture prey with dagger-like hooks. This unique capture device allows odonate larvae to be highly successful predators, feeding on a variety of aquatic organisms including other insects and even small fish. Odonate larvae in turn, provide food for an amazing range of animals, from fish and crayfish to birds such as Common Loons (*Gavia immer*) and juvenile Whooping Cranes (*Grus americana*).

Depending on the species, odonate larvae live in the water for less than two months to more than five years. When the larva is mature it climbs out of the water, often onto a piece of emergent vegetation. In a dramatic metamorphosis, the larval exoskeleton splits open along the head and the top of the thorax and the adult dragonfly emerges from its larval skin. Once emerged, the adult rests while its wings dry and expand. Then it takes flight for the first time, leaving behind the larval skin or exuvium. After emerging, the adults usually spend a period of days or weeks resting, hunting and gaining weight in upland habitat, before returning to the water to breed. During their time away from the water, adults become sexually mature and their colours often change, becoming brighter and more striking.

Like the larvae, adult odonates are voracious predators, preying on flying insects including mosquitoes, midges and even other odonates. Their success as predators is due to their acute vision and their speed and manoeuvrability in the air. Odonates are extremely well adapted to flying and can catch prey, eat, mate and lay eggs while in flight. Large dragonflies have been reported to reach speeds in excess of 50 km per hour! The adult stage is typically the shortest stage of the life cycle, usually lasting only a few weeks. No Canadian odonates over-winter as adults, but at least two species are migratory.

Odonates breed in a wide variety of aquatic habitats. Their distribution is dependent on a number of factors including acidity of the water, water flow, vegetation, substrate type, competition from other organisms, predation, disturbance and pollution levels. Generalist species, which are able to survive in a variety of habitats, tend to be widely distributed. Specialist species, which have specific habitat requirements, such as the Pygmy Clubtail (*Ophiogomphus howei*), a species of clear, fast-flowing streams, tend to have sparser, more localized distributions. This can make specialist species vulnerable to population declines, due to habitat disturbance and destruction.

The odonates are a fascinating group of insects that has been attracting increasing attention in recent years from both professionals and amateurs, including children, as demonstrated by the increasing number of scientific and popular publications devoted to odonates. Odonates are both beautiful, and interesting to observe with their complex behaviours and striking colours. There is even a colourful diversity in the intriguing common names of odonates, such as River Jewelwing (*Calopteryx aequabilis*), Umber Shadowdragon (*Neurocordulia obsoleta*) and Slaty Skimmer (*Libellula incesta*). Because odonates are predatory and voracious, and are in turn, important prey items for fish and birds, they play an important role in the ecosystems in which they live. Some species of odonates are sensitive to water quality, potentially making them important environmental indicators.

Status of knowledge in Canada

The odonates are one of our best-known insect groups, but the life history, distribution and habitat requirements of many species of Canadian odonates are poorly understood. Without this basic knowledge, it will be difficult to determine population trends or to prevent population declines or extinctions.

Over the past decade, odonate surveys have greatly improved the knowledge of odonate habitat and distribution in a number of provinces and territories. For example, prior to 1995 the Quebec Emerald (*Somatochlora brevicincta*) was known only from a few isolated peatlands in Quebec, but has now been found in New Brunswick, Nova Scotia, Newfoundland and Labrador, and British Columbia. This is probably not a recent range expansion; rather, new surveys and a better understanding of its ecology have simply led to its discovery in new locations. Similarly, a recent survey in the Northwest Territories added five species of odonates to the territorial species list.

In the future, systematic surveys, long-term monitoring and focused research projects into biology, life history, threats and other relevant questions will be necessary to improve knowledge of Canadian odonates. This will be particularly important in the north, where odonates are poorly known. Ongoing volunteer projects, such as the Ontario Odonata Survey and Atlas and the Manitoba Dragonfly Survey will be important in providinglong-term information on the distribution and biology of odonates. The results of this general status assessment have aided the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in prioritising odonate species for detailed COSEWIC status assessments, which will examine the status of some species currently ranked *May Be At Risk* in greater detail.

Richness and diversity in Canada

Within Canada, Odonate species richness is highest in the eastern provinces, from Nova Scotia to Ontario (Figures 2-4-i and 2-4-ii, Table 2-4-i), particularly in Ontario, where 168 of Canada's 209 species of odonates can be found. Although species richness is lower in the north than in southern Canada, the abundant, pristine wetlands of the north provide widespread and varied habitat for northern specialists, such as the Treeline Emerald (*Somatochlora sahlbergi*), which is found only in the three territories and in northern Saskatchewan, within Canada. All the odonates known from Canada have also been found in other countries.

Species spotlight - Broadtailed Shadowdragon, Neurocordulia michaeli

Scientists are well aware that the earth's species have not all been discovered or named, but in 1993 a Canadian field biologist reduced the number of species left to be discovered by one. On the Canoose Stream in southwest New Brunswick, Paul-Michael Brunelle came across an exuvium, which he couldn't identify. Exuviae are left behind when a larva metamorphoses into an adult odonate and are useful in identifying odonates. Despite the involvement of several experts, the species still could not be identified. The next year, adult males and females of an unknown species were found in the same location, further deepening the mystery. Finally, in 1996, the unknown adults were seen emerging from the unknown exuviae and it was confirmed that both were of the same, new, species, later named Broadtailed Shadowdragon, *Neurocordulia michaeli*. An easily overlooked species that flies only at dusk, the Broadtailed Shadowdragon has since been found in Maine, and Ontario, although the Ontario record is not included in *Wild Species 2005* as the discovery was made after the odonate rankings were completed in 2003. Broadtailed Shadowdragon has a Canada General Status Rank (Canada rank) of *Sensitive*.

The opportunity to make new discoveries, such as this, is one aspect that attracts enthusiasts to the study of odonates. New county records of odonates are regularly reported, and new provincial and territorial records are not unusual, but the discovery of a new species is a thrill few people can hope to experience in their lifetime.

Species spotlight - River Jewelwing

Reaching lengths of over 5 cm, the River Jewelwing is one of Canada's largest damselflies, and also one of the most spectacular. The River Jewelwing (Canada rank: *Secure*) is found in all the provinces and in Nunavut. Commonly found along the shores of rivers and large creeks, this damselfly has a beautiful, butterfly-like flight.

Female River Jewelwings lay their eggs in the stems of submerged aquatic vegetation, 30 cm or more below the surface of the water; females can remain submerged for half an hour or more, while laying their eggs! Once hatched, the larvae spend at least two years in the water, before metamorphosing into adults. Adult River Jewelwings are distinguished by their spectacular metallic green bodies and their broad wings, which appear as if the outer half has been dipped in black ink. Adult females spend much of their time foraging in upland habitat and only return to the water to mate and lay eggs. Males however, spend most of their time defending their territories along the banks of rivers and large creeks. Once a female enters a male's territory, the male initiates an elaborate courtship dance. First, the male conducts a display flight over a potential egg-laying site in his territory. The flight displays the handsome markings on the hindwings and this may assure the female that he is of the correct species and a suitable mate. Next the male hovers in front of the female, until she allows him to mate. Finally, the female lays her eggs and the life cycle begins again.

The combination of being easy to observe and manipulate, together with a wide distribution and complex behaviour patterns, make these damselflies an excellent study species for a range of behavioural and ecological questions. River Jewelwings have taught scientists much about damselfly movement through upland habitat, courtship behaviour, and species discrimination during courtship. For both amateurs and professionals, these beautiful damselflies are endlessly fascinating to observe.

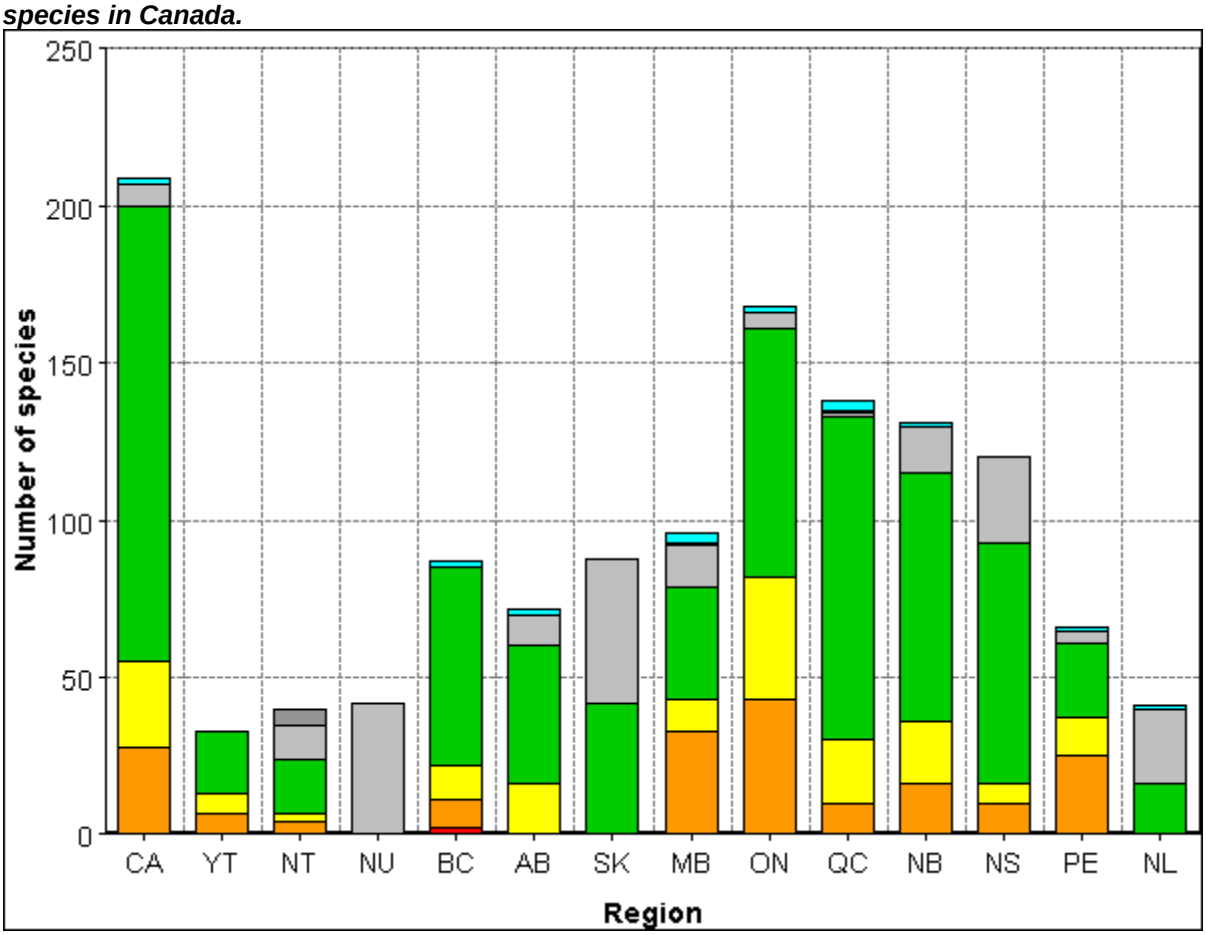
Results of general status assessment

Wild Species 2005 marks the first national assessment for odonates. The rankings for odonates were finished in November 2003 and reflect data available up to that time.

The majority of Canada's 209 odonates have Canada ranks of *Secure* (145 species, 69%, Figures 2-4-i and 2-4-ii and Table 2-4-i). Twenty-seven species have Canada ranks of *Sensitive* (13%), and 28 species have Canada ranks of *May Be At Risk* (13%). No species have Canada ranks of *At Risk* because COSEWIC has not completed any status assessments for odonates. However, COSEWIC status assessments are currently in progress for two odonate species, Rapids Clubtail (*Gomphus quadricolor*) and Pygmy Clubtail, and a further nine species are currently on the candidate list for assessment by COSEWIC.

Seven species of odonates have Canada ranks of *Undetermined* (3%), but this proportion is much higher in some provinces and territories, reflecting a need for increased survey effort. Finally, two species have Canada ranks of *Accidental* (1%).

Figure 2-4-i: Summary of the species richness and 2005 general status ranks of odonate species in Canada.



Percentage

Table 2-4-i: Summary of 2005 general status ranks of odonates in Canada.

	CA	YT	NT	NU	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL
Extirpated	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Extinct	0	0	0	0	0	0	0	0	0	0	0	0	0	0
At risk	0	0	0	0	2	0	0	0	0	0	0	0	0	0
May be at risk	28	7	4	0	9	0	0	33	43	10	16	10	25	0
Sensitive	27	6	3	0	11	16	0	10	39	20	20	6	12	0
Secure	145	20	17	0	63	44	42	36	79	103	79	77	24	16
Undetermined	7	0	11	42	0	10	46	13	5	1	15	27	4	24
Not assessed	0	0	5	0	0	0	0	1	0	0	0	0	0	0
Exotic	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Accidental	2	0	0	0	2	2	0	3	2	3	1	0	1	1
Total	209	33	40	42	87	72	88	96	168	138	131	120	66	41

Threats to Canadian odonates

In order to successfully complete their life cycle, odonates require both aquatic and terrestrial habitats, and are therefore potentially vulnerable to habitat degradation and destruction both on land and in the water. In aquatic systems, destruction and degradation of wetlands, damming and channelling of rivers and streams, and water pollution can all negatively impact odonate populations. Recreational use of waterways can reduce the abundance and diversity of odonates, since boat wakes can kill individuals during the vulnerable emergence period. Odonates are also vulnerable to ecosystem changes resulting from invasion of exotic species. Modifications to land adjacent to aquatic habitat can affect odonates directly, by degrading the upland habitat they use to mature and hunt, and indirectly by affecting water quality.

Conclusion

This general status assessment shows that although more than two-thirds of Canada's odonates have a Canada rank of *Secure*, 13% are ranked *May Be At Risk*. Odonates and insects generally have not received as much attention from biologists and conservationists as well-studied groups, like birds and mammals. However, this general status assessment, which was made possible by the cooperative contributions of both amateur and professional field biologists, has aided COSEWIC in selecting a number of priority species for detailed status assessments. Detailed COSEWIC assessments will consolidate our knowledge of species ranked *May Be At Risk*, while amateur and professional field biologists across the country will continue to improve our knowledge of the life history and distribution of odonates in Canada. The vast areas of Canada where no one has ever looked for odonates makes the discovery of a new species a thrilling possibility!

Further information

Cannings, R. 2002. Introducing the dragonflies of British Columbia and the Yukon. Royal British Columbia Museum, Victoria. 96 pp

Cannings, R. 2004. Resources for the study of Odonata in Canada. Newsletter of the Biological Survey of Canada (Terrestrial Arthropods). 23(1) http://www.biology.ualberta.ca/bsc/news23_1/odonata.htm (Accessed February 8, 2006).

Cannings, R. A. and Stuart, K. M. 1977. The dragonflies of British Columbia. British Columbia Provincial Museum Handbook; no. 35. British Columbia Provincial Museum, Victoria. 256 pp

Dunkle, S. W. 2000. Dragonflies through binoculars. Oxford University Press, New York. 266 pp

Nikula, B. and J. Sones. 2002. Stokes beginners guide to dragonflies and damselflies. Little Brown and Co. 160 pp

Pilon, J.-G. and Laglace., D. 1998. Les Odonates du Québec. Entomofaune du Québec Inc. Chicoutimi, Québec. 367 pp

Pratt, P. D. 2004. Regional lists of Ontario odonata. http://www.netcore.ca/~prairie/odonata.html (Accessed February 8, 2006).

Trueman, J. W. H. and Rowe, R. J. 2001. Odonata. http://tolweb.org/Odonata (Accessed September 1, 2005).

References

Brunelle, P. 2000. A new species of *Neurocordulia* (Odonata: Anisoptera: Cordulidae) from eastern North America. The Canadian Entomologist 132:39-48

Cannings, R. 2002. Rare dragonflies of British Columbia. B.C. Minist. Water, Land and Air Protection, Biodiversity Branch and B.C. Minist. Sustainable Resour. Manage., Conservation Data Centre, Victoria, British Columbia. 6 pp

Cannings, S. G. 2003. Status of river jewelwing (*Calopteryx aequabilis* Say) in British Columbia. B.C. Minist. Water, Land and Air Protection, Biodiversity Branch and B.C. Minist. Sustainable Resour. Manage., Conservation Data Centre, Victoria, BRITISH COLUMBIA. Wildl. Bull. No, B-110. 10 pp

Catling, P.M., Cannings, R.A. and Brunelle, P.M. 2005. An annotated checklist of the Odonata of Canada. Bulletin of American Odonatology 9(1): 1-20

Catling, P., Carriere, S., Johnson, D. and Fournier, M. 2004. Dragonflies of the Northwest Territories, Canada: New Records, ecological observations and a checklist. Argia 16(1): 9-13

Catling, P. M., Hutchinson, R. and Ménard, B. 1996. Dragonflies and damselflies. In Assessment of species diversity in the mixedwood plains ecozone. *Edited by* I. M. Smith, Ecological Monitoring and Assessment Network, Environment Canada. http://www.naturewatch.ca/Mixedwood/odonata/intro.html (Accessed September 1, 2005).

Lawrence, E. Ed. 1995. Henderson's dictionary of biological terms. J. Wiley & Sons, New York. 693 pp

Needham, J. G., Westfall, M. J. and May, M. L. 2000. Dragonflies of North America. Scientific Publishers, Gainesville. 939 pp

Walker, E.M. 1953. The Odonata of Canada and Alaska. Volume 1. University of Toronto Press, Toronto, Ontario. 292 pp

Walker, E.M. 1958. The Odonata of Canada and Alaska. Volume 2. University of Toronto Press, Toronto. 318 pp

Walker, E.M., and Corbet, P. S. 1975. The Odonata of Canada and Alaska. Volume 3. University of Toronto Press, Toronto, Ontario. 308 pp

Westfall, M. J, and May, M. L. 1996. Damselflies of North America. Scientific Publishers, Gainesville. 649 pp

Tiger Beetles


©Henri Goulet: Six-spotted Tiger Beetle

Cicindèles : Coléoptères carnivores de la famille des cicindélidés à la couverture alaire maculée ou rayée - The Canadian Oxford Dictionary.

Quick facts

- There are more than 2600 species of tiger beetles in the world, of which 30 have been found in Canada.
- Tiger beetles belong to the family Cicindelidae and are closely related to the ground beetles (Family Caribidae).
- The majority of Canada's 30 species of tiger beetles (70%) have a Canada General Status Rank (Canada rank) of *Secure* but 17% have Canada ranks of *May Be At Risk* and 7% have Canada ranks of *Sensitive*. 3% of species have Canada ranks of *Not Assessed*. No tiger beetles of Canada ranks of *At Risk*, because COSEWIC has not yet assessed any tiger beetles.
- Tiger beetles are aptly named for their predatory nature and the stripes that many of them wear.
- The Bronzed Tiger Beetle can run at speeds up to 0.5 meters per second; taking body size into account, that is 10 times faster than the fastest human sprinters!

Background

Tiger beetles (Family Cicindelidae) are well named for their predatory nature and the colourful stripes that many of them wear. Due to their large size (relative to other beetles), striking colours, and fascinating behaviour, tiger beetles have been fairly well-studied in Canada, making them a good choice for the first family of beetles to be ranked as part of the general status program. Most tiger beetles are classified as habitat specialists because they use very specific habitat types. Many species live in areas with sparse vegetation and undisturbed soil, such as sand dunes, salt flats, beaches, bare hillsides, sparse prairie habitat and forest openings.

Adult tiger beetles are recognizable by their large compound eyes, wide head and long antennae, as well as their large, sickle-shaped jaws which they use to capture and eat their prey. Like all adult beetles, tiger beetles have two pairs of wings. At rest, the fragile hind wings are hidden beneath the protective sheath of the hardened forewings, or elytra. When the beetle takes flight, the elytra open to allow the hind wings to propel the beetle through the air. Many adult tiger beetles have very striking colours and patterns; the elytra, head and legs can be stripped or spotted with bright metallic greens, blues and reds. The colourful markings actually act as camouflage for the adults, allowing them to blend into the background, so it is usually movement, rather than colour that gives away the location of a tiger beetle.

Adult tiger beetles are voracious predators, locating prey by sight and giving chase across the ground at astonishing speeds of up to 53 body lengths per second (about 10 times faster than a top human sprinter!). But rather than chasing prey continuously, tiger beetles often pause momentarily during the chase before continuing at full speed once more. Scientists now believe they know the reason for this stop-start method of pursuit. At the high speeds that tiger beetles achieve while chasing their prey, light cannot enter the eye fast enough to form an image of the moving prey item; at high speeds the tiger beetle goes temporarily blind! Pausing during the pursuit allows the tiger beetle to relocate its prey, while its incredible speed still allows it to complete the chase successfully.

Tiger beetles are creatures of the sun; they need the warmth of the sunlight to keep their body temperature high enough to maintain their active lifestyle. Even a cloud passing across the sun will stop a tiger beetle in its tracks. To escape bad weather or the cool of the night, tiger beetles dig a shallow tunnel in the ground. To pass the winter, tiger beetles dig a much a longer tunnel, up to 2m deep! The tiger beetle fills in the tunnel behind it and remains at the bottom of the tunnel until the ground warms the next spring.

Tiger beetles have four stages in their life cycle; egg, larva, pupa and adult. Eggs are laid singly in carefully chosen soils, where the moisture and humidity will provide the correct environment for the egg and the developing larva. Once hatched, the larva quickly digs a vertical tunnel deep into the soil. The s-shaped larva resembles a caterpillar, except that the large head is fixed at right angles to the body. Like the adults, tiger beetle larvae are superbly adapted predators, feeding on ants and other small arthropods. The larva waits at the entrance of its tunnel, with its large head blocking the entrance and its huge jaws opened wide. When a prey item comes in range, the larva reaches out at lightening speed to grab its prey. The larva has two curved hooks on its back; if the struggles of its prey threaten to pull it out of its tunnel, the larva jams these hooks into the wall of the tunnel to maintain its position. When the prey is subdued, the larva drops to the bottom of its tunnel with its prey, to enjoy its feast in private.

When the larva is large enough, it retreats into its tunnel, and metamorphoses into a pupa. Pupae do not eat or move; their sole purpose is to undergo the changes that will allow an adult to emerge. In a few weeks, the pupa metamorphoses into an adult tiger beetle, which emerges from the tunnel to begin life on the surface.

Status of knowledge

Due to their interesting behaviours and striking colours, and because they are usually active during the day and are fairly easy to observe, tiger beetles have been better studied than most other families of insects. There is even a scientific journal devoted solely totheir study. Tiger beetles have been used to study such varied topics as sight, thermal ecology and predator avoidance techniques. However, although the life history of tiger beetles in general is well known, life histories of specific species are often less well known, and in particular, there remain many questions about their movements between suitable habitats (dispersal). In addition, there remains much to be discovered about the distribution of Canadian tiger beetles, particularly in terms of the limits their occurrence.

Due in part to their global distribution, well established taxonomy, their specific habitat needs and the relative ease with which they can be identified, tiger beetles are being considered as possible indicators of biodiversity (the diversity of life in all its forms) on a global scale. In this role, tiger beetles are likely to become increasingly important to scientists, conservationists and managers, both within Canada and worldwide.

Richness and diversity in Canada

Twenty-eight of the 30 Canadian tiger beetles belong to the genus *Cicindela*, colourful beetles that are active during the day. The other two beetles belong to the genus Omus. This genus is restricted to the costal region of western North America, and includes species that are flightless and active only at night. Tiger beetles are found in every province and territory except Nunavut, but species richness is highest in the prairie provinces (Figure 2-5-i, Table 2-5-i). British Columbia has the most species that are found nowhere else in Canada (five species).

Species spotlight - Ghost Tiger Beetle, Cicindela lepida

The Ghost Tiger Beetle, *Cicindela lepida*, is a small tiger beetle found on undisturbed white sand in coastal and lake-shore sand dunes, as well as inland sand dunes and sand flats. Within Canada, the Ghost Tiger Beetle is found in the prairie provinces and in Ontario and Quebec. Ghost Tiger Beetles are pale in colour, with faint brownish markings on the elytra, making it difficult to see against the sand. When predators approach, the Ghost Tiger Beetle freezes against the sand and relies on its camouflage to protect it from detection. In fact, its camouflage is so good, that the beetle's shadow is often easier to see than the beetle itself, leading to its unusual name. The life history of the Ghost Tiger Beetle has been described as unique among tiger beetles because the larvae live for two years, over-wintering twice, while the adults only live for about one month.

Although the Ghost Tiger Beetle can form large populations in suitable habitat and is thought to be able colonize new habitat fairly easily, local populations are vulnerable to habitat loss due to human development or to natural succession and to disturbance by heavy recreational use of their habitat. This species has a Canada General Status Rank (Canada rank) of *May Be At Risk*.

Species spotlight - Six-spotted Tiger Beetle, Cicindela sexguttata

Unlike most tiger beetles, which tend to inhabit sparsely vegetated, open habitats, Six-spotted Tiger Beetles, *Cicindela sexguttata*, live on the floor of deciduous forests. This presents Six-spotted Tiger Beetles with a problem: how to maintain a body temperature high enough to sustain their active lifestyle? In the open habitats where most tiger beetles live, there is an abundant supply of sunshine, and tiger beetles bask in the sun to raise their body temperature to the required level, but on the forest floor, sunlight is in short supply. In order to survive in the forest, Six-spotted Tiger Beetles have a lower optimum body temperature than other tiger beetles. In addition, Six-spotted Tiger Beetles spend most of their time in patches of sunlight, created along trails or where trees have fallen over, where temperatures are warm enough for Six-spotted Tiger Beetles to maintain their optimum body temperature. In contrast to other tiger beetles, which chase down their prey over relatively long distance, Six-spotted Tiger Beetle wait within their patch of sunlight, until a prey item comes close enough for them to pounce.

Six-spotted Tiger Beetles have a two year life cycle; females lay eggs in the summer, which hatch into larvae. Larvae overwinter in their tunnels, and pupate around mid-summer of their first year. Adults may briefly emerge at this time, but then overwinter in their tunnels once more, before emerging as sexually mature adults, early the next spring. Within Canada, Six-spotted Tiger Beetles are found in Ontario, Quebec, Nova Scotia and New Brunswick, and they have a Canada rank of *Secure*.

Results of general status assessment

The majority of Canada's 30 species of tiger beetle species have Canada ranks of *Secure* (21 species, 70%, Figures 2-5-i and 2-5-ii, Table 2-5-i). However, 17% have Canada ranks of *May Be At Risk* (five species) and 10% have Canada ranks of *Sensitive* (three species). No species has Canada ranks of *At Risk*, because no COSEWIC status assessments of tiger beetles have been completed. Finally 3% of species have Canada ranks of *Not Assessed* (one species).

Figure 2-5-i: Summary of the species richness and 2005 general status ranks of tiger beetle species in Canada.

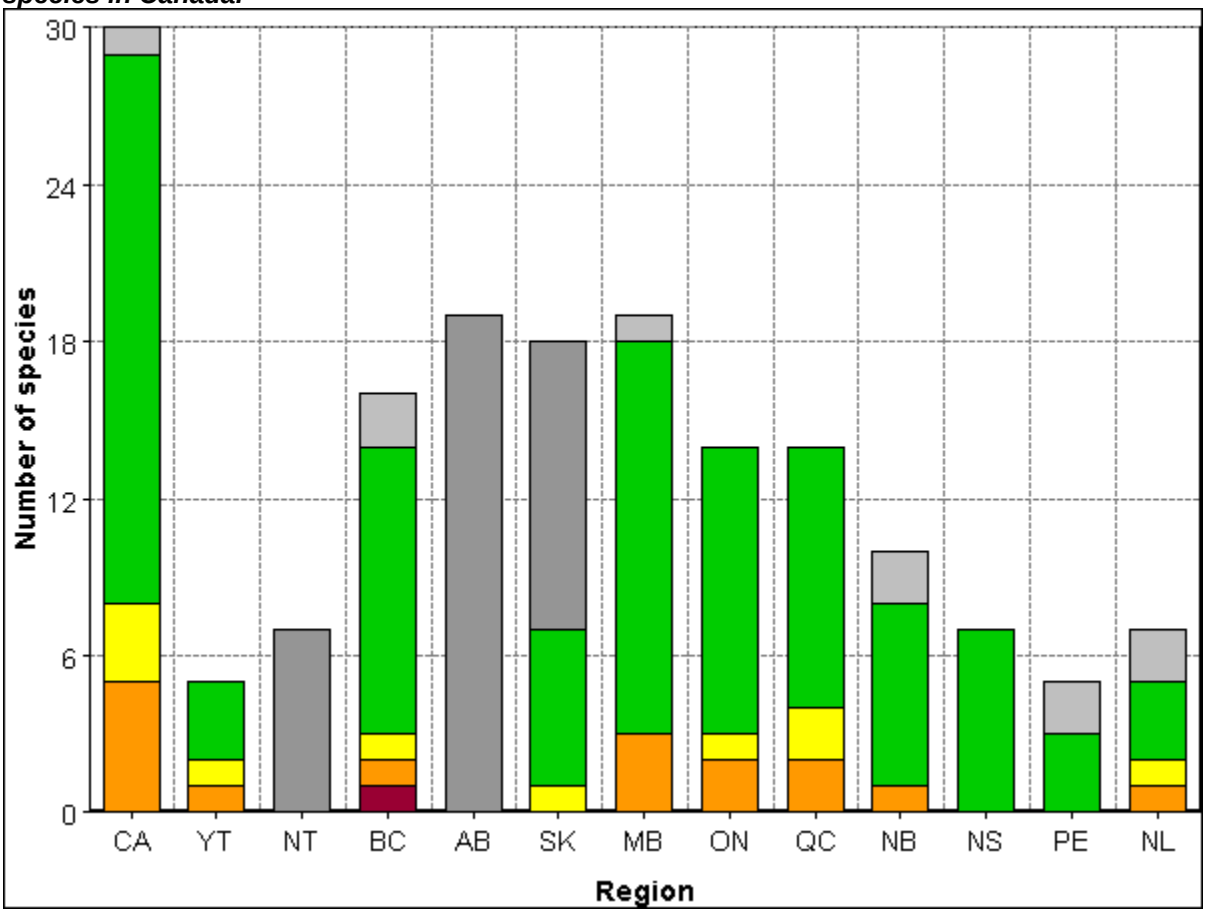


Table 2-5-i: Summary of 2005 general status ranks of tiger beetles in Canada.

	CA	YT	NT	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL
Extirpated	0	0	0	1	0	0	0	0	0	0	0	0	0
Extinct	0	0	0	0	0	0	0	0	0	0	0	0	0
At risk	0	0	0	0	0	0	0	0	0	0	0	0	0
May be at risk	5	1	0	1	0	0	3	2	2	1	0	0	1
Sensitive	3	1	0	1	0	1	0	1	2	0	0	0	1
Secure	21	3	0	11	0	6	15	11	10	7	7	3	3
Undetermined	1	0	0	2	0	0	1	0	0	2	0	2	2
Not assessed	0	0	7	0	19	11	0	0	0	0	0	0	0
Exotic	0	0	0	0	0	0	0	0	0	0	0	0	0
Accidental	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	30	5	7	16	19	18	19	14	14	10	7	5	7

Threats to Canadian tiger beetles

Tiger beetles are vulnerable to habitat loss and disturbance due to natural succession, changes in drainage patterns, erosion control and conversion of natural habitat for human uses. In addition, human recreational use of tiger beetle habitat can kill larvae and disturb the habitat of the adults.

Conclusion

Although tiger beetles have been better studied than many other insect families, much remains to be learned about the range and status of tiger beetles in Canada. The potential role of tiger beetles as indicators of biodiversity may act as an impetus for their further study in Canada and around the world.

Further information

Acorn, J. H. 2004. Grassland tiger beetles in Canada. Arthropods of Canadian Grasslands 10:6-14. http://www.biology.ualberta.ca/bsc/pdf/grasslands10.pdf (Accessed September 15, 2005).

Acorn, J. 2001. Tiger beetles of Alberta. Killers on the clay, stalkers on the sand. University of Alberta Press, Edmonton. 120 pp

Freitag, R. 1998. Catalogue of the tiger beetles of Canada and the United States. Ottawa NRC Research Press, Ottawa. 195 pp

Goulet, H. and Bousquet, Y. 2004. The ground beetles of Canada. http://www.cbif.gc.ca/spp_pages/carabids/phps/index_e.php (Accessed September 15, 2005).

Leonard, J. G. and Bell, R. T. 1999. Northeastern tiger beetles: A field guide to the tiger beetles of New England and eastern Canada. CRC Press, Boca Raton. 176 pp

Marshall, S. 2000. Tiger beetles of Ontario. http://www.uoguelph.ca/~samarsha/tiger-beetles.htm (Accessed September 15, 2005).

Pearson, D. L., Knisley, C. B. and Kazilek, C. J. 2005. A field guide to the tiger beetles of the United States and Canada: Identification, natural history, and distribution of the Cicindelidae. Oxford University Press, Oxford. 292 pp

Pearson, D. L. and Vogler, A. P. 2001. Tiger beetles: The evolution, ecology and diversity of the Cicindelids. Cornell University Press, Ithaca, New York. 333 pp

Young Entomologists' Society. 1998. Tiger beetle world. http://members.aol.com/YESedu/home.html (Accessed September 15, 2005).

Wallis, J. B. 1961. The Cicindelidae of Canada. University of Toronto Press, Toronto, Ontario. xii + 74pp

References

Cassola, F. and Pearson, D. L. 2000. Global patterns of tiger beetle species richness (Coleoptera: Cicindelidae): their use in conservation planning. Biological Conservation 95:197-208

Barber, K. Ed. 1998. The Canadian Oxford Dictionary. Oxford University Press. Toronto, Oxford, New York. 1707 pp

Headstrom, R. 1977. The beetles of America. A.S. Barnes and Co. Inc. Cranbury, NJ. 488 pp

Hilchie, G. J. 1985. The tiger beetles of Alberta (Coleoptera: Carabidae, Cicindelini). Quaestiones Entomolgicae 21:319-347

Pearson, D. L. and Cassola, F. 1992. World-wide species richness patterns of tiger beetles (Coleoptera: Cicindelidae): Indicator taxon for biodiversity and conservation studies. Conservation biology 6(3):376-391

Schultz, T. D. 1998. The utilization of patchy thermal microhabitats by the ectothermic insect predator, *Cicindela sexguttata*. Ecological Entomology 23(4):444-450

Stanton, E. J. and Kurcaewski, F. E. 1999. Notes on the distribution of *Cicindela lepida* Dejean (Coleoptera: Cicindelidae) in New York, Ontario and Quebec. The Coleopterists Bulletin 53(3):275-279

Fishes

© Fisheries and Oceans Canada: Yelloweye Rockfish, *Sebastes ruberrimus*.

Fish - A vertebrate cold-blooded animal with gills and fins and living wholly in water. - The Canadian Oxford Dictionary.

Quick facts

- There are approximately 29 400 known species of fishes in the world, more than any other type of vertebrate.
- Nearly 1400 species of fishes are found in Canadian waters, comprising approximately 60% of all Canada's vertebrate species. 11% of Canada's fishes occur in freshwater habitats, 85% occur in marine habitats and 4% are found in both freshwater and marine habitats.
- A total of 60% of Canada's fish species are ranked *Undetermined* or *Not Assessed*. Most of the fishes ranked *Undetermined* or *Not Assessed* are marine species, reflecting how much we need to learn about marine ecosystems, particularly in the Arctic.
- The majority of freshwater fishes have Canada General Status Ranks (Canada ranks) of *Secure* (64%). However, 10% of freshwater fish species have Canada ranks of *At Risk*.
- Of the 206 fishes that received Canada ranks in both 2002 and 2005, 30 species have changed rank since 2002. The majority of these changes (43%), moved species into a category with a lower level of risk. Changes resulted in an increase in the proportion of species ranked *Secure*.

Background

The fishes are a large and diverse group found in a wide range of habitats, ranging from the depths of the oceans, to constantly changing estuaries, to shallow warm water ponds, to deep, cool lakes and rivers. Modern fishes are split into three major groups; Superclass Agnatha, Class Chondrichthyes and Superclass Osteichthyes (classification from the Integrated Taxonomic Information System). Superclass Agnatha includes the lampreys and hagfishes; primitive, jaw-less fishes that resemble eels. The sharks, rays, skates, chimera and paddlefishes are classified in Class Chondrichthyes. These species all have skeletons made of tough cartilage instead of bone. Finally, Superclass Osteichthyes includes fishes with bony skeletons, and comprises the majority of living fishes. Roughly half of the known vertebrate species in the world belong to Superclass Osteichthyes!

Fishes come in all shapes and sizes, from the enormous Greenland shark (*Somniosus microcephalus*), to the curious and primitive lampreys (family Petromyzontidae), to the torpedo shaped tunas (family Scombridae). However, all fishes share certain common features. For example, all fishes live underwater, and breathe by moving water over their gills, where dissolved oxygen passes into the blood and carbon dioxide passes back out. Most fishes are cold-blooded (ectothermic) meaning their body temperature is determined by the surrounding water temperature. Fishes propel themselves through the water by weaving movements of their body and tail, and control their direction by means of fins. All fishes cover their skin with slimy glandular secretions, and nearly all have scales. Together, the slime and scales provide a smooth, nearly waterproof coating, which reduces friction and allows the fish to glide smoothly through the water. All fishes have a system of sense organs in the skin, collectively called the lateral line system. The lateral line system is sensitive to changes in water pressure, which can be generated by movement in the water, or when a fish changes depth or approaches a stationary object. This information helps fishes navigate their three-dimensional, underwater world.

Fishes eat a variety of food types, from algae and vascular plants to invertebrates and other fishes. In most species, diet changes with age, so that juvenile and adults feed on very different types of food, and few species of fish specialize on only one food source. Fishes show many adaptations to aid them in finding and capturing food. For example, active predators like tunas and some sharks (e.g. family Lamnidae), have very streamlined bodies and are capable of

swimming at high speeds for fairly long periods of time, in order to chase down their prey. On the other hand, some lie-in-wait predators like Northern Pike(*Esox lucius*) and Spotted Gar (*Lepisosteus oculatus*) have long flexible bodies, long, grasping mouths and rely on a short burst of speed once the prey has wandered within reach. Fishes that feed at the water's surface, like Blackstripe Topminnow(*Fundulus notatus*), generally have upward pointing mouths, whereas fishes that feed on the bottom, like the Channel Catfish (*Ictalurus punctatus*) often have mouths on the underside of their head, as well as barbels or whiskers that help them sense food in dark or murky water. Other fishes specialize in feeding on plankton, tiny plants (phytoplankton) and animals (zooplankton) that float in the water (e.g. Paddlefish, *Polyodon spathula*; herrings, family Clupeidae). These fishes filter the plankton from the water using sieve-like gill rakers under their operculum.

Fishes have developed a variety of methods of reproduction. Most fish species are gonochoristic, meaning that they have separate male and female individuals, but some species are hermaphroditic, meaning that individual fishes can change from one sex to the other during their lifetime (e.g. seabasses, family Serranidae). The majority of fish species lay eggs and provide very little care for their young. For example, male and female Lake Whitefish (*Coregonus clupeaformis*) gather in large schools to release eggs and sperm into the water, with little regard for what happens to the eggs or young afterwards. This is known as 'broadcast spawning'. Species that provide little parental investment, tend to produce large numbers of eggs, to increase the chance that some will survive. For example, the broadcast spawner, White Hake (*Urophycis tenuis*) can release more than 3 000 000 eggs per female! Other species produce far fewer eggs, but invest more energy into choosing a mate and caring for the eggs and young. For example, male Threespine Sticklebacks (*Gasterosteus aculeatus*) build a 'nest' of aquatic vegetation, and use elaborate courtship rituals to attract a mate. Females lay eggs in the nest, before being chased away by the male, who tends first the eggs and then the young, until they are independent. Rays and some species of sharks provide their eggs with additional protection by enclosing them in leathery egg cases or purses. The purses can lie on the bottom for a year or more before the eggs hatch. Most species of sharks take the protection of their young a step further, by giving birth to live young (fully formed juveniles). This allows the mother to provide the developing embryos with a stable environment and protect them from predation, but in general very little care is provided once the young are born. Fishes that produce live young typically use internal fertilization, as do mammals and birds.

Status of knowledge

Knowledge of Canadian fishes varies quite widely by species. Species that are important for commercial fisheries, such as Lake Whitefish, Pacific salmon species and Atlantic Cod (*Gadus morhua*), and recreationally sought species, such as Walleye (*Sander vitreus*), have been particularly well studied, and much is known about their biology and ecology. Species of particular scientific interest or importance have also been well studied. For example, members of the stickleback family (Gasterosteidae) have been used to study reproductive behaviour, feeding behaviour and adaptations, diet, effects of pollution, life history, predation, competition, natural selection and genetics. In addition, some exotic species have also been relatively well studied, due to the damage they can cause to native communities and species. However, species outside these categories are less well understood, particularly marine fishes that live in deep water or in the Arctic Ocean.

Many research projects are ongoing in Canada, as scientists work towards filling the gaps in our understanding of fishes. The Pacific Ocean Shelf Tracking Project, or POST, uses an array of listening stations set along the west coast of North America to monitor the movement of marine animals. POST results will give much needed information about little known aspects of the biology of threatened and commercially valued species, and provide unprecedented insight into fish migration. On the east coast, the Centre for Marine Biodiversity is investigating the links between fisheries and habitat and the impacts of exotic species on marine fishes, among other topics. Recent research has focused on studying all species in an ecosystem, in order to understand how an ecosystem functions. This will provide the information necessary to manage fisheries and other activities in a more sustainable manner.

Richness and diversity in Canada

The distribution of Canada's fishes is governed by many factors including salinity (the amount of salt in the water), temperature, and habitat availability to name only a few. There are roughly 1389 species of fish found in Canadian waters, the majority of which are found only in marine waters (1178 species). The number of species occurring only in freshwater 160 species), or in both marine and freshwater 51 species) is much lower.

Of the provinces and territories, Ontario has by far the highest diversity of fish species (154 species), followed by Quebec (117 species, Figure 2-6-i, Table 2-6-i). Many of Ontario's freshwater species are warmwater species found only in the south of the province, and typically have most of their range in the United States. Although the territories have lower species richness than the provinces, many of the fishes found in the territories are coldwater species that have limited or no range in southern Canada or the continental United States (e.g. Broad Whitefish, *Coregonus nasus* Least Cisco, *Coregonus sardinella*).

Canada's marine waters are predominantly the inshore and continental shelf components of the ocean, which are nutrient rich and highly productive. Canada's Atlantic seaboard, with its massive shelf varying in width from 110 to 520 km from shore, supports a high level of species diversity (835 species, Figure 2-6-i, Table 2-6-i). By comparison, the shelves of the Pacific and Arctic seaboards are much narrower, at about 65 km wide, and support lower species diversity.

Species Spotlight: Arctic Char Salvelinus alpinus

Arctic Char (Canada General Status Rank: *Secure*), are closely related to the salmons and trouts and inhabit cold rivers, lakes and streams across Canada. This large and often colourful fish is an example of an anadromous species; that is, a fish that migrates between freshwater (where they spawn) and marine water (where they feed and grow). Arctic Char have the most northerly distribution of any Canadian freshwater fish, and are native to the Yukon Territory, the Northwest Territories, and Nunavut, as well as the eastern and western Arctic Ocean regions, the Atlantic Ocean region, Manitoba, Ontario, Quebec, New Brunswick, and Newfoundland and Labrador.

Arctic Char have two main life history variations; those that migrate between freshwater and marine habitats (sea-run) and those that remain permanently in freshwater. In the Arctic, marine habitats are much richer in nutrients than freshwater habitats, so food is more readily available in the sea than in freshwater. Sea-run Arctic Char take advantage of this by spending the summer feeding in the ocean, then migrating back to freshwater in the fall, before the ocean freezes. Sea-run Arctic Char then overwinter in freshwater, typically in the bottom of deep lakes, before migrating back to sea the next spring.

As their name suggests, freshwater Arctic Char remain in freshwater year round, living in lakes or rivers. Freshwater Artic Char grow much more slowly, and are typically much smaller than sea-run Arctic Char. However, freshwater Arctic Char become sexually mature much more rapidly than sea-run Arctic Char (one to three years for freshwater individuals vs. 10 to 25 years for sea-run individuals). These different life histories provide a fascinating puzzle for scientists, particularly since, in some parts of the Arctic, both varieties of Arctic Char can be found in the same lake. Scientists are also studying how climate change may impact the relative numbers and success of the sea-run and freshwater Arctic Char.

Arctic Char has been an important food source for northern communities for centuries. More recently, Arctic Char sportfishing has become commercially important in northern Canada, and Arctic Char aquaculture operations have developed in southern Canada. Arctic Char is an expensive delicacy, prized even above the best salmon.

Species spotlight: Skates - family Rajidae

The skates, together with the sharks and rays, belong to the class Chondrichthyes. Like all Chondrichthyes, skates have a skeleton made of cartilage, which is tough, supple and half as dense as bone, making skates light-weight and flexible. Skates have flattened, disc-like bodies and characteristic broad pectoral fins or 'wings'. They swim by gently undulating their fins, so that they appear to fly through the water, while the long, thin tail acts as a rudder. Most skates are bottom dwellers, sometimes lying partially buried in sand or gravel. The mouth and gills are

situated on the under-side of the fish, and two breathing holes, or spiracles, are situated on the upper-side. Skates breathe by inhaling water through the spiracles and expelling it through the gills. Their carnivorous diet consists of crabs, shrimps, small crustaceans, small fishes, and cephalopods (squid and octopus). A skate typically cannot capture active animals by a direct attack because of the position of its mouth on the under-side of its body; instead it captures prey by darting forward suddenly and settling down over its prey.

There are over 100 recognized species of skates worldwide, of which 29 are known to occur in Canadian waters. The most common species in eastern Canadian waters is the Thorny Skate (*Amblyraja radiata*). Thorny Skates are brown to gray and are thornier than other species of skates. They can live to at least 16 years and may grow to a length of 100-110 cm. Thorny Skates live in cold water (mainly 2-7°C) at a range of depths, from about 20 - 1000 m. Globally, populations of several different skate species, including Thorny Skate, have been showing evidence of population declines. The Thorny Skate has a Canada General Status Rank (Canada rank) of *May Be At Risk*.

Species spotlight: Rockfish - genus Sebastes

Rockfishes are members of the large Scorpionfish family or Scorpaenidae. There are 42 species of rockfish found in Canadian waters including 38 species found only in the Pacific Ocean region, two species found only in the Atlantic Ocean region and two species found in both the Atlantic Ocean region and the eastern Arctic Ocean region. Rockfishes come in a variety of shapes, sizes and colours, but all have certain characteristics in common, including large mouths, prominent, mildly poisonous spines along the back, and smaller spines on the head. Rockfishes reproduce using internal fertilization and bear live young. They tend to be slow-growing, long-lived, mature at a late age and have highly variable recruitment success. An extreme example is the Yelloweye Rockfish (*Sebastes ruberrimus*) which reaches sexual maturity at approximately 18 years of age and can live in excess of 110 years! These extreme life history traits lead to low population growth, making rockfish populations vulnerable to increased adult mortality, such as fishing.

These fascinating creatures are highly sought after, because they are delicious to eat. Recent monitoring and research programs have indicated that some rockfish stocks in the Strait of Georgia, off Canada's west coast, are at low levels of abundance as a result of harvesting pressure from commercial, recreational and Aboriginal fisheries. Due to growing concerns over rockfish declines, Fisheries and Oceans Canada announced a Rockfish Conservation Strategy in 2002, which included new regulations limiting both commercial and recreational catch of rockfishes, as well as the establishment of Rockfish Conservation Areas (RCA). The intention of the RCAs is to protect rockfish habitat, minimize mortality from directed and incidental fisheries, and allow for the rebuilding of rockfish stocks. Most of Canada's rockfishes have Canada ranks of *Undetermined* or *Sensitive*, but one species (Bocaccio, *Sebastes paucispinis*) has a Canada rank of *At Risk*, and three species have Canada ranks of *May Be At Risk*.

Results of assessment

Most of Canada's 1389 species of fishes have Canada ranks of *Not Assessed* (434 species, 31%) or *Undetermined* (395 species, 28%), while only 17% are ranked *Secure* (238 species, Figures 2-6-i, 2-6-ii, Table 2-6-i). However, all of the species ranked *Not Assessed* and most the species ranked *Undetermined* (391 species) are marine species (Table 2-6-ii). These species generally have a large part of their range in the Arctic Ocean, where little data are available on distribution, population size or threats, or are species commonly found in deep-water, which is not adequately covered by current research programs.

It is important to note that when marine species occur in multiple ocean regions, the Canada rank is often based on the ocean region where its status is best understood. For example, the Pacific Sand Lance (*Ammodytes hexapterus*), occurs in the Pacific Ocean Region (*Secure*), the Western Arctic Ocean Region (*Not Assessed*) and the Eastern Arctic Ocean Region (*Not Assessed*). The Canada rank for this species is *Secure*, based on the Pacific Ocean Region rank, but it is possible that a more thorough analysis of the species' status in the Arctic may lead to a national status change in the future.

If Canada's 1178 species of marine fishes are considered separately from both the freshwater fishes, and fishes that are ranked in both freshwater and in the ocean regions, a total of 70% of

species have Canada ranks of *Undetermined* (391 species) or *Not Assessed* (434 species), reflecting how much we need to learn about marine systems (Figure 2-6-iii, Table 2-6-ii). In addition, 17% of marine fishes have Canada ranks of *Accidental* (200 species), 8% have Canada ranks of *Secure* (94 species), 3% have Canada ranks of *Sensitive* (41 species), and a total of 2% have Canada ranks of *May Be At Risk* (11 species) and *At Risk* (seven species).

The situation is quite different for freshwater fish species (Figure 2-6-iii, Table 2-6-ii). Only 2% of freshwater fishes have Canada ranks of *Undetermined* (three species), and none have Canada ranks of *Not Assessed*. The majority of freshwater species are ranked *Secure* (64%, 103 species), while 13% are ranked *Sensitive* (20 species), 10% are ranked *At Risk* (16 species) and 2% are ranked *May Be At Risk* (three species). Two freshwater fish species, Gravel Chub (*Erimystax x-punctatus*) and Paddlefish are ranked *Extirpated* and one species, Deepwater Cisco (*Coregonus johannae*) is ranked *Extinct*. All three of these species were formerly found in Ontario. Finally, 8% of freshwater fish species are ranked *Exotic* (12 species).

Fishes ranked in both freshwater and marine regions (51 species) show a similar pattern to freshwater fishes; 80% of these species have Canada ranks of *Secure* (41 species), 8% have Canada ranks of *Sensitive* (four species), 6% have ranks of *At Risk* (three species) and 4% have Canada ranks of *May Be At Risk* (two species Figure 2-6-iii, Table 2-6-ii). Only 2% have a Canada rank of *Undetermined* (one species).

Figure 2-6-i: Summary of the species richness and 2005 general status ranks of fish species in Canada. PAC = Pacific Ocean, WAO = Western Arctic Ocean, EAO = Eastern Arctic Ocean and ATL = Atlantic Ocean.

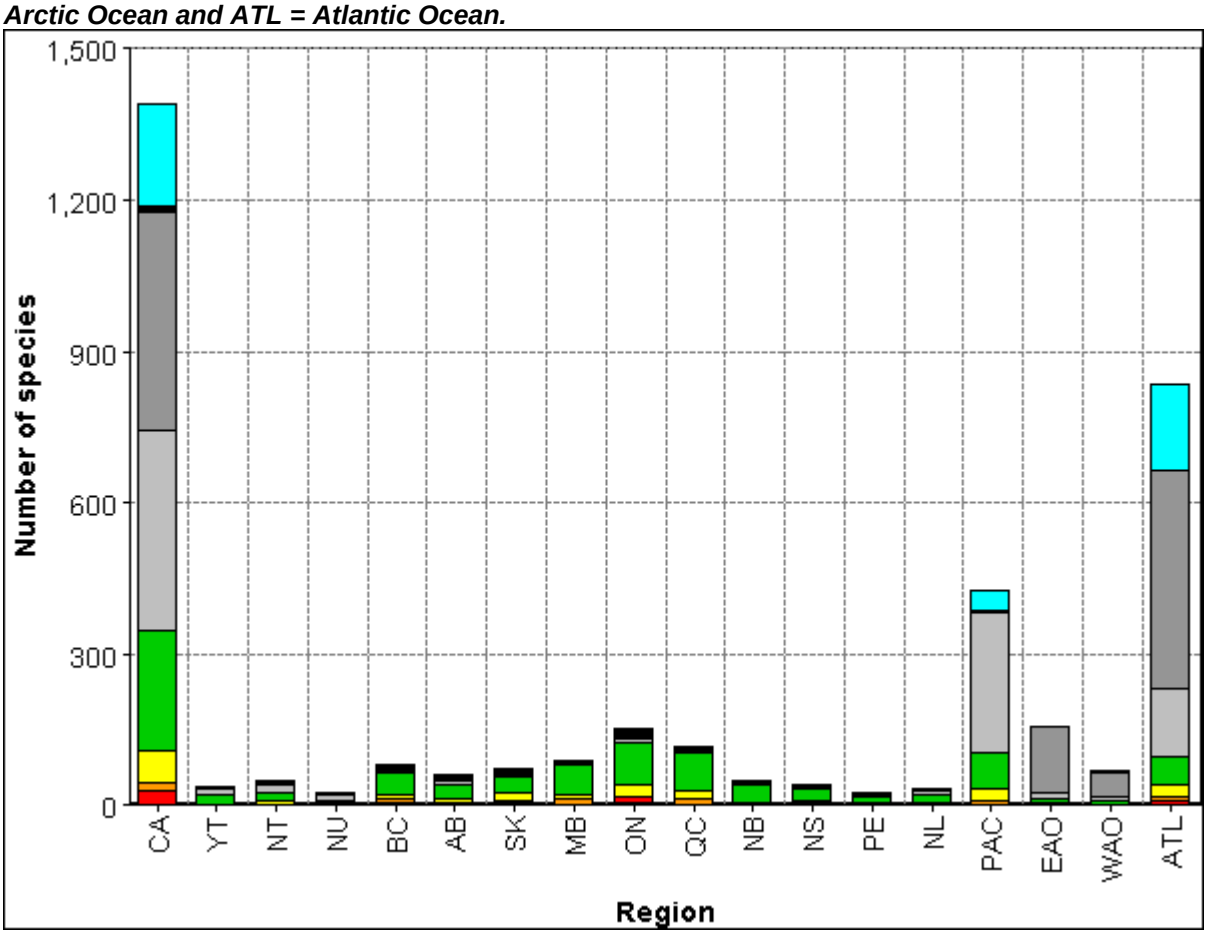
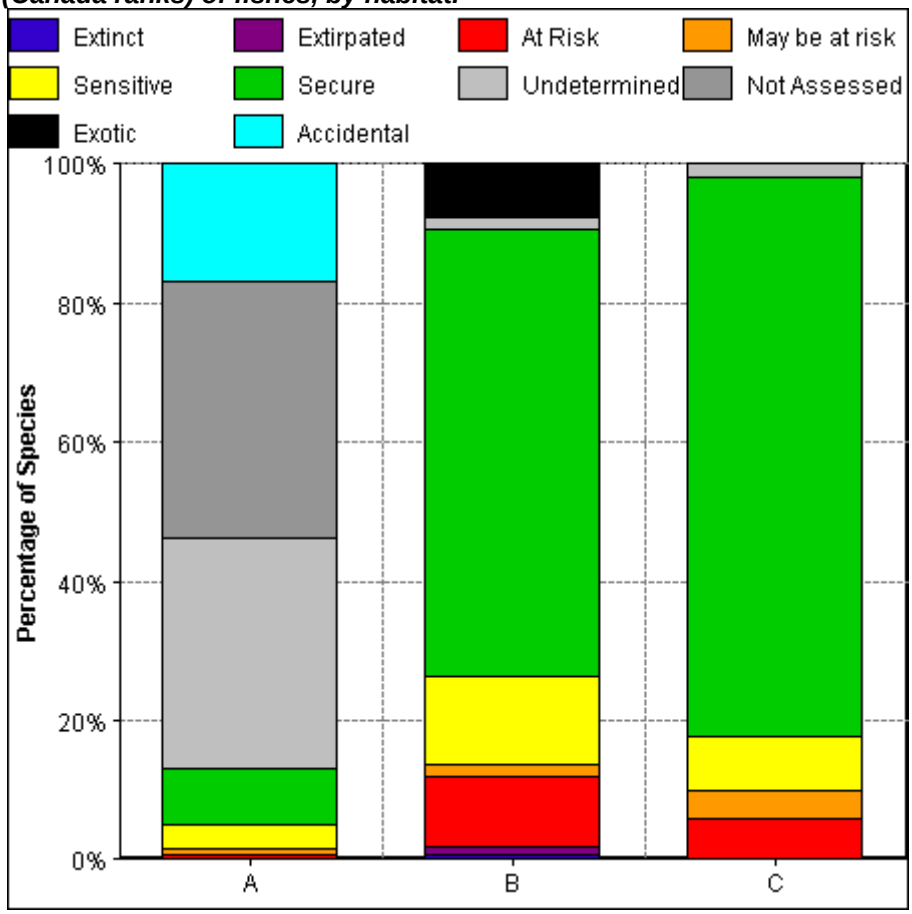


Table 2-6-i: Summary of the 2005 general status ranks of fishes in Canada. PAC = Pacific Ocean, WAO = Western Arctic Ocean, EAO = Eastern Arctic Ocean and ATL = Atlantic Ocean.

	CA	YT	NT	NU	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	PAC	EAO	WAO	ATL
Extirpated	2	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0
Extinct	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
At risk	26	0	1	0	4	5	6	3	10	1	1	2	1	0	2	2	1	8
May be at risk	16	0	1	0	10	2	4	9	3	11	0	3	2	0	7	0	0	11
Sensitive	65	3	9	4	7	7	15	8	21	15	5	5	2	4	23	4	1	24
Secure	238	18	13	7	43	26	32	60	86	76	37	23	12	18	75	6	9	55
Undetermined	395	12	18	11	3	11	0	1	7	1	1	1	1	6	275	13	6	135
Not assessed	434	1	2	2	0	1	0	1	1	1	1	1	1	1	3	130	50	430
Exotic	12	2	0	0	14	9	17	9	20	10	6	7	5	2	0	0	0	0
Accidental	200	0	5	0	0	0	1	0	0	1	0	0	3	1	40	0	4	172
Total	1389	36	49	24	81	61	75	91	154	117	51	42	27	32	425	155	71	835

Figure 2-6-iii: Comparison of the 2005 Canada General Status Ranks (Canada ranks) of fishes, by habitat.



A = marine species, ranked only in ocean regions
B = freshwater species, ranked only in provinces/territories
C = species ranked in both ocean regions and provinces and territories

Table 2-6-ii: Comparison of the 2005 Canada General Status Ranks (Canada ranks) of fishes in Canada, by habitat.

Canada Rank	marine species, ranked only in ocean regions	freshwater species, ranked only in provinces/territories	species ranked in both ocean regions and provinces and territories
Extinct	0	1	0
Extirpated	0	2	0
At Risk	7	16	3
May be at risk	11	3	2
Sensitive	41	20	4
Secure	94	103	41
Undetermined	391	3	1
Not Assessed	434	0	0
Exotic	0	12	0
Accidental	200	0	0
Total	**1178**	**160**	**51**

Comparison with 2002 ranks

Freshwater fishes were first ranked at the provincial and territorial level, in *Wild Species 2000*. However, at that time, Canada ranks were not completed. In 2002, the National General Status Working Group completed the Canada ranks for the 232 freshwater fishes listed in Canada, based solely on the provincial and territorial ranks published in *Wild Species 2000*.

Since 2002, 26 species have been removed from the list of Canadian freshwater fish species, due to new publications that have clarified the taxonomy and distribution of North American fishes. This leaves a total of 206 species that were ranked both in 2002 and 2005. In 2000 and 2002, fishes were ranked solely on the basis of their occurrence and status in freshwater. However, many of these species occur both in freshwater and in marine habitats. Therefore, 49 species that were originally ranked only in the provinces and territories now have ocean region ranks as well. The Canada ranks for the majority of these species (84%) have not changed since 2002. Of the eight species whose Canada rank has changed (16%), five were procedural changes[1] and three changes were due to new COSEWIC assessments.

Of the remaining 157 species, that were ranked only in freshwater in both 2002 and 2005, 22 species have been given a different Canada rank in 2005 (14%). Ten of these changes were procedural changes[1] (45%), six were due to new COSEWIC assessments (27%), two were due to improved information about the species (9%), two were due to a combination of procedural changes and new information (9%), one was due to a combination of new/improved information and biological change (5%), and one was due to biological change (5%).

In total, 30 changes were made to Canada ranks of fishes, of which eight resulted in an increased level of risk and 13 resulted in a reduced level of risk (Table 2-6-iii). The remaining nine changes moved species out of the *Undetermined*, *Not Assessed*, *Accidental* or *Extirpated/Extinct* categories. Changes in the Canada ranks have lead to an increase in the proportion of species ranked *Secure* (Table 2-6-iv).

***Table 2-6-iii: Species summary of Canada General Status Rank (Canada rank) changes between 2002 and* Wild Species 2005.**

2005 Canada rank	2002 Canada rank	English name	Scientific name	Reason for change [a]
At Risk	*Extirpated/Extinct*	Shortnose Cisco	*Coregonus reighardi*	C
At Risk	*May be at risk*	Redside Dace	*Clinostomus elongatus*	I/B
At Risk	*May be at risk*	White Sturgeon	*Acipenser transmontanus*	C
At Risk	*May be at risk*	Striped Bass	*Morone saxatilis*	C
At Risk	*May be at risk*	Western Silvery Minnow	*Hybognathus argyritis*	C
At Risk	*May be at risk*	Speckled Dace	*Rhinichthys osculus*	C
May be at risk	*Undetermined*	Blackfin Cisco	*Coregonus nigripinnis*	I
May be at risk	*Undetermined*	Margined Madtom	*Noturus insignis*	P
Sensitive	*At Risk*	Kiyi	*Coregonus kiyi*	C
Sensitive	*May be at risk*	Atlantic Sturgeon	*Acipenser oxyrinchus*	P
Sensitive	*May be at risk*	Silver Lamprey	*Ichthyomyzon unicuspis*	P
Sensitive	*Secure*	American Brook Lamprey	*Lampetra appendix*	B
Sensitive	*Secure*	Chain Pickerel	*Esox niger*	P
Sensitive	*Secure*	Ghost Shiner	*Notropis buchanani*	P
Sensitive	*Undetermined*	Bering Cisco	*Coregonus laurettae*	C
Secure	*Sensitive*	Chiselmouth	*Acrocheilus alutaceus*	C
Secure	*Sensitive*	Bigmouth Shiner	*Notropis dorsalis*	C
Secure	*Sensitive*	Dolly Varden	*Salvelinus malma*	P
Secure	*Sensitive*	Greenside Darter	*Etheostoma blennioides*	P
Secure	*Sensitive*	Redbreast Sunfish	*Lepomis auritus*	P
Secure	*Sensitive*	Arctic Grayling	*Thymallus arcticus*	P
Secure	*Sensitive*	Bloater	*Coregonus hoyi*	P
Secure	*Sensitive*	Fourhorn Sculpin	*Myoxocephalus quadricornis*	P
Secure	*Sensitive*	Atlantic Salmon	*Salmo salar*	P
Secure	*Sensitive*	Bigmouth Buffalo	*Ictiobus cyprinellus*	P
Secure	*Undetermined*	Deepwater Sculpin	*Myoxocephalus thompsonii*	I
Secure	*Undetermined*	Pygmy Whitefish	*Prosopium coulterii*	P
Secure	*Undetermined*	Arctic Lamprey	*Lampetra camtschatica*	P
Secure	*Not Assessed*	Redfin Pickerel	*Esox americanus*	P/I
Undetermined	*Accidental*	Flathead Catfish	*Pylodictis olivaris*	P

[a] C: change due to new COSEWIC assessment.
B: change due to biological change in species' population size, distribution or threats.
I: change due to improved knowledge of the species.
P: change due to procedural change.

***Table 2-6-iv: Comparison of the Canada General Status Ranks (Canada ranks) of fish species found in freshwater 2002 and* Wild Species 2005.**

Canada rank	Number and percentage of species in each rank in 2002	Number and percentage of species in each rank in *Wild Species 2005*	Summary of change	Reasons for change
0	7 (3%)	-- a		COSEWIC assessment [c]
Extinct	-- a	1 (<1%)		Taxonomy [b]
Extirpated	-- a	2 (1%)		Taxonomy [b]
At Risk	22 (9%)	18 (9%)	↓	Taxonomy [b], COSEWIC assessment [c], Biological change [d]
May be at risk	10 (4%)	5 (2%)	↓	COSEWIC assessment [c], Process [e], Improved knowledge [f], Combination of improved knowledge and biological change [g], Combination of improved knowledge and biological change [h]
Sensitive	30 (13%)	23 (11%)	↓	Taxonomy [b], Process [e], COSEWIC assessment [c], Biological change [d], Combination of process and improved knowledge [h]
Secure	131 (56%)	142 (69%)	↑	Taxonomy [b], Secure [e], COSEWIC assessment [c], Improved knowledge [f], New species [g], Combination of process and improved knowledge [h]
Undetermined	10 (4%)	3 (1%)	↓	*Taxonomy [b], Process [e], New species [g]*
Not Assessed	1 (<1%)	0	↓	Undetermined
Exotic	20 (9%)	12 (6%)	↓	Taxonomy [b], Improved knowledge [f]
Accidental	1 (<1%)	0	↓	Process [e]

Key to symbols:

↑ Number of species in this category has increased.

↓ Number of species in this category has decreased.

↔ An equal number of species have been added and removed from this category; no net change.

= No species have been added or removed from this category.

[a] *The single category of Extinct/Extirpated in Wild Species 2000, was replaced with two separate categories in 2005; Extinct and Extirpated. See the Background section for details.*
[b] *A taxonomical change has lead to the addition or removal of a species from the national list.*
[c] *A formal COSEWIC assessment has been conducted, and used as evidence for a change in rank. A biological change (i.e. a change in species population, distribution or threats) since 2000 is not suggested.*
[d] *A biological change in species' population size, distribution, threats or trends has lead to a change in rank.*
[e] *A different process has been used for assigning ranks, leading to a change in the Canada rank.*
[f] *New information has been collected or brought to light, and used as evidence for a change in rank. A biological change (i.e. a change in species population, distribution or threats) since 2000 is not suggested.*

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[1]For all groups covered in this report, national ranks are generally given based on the regional rank with the lowest level of risk. For example if the provincial and territorial ranks for a species are a mixture of Sensitive and Secure, the default Canada rank is Secure (see main background section for more details and some exceptions to this generalisation) This rule-of-thumb was not closely followed when Canada ranks for freshwater fishes were finalized in 2002. Therefore, many of the Canada rank changes for freshwater fishes are due primarily to the different procedures followed in 2002 and 2005 and are therefore classified as procedural changes. These changes help to ensure that Canada ranks are comparable both within and among taxa.

Threats to Canadian fishes

Some major threats to fish populations include overfishing, pollution, and climate change. In addition, interactions between wild and farmed species, such as competition for food and habitat, interbreeding and introduction of disease and parasites, continue to be cause for concern.

Habitat degradation and destruction are important threats to many fishes. Most fishes use several different habitats during their life cycle, and the loss of any one of those habitats can lead to population declines. Habitat loss, such as wetland drainage, is often a very obvious cause of fish population declines. Habitat degradation, through channelization, damming, siltation, alteration of habitat structure by removal of debris and vegetation, alteration of substrate or ocean floor, or water withdrawal for human use, is often less obvious, but nonetheless an important factor leading to declines in fish populations.

Exotic fishes can have a negative impact on native species and ecosystems through competition, predation, parasitism, introduction of novel diseases or parasites, habitat alterations and hybridization, which can change the genetic structure of native populations. *Exotic* fishes have been causing problems in Canada for many years. For example, the Sea Lamprey (*Petromyzon marinus*), which has been an important factor in massive declines in the abundance and diversity of fishes in the Great Lakes, was first found in Lake Erie in 1921. Introductions of*Exotic* fishes happen in several different ways including deliberate introductions, usually for the purpose of improving commercial or sport-fishing, release or escape of captive fishes from aquariums and fish farms, and the spread of fish populations along new waterways.*Exotic* fishes have been directly linked to the extinction of at least one species in Canada; the Deepwater Cisco. Attempts to control or eradicate *Exotic* species are very expensive. For example, Canada and the United States spend millions of dollars a year, to attempt to control Sea Lamprey populations in the Great Lakes region.

One of the most important threats to marine fishes is overfishing. In some areas, recent research suggests that commercial exploitation has brought populations of marine fishes to historically low levels, and may be preventing populations from recovering. Both target species, and non-target species, whose capture is incidental to the commercial fishing operation (by-catch) are impacted by overfishing. In addition, some methods of fishing can impact the population structure and composition of species caught, by selectively catching certain species or age-classes.

The threats discussed so far are immediate and relatively easy to measure and study. However, climate change may prove the greatest overall threat to Canadian fishes. The effects of climate change are difficult to measure or to predict, because it often acts indirectly, through changes in habitat or food supply. Climate change may also increase the negative impact of other threats (e.g. by creating suitable conditions for invasion of *Exotic* species). Nevertheless, climate change has the potential to greatly alter the diversity and abundance of Canada's native fishes, particularly in the Arctic, where its impact will be greatest.

Conclusion

The results of this status assessment clearly show that our knowledge of Canada's freshwater fishes far exceeds our knowledge of Canada's marine fishes, due to the difficulties of monitoring fish populations at sea, particularly in the Arctic Ocean. This makes it difficult to draw conclusions about the overall status of marine fishes. Hopefully this status assessment will raise awareness of the need to conduct more research on Arctic marine fishes, as this area may be strongly affected by climate change.

The updated freshwater fishes ranks suggest that the status of freshwater fish has not changed markedly since 2000, although the proportion of fishes ranked *Secure* has increased slightly. It should be noted that most of the changes were due to procedural changes and new COSEWIC status assessments.

Further information

Bigelow, H. B. and Schroeder, W. C. 1953. Fishes of the Gulf of Maine. Fishery Bulletin 74. Fishery Bulletin of the Fish and Wildlife Service, Volume 53, No. 592. http://www.gma.org/fogm/ (Accessed December 14, 2005).

Bond, C. E. 1979. Biology of fishes. W. B. Saunders Co., Philadelphia. 514 pp

Cannings, S. G. and Ptolemy, J. 1998. Rare freshwater fish of British Columbia. BC Environment, Victoria. 214 pp

Coad, B. W. with Waszczuk, H. and Labignan, I. 1995. Encyclopedia of Canadian fishes. Canadian Museum of Nature, Ottawa and Canadian Sportfishing Productions, Waterdown, Ontario. 928 pp

Census of marine life. http://www.coml.org/ (Accessed December 15, 2005).

Centre for marine biodiversity. http://www.marinebiodiversity.ca (Accessed December 12, 2005).

Collette, B. B. and Klein-MacPhee, G. (eds.) 2002. Bigelow and Schroeder's Fishes of the Gulf of Maine. 3rd ed. Smithsonian Institution Press, Washington, DC, 748 pp., illus.

Eakins, R. J. 2005. Ontario freshwater fishes life history database. Version 2.80. On-line database. http://www.fishdb.ca (Accessed 15 December, 2005).

Fisheries and Oceans Canada. http://www.dfo-mpo.gc.ca (Accessed October 18, 2005).

Fisheries and Oceans Canada. Can Arctic Char adapt to climate change? http://www.dfo-mpo.gc.ca/science/Story/arctic_char_e.htm (Accessed February 3, 2006).

Fisheries and Oceans Canada. 2002. Inshore rockfish biology. http://www-comm.pac.dfo-mpo.gc.ca/pages/release/bckgrnd/2002/bg007_e.htm (Accessed December 20, 2005).

Fisheries and Oceans Canada. Rockfish conservation strategy. http://www-comm.pac.dfo-mpo.gc.ca/pages/consultations/fisheriesmgmt/rockfish//default_e.htm (Accessed December 19, 2005).

Froese, R. and. Pauly, D. Editors. 2006. FishBase. http://www.fishbase.org, version (02/2006). (Accessed April 4, 2006).

Hart, J. L. 1973. Pacific fishes of Canada. Fisheries Research Board of Canada. Ottawa. 740 pp

Hart, P. J. B., and Reynolds, J. D. 2002. Handbook of fish biology and fisheries: Volume 1, Fish biology. Blackwell Science, 413 pp.

Helfman, G. S., Collette, B. B. and Facey, D. E. 1997. The diversity of fishes. Blackwell Science, 528 pp.

Herbert, P. 2002. Canada's aquatic environments. CyberNatural software. University of Guelph. http://www.aquatic.uoguelph.ca (Accessed 15 December, 2005).

Inland fishes of New Brunswick: http://www.unb.ca/fredericton/science/biology/Fish_key/fish%20welcome.htm (Accessed April 3, 2006)

Integrated Taxonomic Information System (ITIS). http://www.cbif.gc.ca/pls/itisca/taxaget?p_ifx=cbif (Accessed April 3, 2006).

Mandrak, N. E. and Crossman, E. J. 1992. A checklist of Ontario freshwater fishes: annotated with distribution maps. Royal Ontario Museum, Toronto. 176 pp

Marine Species Registers for the North Atlantic Ocean. http://gmbis.marinebiodiversity.ca/nonNARMS/ (Accessed April 3, 2006)

MarineBio.org. http://www.marinebio.com (Accessed December 14, 2005).

Matthews, W. J. 1998. Patterns in freshwater fish ecology. Chapman and Hall, New York. 756 pp
McPhail, J.D., and C.C. Lindsey. 1970. Freshwater fishes of Northwestern Canada and Alaska. Fish. Res. Board Canada. Bulletin 173:381 pp.
Moyle, P. B. and Cech Jr., J. J. 2000. Fishes: and introduction to ichthyology, 4th ed. Prentice Hall, NJ. 612 pp

Nelson, J. S. 2006. Fishes of the World. 4th ed. John Wiley & Sons, New York. http://members.shaw.ca/fishesoftheworld/ (Accessed April 3, 2006).

Nelson, J. S., Crossman, E. J., Espinosa-Pérez, H., Findley, L. T., Gilbert, C. R., Lea, R. N. and Williams J. D. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico. American Fisheries Society, Special Publication 29, Bethesda, Maryland.

Nelson, J. S. and Paetz, M. J. 1992. The fishes of Alberta, 2nd ed. University of Alberta Press, Edmonton; University of Calgary Press, Calgary. 437 pp

Oceans and the Law of the Sea. Division for Ocean Affairs and the Law of the Sea, Office of Legal Affairs, United Nations. http://www.un.org/Depts/los/index.htm (Accessed October 20, 2005).

Pacific Ocean Shelf Tracking Project. http://www.postcoml.org (Accessed December 13, 2005).

Robins, R. C., Ray, C. and Douglass, J. 1986. Atlantic Coast fishes. New York: Houghton Mifflin Company. 354 pp

Saskatchewan fish: http://www.usask.ca/biology/skabugs/fishsk/fish.htm (Accessed April 3, 2006)

Scott, W. B. and Crossman, E. J. 1973. Freshwater fishes of Canada. Bull. Fish. Res. Board Can. 184. 966 pp

Scott, W.B. and M.G. Scott. 1988. Atlantic Fishes of Canada. Can. Bull. Fish. Aquat. Sci. 219: 731

Sebastes.org. http://www.sebastes.org/index.html (Accessed December 21, 2005).

Sierra Club of Canada - BC Chapter. State of the Strait backgrounder. http://sierraclub.ca/bc/aa-bc_upload/fd5c29a62a2f2c66bdb73ed43cec4361/stateofthestrait_backgrounder.pdf (Accessed December 18, 2005).

Stewart, K. and Watkinson, D. 2004. The freshwater fishes of Manitoba. University of Manitoba Press. 276 pp

Wootton, R. J. 1990. Ecology of teleost fishes. Chapman and Hall, London. 404 pp

References

Barber, K. Ed. 1998. The Canadian Oxford dictionary. Oxford University Press. Toronto, Oxford, New York. 1707 pp

Coad, B. W. and Reist, J. D. 2004. Annotated list of the Arctic marine fishes of Canada. Can. MS Rep. Fish. Aquat. Sci. 2674: iv + 112 p

COSEWIC 2002. COSEWIC assessment and status report on the Bocaccio Sebastes paucispinis in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 43 pp

Fisheries and Oceans Canada - Pacific region. Canada's Ocean Act. http://www.pac.dfo-mpo.gc.ca/oceans/OceansAct/OAPart1_e.htm (Accessed October 20, 2005).

Shelton, P. A., Sinclair, A. F., Chouinard, G. A., Mohn, R., and Duplisea, D. E. 2006. Fishing under low productivity conditions is further delaying recovery of Northwest Atlantic cod (Gadus morhua). Canadian Journal of Fisheries and Aquatic Science 63: 235-238

Amphibians

©Parks Canada, 1984: Spotted Salamander (*Ambystoma maculatum*)

Amphibia - The class of vertebrate chordates that contains the frogs, toads, newts and salamanders. The amphibians evolved in the Devonian period (about 370 million years ago) as the first vertebrates to occupy the land, and many of their characteristics are adaptations to terrestrial life. - Oxford Dictionary of Biology.

Quick facts

- There are roughly 5700 species of amphibians worldwide, 46 of which are found in Canada.
- More than two-thirds (65%) of amphibian species have Canada General Status Ranks (Canada ranks) of *Secure*, but 20% have Canada ranks of *At Risk* and 15% have Canada ranks of *Sensitive*. No amphibians have Canada ranks of *May Be At Risk* since all the species ranked *May Be At Risk* in *Wild Species 2000* have since been the subject of detailed status assessments by the Committee on the Status of Wildlife in Canada (COSEWIC).
- Since *Wild Species 2000*, the Rocky Mountain Tailed Frog has been declared a separate species from the Coast Tailed Frog, increasing the total number of amphibian species in Canada to 46.
- Compared to *Wild Species 2000*, the Canada ranks of 77% of amphibian species remain the same, 11% of amphibian species have been moved to a Canada rank with an increased level of risk, and 11% of amphibian species have been moved to a Canada rank with a reduced level of risk. Most of the changes were due to COSEWIC assessments (80%). None of the changes were due to biological changes in species abundance, distribution or threats.
- On a global scale, many amphibian species are at a high level of risk of extinction; the recent Global Amphibian Assessment ranked nearly one-third (32%) of the world's amphibians as Threatened, compared with 23% of all mammal species and 12% of all bird species.
- The Wood Frog has the most northerly distribution of any North American amphibian, and is the only North American amphibian found north of the Arctic Circle.

Background

Canadian amphibians include frogs, toads, newts and salamanders. These cold-blooded vertebrates can be recognized by their soft, moist skin, without scales, feathers or fur. Many amphibians spend the first part of their life cycle as aquatic, gill-breathing larvae (also known as tadpoles) before they metamorphose into terrestrial, air-breathing adults. This dual life cycle allowed ancestral amphibians to be the first vertebrates to inhabit dry land more than 300 million years ago, giving rise to the modern amphibians, reptiles, birds and mammals.

Many people are familiar with the typical life cycle of frogs and toads, in which an aquatic larva with gills metamorphoses into a terrestrial air-breathing adult. However, in the process of adapting to a wide range of habitats, amphibians have developed a variety of different life cycles, ranging from completely aquatic (e.g. Mudpuppy, *Necturus maculosus*), to completely terrestrial. For example, the Northern Red-backed Salamander (*Plethodon cinereus*) lays its eggs on land and guards them until they hatch into juveniles, which look and behave much like the adults. Newts, such as the Roughskin Newt (*Taricha granulosa*) of British Columbia, have an additional stage in their life cycle, known as the eft. Aquatic larvae with gills metamorphose into terrestrial air-breathing efts, which live up to four years in moist terrestrial habitats. Efts must then metamorphose into amphibious adults to breed and complete the life cycle. The amazing diversity of life cycles displayed by amphibians is not matched in any other group of vertebrates.

Unlike reptiles, birds and mammals, adult amphibians do not have waterproof skin. This is advantageous for amphibians because it allows them to breathe through their skin as well as through their lungs, but it makes amphibians prone to dehydration. So how do amphibians survive on dry land? Many amphibians have special skin on their underside through which they can absorb moisture. This allows them to re-hydrate simply by sitting on moist soil or in a small puddle. To reduce water loss, many amphibians are nocturnal. During the day they remain under

logs and rocks. At night, when the air is cooler and less evaporation occurs, they emerge to hunt for food or mates. These physical and behavioural adaptations allow amphibians to survive away from the water, where they can take advantage of many different habitats and food sources.

Like reptiles, amphibians are cold-blooded (ectothermic), meaning they rely on external heat sources (like the sun) to warm their body, rather than producing heat from food energy, like birds and mammals. However, amphibians can survive much further north than reptiles. The distribution of amphibians in northern habitats is largely related to winter temperature and the ability of individual species to tolerate cold. The champion of cold-tolerant amphibians is the Wood Frog (*Rana sylvatica*), the only North American amphibian or reptile found north of the Arctic Circle. Wood Frogs survive cold temperatures by hibernating frozen underground for several months of the year. Normally cells rupture and die when they are frozen, but Wood Frogs produce a special 'anti-freeze' chemical called a cryoprotectant that protects their cells when frozen solid! Cryoprotectants are of great interest to scientists, who have studied Wood Frogs to develop new methods of freezing mammalian organs, so they can be stored before transplantation.

Status of knowledge

People have been studying amphibians for centuries, so the basic biology, physiology and developmental biology of many species, particularly the frogs, is well known. The natural history of most amphibians in Canada is also generally well understood, but the distribution, population size and population structure of amphibians in some regions is not well known. This is partly due to the difficulties in monitoring amphibians which can include their nocturnal and secretive behaviours, their small size and their cryptic appearance. Initiatives such as 'Frogwatch', a program that uses volunteers to monitor amphibian populations across the country, are providing data which will increase our understanding of amphibian distributions, and provide baseline data to monitor population changes.

Genetic tools are becoming increasingly important in amphibian research. For example, in 1997, genetic analysis was used to distinguish the Oregon Spotted Frog (*Rana pretiosa*) as a separate species from the Columbia Spotted Frog (*Rana luteiventris*). Genetic tools have also been used to study Bullfrog (*Rana catesbeiana*) dispersal in Ontario, the impact of clear-cutting on the Coastal Giant Salamander (*Dicamptodon tenebrosus*) in British Columbia and the evolution of new species of salamanders (speciation) in the Rocky Mountains.

In recent years, the impacts of environmental contaminants on the growth and development of amphibians has been studied across Canada. Chemicals and fertilizers, which collect in some aquatic habitats used by amphibians, can cause a range of negative effects including deformities, reduced immune system activity, abnormal behaviours and, in extreme cases, death. However, it is difficult to link these impacts with population declines.

Richness and diversity in Canada

Canada has 46 species of amphibians including one mudpuppy, two newts, seven toads, 18 frogs and 18 salamanders. The most species rich provinces are Ontario (25 species), British Columbia (22 species) and Quebec (21 species) (Figure 2-7-i, Table 2-7-i). British Columbia has the most species found nowhere else in Canada (13 species). All the amphibian species found in Canada are also found in the USA, but several species including the Canadian Toad (*Bufo hemiophrys*) and the Mink Frog (*Rana septentrionalis*), have the majority of their range in Canada.

Species spotlight - Northern Leopard Frog

Northern Leopard Frogs, *Rana pipiens*, (Canada General Status Rank (Canada rank): *Secure*) are found in every province and territory except the Yukon. This medium-sized frog breeds in shallow, warm ponds and produces egg masses of 600 to 7000 eggs. Eggs hatch into tadpoles, which graze on algae for about 9 to 12 weeks, until they are ready to metamorphose into adults. Adults spend the summer feeding away from the water, but return to deep, well-oxygenated water to hibernate.

Northern Leopard Frogs were once common throughout their Canadian range, but during the late 1970s they underwent rapid, widespread population declines in British Columbia, Alberta, Saskatchewan, and Manitoba. In fact, Northern Leopard Frogs had virtually disappeared from

Manitoba by 1976 and from Alberta by 1979. Lack of monitoring before this period makes population trends difficult to interpret, and scientists are still uncertain of the reason for the declines. Since the 1980s, Northern Leopard Frog populations in Alberta and Saskatchewan have been recovering slowly, whereas Manitoba's populations have recovered relatively quickly. In British Columbia, populations have not substantially recovered and are now restricted to a single Wildlife Management Area.

The story of the Northern Leopard Frog demonstrates that even widespread, numerous species are vulnerable to catastrophic population declines and local extirpation. Scientists are now focussing on captive breeding and release in Alberta and British Columbia and population monitoring in Alberta and Saskatchewan to attempt to restore this species to its former range and to improve our knowledge of the Northern Leopard Frog.

Species spotlight - Oregon Spotted Frog

The Oregon Spotted Frog, span class='italic'>Rana pretiosa, was described as a distinct species, separate from the Columbia Spotted Frog, in 1997. In the same year, the Oregon Spotted Frog was the first species to be given an emergency listing of Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). This small frog was once distributed from southwest British Columbia to northwest California, but is now restricted to small, isolated populations and is estimated to have been lost from more than 90% of its historic range. Population declines and range reduction have been linked to habitat loss, changes in hydrology, introduction of exotic predators and vegetation, and isolation of remaining populations. In addition, they are vulnerable to pollution and climate change. Now known from only three populations in southwest British Columbia and less than 30 populations in the United States, this species has a Canada rank of *At Risk*, and an IUCN Red List rank of Vulnerable, meaning it is considered vulnerable to extinction on a global scale.

Since the emergency designation by COSEWIC, work has begun on a recovery plan for the Oregon Spotted Frog with the co-operation of government agencies, universities, local native groups and the public. Captive breeding, habitat mapping and habitat remediation have already begun. Although the three small remaining Canadian populations are isolated from each other and from populations in the United States, the development of the recovery plan and the co-operation between different agencies and groups gives hope that this species can be preserved into the future.

Species spotlight - Western Toad

The Western Toad, *Bufo boreas*, is the only toad found in the Yukon, and it is also found in the Northwest Territories, British Columbia and Alberta. This large toad breeds in the shallow margins of ponds, streams and lakes. Females can produce clutches of up to 15 000 eggs, but may breed only once in their lifetime. Adult toads frequently wander long distances from water and are usually nocturnal, especially at low elevations. In the winter, Western Toads hibernate in animal burrows or under loose debris. Adult Western Toads are carnivorous and eat a wide range of invertebrates including earthworms, beetles, spiders and ants. Despite their ability to release a mild poison, Western Toads are preyed on by reptiles, mammals and birds.

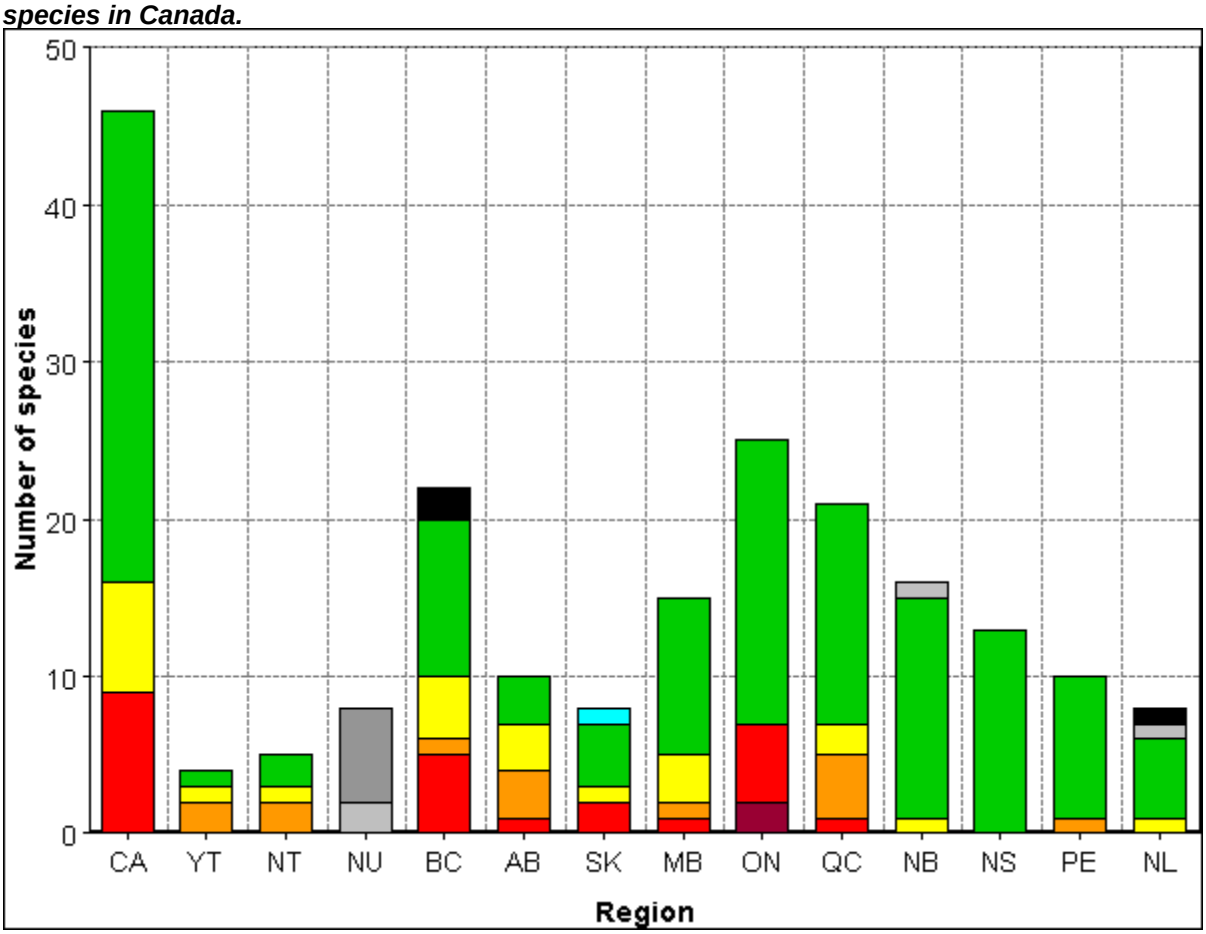
Due to a COSEWIC status assessment (Special Concern, 2002), the Canada rank of the Western Toad has changed from *Secure* in *Wild Species 2000* to *Sensitive* in this report. The COSEWIC status assessment found that populations within the Georgia Basin of south-costal British Columbia are of special concern, due to evidence of population declines and at least one example of a local extirpation. The rest of the Canadian population was considered 'likely not at risk'. Canadian populations of Western Toads are not only a unique component of the fauna of western Canada, they are also important to the global survival of this species, due to declining populations in the United States. Careful monitoring and research are needed to help maintain healthy Canadian populations of Western Toads.

Results of general status assessment

Of the 46 species of amphibians found in Canada, nine species have Canada ranks of *At Risk* (20% of all species), including two toads, three frogs, and four salamanders (Figures 2-7-i and 2-7-ii, Table 2-7-i). Within Canada, all nine species with Canada ranks of *At Risk* have fairly restricted ranges; none are found in the territories or in more than one province.

Seven species of amphibian have Canada ranks of *Sensitive* (15%) and 30 species have Canada ranks of *Secure* (65%). Canada has no *Exotic* or *Accidental* amphibian species and no species have Canada ranks of *May Be At Risk*, *Undetermined* or *Not Assessed*.

Figure 2-7-i: Summary of the species richness and 2005 general status ranks of amphibian species in Canada.



Percentage

Table 2-7-i: Summary of the 2005 general status ranks of amphibians in Canada.

	CA	YT	NT	NU	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL
Extirpated	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Extinct	0	0	0	0	0	0	0	0	0	0	0	0	0	0
At risk	9	0	0	0	5	1	2	1	5	1	0	0	0	0
May be at risk	0	2	2	0	1	3	0	1	0	4	0	0	1	0
Sensitive	7	1	1	0	4	3	1	3	0	2	1	0	0	1
Secure	30	1	2	0	10	3	4	10	18	14	14	13	9	5
Undetermined	0	0	0	2	0	0	0	0	0	0	1	0	0	1
Not assessed	0	0	0	6	0	0	0	0	0	0	0	0	0	0
Exotic	0	0	0	0	2	0	0	0	0	0	0	0	0	1
Accidental	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Total	46	4	5	8	22	10	8	15	25	21	16	13	10	8

Table 2-7-ii: Comparison of the Canada General Status Ranks (Canada ranks) of amphibian species in* Wild Species 2000 *and* Wild Species 2005*.

Canada rank		Number and percentage of species in each in Wild Species 2000	Number and percentage of species in each rank in *Wild Species 2005*	Summary of change	Reason(s) for change(s)
0	0	0	--[a]		
0.2	Extinct	--[a]	0		
0.1	Extirpated	--[a]	0		
1	At Risk	4 (9%)	9 (20%)	↑	COSEWIC assessment[b], Change in taxonomy[c]
2	May be at risk	6 (13%)	0	↓	COSEWIC assessment[b], Improved knowledge[d]
3	Sensitive	6 (13%)	7 (15%)	↑	COSEWIC assessment[b], Improved knowledge[d], Change in taxonomy[c]
4	Secure	29 (64%)	30 (65%)	↑	COSEWIC assessment[b], Improved knowledge[d], Error[e]
5	Undetermined	0	0	=	
6	Not Assessed	0	0	=	
7	Exotic	0	0	=	
8	Accidental	0	0	=	

Key to symbols:		
	↑	Number of species in this category has increased.
	↓	Number of species in this category has decreased.
	↔	An equal number of species have been added and removed from this category; no net change.
	=	No species have been added or removed from this category.

[a] The single category of Extinct/extirpated in Wild Species 2000, was replaced with two separate categories in 2005; Extinct and Extirpated. See the Background section for details.
[b] A formal COSEWIC assessment has been conducted, and used as evidence for a change in rank. A biological change (i.e. a change in species population, distribution or threats) since 2000 is not suggested.
[c] The Rocky Mountain Tailed Frog (Ascaphus montanus), ranked At Risk was split from the Coast Tailed Frog (Ascaphus truei) after the completion of the Wild Species 2000 ranks.
[d] New information has been collected or brought to light, and used as evidence for a change in rank. A biological change (i.e. a change in species population, distribution or threats) since 2000 is not suggested.
[e] An error was detected in one of the Wild Species 2000 ranks, after its publication; the national rank of Canadian Toad was reported as Sensitive - the correct rank was Secure.

***Table 2-7-iii: Summary of Canada General Status Rank (Canada rank) changes, for individual amphibian species, between* Wild Species 2000 *and* Wild Species 2005.**

2005 Canada rank	2000 Canada rank	English name	Scientific name	Reason for change [a]
At Risk	May be at risk	Allegheny Mountain Dusky Salamander	Desmognathus ochrophaeus	C
At Risk	May be at risk	Coastal Giant Salamander	Dicamptodon tenebrosus	C
At Risk	May be at risk	Jefferson Salamander	Ambystoma jeffersonianum	C
At Risk	Sensitive	Great Basin Spadefoot	Spea intermontana	C
Sensitive	May be at risk	Great Plains Toad	Bufo cognatus	C
Sensitive	May be at risk	Spring Salamander	Gyrinophilus porphyriticus	C
Sensitive	May be at risk	Coeur d`Alene Salamander	Plethodon idahoensis	I
Sensitive	Secure	Western Toad	Bufo boreas	C
Secure	Sensitive	Plains Spadefoot	Spea bombifrons	C
Secure	Sensitive	Canadian Toad	Bufo hemiophrys	C/I/E

[a]C: change due to new COSEWIC assessment.
I: change due to improved knowledge of the species.
E: change partially due to error in the 2000 ranks.

Footnote: In Wild Species 2000, species assessment results were presented as the proportion of resident species ('resident species' excludes species with Canada ranks of Extirpated, Extinct and Accidental). In this report, we have used the more straightforward method of presenting results as a proportion of total species richness. Therefore, proportions given in the 'Results of assessment' sub-sections can not be directly compared to those given in the text of Wild Species 2000. To compare results for amphibians directly between the text of Wild Species 2000 and this report please use the following figures, which represent the 2000 results as a proportion of total species richness: Total species richness: 45 species, At Risk: 9%, May Be At Risk: 13%, Sensitive: 13%, Secure: 64%.

Comparison with Wild Species 2000

In late 2000, the Rocky Mountain Tailed Frog (*Ascaphus montanus*) was described as a separate species from the Coast Tailed Frog (*Ascaphus truei*), so there are now 46 species of amphibians in Canada, compared to 45 listed in *Wild Species 2000*. Both species are excluded from further comparisons with *Wild Species 2000*.

Since *Wild Species 2000*, the Canada ranks of 10 species (23%) have been changed (Figure 2-7-iii, Table 2-7-ii and 2-7-iii); half of the changes placed species in ranks with a higher level of risk and half placed species in ranks with a lower level of risk than their original rank. The remaining 34 species (77%) retained the Canada rank they were given in *Wild Species 2000*. The changes have led to an increase in the percentage of species with Canada ranks of *At Risk* and a reduction in the percentage of species with Canada ranks of *May Be At Risk*, while the percentage of species with Canada ranks of *Sensitive* and *Secure* has remained similar between 2000 and 2005 (Table 2-7-ii).

Changes in Canada rank were due to COSEWIC status assessments (80%), improvements in knowledge (10%) and a combination of a formal COSEWIC assessment, improvement in knowledge and an error detected in the 2000 report following its publication (10%). Most of the changes (60%) were due to reclassification of species previously ranked *May Be At Risk* to *At Risk* or *Sensitive*, reflecting improved knowledge rather than biological changes in species' population, distribution or threats since 2000 (Figure 2-7-iii, Table 2-7-iii). Therefore, the large

increase in species with Canada ranks of *At Risk* (Table 2-7-ii), does not reflect a true decline in overall amphibian status since 2000. Rather, by reclassifying species previously ranked *May Be At Risk*, the reassessment simply presents a clearer picture of the true status of amphibians in Canada.

Threats to Canadian amphibians

Global amphibian declines over the last 20 years, have spurred considerable discussion of threats to amphibians. Major threats include habitat loss and degradation, introduction of exotic species, over-harvesting (for commercial and recreational use), increases in UV radiation, pollution, disease and climate change. In addition, road mortality is also a threat to some amphibian populations.

Habitat loss is one of the leading threats to amphibians in Canada. In parts of southern Canada, 90% of wetlands have been drained or otherwise destroyed. Remaining wetlands within agricultural or urban landscapes may be polluted and often retain a reduced abundance and diversity of amphibians. In addition, fragmentation of remaining habitat can reduce or prevent the movement of individuals between populations, leading to reduced population stability and reduced flow of genes between populations.

Fungal and viral diseases have been implicated in some global amphibian declines, even in pristine habitats. Research is showing that disease acts on populations in combination with other stresses. For example, incidence of disease may be increased in populations stressed by other factors such as pollutants or increased UV-B radiation.

Conclusion

This reassessment of Canada's amphibians resulted in an increase in the percentage of amphibians with a Canada rank of *At Risk*, compared to *Wild Species 2000*. However, this change results not from biological changes in species abundance, distribution or threats, but largely from new COSEWIC assessments and improvements in our knowledge of Canadian amphibians. The majority of changes reclassified species from *May Be At Risk* to *At Risk* or *Sensitive*, reflecting the emphasis on improved knowledge rather than biological changes in species status. Therefore, despite the increased proportion of species with a Canada rank of *At Risk*, this report does not reflect a true, biological decline in overall amphibian status since 2000, but instead simply presents a more accurate picture of the true status of Canada's amphibians than was available in 2000.

Further information

AmphibiaWeb: Information on amphibian biology and conservation. http://amphibiaweb.org/ (Accessed September 23, 2005).

Canadian Amphibian and Reptile Conservation Network. http://www.carcnet.ca/ (Accessed February 10, 2006).

Conant, R. and Collins, J. T. 1998. A field guide to reptiles and amphibians of eastern and central North America (3rd Ed.). Houghton Mifflin Co., Boston. 616 pp

EMAN. 2004. Status of amphibian and reptile populations in Canada. http://www.eman-rese.ca/eman/reports/publications/2004/amph_rept_status/toc.html (Accessed September 23, 2005).

Frogwatch. http://www.naturewatch.ca/english/frogwatch/pe/amphib.html (Accessed September 23, 2005).

Froom, B. 1982. Amphibians of Canada. McClelland and Stewart, Toronto, Ontario. 120 pp

IUCN, Conservation International, and NatureServe. 2004. Global amphibian assessment. http://www.globalamphibians.org (Accessed 15 October 2005).

The Tree of Life. 1995. Living amphibians. http://tolweb.org/tree?group=Living_Amphibians&contgroup=Terrestrial_Vertebrates (Accessed 15 October 2005).

Stebbins, R. C. and Cohen, N. W. 1995. A natural history of amphibians. Princeton University Press, Princeton, New Jersey. 316 pp

Virtual exhibit on Canada's biodiversity: focus amphibians. http://collections.ic.gc.ca/amphibians/index.html (Accessed 15 October 2005).

References

COSEWIC. 2000. COSEWIC assessment and update status report on the northern leopard frog *Rana pipiens* (Southern Mountain and Prairie populations) in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. vi + 40 pp

COSEWIC. 2000. COSEWIC assessment and status report on the Oregon spotted frog *Rana pretiosa* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. vi + 22 pp

COSEWIC. 2002. COSEWIC assessment and status report on the western toad *Bufo boreas* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. vi + 31 pp

Fahrig, L., Pedlar, J. H., Pope, S. E., Taylor, P. D. and Wegner, J. F. 1995. Effect of road traffic on amphibian density. Biological Conservation 73(3):177-182

Green, D. M. (Ed) 1997. Amphibians in decline, Canadian studies in a global problem. Herpetological Conservation 1:1-338

Gibbons, J. W., Scott, D. E., Ryan, T. J., Buhlmann, K. A., Tuberville, T. D., Metts, B. S., Greene, J. L., Mills, T., Leiden, Y., Poppy, S. and Winne, C. T. 2000. The global decline of reptiles, déjà vu amphibians. BioScience 50(8): 653-666

Hine, R. S. and Martin, E. Eds. 2004. The dictionary of biology. Oxford University Press, Oxford, England. 698 pp

Oldham, M. J. 1996. Amphibians and reptiles. *In* Assessment of species diversity in the mixedwood plains ecozone. *Edited by* I. M. Smith, Ecological Monitoring and Assessment Network, Environment Canada. http://www.naturewatch.ca/Mixedwood/herps/herps01.html (Accessed 15 October 2005).

Ouellet, M., Bonin, J., Rodrigue, J., DesGranges, J. and Lair., S. 1997. Hindlimb deformities (ectromelia, ectrodactyly) in free-living anurans from agricultural habitats. Journal of Wildlife Diseases 33:95-104

Seburn, D. and Seburn, C. 2000. Conservation priorities for the amphibians and reptiles of Canada. World Wildlife Fund Canada and the Canadian Amphibian and Reptile Conservation Network. Toronto. 92 pp http://www.wwf.ca/NewsAndFacts/Supplemental/herpreport.pdf (Accessed 15 October 2005).

Storfer, A. 2003. Amphibian declines: future directions. Diversity and Distributions 9:151-163

Reptiles

Reptile - Any cold-blooded scaly animal of the class Reptilia including snakes, lizards, crocodiles, turtles, tortoises, etc. - The Canadian Oxford Dictionary

©Ryan M. Bolton: The Wood Turtle, *Glyptemys insculpta*

Quick facts

- There are more than 8000 species of reptiles worldwide, of which 47 species have been found in Canada. Of these, four species are found in marine habitats and 43 species are found in freshwater and terrestrial habitats.
- Of the 47 species of reptiles found in Canada, only 26% have a Canada General Status Rank (Canada rank) of *Secure* while a total of 32% are considered *At Risk* or *May Be At Risk*.
- Compared to *Wild species 2000*, the Canada rank of 13 reptile species (28%) have been altered, leading to an increase in the percentage of species ranked *At Risk* (22% in 2000 vs. 28% in 2005) and a reduction in the percentage of species with Canada ranks of *Secure* (39% in 2000 vs. 26% in 2005). However, changes were primarily due to new COSEWIC assessments (69%) and increased knowledge of the species (8%); none were due to biological changes in species abundance, distribution or threats. Therefore, changes do not represent a worsening situation for reptiles in Canada but simply, a more accurate report on the status of reptiles in Canada, than was available 2000.

Background

A total of 47 species of reptiles has been found in Canada, including 25 snakes, seven lizards, 11 freshwater turtles and four marine turtles[1]. This relatively small group is diverse, and contains species that live in habitats extending from belowground to the treetops, and from the depths of the oceans to the arid badlands. Reptiles can be most easily recognized by their dry scaly skin or, in the case of turtles, their hard, bony shell. Reptile scales are a continuous part of the skin and in some species are modified into unique forms, such as the spines and spikes of the Greater Short-horned Lizard (*Phrynosoma hernandesi*), and the nose scales that give the Eastern Hog-nosed Snake (*Heterodon platirhinos*) its name. All reptiles are cold-blooded, or ectothermic, meaning that instead of using food energy to generate body warmth (as mammals and birds do) they rely on external heat sources, such as the sun. In order to maintain a suitable internal temperature, many reptiles alternate between basking in the sun and hiding in the shade.

Reptiles are descended from amphibians, but unlike amphibians, reptiles have a waterproof skin and are not reliant on water or moist conditions for reproduction. This allowed reptiles to become the first completely terrestrial vertebrates, approximately 300 million years ago. One of the key adaptations that enabled reptiles to reproduce on dry land was the development of a complex egg with a leathery shell. The shell protects the embryo and prevents it from drying out, but is soft enough to expand as the embryo develops. Today, the majority of reptile species still lay eggs, but a few, such as the Northern Alligator Lizard (*Elgaria coerulea*), give birth to live young. This allows the mother to protect the developing young from extreme conditions of heat or cold, and from predators.

All of Canada's terrestrial and freshwater reptiles hibernate to escape the long, cold winter, but different species have unique methods of surviving hibernation. Greater Short-horned Lizards simply bury themselves a few centimetres into the ground, often on a south-facing slope to take advantage of the sun's warmth. Freshwater turtles, such as the Painted Turtle (*Chrysemys picta*) and the Blanding's Turtle (*Emydoidea blandingii*), spend their winters deep underwater, where they are protected from the worst of the cold weather. In order to survive for several months without air, these turtles suck water into and out of their mouths, where specialized tissue in the throat exchanges oxygen and carbon dioxide with the water.

Reptiles sense the world very differently from humans and some even have additional sense organs to provide extra information about their environment. For example, many snakes and lizards use their tongue to detect chemicals in the air (equivalent to our sense of smell). As a snake's tongue flickers in and out of its mouth, tiny airborne particles are collected and analysed by the Jacobson organ in the roof of the mouth. This system can be incredibly sensitive; a male Common Gartersnake

(*Thamnophis sirtalis*) can tell the size and likely productivity of a female with a single flicker of his tongue, by detecting the pheromones she releases. Pit vipers, such as the Western Rattlesnake (*Crotalus oreganus*), have heat sensors concentrated in small pits between the nostril and the eye. These can detect temperature changes of less than 0.1°C! allowing the snake to detect warm-blooded prey, even in the dark. Marine turtles undergo vast migrations each year, and have a remarkable ability to return to specific locations such as nesting beaches or feeding grounds. To accomplish this navigational feat, marine turtles probably use a range of senses including sight and an ability to sense the earth's magnetic field.

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[1]*Over the past decade there has been much scientific debate about the evolutionary relationships between turtles, lizards, snakes, crocodiles and birds leading to the suggestion that turtles should be considered in their own class, separate from the other reptiles. While some organizations have already adopted this approach, the general status program is currently taking the more conservative approach of keeping all turtles, snakes and lizards in their traditional class of Reptilia, until the scientific debate is clarified.*

Status of knowledge of Canadian reptiles

The status of knowledge of Canadian reptiles is highly variable between species. Although some reptile species have been well studied, many have not, and the distribution, population trends and life history of some Canadian reptiles remain poorly known. This is partly due to lack of baseline data and partly due to the difficulties of detecting reptiles, which are often solitary and secretive by nature. Volunteer initiatives such as Nova Scotia Herpetofaunal Atlas and the Ontario Herpetofaunal Summary Atlas are collecting valuable information about the distribution and abundance of reptiles, as well as raising public awareness of this group. To date, COSEWIC has assessed forty species, subspecies and populations of reptiles, consolidating knowledge of species that are already suspected of being at risk.

Canada is home to one of the best studied snake populations in the world, the Red-sided Gartersnakes (*Thamnophis sirtalis parietalis*) of the Narcisse Wildlife Management Area in southern Manitoba. These snakes, a subspecies of the Common Gartersnake, hibernate in communal dens, called hibernacula. In southern Manitoba good hibernacula sites are rare, so snakes crowd into the few available sites, where as many as 10 000 snakes spend the winter together. This large concentration of snakes has allowed researchers to study mating strategies, mating success, thermoregulatory behaviour and migration with relative ease.

In recent years, some Canadian reptile research has focussed on species that are known to be declining. As well as providing information on reasons for declines, these studies can provide valuable information on the life history and distribution of Canadian reptiles. For example, recent studies on the Wood Turtle (*Glyptemys insculpta*, Canada General Status Rank (Canada rank): *Sensitive*), have investigated life history and population size, impacts of agriculture on population recruitment and survival, habitat selection and genetics of isolated populations.

Most reptiles are represented in Canada by populations at the edge of the species geographic range. This offers opportunities to study factors that limit a species' range and compare peripheral populations with those in the center of a species' range. Another hot topic in Canadian reptile research is the thermal ecology of reptiles; how reptiles use different habitats to control their body temperature and the importance of this to their life history and fitness.

Richness and diversity in Canada

Terrestrial and freshwater reptiles are concentrated in southern Canada, with the highest species richness in Ontario (27 species), Quebec (19 species) and British Columbia (16 species) (Figure 2-8-i, Table 2-8-i). British Columbia has the highest number of species (nine) that have been found nowhere else in Canada. Two regions of Canada (Yukon, Newfoundland and Labrador) report no reptile species. All of Canada's reptiles are also found in the US, but several species, such as the Eastern Foxsnake (*Elaphe gloydi*) and the Northern Alligator Lizard, have a large portion of their range in Canada.

Canada's four marine turtles are all found in the Atlantic or Pacific Oceanic regions; none have been found in Arctic waters, where conditions may be too extreme for reptiles to survive (Figure 2-8-i,

Table 2-8-i).

Species Spotlight - Leatherback Seaturtle

The Leatherback Seaturtle *Dermochelys coriacea*, is the world's largest living reptile, reaching a length of 2m and a weight of up to 900kg! Leatherback Seaturtles live in the Atlantic, Pacific and Indian Oceans and nest on sandy beaches in warm tropical waters. Between breeding seasons, they migrate north and can be found off the east and west coasts of Canada in the Atlantic Ocean Region and the Pacific Ocean Region. The Leatherback Seaturtle is the only marine turtle without a hard shell. Instead its back is covered with a semi-flexible substance made of connective tissue and numerous tiny bones, allowing Leatherback Seaturtles to dive to much greater depths than other marine turtles. The favourite food of Leatherback Seaturtles is jellyfish and they have special backward pointing spines in their throat to help them swallow this slippery food. Global populations of Leatherback Seaturtles declined by approximately 70% between 1980 and 1995 and this species has a Canada rank of *At Risk*.

These amazing turtles are difficult to study because they spend very little time on land. After they have hatched the females return to shore only to lay eggs and males never return to shore, making it difficult to study the distribution or migration patterns of these turtles. However, Canadian researchers, working off the coast of Nova Scotia, have pioneered a new method for studying Leatherback Seaturtles. Turtles are captured at sea, and a small satellite transmitter is attached to their shell, before they are released. This does not harm the turtles, and allows researchers to track their movements via satellite. Adult males, adult females and juveniles have been tracked in this manner, the first time that researchers have been able to follow the movements of male or juvenile Leatherback Seaturtles. The results of the study are quite incredible; adults and juveniles completed migrations of approximately 10 000 km from the cold waters off Nova Scotia, to the Caribbean Sea and adjacent areas of the Atlantic Ocean and back again, within a 12 month period. This study, and others like it, provide us with the information necessary to help conserve these giant reptiles.

Species spotlight - Greater Short-horned Lizard

Many Canadians are surprised to learn that seven different species of lizards have been found in Canada! One of the better known Canadian lizards is the Greater Short-horned Lizard, *Phrynosoma hernandesi*. Within Canada, these lizards are patchily distributed in mixed-grass prairie habitat in south-eastern Alberta and south-western Saskatchewan, where they favour sheltered, south-facing slopes. This slow-moving lizard has many potential predators, including hawks and other birds, snakes and mammals. When approached by a predator, the lizard freezes, and relies on its cryptic colouration to escape capture. Greater Short-horned Lizards eat ants, grasshoppers and other small invertebrates, using their excellent eyesight to locate their prey.

Greater Short-horned Lizards are at the very northern edge of their range in Canada. To escape from the cold winter, they hibernate under shallow soil on south-facing slopes. During the summer, these lizards conserve energy and heat by moving slowly, and spending much of their time on south-facing slopes. In addition, the females give birth to live young, allowing the mother to keep the eggs warm and safe from predators.

Greater Short-horned Lizards are patchily distributed in Canada, and most populations are small. Distribution and population size are greatly restricted by environmental variables, and increased grazing and development threaten their habitat. Greater Short-horned Lizards have a Canada rank of *May Be At Risk*.

Results of assessment

Of Canada's 47 species of reptiles, only 26% (12 species) have a Canada rank of *Secure*, while a total of 32% have Canada ranks of *At Risk* (13 species) and *May Be At Risk* (two species, Figures 2-8-i and 2-8-ii, Table 2-8-i). A further 26% have Canada ranks of *Sensitive* (12 species), 4% have Canada ranks of *Exotic* (two species), 4% have Canada ranks of *Accidental* (two species) and 2% have Canada ranks of *Undetermined* (one species). Finally three terrestrial reptiles have Canada ranks of *Extirpated* (6%), none of which have been reported in Canada for at least 40 years.

Figure 2-8-ii: Comparison of the 2005 reptile general status ranks, across Canada. PAC = Pacific Ocean, WAO = Western Arctic Ocean, EAO = Eastern Arctic Ocean and ATL = Atlantic Ocean.

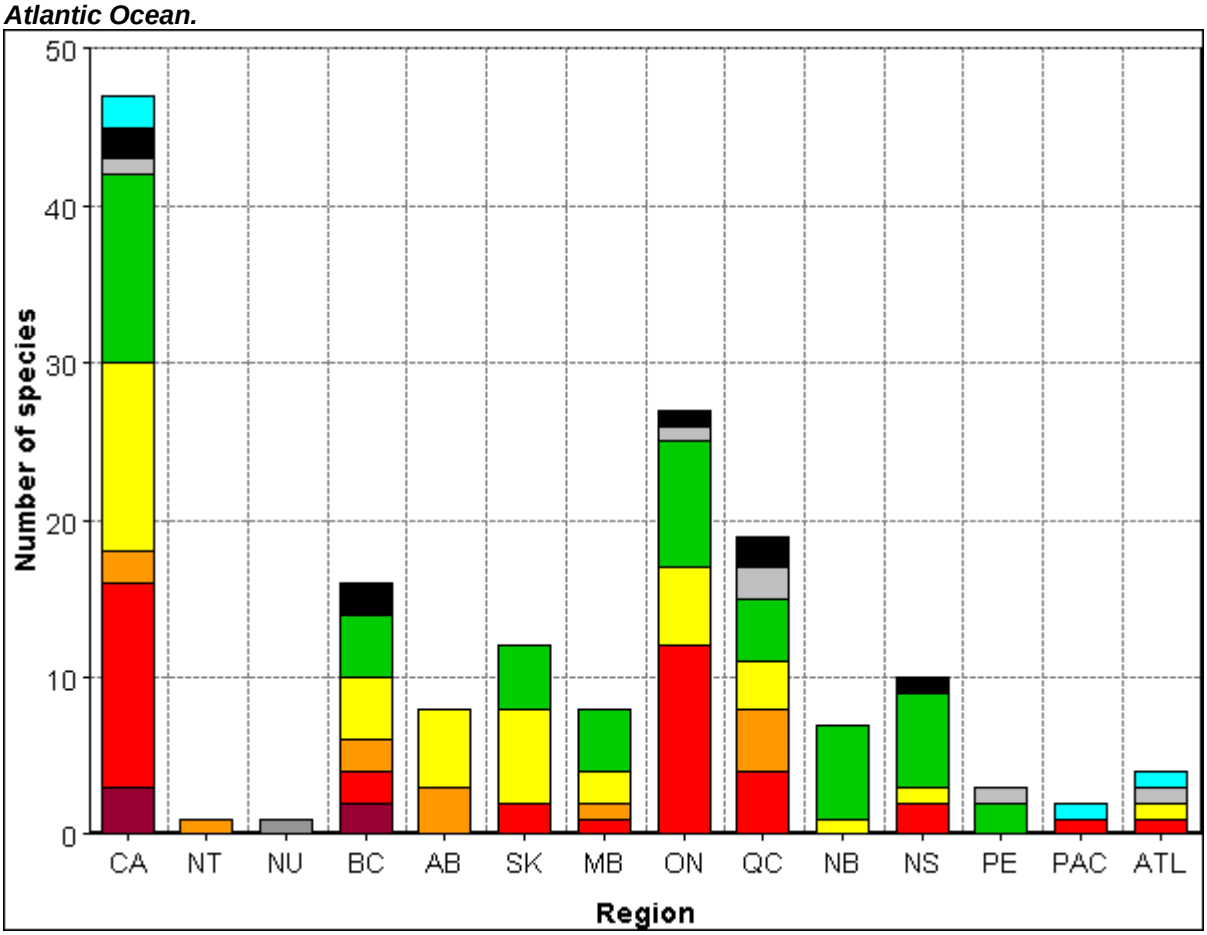

Table 2-8-i: Summary of the 2005 general status ranks of reptiles in Canada. PAC = Pacific Ocean, WAO = Western Arctic Ocean, EAO = Eastern Arctic Ocean and ATL = Atlantic Ocean.

	CA	NT	NU	BC	AB	SK	MB	ON	QC	NB	NS	PE	PAC	ATL
Extirpated	3	0	0	2	0	0	0	0	0	0	0	0	0	0
Extinct	0	0	0	0	0	0	0	0	0	0	0	0	0	0
At risk	13	0	0	2	0	2	1	12	4	0	2	0	1	1
May be at risk	2	1	0	2	3	0	1	0	4	0	0	0	0	0
Sensitive	12	0	0	4	5	6	2	5	3	1	1	0	0	1
Secure	12	0	0	4	0	4	4	8	4	6	6	2	0	0
Undetermined	1	0	0	0	0	0	0	1	2	0	0	1	0	1
Not assessed	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Exotic	2	0	0	2	0	0	0	1	2	0	1	0	0	0
Accidental	2	0	0	0	0	0	0	0	0	0	0	0	1	1
Total	47	1	1	16	8	12	8	27	19	7	10	3	2	4

Footnote: In Wild species 2000, species assessment results were presented as the proportion of resident species ('resident species' excludes species with Canada ranks of Extirpated, Extinct and Accidental). In this report, we have used the more straightforward method of presenting results as a proportion of total species richness. Therefore, proportions given in the 'Results of assessment' sub-sections cannot be directly compared to results given in the text of Wild Species

2000. To compare results for terrestrial and freshwater reptiles directly between the text of Wild Species 2000 and this report, please use the following figures, which represent the 2000 results as a proportion of total species richness: Total species richness: 46 species, Extinct/Extirpated: 0%, At Risk: 22%, May Be At Risk: 4%, Sensitive: 26%, Secure: 39%, Undetermined: 2%, Not Assessed: 0%, Exotic: 2%, Accidental: 4%.

Comparison with Wild species 2000

Since *Wild species 2000*, one species, the Pond Slider (*Trachemys scripta*, Canada rank: *Exotic*), has been added to the national species list, bringing the total number of reptile species in Canada to 47. However, the total number of native species remains unchanged at 45. The Pond Slider is considered to be established and persistent in British Columbia, Ontario, Quebec and Nova Scotia.

In 2004, the ranks of all 46 species of terrestrial and freshwater reptiles ranked in Canada in 2000 were reviewed; 10 species (22%) moved into a category with a higher level of risk, three species (7%) moved into the *Extirpated* category, 33 species (72%) retained the same Canada rank and no species moved into a category with a reduced level of risk (Tables 2-8-ii and 2-8-iii). This led to increases in the number of species with Canada ranks of *Extirpated* and *At Risk* and decreases in the number of species with Canada ranks of *Secure*. However, all the changes were due to detailed COSEWIC assessments or improved knowledge of the species, rather than biological changes in species abundance, distribution or threat (Figure 2-8-iii). Therefore, the increased percentage of species in the *At Risk* category does not necessarily indicate that terrestrial and freshwater reptiles as a group are at higher risk of extinction or extirpation than they were in 2000. The reassessed ranks are simply a more accurate reflection of the current, national status of reptiles in Canada than was available in *Wild species 2000*.

Table 2-8-ii: Comparison of the Canada General Status Ranks (Canada ranks) of reptile species in Wild Species 2000 and Wild Species 2005.

Canada rank		Number and percentage of species in each in Wild Species 2000	Number and percentage of species in each rank in *Wild Species 2005*	Summary of change	Reason(s) for change(s)
0	Extirpated/Extinct	0	--[a]		
0.2	Extinct	--[a]	0		
0.1	Extirpated	--[a]	3 (6 %)	↑	COSEWIC assessment[b]
1	At Risk	10 (22 %)	13 (28 %)	↑	COSEWIC assessment[b]
2	May be at risk	2 (4 %)	2 (4 %)	↔	Improved knowledge[c]<
3	Sensitive	12 (26 %)	12 (26 %)	↔	COSEWIC assessment[b], Improved knowledge[c]<
4	Secure	18 (39 %)	12 (26 %)	↓	COSEWIC assessment[b], Improved knowledge[c]
5	Undetermined	1 (2%)	1 (2%)	=	
6	Not Assessed	0	0	=	
7	Exotic	1 (2 %)	2 (4 %)	↑	Species added[d]
8	Accidental	2 (4%)	2 (4%)	=	

Key to symbols:

↑ Number of species in this category has increased.

↓ Number of species in this category has decreased.

↔ An equal number of species have been added and removed from this category; no net change.

= No species have been added or removed from this category.

[a] *The single category of Extinct/Extirpated in Wild Species 2000, was replaced with two separate categories in 2005; Extinct and Extirpated. See the Background section for details.*

[b] *A formal COSEWIC assessment has been conducted, and used as evidence for a change in rank. A biological change (i.e. a change in species population, distribution or threats) since 2000 is not suggested.*

[c] *New information has been collected or brought to light, and used as evidence for a change in rank. A biological change (i.e. a change in species population, distribution or threats) since 2000 is not suggested.*

[d] *A new species has been added to the national list.*

***Table 2-8-iii: Summary of Canada General Status Rank (Canada rank) changes, for individual reptile species, between* Wild Species 2000 *and* Wild Species 2005.**

2005 Canada rank	2000 Canada rank	English name	Scientific name	Reason for change [a]
Extirpated	At Risk	Pygmy Short-horned Lizard	Phrynosoma douglasii	C
Extirpated	At Risk	Timber Rattlesnake	Crotalus horridus	C
Extirpated	May be at risk	Pacific Pond Turtle	Actinemys marmorata	C
At Risk	Sensitive	Butler's Gartersnake	Thamnophis butleri	C
At Risk	Sensitive	Eastern Hog-nosed Snake	Heterodon platirhinos	C
At Risk	Sensitive	Prairie Skink	Eumeces septentrionalis	C
At Risk	Sensitive	Spotted Turtle	Clemmys guttata	C
At Risk	Secure	Stinkpot	Sternotherus odoratus	C
May be at risk	Secure	Blanding's Turtle	Emydoidea blandingii	I
Sensitive	Secure	Northern Map Turtle	Graptemys geographica	C
Sensitive	Secure	Eastern Ribbonsnake	Thamnophis sauritus	C/I
Sensitive	Secure	Milksnake	Lampropeltis triangulum	C/I
Sensitive	Secure	Western Skink	Eumeces skiltonianus	C/I

[a]C: change due to new COSEWIC assessment.
I: change due to improved knowledge of the species.

Threats to reptiles

The major threat to terrestrial and freshwater reptiles is habitat fragmentation and destruction. For example, populations of Prairie Skink (*Eumeces septentrionalis*) are thought to have declined as prairie habitat has been converted to agriculture and as habitat within protected areas has become fragmented by succession.

Road mortality is a serious threat to some reptile populations, especially for species that are long-lived and rely on high survival rates of adults to sustain their population. Reptiles may be attracted to roads as suitable basking spots, or as suitable nesting substrate, putting then in danger of being killed by passing cars. In addition, roads can create barriers that reptiles must cross to reach breeding or hibernating habitat. Finally, roads can fragment populations by preventing or reducing the number of individuals that move between populations.

Reptiles are popular pets around the world, and although ethical suppliers only sell animals bred and reared in captivity, reptiles are still taken from the wild to be sold as pets. Collecting animals in an unsustainable manner can lead to population declines, and adds an additional pressure to populations that may already be contending with habitat loss or other threats. Both the *Exotic* reptiles found in Canada were introduced into the wild by release of captive animals, and both species have the potential to compete with native reptiles. Other important threats to freshwater and terrestrial reptiles include exotic predators, pollution, disease, exploitation and human fear of reptiles.

Threats to marine reptiles include pollution and injuries and mortalities through contact with fishing equipment. In addition, some marine reptiles face habitat loss and over-exploitation through illegal harvest or poaching on their nesting beaches. Habitat restoration on nesting beaches can be hampered by sand removal.

Conclusion

This report shows that a total of 32% of reptiles species have Canada ranks of *At Risk* or *May Be At Risk* in Canada, the highest proportion of any group covered in this report. *Wild species 2005* presents a more accurate report on the status of reptiles in Canada, than was available 2000, due to an increase in the amount and detail of information available about Canadian reptiles.

Further information

Amphibians and Reptiles of Ontario.
http://www.glfc.cfs.nrcan.gc.ca/landscape/herp_e.html (Accessed September 13, 2005).

Bider, J.R. and Matte, S. 1996. The atlas of amphibians and reptiles of Quebec. St. Lawrence Valley Natural History Society, Sainte-Anne-de-Bellevue, Quebec. 106 pp

Canadian Amphibian and Reptile Conservation Network. http://www.carcnet.ca/ (Accessed September 13, 2005).

Cannings, S. G., Ramsay, L. R., Fraser, D. F. and Fraker, M. A. 1999. Rare amphibians, reptiles, and mammals of British Columbia. Wildlife Branch and Resource Inventory Branch, B.C. Ministry of Environment, Lands, and Parks, Victoria, British Columbia. 400 pp

Cook, F. R. 1984. Introduction to Canadian amphibians and reptiles. National Museum of Natural Sciences, Ottawa, Ontario. 200 pp

EMAN. 2004. Status of amphibian and reptile populations in Canada.
http://www.eman-rese.ca/eman/reports/publications/2004/amph_rept_status/toc.html (Accessed September 13, 2005).

Laurin, M. and Gauthier, J. A. 2000. Diapsida. The Tree of Life Web Project.
http://tolweb.org/tree?group=Diapsida&contgroup=Amniota (Accessed September 13, 2005).

Oldham, M. J. and Weller, W. F. 2000. Ontario herpetofaunal atlas. Natural Heritage Information Centre, Ontario Ministry of Natural Resources.
http://www.mnr.gov.on.ca/MNR/nhic/herps/ohs.html (updated 15-01-2001, Accessed September 13, 2005).

Partners in Amphibian and Reptile Conservation. http://www.parcplace.org/ (Accessed September 13, 2005).

The Centre for North American Herpetology. http://www.naherpetology.org/taxonomy.asp (Accessed September 13, 2005).

The Reptiles of British Columbia. http://www.bcreptiles.ca/ (Accessed September 13, 2005).

References

Alberta Sustainable Resource Development. 2004. Status of the short-horned lizard (*Phrynosoma hernandesi*) in Alberta: update 2004. Alberta Sustainable Resource Development, Fish and Wildlife Division and Alberta Conservation Association Wildlife, Status Report No. 5 (Update 2004). Edmonton, Alberta. 27 pp

Arvisais, M., Levesque, E., Bourgeois, J-C., Daigle, C., Masse, D. and Jutras, J. 2004. Habitat selection by the wood turtle (*Clemmys insculpta*) at the northern limit of its range. Canadian Journal of Zoology 82(3): 391-398

Barber, K. Ed. 1998. The Canadian Oxford Dictionary. Oxford University Press. Toronto, Oxford, New York. 1707 pp

COSEWIC. 2001. COSEWIC assessment and update status report on the leatherback turtle *Dermochelys coriacea* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Ontario. vii + 25 pp

Gibbons, J. W., Scott, D. E., Ryan, T. J., Buhlmann, K. A., Tuberville, T. D. Metts, B. S., Greene, J. L., Mills, T., Leiden, Y., Poppy, S. and Winne, C. T. 2000. The global decline of reptiles, déjà vu amphibians. BioScience 50(8): 653-666

James, J. D. 2002. A survey of short-horned lizard (*Phrynosoma hernandesi hernandesi*) populations in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species At Risk Report No. 29. Edmonton, Alberta. 25 pp

James, M. C., Ottensmeyer, A., and Myers, R. A. 2005. Identification of high-use habitat and threats to leatherback sea turtles in northern waters: new directions for conservation. Ecology Letters 8(2):195-201

Lohmann, K. J., Lohmann, C. M. F., Ehrhart, L. M., Bagley, D. A. and Swing, T. 2004. Geomagnetic map used in sea-turtle navigation. Nature 428:909-910

Oldham, M. J. 1996. Amphibians and reptiles. In Assessment of species diversity in the mixedwood plains ecozone. *Edited by* I. M. Smith, Ecological Monitoring and Assessment Network, Environment Canada. http://www.naturewatch.ca/Mixedwood/herps/herps01.html (Accessed September 13, 2005).

Pough, F. H., Andrews, R. M., Cadle, J. E., Crump, M. L., Savitzky, A. H. and Wells, K. D. 2001. Herpetology, 2nd edition. Prentice Hall, Upper Saddle River, NJ. 612pp

Seburn, D. and Seburn, C. 2000. Conservation Priorities for the Amphibians and Reptiles of Canada. World Wildlife Fund Canada and the Canadian Amphibian and Reptile Conservation Network. Toronto. 92 pp http://www.wwf.ca/NewsAndFacts/Supplemental/herpreport.pdf (Accessed September 13, 2005).

Shine, R., Phillips, B., Waye, H., LeMaster, M. and Mason, R. T. 2003. Chemosensory cues allow courting male garter snakes to assess body length and body condition of potential mates. Behavioral Ecology and Sociobiology 54(2):162-166

Uetz, P., Chenna, R., Etzold, T. and Hallermann, J. 2005. EMBL reptile database. http://www.embl-heidelberg.de/~uetz/ (Accessed September 13, 2005).

Walde, A. D., Bider, J. R., Daigle, C., Masse, D., Bourgeois, J-C., Jutras, J. and Titman, R.D. 2003. Ecological aspects of a wood turtle, *Glyptemys insculpta*, population at the northern limit of its range in Quebec. Canadian Field-Naturalist 117(3):377-388

Birds

©Gordon Court: American Kestrel (*Falco sparverius*)

Bird - A feathered, warm-blooded vertebrate of the class Aves, having a beak and wings, laying eggs and usually able to fly - The Canadian Oxford Dictionary.

Quick facts

- There are approximately 10 000 species of birds worldwide, of which 653 have been found in Canada.
- Each spring, up to 3 billion birds of more than 300 species migrate north to breed in Canada's boreal forest!
- Arctic Terns make an annual migration from their breeding grounds in the Canadian Arctic to their Antarctic wintering grounds, a round-trip of approximately 35 000 km.
- Christmas Bird Counts have been used to survey North American birds since 1900. During the 2004 - 2005 count, 11 829 Canadian volunteers counted 3.05 million birds, of 300 species.
- The majority of bird species have Canada general status ranks (Canada ranks) of *Secure* (55%) or *Accidental* (30%). In addition, 6% of bird species have Canada ranks of *Sensitive*, 4% have Canada ranks of *At Risk*, 2% have Canada ranks of *May Be At Risk*, and less than 1% have Canada ranks of *Extinct* or *Extirpated*.
- Of the 629 species of birds that were ranked in both 2000 and 2005, the Canada ranks of 9% have been altered (55 species). 38% of the changes moved species into a category with a higher level of risk, 36% of the changes moved species into a category with a lower level of risk, and 25% of the changes moved species out of the *Undetermined* or *Not Assessed* categories Changes in Canada rank have not led to substantial changes in the proportion of bird species within each general status rank.

Background

From the delicate Ruby-throated Hummingbird (*Archilochus colubris*) to the majestic Golden Eagle (*Aquila chrysaetos*), birds are arguably the best known and most popular group of species covered in this report. Birds show incredible diversity of shape, size, behaviour and ecology, but they are united by their adaptations for powered flight. These adaptations have shaped every aspect of the biology of birds, from the modification of forelimbs into wings, to the development of a highly efficient one-way breathing system.

Feathers are as unique to birds as hair is to mammals. Whether feathers originally evolved for use in flight, or to aid with insulating and/or cooling of the body (thermoregulation) is uncertain. However, in modern birds, feathers are used for a variety of purposes including the creation of a stream-lined body shape, flight, insulation, and for display. In addition, many bird species have feathers that are specially adapted for particular purposes, such as producing sound during display flights (e.g. Wilson's Snipe, *Gallinago delicata*) and improving hearing. Species of owls, like the Barn Owl (*Tyto alba*), have a facial ruff, hidden beneath their soft facial feathers. The facial ruff is a concave surface, made of stiff, dense feathers, that channels sound into the owl's ears, enhancing its sensitive hearing and allowing it to accurately locate its prey by sound alone.

Flight gives birds the flexibility of moving over large distances to take advantage of different habitats and resources. Canadian winters are harsh and food is often in short supply, particularly for insect-eating birds, so every fall billions of birds migrate south to take advantage of warmer weather and more abundant food supplies. Although most migrants travel south to the United States, the Caribbean and South America, others head to Australasia or Europe. Migrant species are diverse, ranging from tiny songbirds, such as the Blackpoll Warbler (*Dendroica striata*), to waterfowl like the Snow Goose (*Chen caerulescens*), seabirds like the Arctic Tern (*Sterna paradisaea*) and raptors like the Swainson's Hawk (*Buteo swainsoni*). The most spectacular group of migrants is probably the shorebirds. Some shorebirds, such as the Red Knot (*Calidris*

canutus) regularly breed in the Arctic and migrate as far south as the southern tip of South America! Non-migratory birds, or birds that only move short distances, have adaptations to enable them to survive the winter, such as the Grey Jay (*Perisoreus Canadensis*) and the Clark's Nutcracker (*Nucifraga columbiana*) both of which store food to help avoid food shortages, and the White-tailed Ptarmigan (*Lagopus leucura*), which is found in the Arctic and buries itself under the snow to keep warm at night.

Birds need a large, consistent food supply to fuel their warm-blooded metabolism, and they use a wide variety of foods to supply this demand, including seeds, fruit, nectar, tree sap, invertebrates and vertebrates. Because the fore-limbs of birds are highly adapted to flight, their bills and talons are very important in feeding. The shape of a bird's bill can tell you much about their diet, from the large sturdy bill of seed-eating finches, to the hooked bills of hawks and owls. Even bird's tongues vary depending on what they eat. For example, the tongue of a Northern Flicker (*Colaptes auratus*) is sticky, and very long - more than 12 cm from base to tip - to allow it to reach into anthills and extract the ants on which it feeds.

For centuries people have been inspired by the beautiful songs of song birds like the American Robin (*Turdus migratorius*) and the Varied Thrush (*Ixoreus naevius*). Male birds typically use song both to attract a mate (courtship) and to defend their territory from other males. In addition, bird song helps to ensure that mating occurs between individuals of the same species (species recognition). This can be particularly important for groups of species that look very similar, such as the Empidonax flycatchers (genus *Empidonax*). Although song is one of the most important ways that birds attract a mate, it is by no means the only one. For example, many species of duck use visual displays to attract a mate. Studies of Long-tailed Ducks (*Clangula hyemalis*) have identified at least a dozen distinct displays performed by courting males, including head-shaking, neck-stretching and wing-flapping. Duck courtship displays are usually confined to the water, but more aerodynamic birds display in air. One of the most spectacular display flights is the cartwheel display of the Bald Eagle (*Haliaeetus leucocephalus*), during which the pair lock talons high in the sky, and tumble towards the earth, before separating at the last moment to avoid hitting the ground. More practical methods of courtship include nest building (e.g. Marsh Wren, *Cistothorus palustris*) and providing food (e.g. Arctic Tern, Osprey, *Pandion haliaetus*). Because courtship is fundamental to the breeding biology of birds, bird courtship has been well studied, leading to many new theories and discoveries, particularly in the areas of evolution and sexual selection (selection based on secondary sexual characteristics).

Status of knowledge

Birds are perhaps the best studied group covered in this report. Major reasons for this include the relative ease with which many bird species are surveyed, their economic importance, and their popularity with scientists, naturalists and the public. In general, the basic biology and physiology of birds are well understood, and the distribution of birds in Canada is probably better understood than for any other group of wildlife in the country. In addition, regular, long-term surveys, such as the Breeding Bird Survey (BBS), the Maritime Shorebird Survey and the National Harvest Survey, allow the population size and population trends to be estimated for a range of different bird species. To complement surveys that monitor population sizes and trends, other regional and nationwide surveys, such as nest-record schemes and the Monitoring Avian Productivity and Survivorship (MAPS) program, provide information on the life history and reproductive success of many different bird species.

Although huge progress has been made in studying bird distribution, populations and ecology, some groups of birds have proven difficult to sample adequately. In particular, birds breeding in northern Canada are not well surveyed by important schemes such as the Breeding Bird Survey, due to the vast area, and difficulty in accessing much of northern Canada. Other schemes, such as the Christmas Bird Count (CBC) and the Canadian Migration Monitoring Network, which survey birds in the winter and during migration respectively, go part way to filling this gap, but more work is needed to understand the distribution, population sizes and trends of northern birds. In addition, secretive raptors, such as the Cooper's Hawk (*Accipiter cooperii*) and species such as the crossbills (genus *Loxia*) and the redpolls (genus *Carduelis*), whose breeding density and/or patterns of movement are governed by cycles in their food sources, are difficult to survey and monitor. An additional problem is the difficulty of analysing large-scale volunteer based surveys, such as the CBC and the BBS, in a statistically rigorous and consistent manner. Although birds are arguably the best known group covered in this report, on-going improvement of survey

techniques and analysis are needed to ensure we have the best possible data on the widest range of species possible.

Richness and diversity in Canada

A total of 653 bird species have been found in Canada; bird species richness is highest in western and central Canada, peaking in British Columbia (491 species) and Ontario (478 species, Figure 2-9-i, Table 2-9-i). Species richness is lower in the three territories than in the provinces, but the territories provide core breeding habitat for a range of bird species, particularly shorebirds.

Compared to the other species groups covered in this report, the proportion of bird species ranked *Accidental* is high across the country, reflecting the highly mobile and migratory nature of many bird species (Figure 2-9-ii). Accidental occurrences often result from bad weather conditions, which blow migrating birds off-course, or when juvenile birds get lost and appear many kilometres from their normal migration routes. The percentage of species ranked *Accidental* peaks in the maritimes (35% - 44%), which receive *Accidental* species from the rest of North America, Europe and Africa, as well as wandering sea birds.

Species spotlight: Atlantic Puffin

Atlantic Puffins, *Fratercula arctica*, are pigeon-sized seabirds, easily recognized by their striking black and white plumage, and large, colourful bills. As their name suggests, Atlantic Puffins are found in the northern Atlantic Ocean where they breed on the east coast of Canada, and the northeast coast of the United States as well as the coasts of Greenland, Europe and Russia. Atlantic Puffins typically breed in dense colonies on grassy slopes or cliff-tops of small islands. Colonies consist of many pairs of puffins, each with their own nesting burrow, which the pair defends vigorously. Adult puffins dig the burrows with their large bills, strong feet and sharp claws, and burrows may be re-used by the same pair for many years. The female lays one egg at the back of the tunnel, and both parents take turns incubating the egg, and eventually feeding the chick. Once the young is independent, Atlantic Puffins leave the land and spend the rest of the year feeding at sea. Atlantic Puffins typically breed for the first time when they are five years old, and can live up to about 25 years.

Atlantic Puffins feed on small marine fishes, captured underwater. Using their short wings as paddles, they 'fly' through the water, capturing fish one at a time from large schools of Capelin (*Mallotus villosus*), herring (family Clupeidae) or other small fish. In flight, puffins flap their wings extremely fast (300-400 times per minute!). Wing size for this bird (and other diving birds) is a compromise between flight (where large wings are better) and swimming (where small wings are better).

Like other seabirds, Atlantic Puffins have low rates of reproduction and long-lived adults that reproduce many times during their life. These life history traits mean that many seabirds are particularly vulnerable to increased rates of adult mortality. In the past puffins were harvested for food and for their feathers, leading to population declines in Canada and the United States, but this pressure has now largely been removed. Today, Atlantic Puffins and other seabirds are vulnerable to pollution (including oil spills and other environmental contamination), reduced food supply, drowning in fishing nets, and predation and competition from gulls. Atlantic Puffins are difficult to monitor, because their breeding grounds are remote and because they nest underground. Nevertheless, standardized surveys have shown that the Canadian population as a whole appears to be stable or increasing, despite differing trends among colonies. Atlantic Puffins have a Canada General Status Rank (Canada rank) of *Secure*.

Species spotlight - Western Screech-Owl, **Megascops kennicotti**

Western Screech-Owls, (*Megascops kennicottii*, are small, nocturnal owls, with large eyes and ear tufts. They have a diverse diet of insects and small mammals and have even been observed catching and eating crayfishes and bats! Like many other owls, Western Screech-Owls have numerous adaptations to nocturnal hunting. Their excellent eyesight and hearing help them to detect their prey, while the leading edge of their flight feathers is serrated, allowing them to fly silently, so that prey are not aware of their approach. Also, their strong sharp talons are adapted

for grasping and carrying heavy prey. Owls swallow their prey whole, but they can't digest the bones, fur or feathers of their prey. These are separated from the meat, and coughed back up as an owl pellet. Scientists study the distribution and contents of owl pellets to learn what habitats the owls are using, and what they are eating.

Western Screech-Owls do not migrate; instead, they spend the whole year defending their territory with their mate. Western Screech-Owls nest in natural tree cavities, old woodpecker holes or nest-boxes. Males and females share the nesting duties; females incubate the eggs and guard the nest, while males bring food for both the female and the young. Like many species of owls, young Western Screech-Owls leave the nest before they can fly, and the parents must spend several more weeks feeding the young before they are independent. Western Screech-Owls nest in deciduous and mixedwood forests, and reach their highest densities in riparian habitat (close to rivers or other water sources).

Within Canada, Western Screech-Owls are found primarily in British Columbia, although a few records exist in Alberta and Saskatchewan. The two subspecies of the Western Screech-Owl known to occur in Canada were both were assessed by COSEWIC in 2002. The macfarlanei subspecies (*Megascops kennicotti macfarlanei*) was assessed as Endangered, and the kennicottii subspecies (*Megascops kennicotti kennicottii*) was assessed as Special Concern. Western Screech-Owl has a Canada rank of *Sensitive*, which has changed from *Secure* in 2000, due to the new COSEWIC reports.

Species spotlight: Red-headed Woodpecker

Red-headed Woodpeckers, *Melanerpes erythrocephalus*, are medium-sized, colourful woodpeckers that live in southeast Canada, southcentral Canada and the eastern United States. This noisy and intriguing species has a varied diet of insects and plant matter including seeds nuts, corn, berries and fruit. One of the Red-headed Woodpecker's favourite methods for catching insects is known as 'fly-catching' (flying out from a perch to capture insects in mid-air), a behaviour usually considered more typical of flycatchers, like the Eastern Kingbird (*Tyrannus tyrannus*), than woodpeckers! Red-headed Woodpeckers are one of the few species of woodpeckers known to regularly store food, and the only woodpecker species known to cover stored food with wood or bark.

Red-headed Woodpeckers typically nest in open deciduous forest, where trees are spaced fairly widely and where there are lots of dead trees (snags) for nesting and feeding. Red-headed Woodpeckers are known as 'primary cavity nesters' because they excavate their own nest hole, usually in dead wood. Once they have finished with their cavity, it is often re-used by other animals, ranging from squirrels to American Kestrels (*Falco sparverius*). Red-headed Woodpeckers defend their nest vigorously against members of their own species and other possible competitors such as Pileated Woodpeckers (*Dryocopus pileatus*), European Starlings (*Sturnus vulgaris*) and Red-bellied Woodpeckers (*Melanerpes carolinus*). In the fall, most Red-headed Woodpeckers migrate south to spend the winter in the United States. Their wintering-areas are not fixed, but vary from year to year, depending mainly on the availability of their winter foods (primarily beechnuts and acorns).

Red-headed Woodpeckers have undergone fairly large fluctuations in population size since European settlers first arrived in North America. The small-scale clearing of forests by early settlers created forest edges and clearings, which provided good breeding habitat for Red-headed Woodpeckers. However, as huge tracts of forest in eastern North America were logged, the winter food supply of Red-headed Woodpeckers (beechnuts and acorns) declined, as did Red-headed Woodpecker populations. More recently, large-scale die-offs of Elm trees (genus *Ulmus*) and American Chestnut trees (*Castanea dentata*) in the middle of the last century left behind numerous large, decaying trees. This probably benefited Red-headed Woodpeckers by providing suitable nesting and feeding sites. Since 1966, Red-headed Woodpecker populations have been tracked across North America by the Breeding Bird Survey (BBS). Analysis of BBS trends suggests that Red-headed Woodpeckers have been undergoing significant declines across North America since the beginning of the survey, at a rate of about -2.7% per year. This suggests that the number of Red-headed Woodpeckers in North America may have declined by about 65% since 1966! The primary reason for population declines is thought to be loss of breeding habitat, due to removal of large dead trees.

In 2000, Red-headed Woodpeckers had a Canada rank of *Sensitive*. This has been changed to *May Be At Risk* in 2005, due to a combination of new information about population size, and the high rate of population decline. Red-headed Woodpecker was first assessed by COSEWIC in 1996 (Special Concern); COSEWIC plans to re-assess the status of this species in 2007.

Results of assessment

More detailed information is available about bird populations than for any other groups of species covered in this report. In particular, the Breeding Bird Survey (BBS) makes large-scale, long-term data on population trends widely available for a variety of bird species. BBS data is most useful for studying the relative population trends of songbirds that are widely distributed in southern Canada. In some cases, BBS data shows that bird species are undergoing population declines, despite having a large, wide-spread population. For example, the Canada Warbler (*Wilsonia canadensis*) has an estimated total population size of 1.4 million individuals, of which at least 80% breed in Canada. However, BBS data for this species show a significant, long-term population decline, which has led the Partners in Flight (PIF) program to put this species on their 'watch list'. Such species receive regional and Canada General Status ranks of *Secure*, to maintain consistency with other groups, for which detailed, long-term information on population trends is simply not available. The comments field in the general status search tool provides additional information on long-term trends population trends, where applicable.

The majority of Canada's bird species are migratory and use different habitats and different regions of Canada throughout the year, exposing them to different threats in different periods of their life cycle.. When Canada ranks were created for migratory birds, particular attention was paid to each species' status on its breeding grounds. For example, within Canada, the Ruddy Turnstone (*Arenaria interpres*) breeds primarily on the tundra in northern Nunavut. Here it is ranked *Sensitive* due to population declines. However, the Ruddy Turnstone is a common migrant in suitable habitat throughout much of southern Canada, and is ranked *Secure* in every province except Saskatchewan where it is ranked *Accidental*. Nevertheless, Ruddy Turnstone received a Canada rank of *Sensitive*, due to concerns within its breeding range. This kind of exception was applied to approximately 16 bird species, and is documented in the comments section of the general status search tool.

The majority of bird species have Canada ranks of *Secure* (55%, 358 species, Figure 2-9-i and 2-9-ii, Table 2-9-i). However, nearly a third of bird species have Canada ranks of *Accidental* (30%, 195 species), the highest percentage of *Accidental* species of any group covered in this report. In addition, 6% of bird species have Canada ranks of *Sensitive* (41 species), 4% have Canada ranks of *At Risk* (27 species), 2% have Canada ranks of *May Be At Risk* (12 species) and less than 1% have ranks of *Extinct* (three species) or *Extirpated* (one species). Finally, 2% of bird species have Canada ranks of *Exotic* (11 species) and 1% have Canada ranks of *Undetermined* (five species).

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Figure 2-9-i: Summary of the species richness and 2005 general status ranks of birds in Canada.

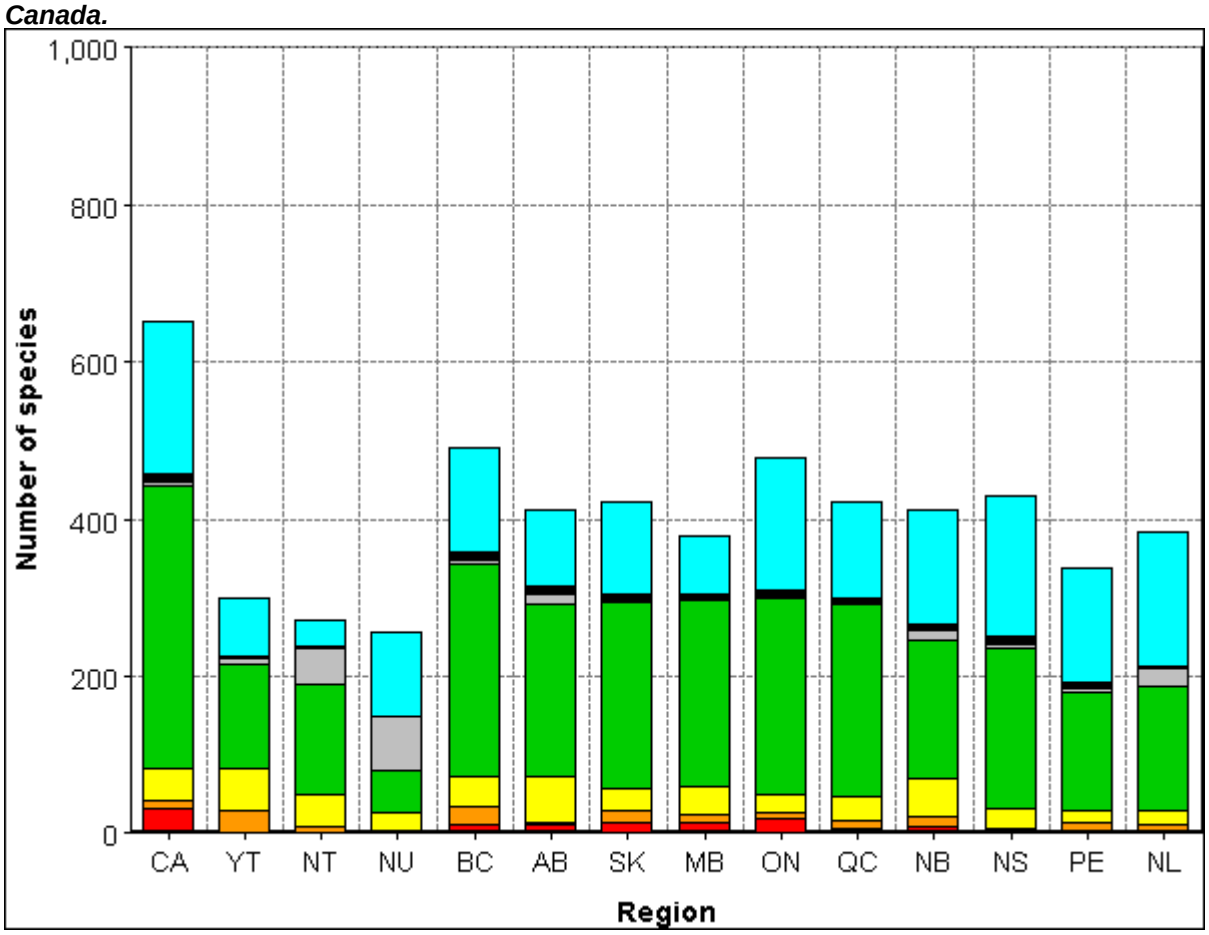

Table 2-9-i: Summary of the 2005 general status ranks of bird species in Canada.

	CA	YT	NT	NU	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL
Extirpated	1	0	0	1	2	2	1	2	1	2	0	0	1	0
Extinct	3	0	0	1	1	1	1	1	1	3	3	3	1	2
At risk	27	0	2	2	9	8	11	11	16	2	7	3	1	3
May be at risk	12	29	7	1	22	3	17	10	10	9	12	1	12	7
Sensitive	41	54	40	21	39	59	27	35	21	30	47	24	14	17
Secure	358	133	142	54	271	220	238	237	252	246	178	205	152	159
Undetermined	5	8	45	68	3	13	0	0	0	3	13	5	4	23
Not assessed	0	0	0	0	0	0	1	0	0	0	0	1	0	0
Exotic	11	3	3	2	12	9	9	9	9	6	6	10	7	3
Accidental	195	72	33	106	132	96	116	75	168	122	146	178	145	169
Total	653	299	272	256	491	411	421	380	478	423	412	430	337	383

Footnote: In Wild species 2000, species assessment results were presented as the proportion of resident species ('resident species' excludes species with Canada ranks of Extirpated, Extinct and Accidental). In this report, we have used the more straightforward method of presenting results as a proportion of total species richness. Therefore, proportions given in the 'Results of assessment' sub-sections cannot be directly compared to results given in the text of Wild Species 2000. To compare results for birds directly between the text of Wild Species 2000 and this report please use the following figures, which represent the 2000 results as a proportion of total species richness: Total species richness: 639 species Extinct/Extirpated: 1%, At Risk: 3%, May Be At

Risk: 2%, Sensitive: 8%, Secure: 54%, Undetermined: 3%, Not Assessed: 0%, Exotic: 2%, Accidental: 27%.

Comparison with Wild Species 2000

The total number of bird species ranked in Canada has changed from 639 in 2000 to 653 in 2005. Since 2000, 17 new bird species have been added to the national list. All of these species have Canada ranks of *Accidental*, and most have been recorded from only one province or territory. Two bird species, Crested Myna (*Acridotheres cristatellus*) and Mountain Quail (*Oreortyx pictus*, both previously ranked *Exotic*), have been removed from the national list, since they are no longer found in Canada. In addition, there have been several taxonomic changes. Black-backed Wagtail is no longer considered a separate sub-species from White Wagtail (*Motacilla alba*), due to new information about the extent of hybridization between these taxa. Following genetic studies, Cackling Goose (*Branta hutchinsii*) is now ranked as a full species, separate from Canada Goose (*Branta canadensis*). Finally, although the taxonomy of snipe (genus *Gallinago*) remains unclear, two separate species are now ranked in Canada; Wilson's Snipe (*Gallinago delicata*, found across the country), and Common Snipe (*Galinago galinago*, breeds in Europe, a rare visitor to Canada's east coast). In addition, the taxonomic treatment of two sets of species has been altered since 2000. In 2000, two sub-species of *Anas crecca*; American Green-Winged Teal and Eurasian Green-winged Teal, were ranked separately. In 2005, both sub-species are now ranked together as a single species; Green-winged Teal. Similarly, two sub-species of *Numenius phaeopus*, Whimbrel and Eurasian Whimbrel were ranked separately in 2000, but are now ranked together as a single species; Whimbrel. Once species which have undergone taxonomic changes are excluded, a total of 629 species were ranked in Canada in both 2000 and 2005.

Changes to Canada ranks have been made for 9% of the species that were ranked in both 2000 and 2005 (55 species, Table 2-9-ii). 38% of the changes moved species into a category with a higher level of risk (21 changes), 36% of the changes moved species into a category with a lower level of risk (20 changes), and 25% of the changes moved species out of the *Undetermined* (12 changes) or *Not Assessed* categories (two changes). Changes in Canada ranks had no major impact on the overall percentage of species in each general status category (Table 2-9-iii). The majority of changes were due to changes in process (62%, 34 species). Other changes were due to new or updated COSEWIC assessments (16%, nine species), improved information (11%, six species), and a combination of improved information and biological change (11%, six species).

Table 2-9-ii: Summary of Canada General Status Rank (Canada rank) changes, for individual bird species, between Wild Species 2000 and Wild Species 2005.

2005 Canada rank	2000 Canada rank	English name	Scientific name	Reason for change
At Risk	May be at risk	Ivory Gull	Pagophila eburnea	C
At Risk	May be at risk	Pink-footed Shearwater	Puffinus creatopus	C
At Risk	May be at risk	Ross's Gull	Rhodostethia rosea	C
At Risk	Sensitive	Least Bittern	Ixobrychus exilis	C
At Risk	Sensitive	Williamson's Sapsucker	Sphyrapicus thyroideus	C
At Risk	Secure	Golden-winged Warbler	Vermivora chrysoptera	C
May be at risk	Sensitive	Clark's Grebe	Aechmophorus clarkii	P
May be at risk	Sensitive	Snowy Egret	Egretta thula	I
May be at risk	Sensitive	Cerulean Warbler	Dendroica cerulea	B/I
May be at risk	Sensitive	Red-headed Woodpecker	Melanerpes erythrocephalus	B/I
May be at risk	Secure	Red Knot	Calidris canutus	P
Sensitive	May be at risk	Great Egret	Ardea alba	P
Sensitive	Secure	Ruddy Turnstone	Arenaria interpres	P
Sensitive	Secure	Sanderling	Calidris alba	P
Sensitive	Secure	Semipalmated Sandpiper	Calidris pusilla	P
Sensitive	Secure	American Golden-Plover	Pluvialis dominica	P
Sensitive	Secure	Black-bellied Plover	Pluvialis squatarola	P
Sensitive	Secure	American White Pelican	Pelecanus erythrorhynchos	P
Sensitive	Secure	Harris's Sparrow	Zonotrichia querula	P
Sensitive	Secure	Wandering Tattler	Heteroscelus incanus	I
Sensitive	Secure	Rusty Blackbird	Euphagus carolinus	C
Sensitive	Secure	Western Screech-Owl	Megascops kennicotti	C
Sensitive	Undetermined	Little Gull	Larus minutus	P
Secure	Sensitive	Buller's Shearwater	Puffinus bulleri	P
Secure	Sensitive	Red-necked Phalarope	Phalaropus lobatus	P
Secure	Sensitive	Dovekie	Alle alle	P
Secure	Sensitive	Grasshopper Sparrow	Ammodramus savannarum	P
Secure	Sensitive	Tufted Titmouse	Baeolophus bicolor	P
Secure	Sensitive	Upland Sandpiper	Bartramia longicauda	P
Secure	Sensitive	Black Tern	Chlidonias niger	P
Secure	Sensitive	Common Nighthawk	Chordeiles minor	P
Secure	Sensitive	Black-headed Gull	Larus ridibundus	P
Secure	Sensitive	White-winged Scoter	Melanitta fusca	P
Secure	Sensitive	Surf Scoter	Melanitta perspicillata	P

2005 Canada rank	2000 Canada rank	English name	Scientific name	Reason for change
Secure	Sensitive	Black-crowned Night-Heron	Nycticorax nycticorax	P
Secure	Sensitive	Brewer's Sparrow	Spizella breweri	P
Secure	Sensitive	Swainson's Hawk	Buteo swainsoni	I
Secure	Sensitive	Red-shouldered Hawk	Buteo lineatus	C
Secure	Sensitive	White-throated Swift	Aeronautes saxatalis	B/I
Secure	Sensitive	Lark Bunting	Calamospiza melanocorys	B/I
Secure	Sensitive	Peregrine Falcon	Falco peregrinus	B/I
Secure	Sensitive	Laughing Gull	Larus atricilla	B/I
Secure	Undetermined	Black Swift	Cypseloides niger	P
Secure	Undetermined	Lesser Black-backed Gull	Larus fuscus	P
Secure	Undetermined	Northern Wheatear	Oenanthe oenanthe	P
Secure	Undetermined	Manx Shearwater	Puffinus puffinus	P
Secure	Undetermined	Dickcissel	Spiza americana	P
Secure	Undetermined	Cassin's Vireo	Vireo cassinii	P
Accidental	Undetermined	Chuck-will's-widow	Caprimulgus carolinensis	P
Accidental	Undetermined	Worm-eating Warbler	Helmitheros vermivorum	P
Accidental	Undetermined	Ruff	Philomachus pugnax	P
Accidental	Undetermined	Parakeet Auklet	Aethia psittacula	I
Accidental	Undetermined	Red-throated Pipit	Anthus cervinus	I
Accidental	Not Assessed	Fea's Petrel	Pterodroma feae	P
Accidental	Not Assessed	Mottled Petrel	Pterodroma inexpectata	I

[a]C: change due to new COSEWIC assessment.
P: change due to procedural change.
I: change due to improved knowledge of the species.

Table 2-9-iii: Comparison of the Canada General Status Ranks (Canada ranks) of birds species between Wild Species 2000 and Wild Species 2005.

Canada rank	Number and percentage of species in each in Wild Species 2000	Number and percentage of species in each rank in *Wild Species 2005*	Summary of change	Reason(s) for change(s)
Extirpated/Extinct	4 (1%)	-- [a]		
Extinct	-- [a]	3 (<1%)		
Extirpated	-- [a]	1 (<1%)		
At Risk	21 (3%)	27 (4%)	↑	COSEWIC assessment [b]
May be at risk	11 (2%)	12 (2%)	↔	COSEWIC assessment [b], Combination of improved knowledge and biological change [c], Process [d], Improved knowledge [e]
Sensitive	53 (8%)	41 (6%)	↓	COSEWIC assessment [b], Combination of improved knowledge and biological change [c], Process [d], Improved knowledge [e], Taxonomy [f]
Secure	345 (54%)	358 (55%)	↑	COSEWIC assessment [b], Combination of improved knowledge and biological change [c], Process [d], Improved knowledge [e], Taxonomy [f]
Undetermined	17 (3%)	5 (1%)	↑	Process [d], Improved knowledge [e]
Not Assessed	2 (<1%)	0	↓	Process [d], Improved knowledge [e]
Exotic	13 (2%)	11 (2%)	↓	Biological change [h]
Accidental	173 (27%)	195 (30%)	↑	Process [d], Improved knowledge [f], Taxonomy [e], New Species [g]

Key to symbols:

↑ Number of species in this category has increased.

↓ Number of species in this category has decreased.

↔ An equal number of species have been added and removed from this category; no net change.

= No species have been added or removed from this category.

[a] *The single category of Extinct/Extirpated in Wild Species 2000, was replaced with two separate categories in 2005; Extinct and Extirpated. See the Background section for details.*

[b] *A formal COSEWIC assessment has been conducted, and used as evidence for a change in rank. A biological change (i.e. a change in species population, distribution or threats) since 2000 is not suggested.*

[c] *A combination of improved knowledge and biological change was used as evidence for a change in rank.*

[d] *A different process has been used for assigning ranks, leading to a change in the Canada rank.*

[e] *New information has been collected or brought to light, and used as evidence for a change in rank. A biological change (i.e. a change in species population, distribution or threats) since 2000 is not suggested.*

[f] *A taxonomic change has lead to the addition or removal of a species from the national list.*

[g] *A new species has been added to the national list.*

[h] *A biological change in species' population size, distribution, threats or trends has lead to species being removed from the national list.*

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[1] *For all groups covered in this report, national ranks are generally assigned based on the regional rank with the lowest level of risk. For example if the provincial and territorial ranks for a species are a mixture of Sensitive and Secure, the default Canada rank is Secure (see Background section for more details and some exceptions to this generalisation). This rule-of-thumb was not always followed when Canada ranks for birds were finalized in 2000. Therefore, many of the Canada rank changes for birds are due primarily to the different procedures followed in 2000 and 2005, and are classified as procedural changes. These changes help to ensure that Canada ranks are comparable both within and among species groups.*

Threats to Canadian birds

The major threats to Canadian birds are fairly well known, and include habitat loss and fragmentation, pollution and contamination, changes in rates of predation and brood parasitism, disease, overexploitation, competition from invasive or *Exotic* species, anthropogenic mortality (e.g. building strikes, road mortality) and natural and anthropogenic climate variation. However, the situation is complicated by the fact that threats can occur in migratory stopovers and in wintering habitat as well as in breeding habitat. Therefore, many research programs involve international co-operation to study the same species in different locations and at different points in the life cycle.

Conclusion

Canada provides important breeding habitat for many species of North American birds, and many Canadians appreciate the diversity and abundance of birds that spend all, or part of the year here. For these reasons, and many others, it is important to update general status ranks for birds regularly. Although the proportions of bird species in each general status rank have not changed significantly since 2000, this update has allowed Canada ranks to be adjusted to ensure that ranks are comparable within and among species groups, as well as allowing the national list to be updated with species new to Canada. Although birds are generally better studied that other groups covered in this report, it is still important to improve our knowledge of bird populations, particularly for species breeding in northern Canada and other remote locations, and for species not adequately covered by current surveys.

Further information

Bird Studies Canada. http://www.bsc-eoc.org/bscmain.html

Bird Trends: A report on results of national ornithological surveys in Canada. Vol 6-9 http://www.cws-scf.ec.gc.ca/birds/news/index_e.cfm

Brooke, M. and Birkhead, T. (Eds). 1991. The Cambridge encyclopaedia of ornithology. Cambridge University Press, Cambridge. pp 362

Canadian Migration Monitoring Network. http://www.bsc-eoc.org/national/cmmn.html (Accessed March 31, 2006).

Canadian Wildlife Service. Wildlife Research. http://www.cws-scf.ec.gc.ca/theme.cfm?lang=e&category=14 (Accessed March 31, 2006).

Cannings, R. J., and T. Angell. 2001. Western Screech-Owl (*Otus kennicottii*). *In* The Birds of North America, No. 597 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Chardine, J. W. 1999. Population status and trend of the Atlantic Puffin in North America. Bird Trends:15-17

Christmas Bird Count in Canada. http://www.bsc-eoc.org/national/cbcmain.html (Accessed March 31, 2006).

COSEWIC 2002. COSEWIC assessment and update status report on the Western Screech-owl *Otus kennicottii* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 31 pp

Ehrlich, P. R., Dobkin, D. S. and Wheye, D. 1988. The birder's handbook. A field guide to the natural history of north American birds. Simon & Schuster Inc, New York. pp 785

Faaborg, J. 1988. Ornithology. An ecological approach. Prentice Hall, New Jersey. pp470

Fundy shorebirds. http://www.speciesatrisk.ca/fundyshorebirds/ (Accessed March 31, 2006).

Lowther, P. E., A. W. Diamond, S. W. Kress, G. J. Robertson, and K. Russell. 2002. Atlantic Puffin (*Fratercula arctica*). In The Birds of

North America, No. 709 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Monitoring Avian Productivity and Survivorship (MAPS) program. http://www.birdpop.org/maps.htm Accessed March 31, 2006).

North American Breeding Bird Survey. http://www.pwrc.usgs.gov/BBS/ (Accessed March 31, 2006).

Poole, A. (Editor). 2005. The Birds of North American Online: http://bna.birds.cornell.edu/BNA/. Cornell Laboratory of Ornithology, Ithaca, NY.

Sauer, J. R., Hines, J. E., and Fallon, J. 2005. The North American Breeding Bird Survey, results and analysis 1966 - 2004. Version 2005.2. USGS Patuxent Wildlife Research Center, Laurel, MD. http://www.mbr-pwrc.usgs.gov/bbs/ (Accessed March 31, 2006).

Smith, K. G., Withgott, J. H. and Rodewald, P. G. 2000. Red-headed Woodpecker (Melanerpes erythrocephalus). In The Birds of North America, No. 518 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

References

American Ornithologists' Union. 1998. Checklist of North American Birds, 7th ed. American Ornithologists' Union, Washington, D.C.

Banks, R. C., Cicero, C. Dunn, J. L., Kratter, A. W., Rasmussen, P. C., Remsen Jr., J. V., Rising, J. D. and Stotz, D. F. 2005. Forty-sixth supplement to the American Ornithologists' Union *Checklist of North American Birds*. Auk 122(3):1026-1031

Barber, K. Ed. 1998. The Canadian Oxford Dictionary. Oxford University Press. Toronto, Oxford, New York. 1707 pp

Cannings, D. 2005. The 105th Christmas bird count: Cross-Canada report. Birdwatch Canada 32:13-17

Robertson, G. J., Wilhelm, S. I. and Taylor, P. A. 2004. Population size and trends of seabirds breeding on Gull and Great Islands, Witless Bay Islands Ecological Reserve, Newfoundland, up to 2003. Canadian Wildlife Service technical report series No. 418. Atlantic Region. Viii + 45 pp

Robertson, G. J. and Elliot, R. D. 2002. Population size and trends of seabirds breeding in the Gannet Islands, Labrador. Canadian Wildlife Service technical report series No. 393. Atlantic Region. v + 36 pp

Robertson, G. J., Elliot, R. D. and Chaulk, K. G. 2002. breeding seabird population in Groswater Bay, Labrador, 1978 and 2002. Canadian Wildlife Service technical report series No. 394. Atlantic Region. iv + 31 pp

Robertson, G. J. and Elliot, R. D. 2002. Changes in seabird populations breeding on Small Island, Wadham Islands, Newfoundland. Canadian Wildlife Service technical report series No. 381. Atlantic Region. iii + 26 pp

Rodway, M. S., Regher, H. M. and Chardine, J. W. 2003. Status of the largest breeding concentration of Atlantic Puffins *Fratercula arctica*, in North America. The Canadian Field-Naturalist 117(1):70-75

Mammals

Mammal - Any warm-blooded animal of the vertebrate class Mammalia, members of which are characterized by the possession of mammary glands and a four-chambered heart, including human beings, carnivores, ungulates, rodents, whales, etc. - The Canadian Oxford Dictionary.

© B. T. Aniskowicz-Fowler: Moose (*Alces alces*)

Quick facts

- There are more than 5000 known species of mammals, divided into 26 orders. The rodents are the largest order of mammals in the world, both in terms of number of species, and number of individuals.
- A total of 218 species of mammal have been found in Canada, including 169 species ranked in the provinces and territories and 49 ranked in the ocean regions.
- Since *Wild Species 2000*, three terrestrial mammals and one marine mammal have been added to the species list. All four additions were due to genetic analyses of existing species.
- The majority of mammal species have Canada ranks of *Secure* (64%), but 11% have Canada ranks of *Sensitive*, 6% have Canada ranks of *At Risk* and 5% have Canada ranks of *May Be At Risk*.
- Of the 210 species that were ranked in both 2000 and 2005, the majority (81%) have retained the rank they were given in 2000. Of the 40 species whose Canada rank has changed, 18% have changed to a Canada rank with a reduced level of risk, 25% have changed to a Canada rank with an increased level of risk and 57% have moved into or out of the *Undetermined*, *Not Assessed* or *Accidental* categories. The majority of these changes were due to new or updated COSEWIC assessments (40%).
- The world's largest mammal is the Blue Whale, which can grow up to 25 m long and weigh up to 100 tonnes.

Background

From the Atlantic Walrus (*Odobenus rosmarus*) of the frozen Arctic, to the American Bison (*Bos bison*) of the prairies, to the Red Squirrel (*Tamiasciurus hudsonicus*) in your backyard or local park, mammals are a familiar and diverse group found throughout Canada. Mammals are able to endure Canada's varied and sometimes harsh climate because they are warm-blooded (endothermic). This means that mammals are able to keep their core body temperature stable, despite outside temperature fluctuations. Mammals are believed to have evolved from a group of reptiles, called the synapsids, more than 200 million years ago, slightly before the dinosaurs appeared on earth. Since the disappearance of the dinosaurs, about 65 million years ago, mammals have spread and diversified to reach their present, global distribution.

One of the defining characteristics of mammals is the possession of hair, from the short, velvety hair of the Townsend's Mole (*Scapanus townsendii*), to the thick, shaggy coat of the Muskox (*Ovibos moschatus*). The most important function of hair is to provide insulation from the cold. For example, the hair of the Arctic Fox (*Vulpes lagopus*) provides such efficient insulation that they can remain active even at temperatures below -50 °C! Some mammals loose their hair as adults, so they use other methods of insulation. For example, Cetaceans (whales, dolphins and porpoises) which loose their hair soon after birth, are insulated by a thick layer of blubber. Other important uses of hair include camouflage (e.g. the white, winter coat of the Snowshoe Hare, *Lepus americanus*) and communication (e.g. the White-tailed Deer, *Odocoileus virginianus*, uses its white tail to flash a danger signal as it runs from a predator). There are two main types of hair, underfur and guardfur, each with its own function. The thick, soft underfur traps a layer of warm air to insulate the body, while the guardfur acts to protect the underfur. The long, soft underfur of the Muskox is one of the most luxurious and expensive natural fibres in the world.

All female mammals possess mammary glands, which produce milk to feed their young. Milk is rich in proteins and fat, and provides the young with the nutrients and energy they need to develop and grow. While they depend on their mother for milk, the young develop social behaviours and learn about their environment, including which foods are good to eat and how to find them. Some mammals, such as the Caribou (*Rangifer tarandus*), give birth to precocial young, which are well developed and can run almost immediately after birth. Young Caribou stagger to their feet less than an hour after birth, and can run fast enough to keep up with the herd within the first day or two of life. In contrast, altricial young are born helpless, often blind, and with very limited mobility. For example, Eastern Grey Squirrels (*Sciurus carolinensis*) are born naked and toothless, and their eyes and ears are scarcely visible. It takes over a month before their eyes begin to open, and almost two months before they venture outside the nest.

Some of Canada's most distinctive mammals are those that live in the Arctic tundra, including the Polar Bear (*Ursus maritimus*), Arctic Fox, Caribou, Muskox, and several different types of lemming. While some of these mammals, such as the Caribou, migrate south during the winter, many are resident on the tundra year round. Arctic mammals show many adaptations to the extreme cold, including thick fur coats and high metabolic rates. Several Arctic mammals, such as the Muskox and Polar Bear have evolved a large size and compact shape, to reduce heat loss. Small mammals, such as the Northern Bog Lemming (*Synaptomys borealis*) spend the winter under the snow. Deep snow acts as an insulating layer, protecting the lemmings from extreme surface temperatures. Many Arctic mammals keep their extremities at temperatures close to freezing while their core body temperature does not fluctuate. For example, the temperature of a Caribou's legs can be as much as 100C cooler than its core body temperature. This is accomplished by a special arrangement of blood vessels that allow the warmth of the blood being pumped to the extremities to heat the blood returning to the core (this system is called counter-current heat exchange). Only one Arctic mammal, the Arctic Ground Squirrel (*Spermophilus parryii*), undergoes true hibernation, during which its body temperature drops far below normal.

Status of knowledge of mammals in Canada

In general, mammals in Canada have been well-studied, and the basic biology and physiology, distribution and ecology of many mammal species are well understood. In recent years, technological advances including satellite telemetry and new genetic tools have been used to further improve knowledge of Canadian mammals. However, there remain challenges that make studying mammals in the wild difficult, including nocturnal or secretive behaviour, remote distribution, difficulty in handling wild mammals and the vast distances covered by some large mammals. In addition, many marine mammals can be difficult to study due to the long time spent under water, and the short time spent at the surface.

A major focus of mammalogy in Canada has been studies of large mammals, such as Caribou, Wapiti (also known as elk, *Cervus canadensis*) and Polar Bears. Large mammals are important to study because of their economic value, potential for conflict with humans and their importance in the ecosystems in which they live. For example, recent research in Banff National Park has shown that by controlling the Wapiti population, Grey Wolves (*Canis lupus*) have an indirect impact on the local vegetation structure and bird communities. In areas of high Grey Wolf density, there are fewer Wapiti, more regenerating vegetation, more warblers and fewer sparrows. Studies like this demonstrate the importance of large mammals in shaping their local ecosystems.

Tracking mammals at sea is a difficult task, and can limit research on deep-sea marine mammals, but new technology, including satellite tracking, satellite remote sensing and acoustic remote sensing, is helping to improve knowledge in this area. For example, Blue Whale (*Balaenoptera musculus*) migration and habitat use has been followed using acoustic and satellite remote sensing, allowing continuous, large-scale, spatial and temporal tracking of Blue Whale movements for the first time.

In general, mammals that are not considered economically or culturally important (such as shrews, family Soricidae), have not been studied as well as large, charismatic or economically important mammals, like the Polar Bear or Caribou. For example, bats (order Chiroptera) are generally less well-studied and less well understood than many other mammal groups, and the distribution, ecology and life history of some bats in Canada is still poorly known. However, new studies are starting to close this gap. For example, recent surveys in Nova Scotia discovered Canada's first known breeding colony of Eastern Pipistrelles (*Pipistrellus subflavus*). Other recent bat studies have focussed on habitat use, echolocation, diet and thermal ecology of bats.

Richness and diversity in Canada

There are nine orders of mammals in Canada, of which the rodents (Order Rodentia), with 71 species, is by far the most species rich. Of Canada's 218 mammal species, 169 are ranked only in the provinces and territories and 49 are ranked only in the ocean regions (Figure 2-10-i, Tables 2-10-i and 2-10-ii).

British Columbia (118 species, Table 2-10-i) has the highest species richness of mammals in Canada, due primarily to high numbers of insectivores (Order Insectivora) and bats (Order Chiroptera) found in the province.

The majority of Canada's 49 species of marine mammals are found in the Atlantic Ocean Region (32 species) or the Pacific Ocean Region (30 species, Table 2-10-i). Twenty-three species are found in more than one ocean region.

Species spotlight - Northern Long-eared Myotis, Myotis septentrionalis

The Northern Long-eared Myotis, *Myotis septentrionalis*, is a medium-sized bat found in all the provinces and territories except Nunavut. Like all Canada's bats, the Northern Long-eared Myotis is nocturnal; during the day it roosts under the peeling bark of decaying trees and at night it hunts for insects. The Northern Long-eared Myotis uses two main hunting techniques; catching insects that are resting on trees and bushes (gleaning) and catching insects in flight (hawking). In both cases, the Northern Long-eared Myotis uses echolocation to detect its prey. These bats are active only during the warmer months of the year (approximately April to September). During the rest of the year, they hibernate in caves or abandoned mines where the humidity is high and the temperature hovers just above freezing.

The nocturnal and secretive behaviour of the Northern Long-eared Myotis make this species difficult to study, but new technology is increasing the ability of scientists to investigate bat habitat use. For example, researchers can set up microphones in different habitats to record the sounds made by feeding bats. Since different species of bats make different sounds, computer programs can analyse the recordings and find out which species are feeding in which habitat type. In addition, by capturing bats and attaching tiny radio-transmitters, researchers can find out exactly which trees bats prefer to roost in. Results from these studies show that mature forest habitat, with large decaying coniferous and deciduous trees is important for these bats. This kind of information helps foresters and wildlife mangers make informed decisions about which types of habitat should be conserved to support healthy bat populations. Leaving individual mature deciduous and coniferous trees as well as patches of intact mature forest in harvested landscapes may help support Northern Long-eared Myotis populations. In turn, bats can help to control outbreaks of forest pests, such as Spruce Budworm (*Choristoneura fumiferana*).

The Northern Long-eared Myotis is more common in eastern and central Canada (ranked *Secure* or *Sensitive*) than in western and northern Canada (ranked *May Be At Risk* or *Undetermined*). This is due its preference for mature mixed wood forest, which is more widely available in eastern Canada, as well as the availability of suitable hibernation sites and climate. Due to its large range in Canada, Northern Long-eared Myotis has a Canada General Status Rank (Canada rank) of *Secure*. This has changed from *Sensitive* in 2000, due to a combination of new information and a process change.

Species spotlight - Northern Bottlenose Whale, Hyperoodon ampullatus

The Northern Bottlenose Whale, *Hyperoodon ampullatus*, is named for its dolphin-like beak and prominent 'egg-head' forehead, which is particularly large in adult males. They are found in the northern Atlantic Ocean, where they favour deep, cool water. Northern Bottlenose Whales are very sociable animals, and live in small groups, or pods. Males are larger than females and can reach up to 10 m in length, and weigh up to 7.5 tonnes! In males, the lower jaw of the beak holds two small teeth, but the female has no teeth at all. Northern Bottlenose Whales dive up to 1000 m in depth for as long as 70 minutes, searching for their favourite food of squid (genus *Gonatus*).

Two distinct populations of Northern Bottlenose Whales are found in Canada; one off the northern Labrador coast, within the Eastern Arctic Oceanic Region (Davis Strait population) and another off the southeast coast of Nova Scotia, within the Atlantic Oceanic Region (Scotian Shelf population). The Soctian Shelf population lives within an underwater canyon called The Gully. This population of about 130 animals has a unique migratory strategy and life history compared to other bottlenose whale populations.

Northern Bottlenose Whales were hunted for centuries for their spermaceti oil, which was used to make high quality lubricating oil and candles. Bottlenose whales were easy prey for whale hunters because they are attracted to boats by their intense curiosity. Pod-members are extremely protective of injured or distressed companions, so whalers were often able to harvest the majority of the pod, before the remaining members dived for safety. By the mid 1970's global populations of Northern Bottlenose Whales were reduced to vulnerable levels. In 1973 commercial hunting ceased and in 1977 the species was classified as a protected species by the International Whaling Committee, but global populations of Northern Bottlenose Whales have not yet fully recovered. In Canada, the Davis Strait population is currently assessed as Not At Risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), but the Scotian Shelf population was assessed by COSEWIC as Endangered (2002), and is now protected under Canada's Species At Risk Act.

Fortunately for researchers, the Northern Bottlenose Whale's sociable nature has made the study of its biology and behaviours relatively easy, since observers are able to approach the whales without disturbing them. The Gully, home of the Scotian Shelf population of Northern Bottlenose Whales, is a Marine Protected Area, but is surrounded by oil and gas discoveries and is close to trans-Atlantic shipping routes. Recent research in this area has attempted to determine the effects of human activities on the whales, including commercial shipping, fishing activity, and the offshore oil and gas industry. The Northern Bottlenose Whale has a Canada rank of *Sensitive*; this has not changed since *Wild Species 2000*.

Species spotlight - Common Grey Fox, Urocyon cinereoargenteus

Common Grey Foxes, *Urocyon cinereoargenteus*, are the only member of the dog family (family Canidae) in Canada with the ability to climb trees! This small fox has short legs and long, strong back claws that allow it to scramble up tree trunks to escape from predators or look for food, such as fruit, birds and rodents. On the ground, Common Grey Foxes also eat rabbits and other small mammals. Slightly smaller and greyer in colour that the Red Fox, Common Grey Foxes are native to Ontario and have also been recorded in Quebec, Manitoba and Alberta.

Common Grey Foxes have an intriguing history in Canada. Archaeological records from the villages of Aboriginal Peoples indicate that in the past, Common Grey Foxes were almost as abundant as Red Foxes in southern Ontario. However, the records of European settlers make no mention of this unusual species. In fact it wasn't until early in the 1890s that Common Grey Foxes were reported first in Quebec, and then in Ontario. No one is certain what caused Common Grey Foxes to disappear from Ontario for more than 300 years, or why they have become re-established over the past 100 years. However, it has been suggested that warmer temperatures in recent years have allowed northern populations, like those in southern Ontario, to survive and increase. Today, the only place in Canada where Common Grey Foxes are known to breed is Pelee Island in southern Ontario. Records of Common Grey Foxes in other parts of Ontario and in southern Manitoba are probably single individuals that have travelled across the border from the United States, where Common Grey Foxes remain widespread.

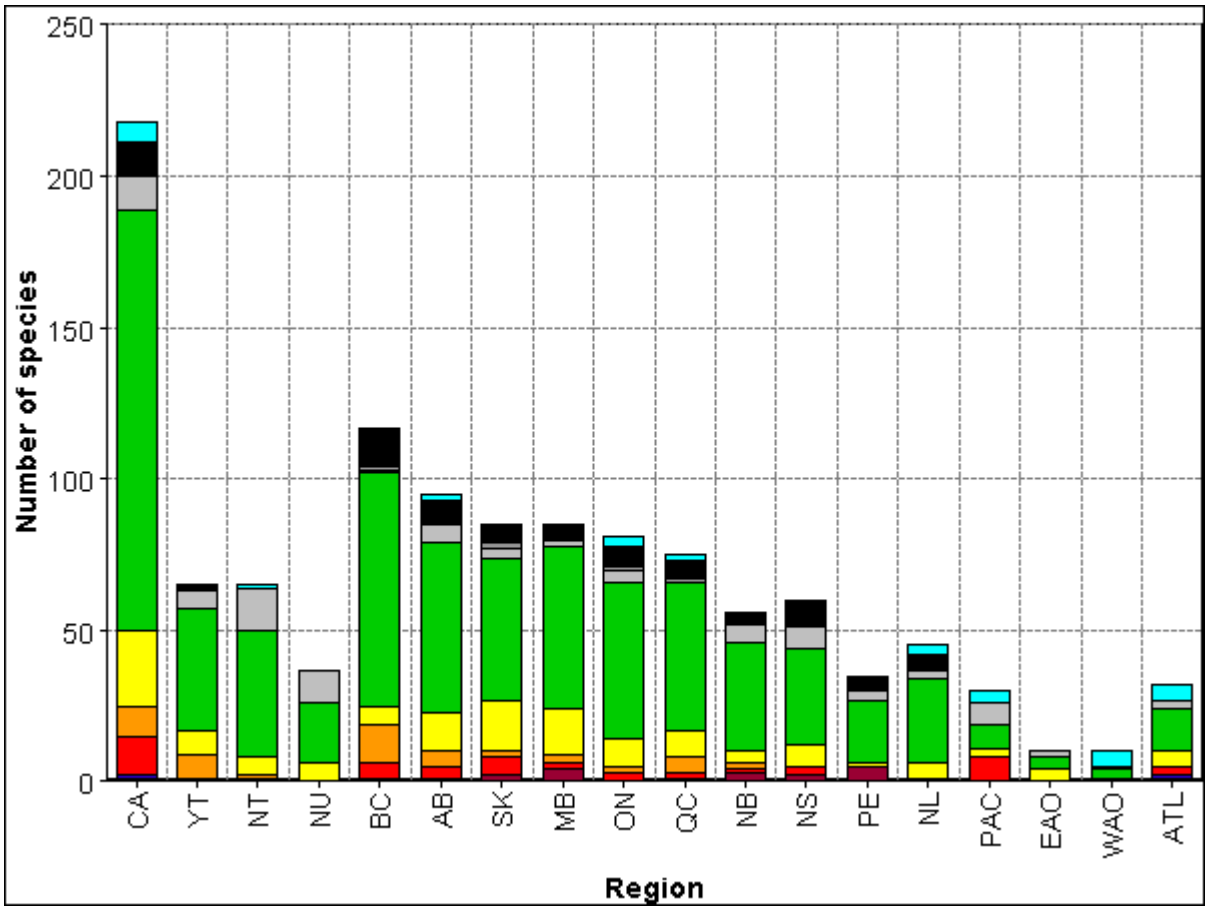
Due to its small range and small population size in Canada, and because its forested habitat is under threat from human development, Common Grey Fox has a Canada rank of *At Risk*. This rank has changed from *Not Assessed* in *Wild Species 2000*, due to an updated COSEWIC status assessment of Threatened.

Results of assessment

The majority of mammals have Canada ranks of *Secure* (64%, 139 species, Figures 2-10-1 and 2-10-ii, Table 2-10-i). However, 11% have Canada ranks of *Sensitive* (25 species), 6% have Canada ranks of *At Risk* (13 species), 5% have Canada ranks of *May Be At Risk* (10 species), and a total of 1% have Canada ranks of *Extirpated* (one species, Black-footed Ferret, *Mustela nigripes*) and *Extinct* (one species, Sea Mink, *Mustela macrodon*). In addition, 5% of mammal species have Canada ranks of *Exotic* (11 species), 5% have Canada ranks of *Undetermined* (11 species), and 3% have Canada ranks of *Accidental* (seven species).

Compared to terrestrial and freshwater mammals, a lower proportion of marine mammals have Canada ranks of *Secure* (terrestrial and freshwater mammals: 70% vs. marine mammals: 43%, Figure 2-10-iii, Table 2-10-ii), *May Be At Risk* (6% vs. 0%) and *Exotic* (7% vs. 0%), whereas a relatively high proportion of marine mammal species have Canada ranks of *At Risk* (terrestrial and freshwater mammals: 5% vs. marine mammals: 10%), *Sensitive* (9% vs. 18%), *Undetermined* (2 % vs. 16%), and *Accidental* (1% vs. 10%).

Figure 2-10-i: Summary of the species richness and 2005 general status ranks of mammals in Canada.

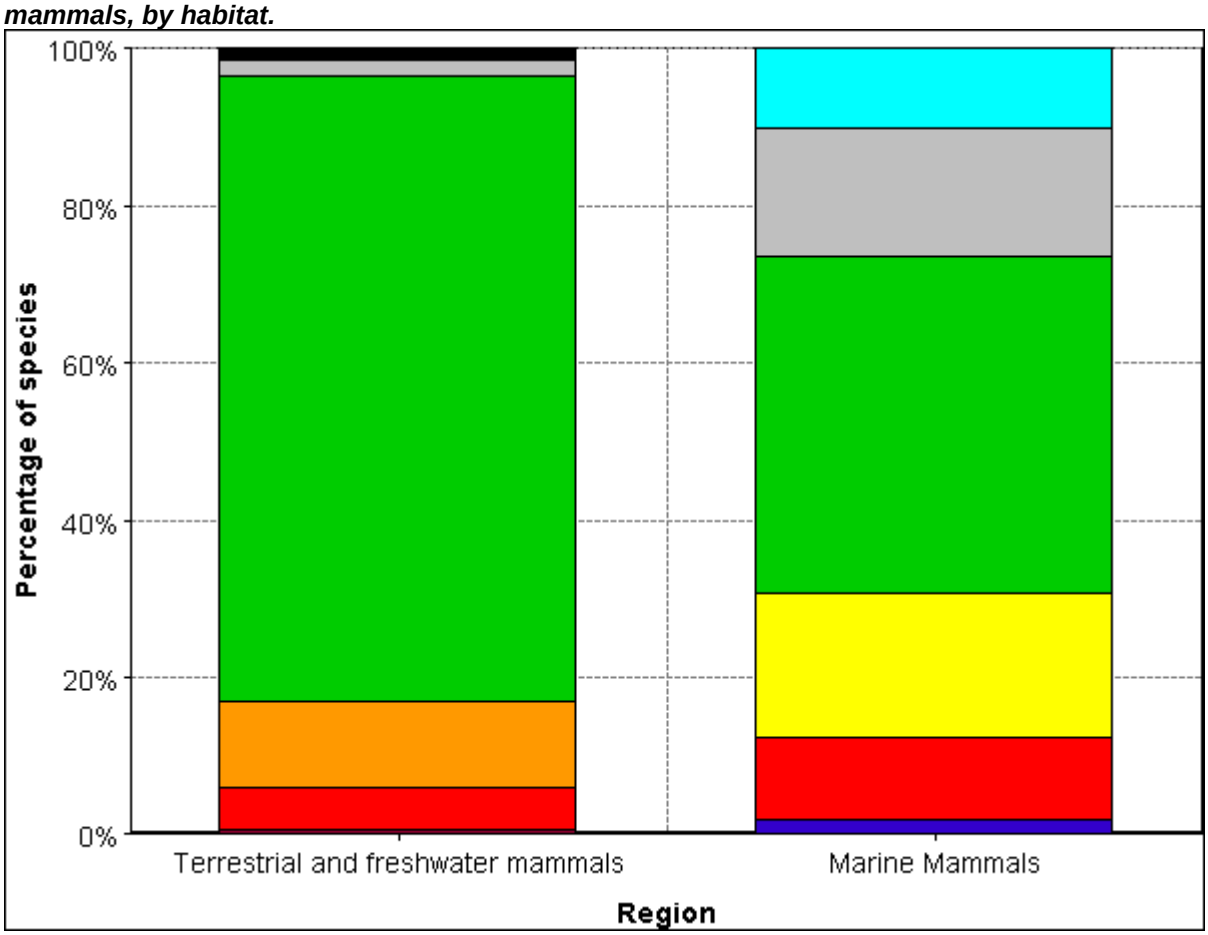


Percentage

Table 2-10-i: Summary of the 2005 general status ranks of mammal species in Canada.

	CA	YT	NT	NU	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	PAC	EAO	WAO	ATL
Extirpated	1	0	0	0	1	1	2	4	0	1	3	2	5	0	0	0	0	1
Extinct	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
At risk	13	1	1	0	5	4	6	2	3	2	1	3	0	1	8	0	0	3
May be at risk	10	8	1	0	13	5	2	3	2	5	2	0	0	0	0	0	0	0
Sensitive	25	8	6	6	6	13	17	15	9	9	4	7	1	5	3	4	1	5
Secure	139	40	42	20	77	56	47	54	52	49	36	32	21	28	8	4	3	14
Undetermined	11	6	14	11	1	6	3	2	4	0	6	7	3	3	7	2	1	3
Not assessed	0	0	0	0	1	0	2	0	1	1	0	0	0	0	0	0	0	0
Exotic	11	2	0	0	12	8	5	4	7	6	4	8	4	5	0	0	0	0
Accidental	7	0	1	0	1	2	1	1	3	2	0	1	1	3	4	0	5	5
Total	218	65	65	37	117	95	85	85	81	75	56	60	35	45	30	10	10	32

Figure 2-10-iii: Comparison of the 2005 Canada General Status Ranks (Canada ranks) of mammals, by habitat.



Number of species

Table 2-10-ii: Summary of the 2005 general status ranks of mammals in Canada, by habitat.

Rank			Terrestrial and freshwater mammals	Marine Mammals
	0.1	Extirpated	1	0
	0.2	Extinct	0	1
	1	At risk	8	5
	2	May be at risk	10	0
	3	Sensitive	16	9
	4	Secure	118	21
	5	Undetermined	3	8
	7	Exotic	11	0
	8	Accidental	2	5
Total			**169**	**49**

Footnote: In Wild species 2000, species assessment results were presented as the proportion of

resident species ('resident species' excludes species with Canada ranks of Extirpated, Extinct and Accidental). In this report, we have used the more straightforward method of presenting results as a proportion of total species richness. Therefore, proportions given in the 'Results of assessment' sub-sections cannot be directly compared to results given in the text of Wild Species 2000. To compare results for terrestrial and freshwater mammals directly between the text of Wild Species 2000 and this report please use the following figures, which represent the 2000 results as a proportion of total species richness: Total species richness: 167 species; Extinct/Extirpated: 1%, At Risk: 3%, May Be At Risk: 5%, Sensitive: 14%, Secure: 65%, Undetermined: 4%, Not Assessed: 1%, Exotic: 7%, Accidental: 1%. For marine mammals: Total species richness: 48 species; Extinct/Extirpated: 2%, At Risk: 6%, May Be At Risk: 0%, Sensitive: 10%, Secure: 65%, Undetermined: 8%, Not Assessed: 4%, Exotic: 0%, Accidental: 4%.

Comparison with Wild Species 2000

Since *Wild Species 2000*, taxonomic changes have been made to four groups of species, due to new genetic analyses; Eastern Wolf (*Canis lycaon*) is now ranked separately from Grey Wolf (*Canis lupus*), Maritime Shrew (*Sorex maritimensis*) is now ranked separately from Long-tailed Shrew (*Sorex dispar*), Eastern Heather Vole (*Phenacomys ungava*) is now ranked separately from Western Heather Vole (*Phenacomys intermedius*), and North Pacific Right Whale (*Eubalaena japonica*) is now ranked separately from North Atlantic Right Whale (*Eubalaena glacialis*). In addition, Nutria (*Myocastor coypus*), ranked *Exotic* in 2000, has been removed from the national list.

Of the 210 species that were ranked in both 2000 and 2005, the majority retain the same Canada rank they were given in 2000 (81%, 170 species). However, 3% have changed to a Canada rank with a reduced level of risk (seven species), 5% have changed to a Canada rank with an increased level of risk (ten species) and 11% have been moved into or out of the *Undetermined*, *Not Assessed* or *Accidental* categories (23 species). The majority of these changes were due to new or updated COSEWIC assessments (40%, 16 changes, Table 2-10-iii), or changes in process[1] (35%, 14 changes). In addition, 13% of changes were due to new or improved information (five changes), 8% of changes were due to a combination of new or updated information and changes in process (three changes), 3% of changes were due to a combination of biological change and new or improved information (one changes) and 3% were due to biological change in species population size, distribution, trends or threats (one species). Changes in Canada rank have not led to substantial changes in the proportion of species ranked in each category (Table 2-10-iv).

***Table 2-10-iii: Species summary of Canada General Status Rank (Canada rank) changes between* Wild Species 2000 *and* Wild Species 2005.**

2005 Canada rank	2000 Canada rank	English name	Scientific name	Reason for change [a]
At Risk	Sensitive	American Bison	Bos bison	C
At Risk	Sensitive	Blue Whale	Balaenoptera musculus	C
At Risk	Undetermined	Common Grey Fox	Urocyon cinereoargenteus	C
At Risk	Not Assessed	Sei Whale	Balaenoptera borealis	C
May be at risk	Sensitive	Great Basin Pocket Mouse	Perognathus parvus	B
May be at risk	Sensitive	Black-tailed Prairie Dog	Cynomys ludovicianus	C
May be at risk	Undetermined	Western Harvest Mouse	Reithrodontomys megalotis	P
Sensitive	At Risk	Bowhead Whale	Balaena mysticetus	C
Sensitive	Secure	Northern Sea Lion	Eumetopias jubatus	C
Sensitive	Secure	Gray Whale	Eschrichtius robustus	C
Sensitive	Secure	Narwhal	Monodon monoceros	C
Sensitive	Secure	Atlantic Walrus	Odobenus rosmarus	I/B
Secure	Undetermined	Harbour Porpoise	Phocoena phocoena	C
Secure	Undetermined	Killer Whale	Orcinus orca	C
Secure	Sensitive	Cascade-mantled Ground Squirrel	Spermophilus saturatus	C
Secure	Sensitive	Pronghorn	Antilocapra americana	I/B
Secure	Undetermined	Southern Flying Squirrel	Glaucomys volans	I/B
Secure	Sensitive	Northern Long-eared Myotis	Myotis septentrionalis	P
Secure	Sensitive	Eastern Red Bat	Lasiurus borealis	P
Secure	Undetermined	Harbour Seal	Phoca vitulina	I
Secure	Undetermined	Northern Collared Lemming	Dicrostonyx groenlandicus	I
Secure	Undetermined	Thirteen-lined Ground Squirrel	Spermophilus tridecemlineatus	P
Secure	Undetermined	Richardson's Collared Lemming	Dicrostonyx richardsoni	P/I
Secure	Undetermined	Prairie Vole	Microtus ochrogaster	P/I
Undetermined	May be at risk	Western Red Bat	Lasiurus blossevillii	I
Undetermined	Sensitive	Ogilvie Mountain Collared Lemming	Dicrostonyx nunatakensis	I
Undetermined	Secure	Risso's Dolphin	Grampus griseus	I
Undetermined	Secure	Baird's Beaked Whale	Berardius bairdii	I
Undetermined	Secure	Short-finned Pilot Whale	Globicephala macrorhynchus	I
Undetermined	Secure	Hubb's Beaked Whale	Mesoplodon carlhubbsi	I

2005 Canada rank	2000 Canada rank	English name	Scientific name	Reason for change [a]
Undetermined	Secure	Stejneger's Beaked Whale	Mesoplodon stejnegeri	I
Undetermined	Secure	False Killer Whale	Pseudorca crassidens	I
Undetermined	Secure	Barrenground Shrew	Sorex ugyunak	P
Undetermined	Not Assessed	Minke Whale	Balaenoptera borealis	I
Exotic	Not Assessed	Feral Dog	Canis familiaris	I
Accidental	Secure	Pygmy Sperm Whale	Kogia breviceps	I
Accidental	Secure	Striped Dolphin	Stenella coeruleoalba	I
Accidental	Undetermined	Dwarf Sperm Whale	Kogia simus	I

[a]C = COSEWIC assessment
P = Procedure change
I = Improved knowledge
B = Biological change

***Table 2-10-iv: Comparison of the Canada General Status Ranks (Canada ranks) of mammal species in* Wild Species 2000 *and* Wild Species 2005.**

Canada rank	Number and percentage of species in each rank in *Wild Species 2000*	Number and percentage of species in each rank in *Wild Species 2005*	Summary of change	Reason(s) for change(s)
Extirpated/Extinct	2 (1%)	-- [a]		
Extinct	-- [a]	1 (<1%)		
Extirpated	-- [a]	1 (<1%)		
At Risk	8 (4%)	13 (6%)	↑	Change in taxonomy [b], COSEWIC assessment [c]
May be at risk	9 (4%)	10 (5%)	↑	COSEWIC assessment [c], Biological change [d], Procedural change [e], Improved knowledge [f]
Sensitive	29 (13%)	25 (11%)	↓	Change in taxonomy [b], COSEWIC assessment [c], Biological change [d], Procedural change [e], Improved knowledge [f], Combination of new information and biological change [g]
Secure	139 (65%)	139 (64%)	↓	Change in taxonomy [b], COSEWIC assessment [c], Procedural change [e], Improved knowledge [f], Combination of new information and biological change [g], Combination of procedural change and new information [h]
Undetermined	10 (5%)	11 (5%)	↔	COSEWIC assessment [c], Procedural change [e], Improved knowledge [f], Combination of procedural change and new information [h]
Not Assessed	3 (1%)	0	↓	COSEWIC assessment [c], Improved knowledge [f]
Exotic	11 (5%)	11 (5%)	↑	Improved knowledge [f]
Accidental	4 (2%)	7 (3%)	↑	Procedural change [e], Combination of procedural change and new information [h]

Key to symbols:

↑ Number of species in this category has increased.

↓ Number of species in this category has decreased.

↔ An equal number of species have been added and removed from this category; no net change.

= No species have been added or removed from this category.

[a] *The single category of Extinct/extirpated in Wild Species 2000, was replaced with two separate categories in 2005; Extinct and Extirpated. See the Background section for details.*
[b] *A change in taxonomy has resulted in a species being added to the national list.*
[c] *A formal COSEWIC assessment has been conducted, and used as evidence for a change in rank. A biological change (i.e. a change in species population, distribution or threats) since 2000 is not suggested.*
[d] *A biological change (i.e. a change in species population, distribution or threats) has lead to a change in rank.*
[e] *A different process has been used for assigning ranks, leading to a change in the Canada rank.*
[f] *New information has been collected or brought to light, and used as evidence for a change in rank. A biological change (i.e. a change in species population, distribution or threats) since 2000 is not suggested.*
[g] *A combination of new information and biological change (i.e. a change in species population, distribution or threats) has lead to a change in rank.*
[h] *A combination of new information and a change in the procedure for assigning Canada ranks has led to a change in rank.*

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[1]For all groups covered in this report, national ranks are generally given based on the regional rank with the lowest level of risk. For example if the provincial and territorial ranks for a species are a mixture of Sensitive and Secure, the default Canada rank is Secure (see main background section for more details and some exceptions to this generalisation) This rule-of-thumb was not followed for all species when Canada ranks for mammals were finalized in 2000. Therefore, some of the Canada rank changes for mammals are due primarily to the different procedures followed in 2000 and 2005 and are classified as procedural changes. These changes help to ensure that Canada ranks are comparable both within and among taxa.

Threats to mammals in Canada

Mammals are a large and varied group, and the threats facing them are similarly varied. Habitat loss, fragmentation and degradation are important threats for many mammal species, especially large mammals, habitat specialists and mammals whose range overlaps areas of dense human habitation. Other threats to Canadian mammals include overexploitation, disease, exotic species, hybridization and climate change. In addition, lack of information on mammals such as bats and shrews make it difficult to detect or reverse population declines.

Marine mammals typically face a different set of threats to freshwater and terrestrial mammals. In particular, human activities at sea can often be harmful to marine mammals. Two of the greatest threats are entanglements with fishing gear and collisions with boats. In addition, from petroleum activity, such as seismic exploration, and commercial ship traffic may cause physical damage to marine mammal hearing or interfere with their feeding, migration or communication. Commercial ship traffic is responsible for much of the noise pollution found in the world's oceans today. Considerable work remains to be completed to explore these impacts more fully.

Exposure of marine mammals to pollutants has been much publicised. For example, the resident Killer Whales (*Orcinus orca*) of the Pacific coast are among the most contaminated marine mammals in the world. Marine mammals are vulnerable to pollutants for several reasons including their position at, or close to, the top of the food chain, and their long life cycles. Marine mammals generally do not metabolise pollutants well. Instead they are stored in the blubber, from where they can be passed to the young during suckling, or to predators, including humans. Marine mammals with high levels of contamination can face reduced survival and suppression of the immune system leading to increased rates of disease. However, it if difficult to make direct links between high levels of contamination and population declines.

Conclusion

Compared to terrestrial and freshwater mammals, the proportion of marine mammals ranked *Secure* is low, and the proportion of marine mammals with Canada ranks of *At Risk*, *Sensitive* or *Undetermined* is high. This reflects both the increased risks faced by marine mammals, as well how much more we need to learn about marine ecosystems and the species that live there.

This updated general status assessment of mammals allowed the general status national mammal lists to be updated with the latest scientific knowledge. Although the Canada ranks of X18% of mammal species were altered, the overall proportion of mammal species in each of the general status categories has not changed substantially since 2000.

Further information

Banfield, A. W. F. 1977. The mammals of Canada. University of Toronto Press, Toronto, Ontario. 438 pp

Cetacean Research & Rescue Unit. Bottlenose whale (Hyperoodon ampullatus). http://www.crru.org.uk/education/factfiles/bnwhale.htm (Accessed November 3, 2005).

Fisheries and Oceans Canada. 2006. Observatoire du Saint-Laurent/St. Lawrence Observatory. Marine mammal research. http://www.osl.gc.ca/mm/en/index.html (Accessed February 10, 2006).

Fisheries and Oceans Canada. 2005. Arctic marine mammal ecology and assessment research section. http://www.dfo-mpo.gc.ca/regions/central/science/arcres/mam_e.htm (Accessed February 10, 2006).

Fisheries and Oceans Canada. 2005. Cetacean research program. http://www-sci.pac.dfo-mpo.gc.ca/sa/cetacean/default_e.htm (Accessed February 10, 2006).

Fisheries and Oceans Canada. 2004. Aquatic species at risk - Killer Whale, Northeast Pacific transient population. http://www.dfo-mpo.gc.ca/species-especes/species/species_killerWhale_NE_Pac_e.asp (Accessed 16 January, 2006).

Fisheries and Oceans Canada. 2004. Aquatic species at risk - Northern Bottlenose Whale, Scotian Shelf population. http://www.dfo-mpo.gc.ca/species-especes/species/species_northernBottlenoseWhale_e.asp (Accessed November 3, 2005).

Forsyth, A. 1985. Mammals of the Canadian wild. Camden House, Camden East, Ontario. 351 pp

Gaskin, D. E. 1972. Whales, dolphins and seals. Heinemann educational books, Auckland. 200 pp

Hebridean Whale and Dolphin Trust. Northern Bottlenose Whale, *Hyperoodon ampullatus*. http://www.whaledolphintrust.co.uk/whales_dolphins/northern-bottlenose-whale.asp (Accessed November 3, 2005).

Jansa, S. 1999. *Urocyon cinereoargenteus*. Animal Diversity Web. http://animaldiversity.ummz.umich.edu/site/accounts/information/Urocyon_cinereoargenteus.html (Accessed January 16, 2006).

MarineBio.org. 2005. Northern bottlenose whale - Hyperoodon ampullatus. http://marinebio.org/species.asp?id=324 (Accessed November 3, 2005).

Ollendorff, J. 2002. Myotis septentrionalis. Animal Diversity Web. http://animaldiversity.ummz.umich.edu/site/accounts/information/Myotis_septentrionalis.html (Accessed January 16, 2006).

Savage, A. and Savage, C. 1981. Wild mammals of western Canada. Western Producer Prairie Book, Saskatoon, Saskatchewan. 209 pp

References

Barber, K. (Ed). 1998. The Canadian Oxford Dictionary. Oxford University Press. Toronto, Oxford, New York. 1707 pp

Broders, H. G. and Forbes, G. J. 2004. Interspecific and intersexual variation in roost-site selection of northern long-eared and little brown bats in the Greater Fundy National Park ecosystem. Journal of Wildlife Management 68(3):602-610

Broders, H. G., Quinn, G. M., and Forbes, G. J. 2003 Species status, and the spatial and temporal patterns of activity of bats in southwest Nova Scotia, Canada. Northeastern Naturalist: 10(4):383-398

Burtenshaw, J. C., Oleson, E. M., Hildebrand, J. A., McDonald, M. A., Andrew, R. K., Howe, B. M. and Mercer, J. A. 2004. Acoustic and satellite remote sensing of blue whale seasonality and habitat in the Northeast Pacific. Deep-Sea Research II 51:967-986

Caceres, M. C. and Pybus, M. J. 1997. Status of the northern long-eared bat (*Myotis septentrionalis*) in Alberta. Alberta Environmental Protection, Wildlife Management Division, Wildlife Status Report No. 3, Edmonton, Alberta. 19 pp

COSEWIC. 2002. COSEWIC assessment and update status report on the grey fox *Urocyon cinereoargenteus interior* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Canada. vi + 32 pp

COSEWIC. 2002. COSEWIC assessment and update status report on the northern bottlenose whale *Hyperoodon ampullatus* (Scotian shelf population) in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Canada. vi + 22 pp

Fuller, T. K. and Cypher, B. L. 2004. Grey Fox, *Urocyon cinereoargenteus. In* Sillero-Zubiri, C., Hoffmann, M. and Macdonald, D.W. (eds). 2004. Canids: Foxes, wolves, jackals and dogs. Status survey and conservation action plan. IUCN/SSC Canid Specialist Group. Gland, Switzerland and Cambridge, UK. x + 430 pp

Hebblewhite, M., White, C. A., Nietvelt, C. G., McKenzie, J. A., Hurd, T. E., Fryxell, J. M., Bayley, S. E. and Paquet, P. C. 2005. Human activity mediates a trophic cascade caused by wolves. Ecology 86(8):2135-2144

Jung, T. S., Thompson, I. D. and Titman, R. D. 2004. Roost site selection by forest-dwelling male Myotis in central Ontario, Canada. Forest Ecology and Management 202:325-335

Patriquin, K. J. and Barclay, R. M. R. 2003. Foraging by bats in cleared, thinned and unharvested boreal forest. Journal of Applied Ecology 40:646-657

Section 3: Summary of overall results

This report represents a huge achievement, by presenting general status assessments for all of Canada's vascular plant species, all of Canada's vertebrate species, and four groups of invertebrates. The largest group assessed was the vascular plants, with 5078 species, demonstrating the commitment of botanists across the country to assessing and conserving Canada's plants. Despite the number and variety of species assessed, this report represents only about 10% of the total number of species that have been described in Canada! The most species rich regions are Ontario (4056 species, Figure 3-1), British Columbia (3627 species) and Quebec (3330 species), due to the variation in climate and geology that provide diverse habitats in which different species can survive. However, the region with the highest diversity (species richness/area) is Prince Edward Island; the region where you can see the highest number of species in the smallest area!

The majority of the 7736 species assessed in this report received Canada ranks of *Secure* (3543 species, 46%, Figures 3-1 and 3-2). This number varied by species group, ranging from 17% (fishes) to 70% (tiger beetles). Similarly the proportion of species with Canada ranks of *At Risk* and *May Be At Risk* ranged from 0% (crayfishes) to 32% (reptiles, Figure 3-3). However, part of the variation in the proportion of species with low or high levels of risk is associated with variation in the proportion of species with Canada ranks of *Undetermined*, *Not Assessed*, *Exotic* or *Accidental* (e.g. fishes has a large proportion of species ranked *Undetermined* and *Not Assessed*, and a correspondingly small proportion of species ranked *Secure*). Therefore, to get a clearer picture of which species groups are most secure, or most at risk, we can focus just on species with Canada ranks of *At Risk*, *May Be At Risk*, *Sensitive* and *Secure* (Figure 3-4). This shows that reptiles and freshwater mussels have the lowest proportion of species with Canada ranks of *Secure* and the highest proportion of species with Canada ranks of *At Risk* and *May Be At Risk*. Amphibians also have a high proportion of species ranked *At Risk*. A similar graph, comparing regional ranks among provinces, territories and ocean regions, shows that the four ocean regions, and especially the Eastern Arctic Ocean region, have relatively high proportions of species ranked *At Risk* (Figure 3-5).

Exotic species have been introduced to Canada, both deliberately and accidentally, from around the world. In addition, species with regional ranks of *Exotic* are often native species that have been moved from regions of the country in which they traditionally occur, to regions in which they are not naturally found. Whether from abroad, or from a different part of Canada, *Exotic* species can cause problems for native species in a variety of ways, including competition for space and resources, predation, hybridization and introduction of new diseases. Most of the species that were given a Canada rank of *Exotic* in this report are vascular plants (Table 3-1); in fact, vascular plants have the highest proportion of *Exotic* species of any group covered in this report (Figure 3-6). Crayfishes also have a high proportion of species with Canada ranks of *Exotic*. However, the species group with the lowest proportion of regularly occurring, native species is the birds, since a large proportion of bird species are *Accidental* (i.e. do not regularly occur in Canada). The proportion of regularly occurring, native species is higher in the territories than in the provinces (Figure 3-7). This is probably due to a combination of reduced human activity in the north, the harsh climate, which makes it difficult for new species to survive, and the distance from sources of non-native species.

For most species groups and regions, the proportion of species ranked *Undetermined* or *Not Assessed* is low, typically less than 10% (Figures 3-8 and 3-9). This shows how much importance was placed on gathering together enough information to allow a true assessment of each species. We hope that this report will encourage more information to be collected on species currently ranked *Undetermined* or *Not Assessed*. The fishes, in particular the marine fishes, had a much higher proportion of species with Canada ranks of *Undetermined* or *Not Assessed* than any other group. This reflects the difficulty of surveying fishes in remote, off-shore locations. Without information on the status of these species, it is difficult to judge how human uses of the oceans affect ocean ecosystems and species.

One of the important achievements of this report is to update the status assessments of ferns and orchids, freshwater fishes, amphibians, reptiles, birds and mammals. Updates have resulted in the addition of 28 new species to the national list, due to a combination of species that are new to

Canada, and taxonomic changes. Just as importantly, 35 species have been removed from the national list, primarily due to taxonomic changes. Updating the national species lists in this way, keeps the general status program and the *Wild Species* series abreast of the latest scientific knowledge.

Of the 1330 species that were ranked in both 2000 and 2005, the vast majority have retained the Canada rank they were given in 2000 (1164 species, 87%, Figure 3-10). Of the 166 changes that were made to Canada ranks, most were due to changes in process (40%, 66 changes, Figure 3-11) or to new or updated Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessments (33%, 54 changes). Only 10 changes (6%) were wholly or partly due to biological change in species population size, distribution, threats or trends. In total, 39% of changes involved species moving into a rank with an increased level of risk (65 changes), 31% involved species moving into a rank with a reduced level of risk (52 changes), and 30% involved species moving into or out of the *Undetermined*, *Not Assessed*, *Accidental* or *Extirpated* ranks (50 species). Considering only the species ranked in both 2000 and 2005, changes in Canada rank have had no significant impact on the proportion of species in each general status category.

One of the aims of the *Wild Species* series is to help COSEWIC prioritize species for detailed status assessments. In this report, three groups that have not yet been covered by COSEWIC have been assessed; crayfishes, tiger beetles and odonates. Thirty-two of the 250 species in these three groups have been given Canada ranks of *May Be At Risk* (Table 3-1), suggesting that these species may require detailed COSEWIC status assessments. In addition, the general status program has built contacts and relationships with people working on these species groups that will benefit both the general status program, and COSEWIC. In the future we hope that the *Wild Species* series will continue to assess groups that have not been assessed by COSEWIC, in order to help prioritize species for detailed COSEWIC assessments. However, as the *Wild Species* program assesses species groups which are not well-known or well-studied in Canada (e.g. grasshoppers and crickets), the proportion of species that receive ranks of *Undetermined* and *Not Assessed* is likely to rise.

Figure 3-1: Summary of the species richness and 2005 general status ranks of wild species in Canada. Species groups included: vascular plants, freshwater mussels, crayfishes, tiger beetles, odonates, fishes, amphibians, reptiles, birds and mammals. PAC = Pacific Ocean, WAO = Western Arctic Ocean, EAO = Eastern Arctic Ocean and ATL = Atlantic Ocean.

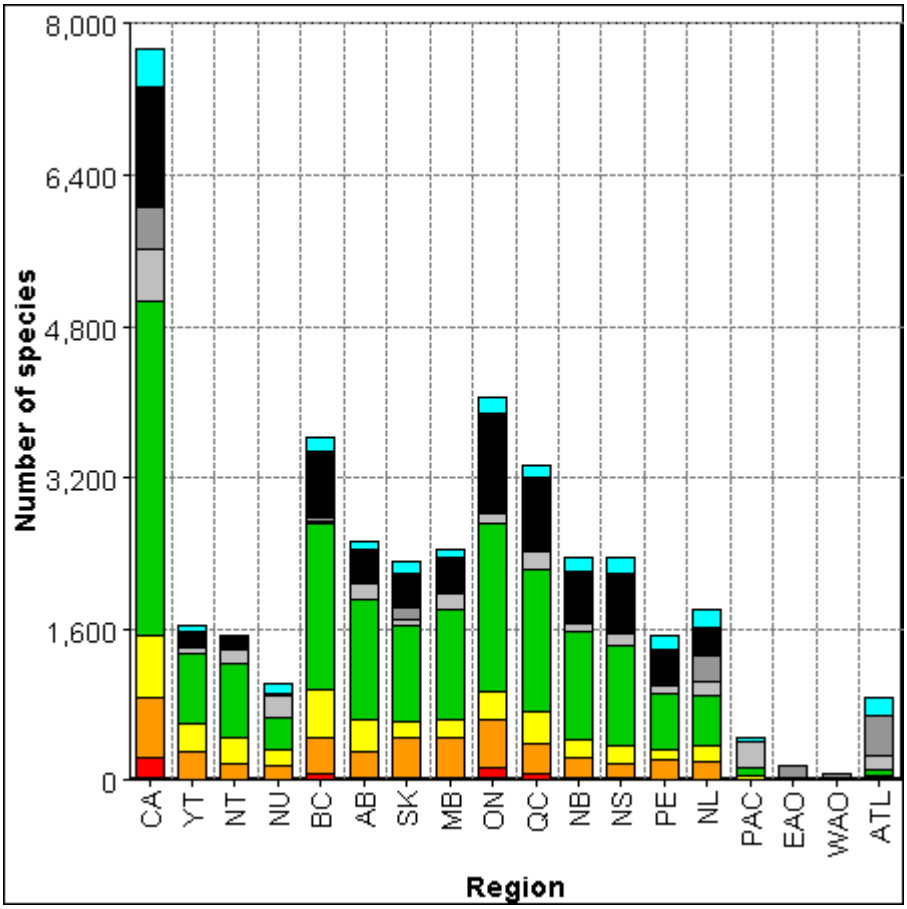


Figure 3-2: Comparison of 2005 general status ranks of wild species across Canada. Species groups included: vascular plants, freshwater mussels, crayfishes, tiger beetles, odonates, fishes, amphibians, reptiles, birds and mammals. PAC = Pacific Ocean, WAO = Western Arctic Ocean, EAO = Eastern Arctic Ocean and ATL = Atlantic Ocean.

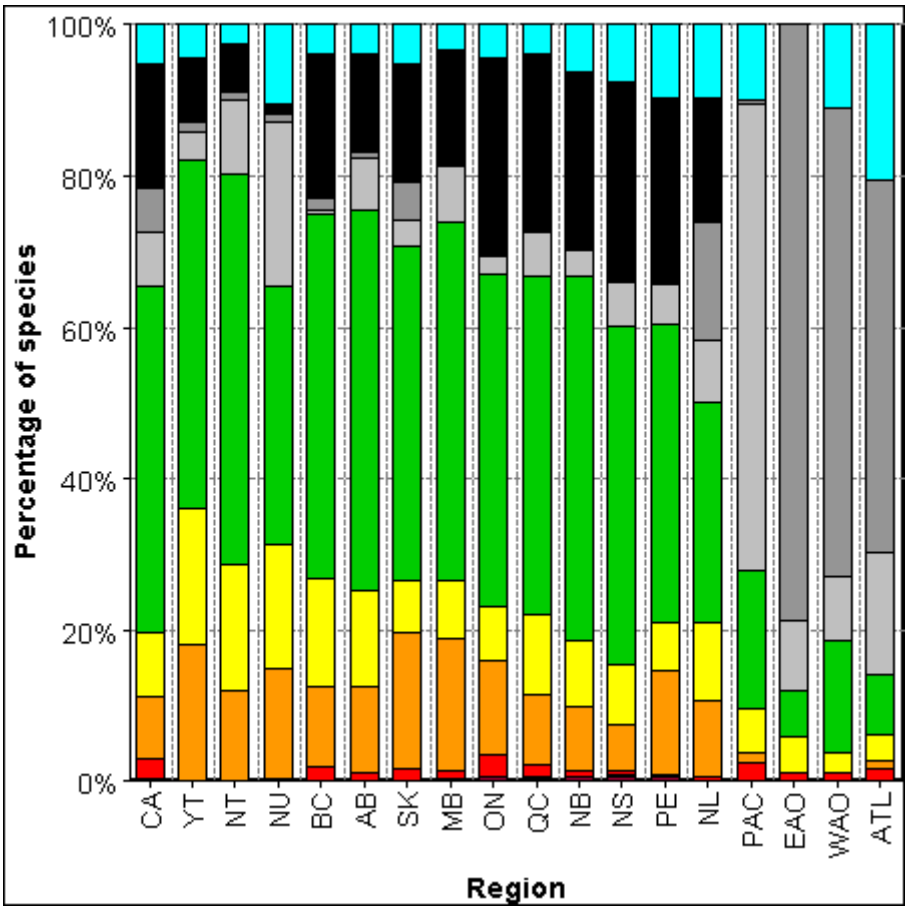


Table 3-1: Summary of the species richness and 2005 general status ranks of wild species in Canada. Species groups included: vascular plants, freshwater mussels, crayfishes, tiger beetles, odonates, fishes, amphibians, reptiles, birds and mammals. CA = Canada, PAC = Pacific Ocean, WAO = Western Arctic Ocean, EAO = Eastern Arctic Ocean and ATL = Atlantic Ocean.

Rank	CA	YT	NT	NU	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	PAC	EAO	WAO	ATL
Extirpated	30	0	0	1	8	4	3	6	30	14	13	16	12	0	0	0	0	1
Extinct	5	0	0	1	1	1	1	1	2	4	3	3	1	2	0	0	0	1
At risk	206	1	4	2	64	24	34	29	109	60	17	18	3	8	11	2	1	12
May be at risk	634	296	183	149	382	287	419	426	511	309	200	143	208	181	7	0	0	11
Sensitive	657	300	258	168	515	326	157	189	291	350	206	183	99	189	26	8	2	30
Secure	3543	757	793	350	1747	1273	1023	1155	1780	1486	1138	1061	607	521	83	10	12	69
Undetermined	534	62	152	221	19	176	75	178	98	198	80	136	80	148	282	15	7	139
Not assessed	465	22	17	10	57	23	118	2	3	7	4	2	2	281	3	130	50	430
Exotic	1256	139	98	15	699	324	361	375	1059	774	554	622	375	295	0	0	0	0
Accidental	406	72	39	106	135	100	119	79	173	128	147	179	150	174	45	0	9	178
Total	7736	1649	1544	1023	3627	2538	2310	2440	4056	3330	2362	2363	1537	1799	457	165	81	871

Figure 3-3: Comparison of 2005 general status ranks of wild species in Canada.

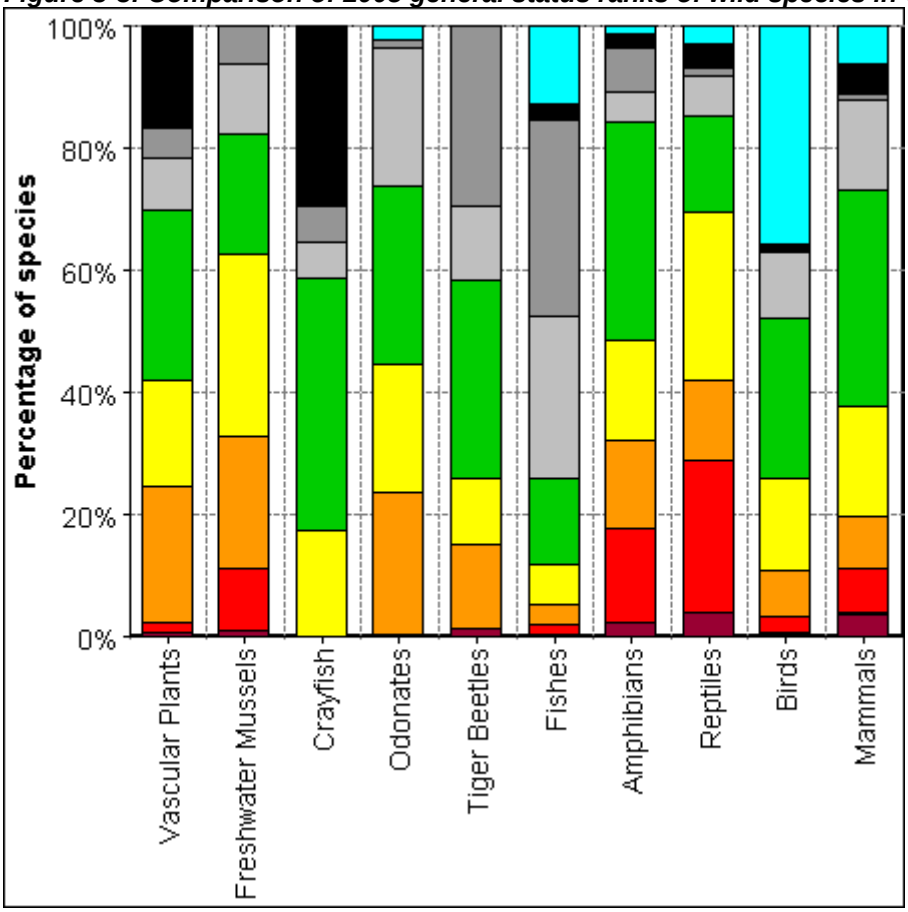


Figure 3-4: Comparison of the 2005 Canada General Status Ranks (Canada ranks), among species groups. Species ranked Extinct, Extirpated, Undetermined, Not Assessed, Exotic and Accidental are excluded.

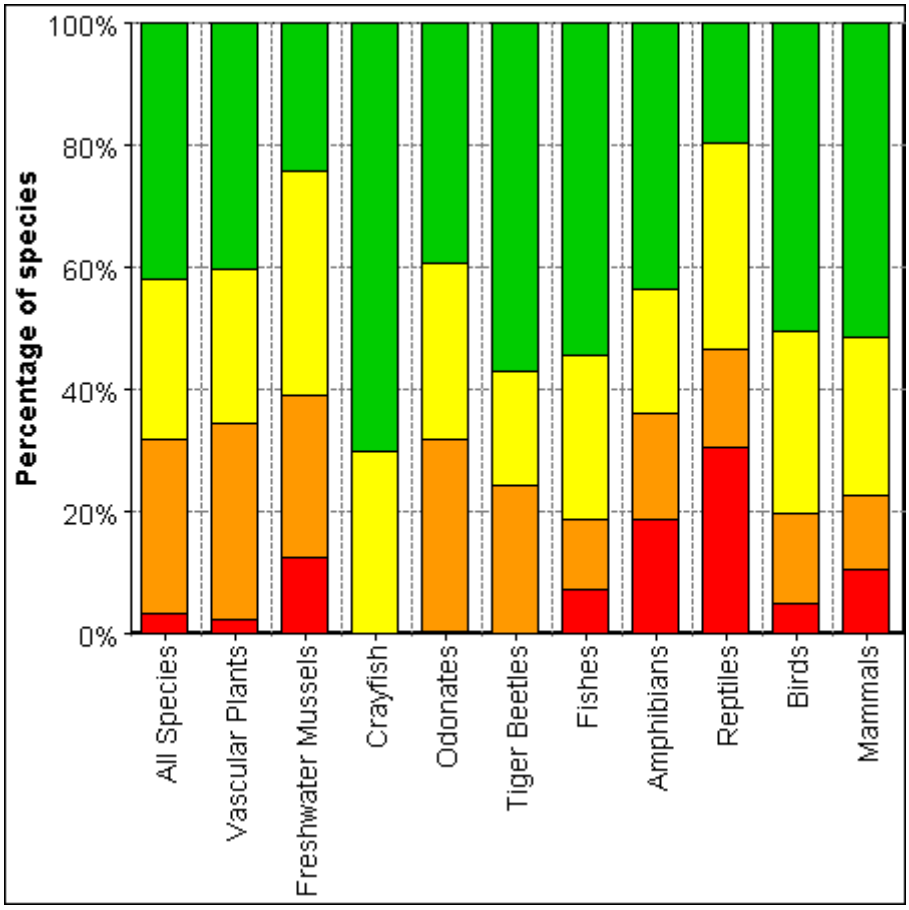


Figure 3-5: Comparison of the 2005 Canada General Status Ranks (Canada ranks), among regions. Species ranked Extinct, Extirpated, Undetermined, Not Assessed, Exotic and Accidental are excluded. PAC = Pacific Ocean, WAO = Western Arctic Ocean, EAO = Eastern Arctic Ocean and ATL = Atlantic Ocean.

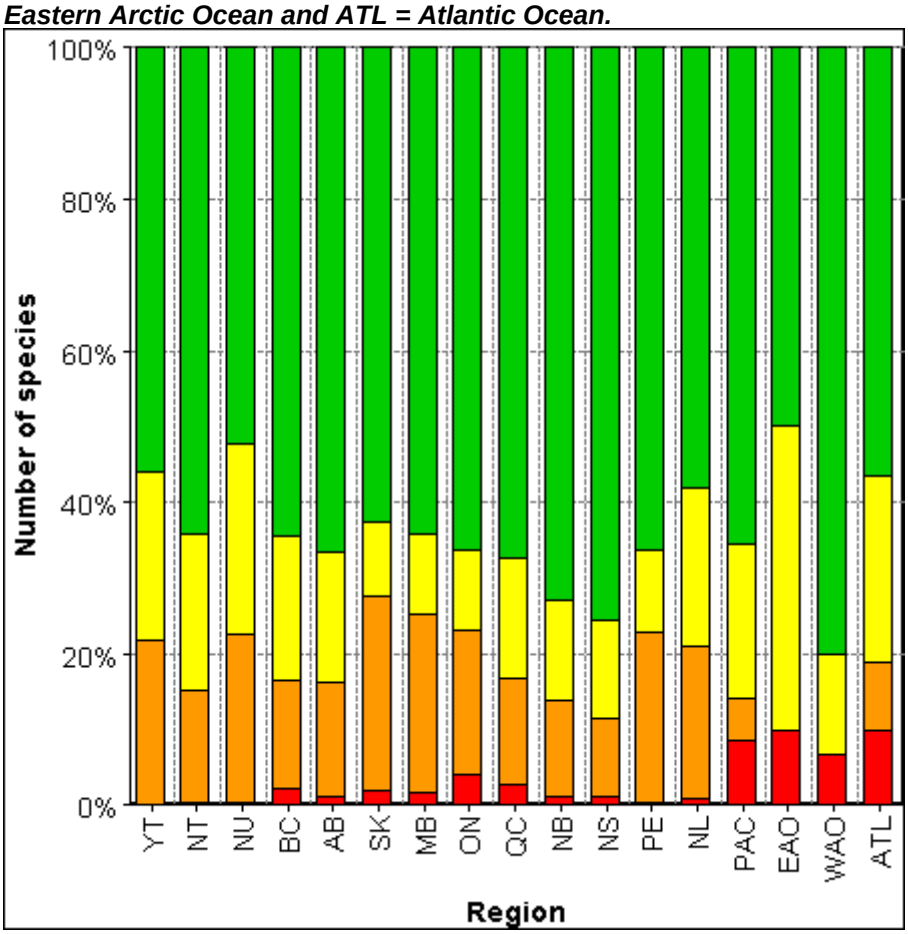


Figure 3-6: Comparison of the proportion of species ranked Exotic and Accidental among species groups.

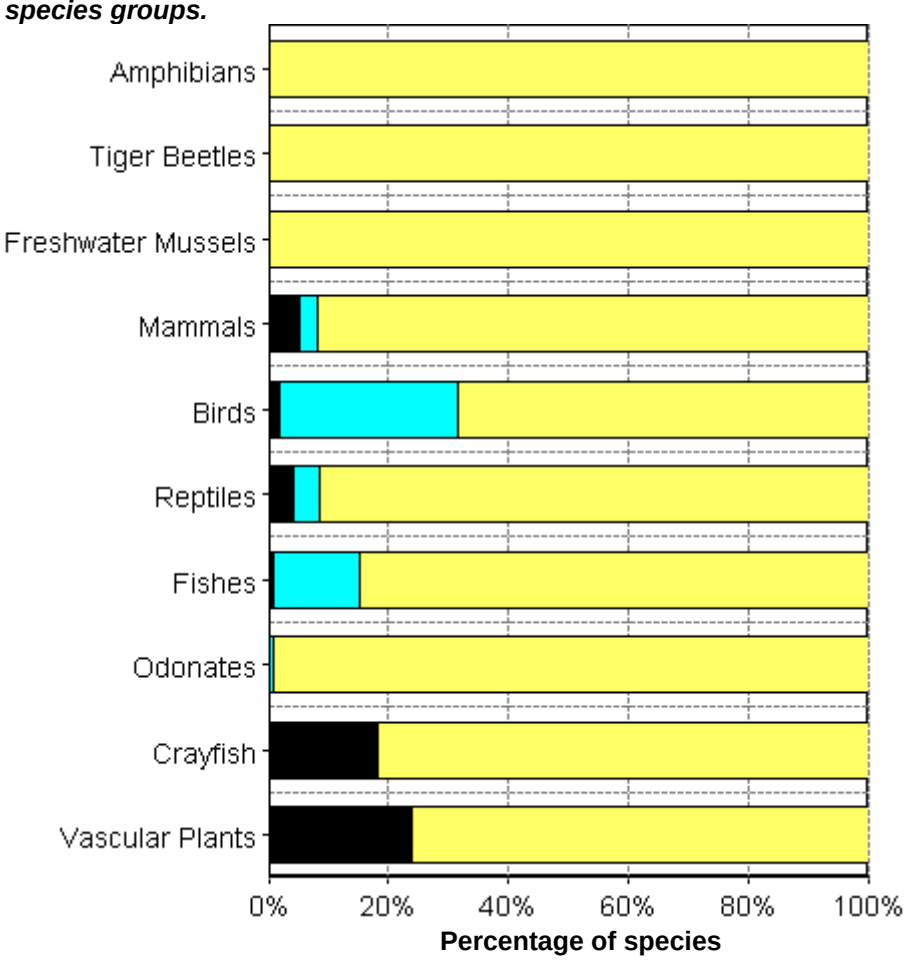


Figure 3-7: Comparison of the proportion of species ranked Exotic and Accidental among regions.

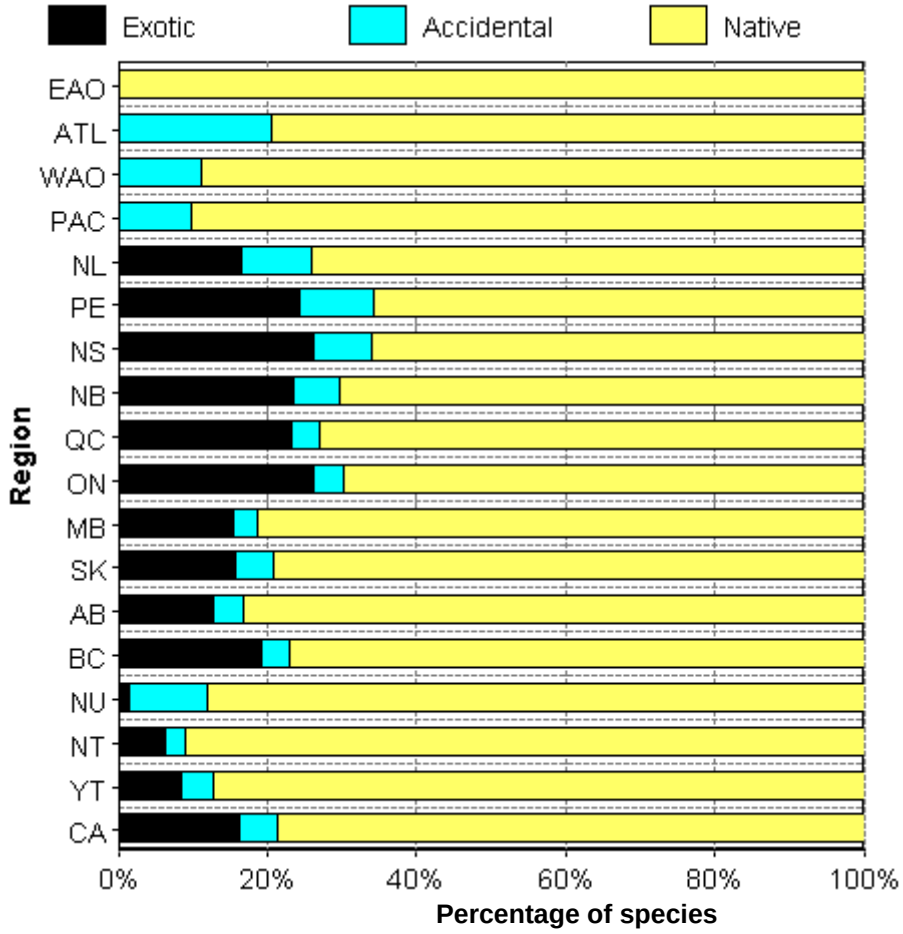


Figure 3-8: Comparison of the proportion of species ranked Undetermined and Not Assessed among species groups.

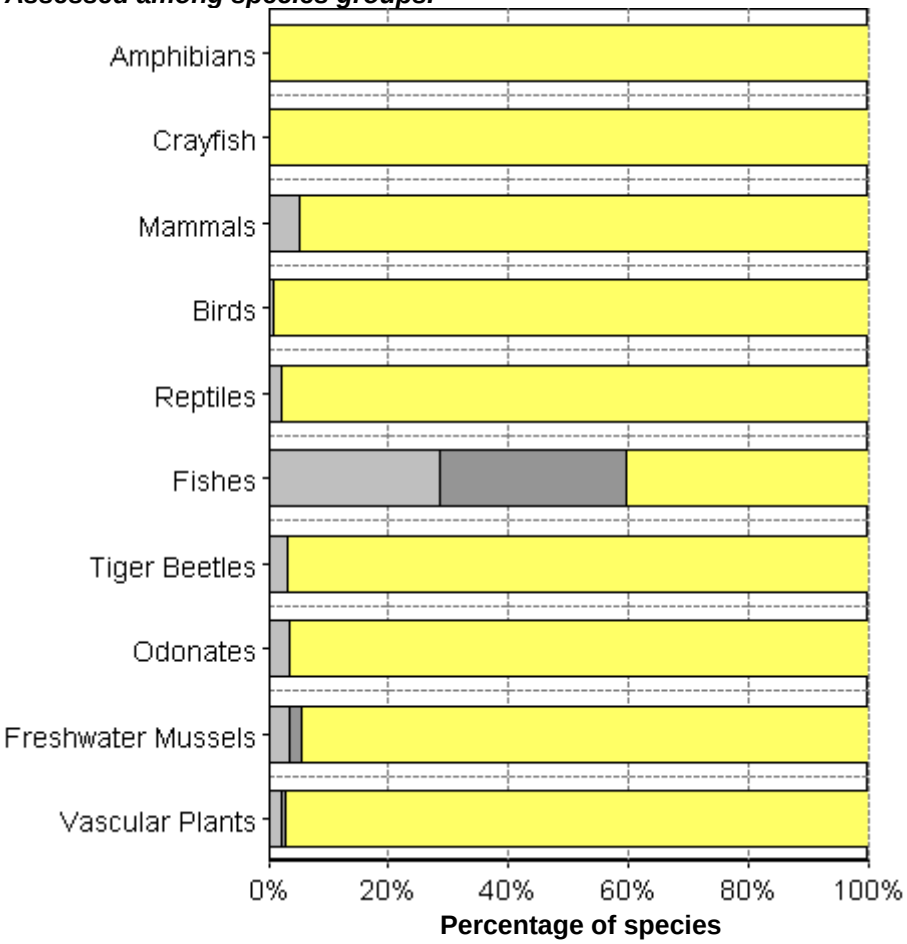


Figure 3-9: Comparison of the proportion of species ranked Undetermined and Not Assessed among regions.

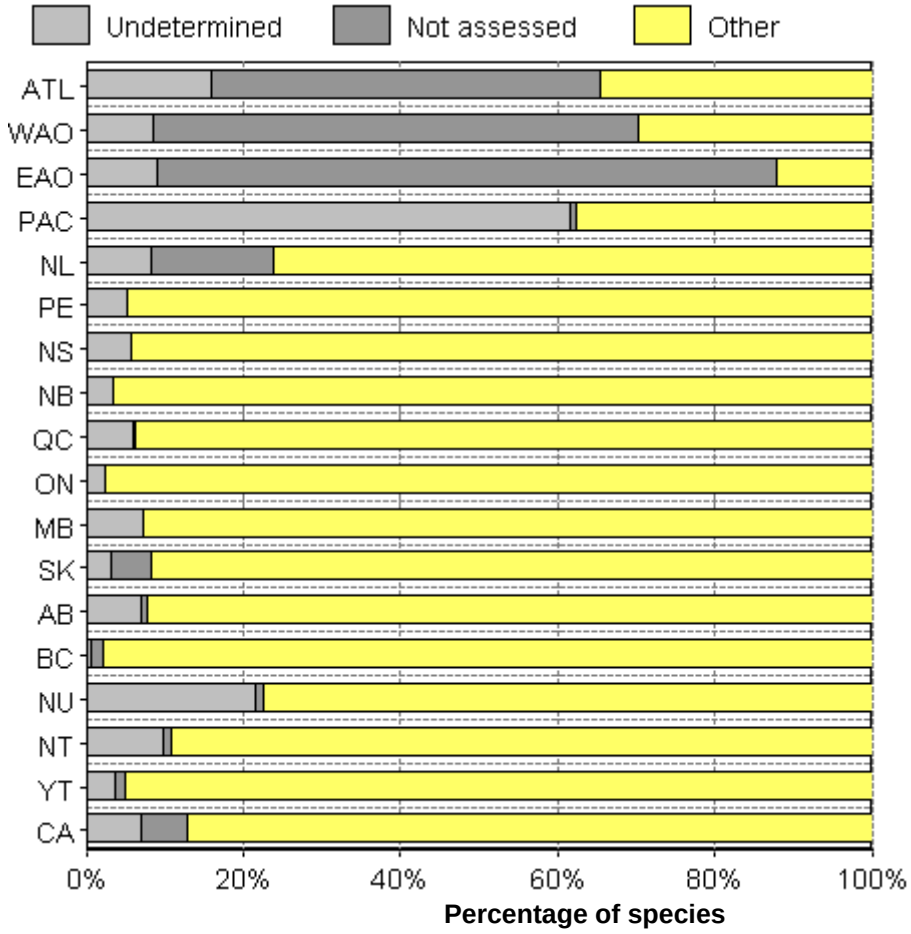
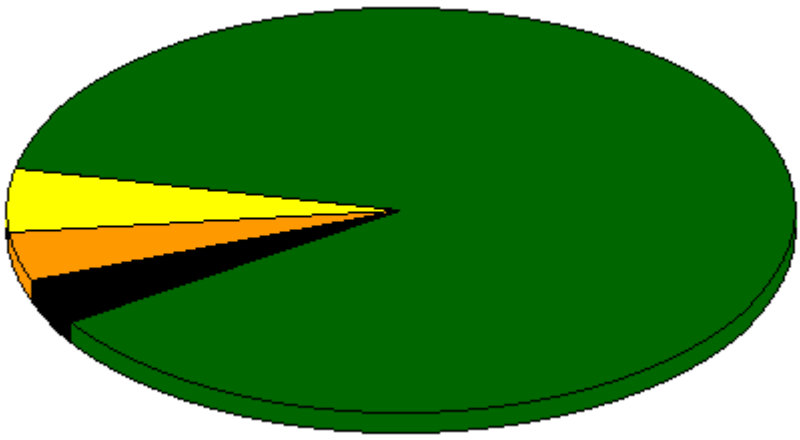
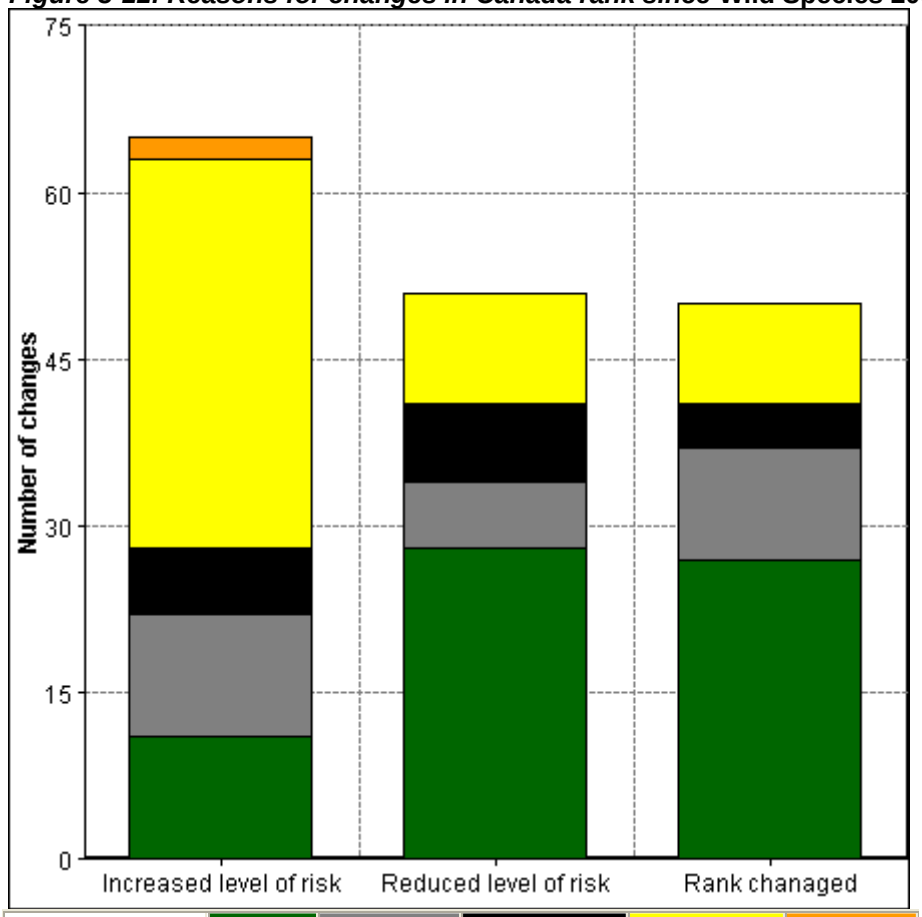


Figure 3-10: Changes in Canada rank for species ranked in both Wild Species 2000 and Wild Species 2005.



	No Change	1164
	Change to rank with increased level of risk	65
	Change to rank with reduced level of risk	51
	Rank chanaged to or from Undetermined, Not Assessed, Exotic, Accidental or Extripated categories	50

***Figure 3-11: Reasons for changes in Canada rank since* Wild Species 2000.**



	Process	Improved knowledge	Combination of reasons	New or updated COSEWIC assessment	Biological change
Change to rank with increased level of risk.	11	11	6	35	2
Change to rank with reduced level of risk.	28	6	7	10	0
Rank changed to or from Undetermined, Not Assessed, Exotic, Accidental or Extirpated categories.	27	10	4	9	0

Next Steps

The vision of the *Wild Species* series is of a single platform for wild species assessment and monitoring: a tool that allows a wide variety of species from all regions of Canada to be ranked under the same system. This allows everyone from the resource manager to the high school student the ability to place a species in a geographic, taxonomic, and ecological context, and to gain an impression of the species' general status in that context. *Wild Species 2005* has contributed to this goal by increasing the number and variety of species assessed by the general status program, and by providing updated ranks for species first assessed in 2000. However, the *Wild Species* series is a product of an ongoing, national program and the next report will aim to include an even broader diversity of species. Priorities for the future of the *Wild Species* series include:

- **Increase the number and variety of species assessed.** This report increased the number of species assessed to almost 8000, including all of Canada's vertebrate species, all of Canada's vascular plants, and four important groups of invertebrates. Still, this represents only about 10% of the species known to reside in Canada! The vast majority of species left to be assessed are insects and other invertebrates. To date, the general status program has focused on groups for which experts and information are fairly readily available. However, as the program delves deeper into insects and other invertebrates, non-vascular plants and algae, fungi and lichens, information will be less readily available and the process of assessing Canada's wild species will become even more challenging. Nevertheless, the benefits of assessing these less well-known groups will be enormous, and the results will be helpful to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in prioritizing species for detailed status assessments. In particular, the National General Status Working Group is planning on assessing the mosses, lichens, grasshoppers and crickets, and some families of moths for the next *Wild Species* report.
- **Address gaps in coverage for those species groups already assessed.** Data were lacking for some species in some regions (*Not Assessed*), or the data were insufficient to allow a confident assessment of the species' general status to be made (*Undetermined*). It is hoped that the *Wild Species* series will continue to raise the profile of existing data gaps and stimulate people either to contribute data for these species, or to collect new data to address these shortfalls. In particular, it is hoped that the *Wild Species* series will stimulate more basic survey work on the distribution and abundance of Canadian species.
- **Continue to update general status assessments.** Updating general status assessments has two benefits. Firstly it allows the incorporation of new data and new data sources, to maintain the best possible estimate of species' status. Secondly, periodically updating general status assessments will allow Canadians to track patterns of improvement or decline in species' status through time. Such patterns not only give a better indication of the nature and magnitude of a problem, but also may point the way to improved conservation practices.
- **First report under the Species At Risk Act.** Under the federal Species At Risk Act (SARA), proclaimed in June 2003, a general report on the status of wildlife in Canada must be prepared every five years and be made available to the public on the SARA public registry. The first of these reports is due in 2008, and *Wild Species 2005* will be a major source of information for this report. For more information, please visit the SARA public registry website.

  The *Wild Species* series highlights both the wealth of knowledge we have about Canada's wild species, and the information gaps that need to be filled. In the future, the *Wild Species* series will continue to consolidate our knowledge of wild species by using information from experts, both amateurs and professionals, to create a baseline for comparison of the status of Canada's species. We hope that people will be encouraged by the release of these reports to contribute data on their own, or to become involved

with general status assessments in their province or territory. If you want to help in the effort to collect information on Canada's species, see Appendix I.

Human impacts upon natural systems can be complex, subtle, and ongoing and large-scale, long-term programs, like the *Wild Species* series, are essential in understanding exactly what these impacts are. Future reports will continue to require long hours from experts across the country, but this effort is a small price to pay to help sustain Canada's majestic natural heritage.

List of Appendices

Appendix I: Contacts for members of the National General Status Working Group

For further information on the general status program in a particular region, including specific information about general status assessments or general status ranks, please contact the appropriate working group member.

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http://www3.gov.ab.ca/srd/fw/speciesatrisk/general.html

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Appendix II: Credits and Acknowledgements

Acknowledgements

The National General Status program relies on the efforts of numerous volunteers who are involved in data collection, provide their personal data for consideration during general status assessments, and participate in regional and national roll-ups. We wish to thank everyone who has volunteered their time for the National General Status program, without whom this work would not be possible.

Credits

English text: Judith Phillips, Terry Johnson (marine fishes, marine mammals) with editorial input from General Status Evaluation Coordinators and the NGSWG.
French translation/revision/biological verificiation: Montreal Translation Bureau, Françoise Nadeau, Annie Levesque, Jean-Maurice Coutu, Alain Filion, Elsa Gagnon, Lucie Métras, Simon Nadeau

General Status Evaluation Coordinators::
Vascular plants: Marilyn Anions in consultation with Michael Oldham and Peter L. Achuff
Freshwater mussels: Janice Smith
Crayfighes: Dave Fraser
Odonates: James R. Duncan
Tiger beetles: Mark Elderkin and Shelley Ann Pardy Moores
Fishes: Lara Cooper
Amphibians: James R. Duncan
Reptiles: James R. Duncan
Birds: Lisa Twolan
Mammals: Thomas Jung

Website design and maintenance: Sean Steele
Database and mapping: Jenny Wu.

Appendix III: References and further information

This list includes websites and references of general interest. For specific taxonomic references, see the reference section at the end of each general status summary.

Accord for the Protection of Species At Risk in Canada.
http://www.speciesatrisk.gc.ca/recovery/accord_bac_e.cfm

Canadian Biodiversity Information Facility. http://www.cbif.gc.ca/
Includes 'Species access Canada' (internet access to information associated with the billions of specimens housed in the world's natural history collections), 'Integrated Taxonomic Information System' (catalogue of common and scientific names and useful taxonomy source) and 'Species bank' (a growing library of digital information about the biological species of Canada).

Canadian Endangered Species Conservation Council (CESCC). 2001. Wild Species 2000: The General Status of Species in Canada. Ottawa: Minister of Public Works and Government Services Canada. http://www.wildspecies.ca

Canadian Biodiversity Information Network. http://www.cbin.ec.gc.ca/

Canadian shorebird conservation plan. http://www.cws-scf.ec.gc.ca/mbc-com/default.asp?lang=en&n=D1610AB7

Canadian Wildlife Service. http://www.cws-scf.ec.gc.ca/

Convention on the International Trade in Endangered Species of Wild Fauna and Flora. http://www.cites.ec.gc.ca/

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). http://www.cites.ec.gc.ca/

Environment Canada. http://www.ec.gc.ca/

Fisheries and Oceans Canada (DFO). http://www.dfo-mpo.gc.ca/

Mosquin, T., Whiting, P. G. and McAllister, D. E. 1995. Canada's biodiversity: The variety of life, its status, economic benefits, conservation costs and unmet needs. Canadian Museum of Nature, Ottawa, Canada. 293 pp

NatureServe Canada. www.natureserve-canada.ca
Access to the Canadian network of member programs of NatureServe.

NatureServe Explorer. www.natureserve.org/explorer
An online encyclopaedia of life

Parks Canada. http://www.pc.gc.ca/

Partners in Flight - Canadian landbird conservation plan. http://www.cws-scf.ec.gc.ca/mbc-com/default.asp?lang=en&n=7AEDFD2C

Species At Risk Act Public Registry. http://www.sararegistry.gc.ca/

Species At Risk (Canada). http://www.speciesatrisk.gc.ca/

The Atlas of Canada. http://atlas.gc.ca

The IUCN Red List of Threatened Species. http://www.redlist.org/

The World Conservation Union (IUCN). http://www.iucn.org/

Tree of Life. http://tolweb.org/tree/
A worldwide project that provides information about the diversity of organisms on Earth, their evolutionary history (phylogeny), and characteristics.

University of California Museum of Paleotntology (UCMP). http://www.ucmp.berkeley.edu/
Provides information of a wide variety of organisms, both living and extinct.

University of Michigan Museum of Biology Animal Diversity Web. http://animaldiversity.ummz.umich.edu/site/index.html
Online database of animal natural history, distribution, classification, and conservation biology

Wings Over Water. Canada's Waterbird Conservation Plan. http://www.cws-scf.ec.gc.ca/mbc-com/default.asp?lang=en&n=B65F9B7E

Regional Websites

Northwest Territories. http://www.nwtwildlife.com
British Columbia. http://www.env.gov.bc.ca/atrisk/
Alberta. http://www3.gov.ab.ca/srd/fw/speciesatrisk/general.html
Saskatchewan: http://www.biodiversity.sk.ca
Quebec: http://www.cdpnq.gouv.qc.ca/
New Brunswick. http://www.gnb.ca/0078/fw/other_wildlife-e.asp
Nova Scotia. http://www.gov.ns.ca/natr/wildlife/genstatus/
Newfoundland and Labrador. http://www.env.gov.nl.ca/env/wildlife/default.htm

General Status Search Tool

The General Status Search Tool provides access to the general status ranks on which *Wild Species 2005* is based. The ranks are an expert opinion of the status and distribution of each species status, based on the best available data at the time of assessment. For more information about the methods of generating general status ranks, please see the Background section. General status ranks represent a coarse-scaled estimate of the status of each species within Canada, are not meant to replace the ranking systems of other programs with different goals and priorities (e.g. COSEWIC, Partners in Flight).

The General Status Search Tool provides both national ranks and regional ranks, for each region in which a species occurs. A comments field provides additional information where available. You can search by species common name, species scientific name, species group, region, rank, or year of assessment.

The general status ranks for the Yukon and Nunavut are draft ranks until they have been reviewed by the Yukon Fish and Wildlife Management Board, the Wildlife Management Advisory Council (North Slope) and the Nunavut Wildlife Management Board (NWMB). The general status ranks for the Northwest Territories have been reviewed by the Wildlife Management Advisory Council (NWT), the Fisheries Joint Management Committee, the Sahtu Renewable Resources Board, and the Gwich'in Renewable Resource Board.

Taxonomic Group	Status	Region
Report year 2005	☐ Extirpated	☐ Canada
☐ Vascular Plants	☐ Extinct	☐ YT
☐ Ferns	☐ At risk	☐ NT
☐ Orchids	☐ May be at risk	☐ NU
☐ Freshwater Mussels	☐ Sensitive	☐ BC
☐ Crayfish	☐ Secure	☐ AB
☐ Odonata	☐ Undetermined	☐ SK
☐ Tiger Beetles	☐ Not assessed	☐ MB
☐ Fishes	☐ Exotic	☐ ON
☐ Amphibians	☐ Accidental	☐ QC
☐ Reptiles	☐ Not Present	☐ NB
☐ Birds		☐ NS
☐ Mammals		☐ PE
To search all vascular plants assessed in 2005, please tick off Vascular Plants 2005, Ferns 2005 and Orchids 2005.		☐ NL
		☐ Pacific Ocean
		☐ Western Arctic Ocean
Report year 2002		☐ Eastern Arctic Ocean
☐ Butterflies		☐ Atlantic Ocean

Report year 2000

- [ ] Ferns
- [ ] Orchids
- [ ] Butterflies
- [ ] Freshwater Fish
- [ ] Amphibians
- [ ] Reptiles
- [ ] Birds
- [ ] Mammals

Search by species name:

Common name:

Scientific name:

Family name:

Order name:

Search Clear